सामान्य विज्ञान संस्कृत शिक्षा कक्षा 12

कक्षा 12

संस्कृत शिक्षा

सामान्य विज्ञान

(वरिष्ठ उपाध्याय)

माध्यमिक शिक्षा बोर्ड राजस्थान, अजमेर

संस्कृत शिक्षा

विषय–सामान्य विज्ञान
(कक्षा 12 वरिष्ठ उपाध्याय)

(माध्यमिक शिक्षा बोर्ड राजस्थान, अजमेर द्वारा कक्षा 12 के लिए
नवीन पाठ्यक्रमानुसार संस्कृत शिक्षा विषय सामान्य विज्ञान (कक्षा 12 वरिष्ठ उपाध्याय)
की अधिकृत पाठ्य पुस्तक)

माध्यमिक शिक्षा बोर्ड, राजस्थान द्वारा प्रकाशित

पाठ्यपुस्तक लेखन समिति

संस्कृत शिक्षा

सामान्य विज्ञान (कक्षा 12 वरिष्ठ उपाध्याय)

संयोजक

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सम्राट पृथ्वीराज चौहान राजकीय महाविद्यालय, अजमेर

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राजकीय उच्च माध्यमिक विद्यालय
नांदिया – सिरोही

श्रीमती कविता व्यास
प्राध्यापक, राजस्थान संस्कृत
शिक्षक प्रशिक्षण विद्यालय
महापुरा – जयपुर

पाठ्यक्रम समिति

संस्कृत शिक्षा

सामान्य विज्ञान (कक्षा 12 वरिष्ठ उपाध्याय)

संयोजक

डॉ. एस. एस. कटेवा
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श्रीमती अर्चना
राजकीय वरिष्ठ उपाध्याय संस्कृत विद्यालय,
हाथोज, जिला जयपुर

प्रस्तावना

यह पुस्तक माध्यमिक शिक्षा बोर्ड, अजमेर द्वारा स्वीकृत नए पाठ्यक्रम अनुसार संस्कृत शिक्षा के लिए कक्षा बारह (उपाध्याय) के लिए विज्ञान विषय के लिए सरल भाषा में लिखी गयी है। विषय सामग्री को सुरूचि पूर्ण एवं बोधगम्य बनाने के लिए यथा संभव चित्रों तथा सारिणियों का समायोजन किया गया है।

इस पुस्तक में कक्षा के स्तर, विषय की आवश्यकताएँ तथा समान स्तर की प्रतियोगिता परीक्षाओं को ध्यान में रखते हुए विषय सामग्री समायोजित की गई है। यथा संभव तकनीकी शब्दों का अंग्रेजी रूपांतरण भी दिया गया है। जहां आवश्यकता हुई संबंधित वैज्ञानिक नाम भी देने का प्रयास किया गया है। विषय जानकारी की दृष्टि से महत्वपूर्ण बिन्दु, वस्तुनिष्ठ, अतिलघूत्तरात्मक, लघूत्तरात्मक एवं निबन्धात्मक प्रश्नों का समावेश अध्यायों के अन्त में किया गया है।

इस पुस्तक में पाठ्यक्रम से सम्बन्धित विषयवस्तु लिखते समय यह ध्यान रखा गया है कि पाठ्य सामग्री नवीनतम एवं पाठ्यक्रम के अनुरूप हो। इसे अधिक उपयोगी एवं समग्र बनाने के लिए यथास्थान नई जानकारी अन्य पुस्तकों से उपलब्ध करायी गयी है। इसका प्रमुख उद्देश्य बालकों को सरल एवं सुग्राही विषयवस्तु प्रदान करने का रहा है। इन समस्त पुस्तकों का उल्लेख करना संभव नहीं है तथापि लेखकगण उनके प्रति अपना आभार व्यक्त करते हैं।

लेखकगण, माध्यमिक शिक्षा बोर्ड के अध्यक्ष तथा निदेशक महोदय के आभारी हैं कि उन्होंने हमें इस पुस्तक के लेखन का अवसर दिया। हम एपेक्स पब्लिशिंग हाऊस, उदयपुर का डी.टी.पी. कार्य के लिए हृदय से आभार प्रकट करते हैं।

हमें विश्वास है कि यह पुस्तक विद्यार्थियों, अध्यापकों तथा पाठकों के लिए उपयोगी साबित होगी। भरसक प्रयासों के बावजूद विषय–वस्तु में कुछ त्रुटियाँ अवश्य रह गयी होगी जिनके निवारण के लिए हम पाठकों से अनुरोध करते है कि आपके सुझाव हमें तथा बोर्ड को भेजें जिससे कि भविष्य में इस पुस्तक में सुधार कर इसे और अधिक उपयोगी बनाया जा सकें।

– संयोजक एवं लेखकगण

SYLABUS

सामान्य विज्ञान

(कक्षा 12 वरिष्ठ उपाध्याय)

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bdkbZ&I

v/;k;&1 fo|qr LFkkfrdh %& कूलॉम नियम, विद्युत क्षेत्र, विद्युत क्षेत्र की तीव्रता, बल रेखाएँ, विभव; विद्युत द्विध्रुव, विद्युत द्विध्रुव के कारण किसी बिन्दु पर विद्युत क्षेत्र की तीव्रता एंव विभव की गणना।

v/;k;&2 fLFkj pEcdh; %& चुम्बक की मूल अवधारणा, बायो–सेवर्ट का नियम; वर्तुल कुण्डली के अक्ष पर चुम्बकीय क्षेत्र की गणना, एम्पियर का नियम, फ्लेमिंग के दायें हाथ का नियम, टॉरोइड एवं परिनालिका में चुम्बकीय क्षेत्र, चुम्बकीय अभिवाह, प्रकृति के मूल बलों का परिचय एवं तुलना (नाभिकीय, गुरूत्वाकर्षण एवं विद्युत चुम्बकीय बल)

bdkbZ&II

v/;k;&3 ifrjks/k ,oa l/kkfj=%& परिभाषा एवं कार्यप्रणाली, आकार का प्रतिरोध एवं धारिता पर प्रभाव, प्रतिरोध एवं संधारित्र के श्रेणी एवं समानान्तर संयोजन, किरचॉफ के नियम, व्हीटस्टोन सेतु।

v/;k;&4 foHkoekih %& सिद्धान्त, संरचना एवं उपयोग, विभवमापी द्वारा विभवान्तर एवं सेलों का आन्तरिक प्रतिरोध ज्ञात करना, गेल्वेनोमीटर, अमीटर एवं वोल्टमीटर की संरचना, गेल्वेनोमीटर का अमीटर एवं वोल्टमीटर में रूपान्तरण।

bdkbZ&III

v/;k;&5 fo|qrpEcdh; izsj.k%& प्रेरण का फेराडे का नियम, प्रेरकत्व, स्वप्रेरकत्व एवं अन्योन्य प्रेरकत्व, चुम्बकीय क्षेत्र में कुण्डली का घूर्णन; दिष्ट एवं प्रत्यावर्ती धाराएँ, वर्ग माध्य मूल एवं शिखर मान, ट्रांसफार्मर की संरचना एवं कार्यप्रणाली, शक्ति का दूरस्थ संचरण, डायनेमो एवं मोटर की कार्यप्रणाली एवं संरचना, चोक कुण्डली, शक्तिविहीन धारा; संधारित्र एवं प्रेरकत्व में धारा एवं विभव के मध्य कला संबंध (सूत्र व्युत्पत्ति नहीं), आवेशन तथा निरावेशन (बिना व्युत्पत्ति के) प्रतिबाधा एवं प्रतिघातों की अवधारणा।

bdkbZ&IV

v/;k;&6 ijek.kq fl)kUr%& परमाणु सिद्धान्त का उद्भवः बोर का परमाणु सिद्धान्त; बोर के परमाणु सिद्धान्त से हाइड्रोजन परमाणु की त्रिज्या एवं इलेक्ट्रान की ऊर्जा की गणना, हाइड्रोजन परमाणुका वर्णक्रम एवं क्वाण्टम संख्याएं; पॉली अपवर्जन सिद्धान्त, परमाणुओं के इलेक्ट्रानिक विन्यास,

v/;k;&7 /kkRod fdj.k%& उत्पत्ति एवं विश्लेषण, समस्थानिक, –किरणों की उत्पत्ति, गुण एवं उपयोग, द्रव्य तरंगें:– डी ब्रोग्ली अवधारणा; डेवीसन जर्मर प्रयोग; बोर कक्षक, ऊर्जा एवं व्याख्या

v/;k;&8 jfM;ks/kfeZrk%& परिभाषा, एल्फा, बीटा एवं गामा किरणों के गुण एवं विभेद; अवक्षय के नियम; अर्ध एवं माध्य आयु; रेडियोधर्मी पदार्थों के उपयोग

bdkbZ&V

v/;k;&9 inkFkksZ dk pEcdh; xq.k%& पारगम्यता, विद्युतशीलता, संवेदनशीलता, (susceptibility) चुम्बकीय राशियां एवं उनके मध्य सम्बन्ध; प्रति, अनु एवं लौह चुम्बकीय पदार्थ एवं इन पर चुम्बकीय क्षेत्र के प्रभाव

v/;k;&10 v/kpkyd%& चालक, कुचालक एवं अर्धचालक की परिभाषा; ऊर्जा अन्तराल, नैज एवं अशुद्ध अर्धचालक,

p एवं n अर्द्धचालक, p n संधि, अग्र एवं पश्च अभिनति।

v/;k;&11 अर्ध एवं पूर्ण तंरग दिष्टकारी के लाक्षणिक गुणधर्म एवं उपयोग

¼[k.M&[k½ jlk;u

bdkbZ&VI

v/;k;&12 jklk;fud vkcU/ku %& • अष्टक नियम– सीमाएँ • आयनिक आबन्ध • आयनिक यौगिकों के सामान्य अभिलाक्षणिक गुण • सहसंयोजक आबन्ध • सहसंयोजक यौगिको के सामान्य अभिलाक्षणिक गुण • उपसहसंयोजक आबन्ध • परमाणु कक्षकों का अतिव्यापन • संकरण (sp, sp^2, sp^3 संकरण)

bdkbZ&VII

v/;k;&13 jklk;fud rFkk vk;fud lkE; %& • रासायनिक साम्य की प्रकृति; भौतिक प्रक्रमों में साम्य, रासायनिक प्रक्रमों में साम्य • द्रव्य अनुपाती क्रिया का नियम • रासायनिक साम्य स्थिरांक एवं साम्य को प्रभावित करने वाले कारक • समआयन प्रभाव और इसका महत्त्व • विलेयता गुणफल और इसका महत्त्व

bdkbZ&VIII

v/;k;&14 /kkrq ,oa /kkrq deZ %& • धात्विक आबन्ध की प्रकृति • प्रकृति में धातुओं की उपस्थिति • धातु निष्कर्षण के विभिन्न पद– अयस्कों का सान्द्रण, सान्द्रित अयस्क का ऑक्साइड में परिवर्तन ऑक्साइड का अपचयन। • अयस्कों से धातु निष्कर्षण (Fe, Al, Cu, Ag) • धातुओं का शुद्धिकरण

bdkbZ&IX

v/;k;&15 dkcZfud jlk;u %& • कार्बनिक यौगिकों का वर्गीकरण एवं नामकरण • सजातीय श्रेणी • समावयवता (स्थिति, शृंखला, क्रियात्मक समूह मध्यावयवता) हाइड्रोकार्बन • ऐल्केन, ऐल्कीन तथा ऐल्काइन–सामान्य विरचन विधियाँ एवं उपयोगिता

bdkbZ&X

v/;k;&16 cgqyd %& • बहुलक • बहुलकों का वर्गीकरण एवं व्यापारिक महत्त्व (पॉलीप्रोपीन, पॉलीस्टाइरीन, पॉलीविनाइल क्लोराइड, टेरीलीन, नाइलॉन)

¼[k.M&x½ Tkho foKku

bdkbZ&XI

v/;k;&17 आवृतबीजी पादपों का वर्गीकरण (बेन्थम व हुकर), पुष्प की संरचना एवं कार्य, परागण, निषेचन, भ्रूणपोष संरचना, प्रकार एवं परिवर्धन, फल एवं बीज निर्माण, प्रकीर्णन

v/;k;&18 मुख्य पादप कुलों का वानस्पतिक वर्णन एवं आर्थिक महत्त्व–मालवेसी, कुकरबीटेसी, सोलेनेसी एवं पोएसी।

bdkbZ&XII

v/;k;&19 जड़ तना एवं पत्ती की आन्तरिक संरचना। जड़ एवं तने में द्वितीयक वृद्धि ड्रेसिना, एकाइरेन्थस, निकटेन्थस, एवं बिग्नोनिया में असंगत द्वितीयक वृद्धि।

bdkbZ&XIII

v/;k;&20 औषधिय महत्त्व के मुख्य पादपों का सामान्य विवरण– राउल्फिया सरपेन्टाइना, कुरकुमा लोंगा, पेपेवर सोमनीफेरम, फेरूला असाफोइटिड़ा एवं सिनकोना ऑफिसनेलिस।

bdkbi&XIV

v/;k;&21 पादप शरीर क्रिया विज्ञान– परासरण, विसरण, वाष्पोत्सर्जन, प्रकाश संश्लेषण एवं श्वसन।

v/;k;&22 ग्लाइकोलाइसिस एवं क्रेब चक्र। पादप वृद्धि हॉरमोन्स का सामान्य विवरण

ikf.k 'kkL=

bdkbi&XV ofxdh ¼tUrqvksa esa Okxhdj.k½

v/;k;&23 जन्तु जगत का वर्गीकरण– अकशेरूकी व कशेरूकी के सामान्य लक्षणों का विवरण उदाहरण सहित वर्गों तक प्रमुख लक्षण ।

- अमीबा, एस्केरिस, फेरेटिमा, एवं पेरीप्लेनेटा का आवास, स्वभाव, संरचना एवं जीवन चक्र।

bdkbi&XVI ¼'kkjhfjdh ,oa dkf;dh&I½

v/;k;&24 पाचन तंत्र

v/;k;&25 श्वसन तंत्र

v/;k;&26 परिसंचरण तंत्र

bdkbi&XVII ¼'kkjhfjdh ,oa dkf;dh&II½

v/;k;&27 उत्सर्जन तंत्र

v/;k;&28 अन्तः स्त्रावी ग्रन्थियां– सामान्य परिचय

v/;k;&29 तंत्रिका तंत्र– केन्द्रीय तंत्रिका तंत्र, परिधीय तंत्रिका तंत्र एवं स्वायत्त तंत्रिका तंत्र

v/;k;&30 जनन तंत्र– नर व मादा जनन अंगो का विवरण

bdkbi&XVIII ¼tUrqvksa esa fodkl½

v/;k;&31 जन्तुओं में विकास का सामान्य परिचयः– जन्तुओं में युग्मक निर्माण अण्डे की संरचना, अण्डो के प्रकार, उदाहरण– कीट, मेढ़क, चूजा व स्तनधारी नर युग्मक की संरचना।

v/;k;&32 जन्तुओं में निषेचनः– निषेचन के प्रकार, स्तनधारी प्राणीयों में निषेचन। विदलन– विदलन, विदलन का महत्त्व, मोरुला, गेस्टूला, गेस्टूला के प्रकार व महत्त्व।

विषय–सूची

इकाई – XVII

इकाई – XVIII

bdkb & I

v/;k; & 1
fLFkj o|frdh
(Electrostatics)

fLFkj o|frdh

Hkkfrdh dh og 'kk[kk ft le fLFkj vko'kk d e/; yxu oky cy o mRiUu {k=k dk v/;;u fd;k tkrk g] fLFkj o|frdh dgykrh gA bl v/;k; e ge vko'kk dh vo/kkj.kk] mud e/; yxu oky cy o mRiUu {k=k dk v/;;u djxA

vko'k dh vo/kkj.kk

vkt l yxHkx 2500 o"k io ;ukuh nk'kfud FkY l u çf{kr fd;k fd tc vEcj (Amber) uked inkFk dk Åu (Wool) l jxMk tkrk g rk mle gYdh oLrvk t l dkxt d VdM] frud bR;kfn dk viuh vkj vkdf"kr dju dk x.k mRiUu gk tkrk gA lu 1600 e bXy.M d oKkfud fxYcV u viuh [kktk e ik;k fd vEcj dh Hkkfr vU; fo|rjk/kh inkFk Hkh jxM tku ij gYdh oLrvk dk viuh vkj vkdf"kr djr gA t l fd &

1- dkp dh NM dk j'keh diM ij jxMu l NM ,o diM nkuk e gYdh oLrvk dk vkdf"kr dju dk x.k mRiUu gk tkrk gA
2- ,ckukbV dh NM dk Åuh diM ij jxMu ij Hkh bu nkuk e gYdh oLrvk dk vkdf"kr dju dk x.k mRiUu gk tkrk gA

mi;Dr mnkgj.kk l Li"V g fd bu inkFkk e ;g x.k jxM tku d dkj.k vFkkr ?k"k.k d dkj.k mRiUu gkrk gA bl x.k dk çkIr dj yu ij oLr dk vkof'kr dgk tkrk gA ft l dk Kku ml oLr }kjk vU; oLrvk ij yxk; tku oky cy l fd;k tkrk gA bl cy dk o|r cy (Electric force) dgr gA

mDr ç{k.kk e ;g Hkh ik;k x;k fd nk fo|rjk/kh inkFkk ¼oLrvk½ dk vkil e jxMk tkrk g rk nkuk oLr, ,d lkFk vkof'kr gkrh g rFkk bud e/; vkd"k.k cy mRiUu gkrk gA tc ,d gh çdkj dh nk oLrvk dk fdl h vU; fo|rjkèkh oLr l jxMk tk; ¼t l nk dkp dh NMk dk ,d lkFk j'keh diM l jxMk tk;½ rk ,d gh çdkj dh nkuk oLrvk ¼dkp dh NM½ d e/; çfrd"k.k dk cy mRiUu gkrk gA bl ;g fu"d"k fudyrk g fd vko'k nk çdkj dk gkrk gA

oKkfud cUtfeu Ýdfyu d vulkj bu vko'kk dk èkukRed ,o _.kRed vko'k dgr gA tc nk fo|rjk/kh oLrvk dk vkil e jxMk tkrk g rk mud e/; ?k"k.k d dkj.k vko'kk dk iuforj.k gk tkrk g ft l d ifj.kkeLo:i oLrvk e leku ,o foijhr çÑfr dk vko'k vk tkrk gA oLrr% fdl h oLr e /kukRed ,o _.kRed vko'k leku ek=k e mifLFkr gkr g ft l d dkj.k oLr fo|r mnkl hu gkrh gA ?k"k.k ;k vU; dkj.kk l oLr e _.kko'k dh vfèkdrk gku ij oLr _.kkof'kr rFkk /kuko'k dh vf/kdrk gku ij oLr /kukof'kr dgykrh gA

foKku d vk/kfud fl)krk d vulkj fdl h oLr dk vkof'kr dju d fy, ijek.k e mifLFkr byDVku mÙkjnk;h gkr gA ,d byDVku vko'k dk eku _.kRed 1.6×10^{-19} dyke gkrk g rFkk bl –e l 0;Dr djr gA

vko'k d ckj e egRoi.k rF;

1- vko'k inkFk dk ey x.k gkrk g ft l uk rk u"V fd;k tk l drk g vkj uk gh mRiUu (create) fd;k tk l drk gA
2- vko'k nk çdkj d gkr gA /kuRed o _.kRedA leku çdkj d vko'k l tkrh; ,o foijhr çdkj d vko'k fo tkrh; vko'k dgykr gA
3- vko'k ,d vfn'k jkf'k gkrk gA

4- oLrvk ij vko'k] vko'kk d iuforj.k d ifj.kkeLo: i çkIr gkrk gA

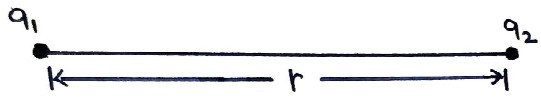
5- vko'k Dok.VhÑr gkrk gA bld Dok.Vk dk eku $e = 1.6 \times 10^{-19}$ dyke gkrk g] vFkkr fdlh oLr ij vko'k dk eku vko'k Dok.Vk d i.k x.kt d :i e gh 0;Dr fd;k tk ldrk gA

6- ltkrh; vko'kk d e/; çfrd"k.k cy rFkk fotkrh; vko'kk d e/; vkd"k.k cy yxrk gA

7- vko'k dk SI ek=d dyke gkrk gA ,d dyke vko'k e mifLFkr byDVkuk dh l[;k 6.25×10^{18} gkrh gA

dyke dk fu;e

nk fLFkj fcn vko'kk d e/; yxu oky fLFkj fo|r cy dk Kkr dju d fy, dyke u lu 1785 e ,d fu;e çfrikfnr fd;k] ftl dyke dk fu;e dgr gA



fp= 1-1

bl fu;e d vulkj nk fcn vko'kk q_1,o q_2 tk ,d nlj l r njh ij fLFkj voLFkk e g] d e/; yxu okyk fLFkj fo|r cy &

(i) nkuk vko'kk d x.kuQy d lekuikrh gkrk g] rFkk

(ii) nkuk vko'kk d e/; njh d ox d 0;RØekuikrh gkrk g vFkkr

$$F \propto \frac{q_1 q_2}{r^2}$$

;k $$F = \frac{K q_1 q_2}{r^2}$$ ---¼1½

tgk K ,d lekuikrh fu;rkd g ftldk eku vko'kk d e/; mifLFkr ek/;e ,oa ekiu dh i)fr ij fuHkj djrk gA fuokr e $K = \frac{1}{4\pi\varepsilon_0} = 9\times10^9\ Nm^2/C^2$ tgk ε_0 dk fuokr dh fo|r'khyrk dgr gA bldk eku $8.85 \times 10^{-12} C^2/Nm^2$ gkrk gA lehdj.k ¼1½ e çnf'kr fLFkj fo|r cy dk dyke cy dgr gA ;g cy njh d ox d 0;RØekuikrh gku d dkj.k] 0;RØe ox cy dk mnkgj.k Hkh gA

dyke cy dh fn'kk] nkuk vko'kk dk feyku okyh j[kk d vufn'k gkrh gA ltkrh; vko'kk d e/; dyke cy dk eku /kukRed ikIr gkrk g tk fd cy dh ifrd"k.k iÑfr n'kkrk g] tcfd fotkrh; vko'kk d e/; dyke cy dk eku _.kkRed çkIr gkrk g tk fd cy dh vkd"k.k çÑfr n'kkrk gA

lfn'k :i e dyke cy dk fuEu çdkj fy[kk tkrk g&

$$\vec{F} = \frac{K q_1 q_2}{r^2}\hat{r}$$ ---¼2½

tgk $\hat{r}$ nkuk vko'kk dk feyku okyh j[kk d vufn'k ,dkd lfn'k gA ;fn nkuk vko'kk d e/; fuokr d LFkku ij dkb vU; ek/;e gk rk bl fLFkfr e lekuikrh fu;rkd dk eku $K = \frac{1}{4\pi\varepsilon}$ gkxkA tgk ε ek/;e dh fo|r'khyrk gA

dyke cy dh fo'k"krk, ¼ dyke cy dh çe[k fo'k"krk, fuEu g ¼&

1- dyke cy nh?k ijkl ¼$10^{8\&14}$ ehVj l vuUr rd½ d cy gkr gA

2- dyke cy dUæh; ,o lj{kh cyk dk mnkgj.k gA

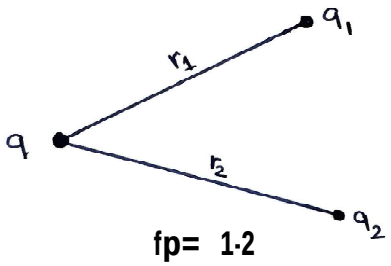
3- dyke cy 0;RØe ox $\left(F \propto \frac{1}{r^2}\right)$ fu;e dk ikyu djrk gA

4- dyke cy v/;kjki.k fl)kr dk ikyu djrk gA

5- dyke cy dk /kukRed eku vko'kk d e/; çfrd"k.k dk rFkk _.kkRed eku vko'kk d e/; vkd"k.k dk n'kkrk gA

vko'kk d v/;kjki.k dk fl)kr

vko'kk d v/;kjki.k d fl)kr d vulkj fdlh fcn vko'k ij vU; fcn vko'kk d }kjk ifj.kkeh dyke cy dk eku] vU; fcn vko'kk d }kjk Lor= :i l] vko'k ij dk;jr dyke cyk d lfn'k ;kx d cjkcj gkrk gA



fp= 1-2

fp=kulkj q vko'k ij vU; fLFkj vko'kk q_1,o q_2 d dkj.k yxu oky dyke cyk dk eku Øe'kk $\vec{F}_1$ o $\vec{F}_2$ gk rk] nkuk vko'kk d dkj.k vko'k ij yxu oky ifj.kkeh cy dk

eku $\vec{F} = \vec{F}_1 + \vec{F}_2$ gkxkA

tgk $F_1 = \frac{Kqq_1}{r_1^2}$ rFkk $F_2 = \frac{Kqq_2}{r_2^2}$

fo|r {k= ,o fo|r {k= dh rhork

fcn vko'k d pkjk vkj dk og {k=] ft le dkb vU; vko'k fo|r cy dk vuHko djrk g] fo|r {k= dgykrk gA fo|r {k= ,d lfn'k jkf'k g rFkk bl dk ekiu fo|r {k= dh rhork $\vec{E}$ d }kjk fd;k tkrk gA

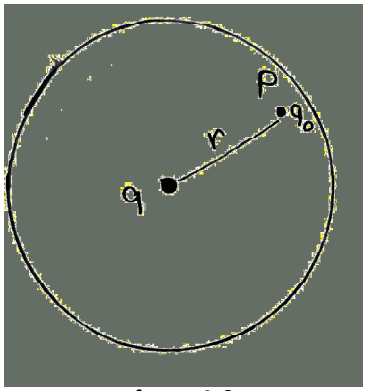
fo|r ifj?kVukvk dk v/;;u dju d fy; ,d vR;Ur y?k /ku fcn vko'k] ft l dk viuk dkb fo|r {k= ugh gkrk g dh dYiuk dh tkrh gA bl dkYifud y?k /ku fcn vko'k dk ijh{k.k vko'k (q_0) dgr gA

fo|r {k= e fLFkr fdlh fcn ij ,dkd ijh{k.k vko'k ij yxu oky fo|r cy dk fo|r {k= dh rhork dgr gA bl $\vec{E}$ l 0;Dr djr gA xf.krh; :i e fdlh fcn ij fo|r {k= dh rhork $\vec{E}$ ml fcn ij j[k ijh{k.k vko'k q_0 ij yxu oky fo|r cy rFkk ijh{k.k vko'k d ifjek.k dh fu"ifr d cjkcj gkrh g vFkkr

$$\vec{E} = \frac{\vec{F}}{q_0} \qquad \text{---¼3½}$$

lehdj.k ¼3½ l Li"V g fd fo|r {k= dh rhork dh fn'kk] fo|r cy dh fn'kk d vufn'k gkrh gA fo|r {k= dh rhork dk ek=d 0;Vu@dyke gkrk gA

fdlh fcn vko'k q d dkj.k mRiUu fo|r {k= e fdlh fcn P ij fo|r {k= dh rhork Kkr dju d fy, ekuk fd fufn"V fcn P ij ,d ijh{k.k vko'k q_0 fo|eku gA tlk fd fp= 1-3 e n'kk;k x;k gA ;fn nkuk vko'kk d e/; njh r



fp= 1-3

rFkk ek/;e dk ijko|rkd K gk rk ifjHkk"kk l nkuk vko'kk d e/; cy ,o q_0 dk vuikr fufn"V fcn ij fo|r {k= dh rhork d eku dk 0;Dr djxkA

xf.krh; :i l &

nkuk vko'kk d e/; cy $F = \frac{Kqq_0}{r^2}\hat{r}$

vr% fo|r {k= dh rhork $\vec{E} = \frac{\vec{F}}{q_0}$

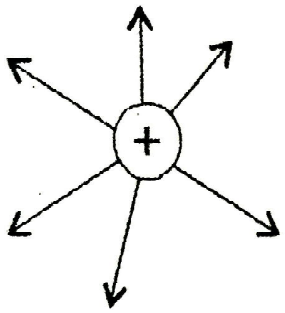
$$= \frac{\frac{Kqq_0}{r^2}\hat{r}}{q_0} = \frac{Kq}{r^2}\hat{r} \qquad \text{---¼4½}$$

tk fd fo|r {k= e fcnor vko'kq d dkj.k rnjh ij fLFkr fufn"V fcn P ij fo|r {k= dh rhork d eku dk 0;Dr djrk gA

fo|r {k= ¼cy½ j[kk,

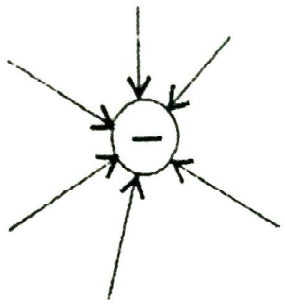
Hkkfrdh e fo|r {k= dk fp=.k fo|r cy j[kkvk d }kjk fd;k tkrk gA fo|r cy j[kk, og dkYifud oØ g ftl dfdlh fcn ij [khph x;h Li'k j[kk ml fcn ij fo|r {k= dh fn'kk ¼cy dh fn'kk½ dk çnf'kr djrh gA fo|r cy j[kkvk d fuEufyf[kr x.k/ke gkr g&

1- fo|r cy j[kk, fcnor /ku vko'k l çkjHk gkdj f=T; ckgj dh vkj lHkh fn'kkvk e pyrh g rFkk vur ij lekIr gkrh g] tlk fd fp= 1-4 e n'kk;k x;k gA



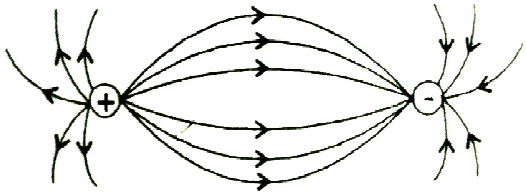
fp= 1-4

2- fo|r cy j[kk, fcnor _.k vko'k d dkj.k mRiUu fo|r {k= e vur l çkjHk gkdj f=T; vnj dh vkj ¼_.k vko'k dh vkj½ funf'kr gkrh gA bl fp= 1-5 e n'kk;k x;k gA



fp= 1-5

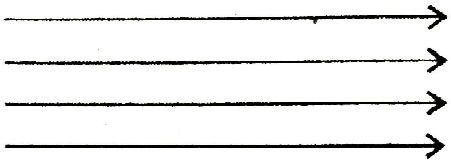
3- /ku vko'k ,o _.k vko'kk d e/; fo|r cy j[kk, èku vko'k l çkjHk gkdj _.k vko'k ij lekIr gkrh gA bl fp= 1-6 l n'kk;k x;k gA



fp= 1-6

4- fo|r {k= e dkb Hkh nk cy j[kk, ijLij ,d nlj dk çfrPNn ugh djrh g D;kfd ,l fLFkfr e çfrPNn fcn ij nk vyx&vyx Li'k j[kk, [kph tk ldrh g] tk fd ,d fcn ij cy dh nk fn'kk, çnf'kr djxhA ,d gh fcn ij fo|r cy dh nk fn'kk, vlEHko gA

5- ,d leku fo|r {k= e fo|r cy j[kk, lekrj ,o leku njh ij gkrh g] tl k fd fp= 1-7 e çnf'kr gA



le fo|r {k=

fp= 1-7

6- fo|r {k= e fdlh {k=Qy l yEcor fn'kk e xtju okyh fo|r cy j[kkvk dh dy l[;k] fo|r ¶yDl dgykrh gA

foHko

fo|r {k= e fdlh fcn ij ,dkd /ku vko'k dk vuUr l fo|r {k= e yku e fd;k x;k dk; fo|r foHko dgykrk gA fo|r foHko ,d vfn'k jkf'k gkrh g rFkk bl V l çnf'kr djr gA xf.krh; :i e fo|r foHko dk fuEu çdkj ifjHkkf"kr djr g &

fo|r {k= e fLFkr fdlh fcn ij fo|r foHko dk eku fo|r {k= e ijh{k.k /ku vko'k q_0 dk vuUr l ml fcn ij yku e fd; x; dk; W ,o ijh{k.k /ku vko'k d eku dh fu"ifr d cjkcj gkrk g] vFkkr

$$V = \frac{W}{q_0} \qquad \text{---(5)}$$

pfd fo|r {k= e fd;k x;k dk; fo|r fLFkfr t Åtk (U) d :i e lxfgr gk tkrk g vr%

W=U

lehdj.k (5) l

$$V = \frac{U}{q_0} \qquad \text{---(6)}$$

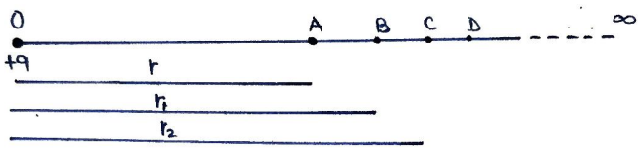
lehdj.k (5) rFkk lehdj.k (6) fo|r {k= e fdlh fcn ij foHko d eku dk 0;Dr djrh gA foHko dk ek=d Nm/C ;k okYV gkrk gA

fo|r {k= e fLFkr nk fcnvk ij foHkok dk vrj foHkokrj dgykrk gA ;fn ijh{k.k /ku vko'k q_0 dk fo|r {k= e fLFkr nk fcnvk A rFkk B d eè; foLFkkfir dju e fd;k x;k dk; W_{AB} gk rk foHkokrj

$$V_B - V_A = \frac{W_{AB}}{q_0} = \frac{U_B - U_A}{q_0} \qquad \text{---(7)}$$

fcn vko'k d dkj.k fdlh fcn ij foHko

fcn vko'k d dkj.k fo|r {k= e fLFkr fdlh fcn ij foHko dh x.kuk dju d fy; ekuk fd +q dyke dk ,d fcn vko'k fp= (1-8) d vulkj fcn O ij fLFkr gA bl fcn vko'k d dkj.k mRiUu fo|r {k= e fdlh fcn A ij foHko dh x.kuk d fy; ,d /ku ijh{k.k vko'k q_0 dk vuUr l fcn A ij yku e fo|r {k= d fo:) fd; x; dk; dh x.kuk djxA



fp= 1-8

ekuk fd O l A d e/; dh njh r gA vc ge vuUr l A d e/; B, C, D, ... fcnvk dh dYiuk djr gA bu fcnvk dh O l nfj;k Øe'kk r_1, r_2, r_3 .....gA tc

ijh{k.k vko'k B fcn ij gk rk fcn vko'k q ,o ijh{k.k vko'k q_0 d e/; yxu oky fo|r cy dk eku

$$F_B = \frac{Kqq_0}{r_1^2}$$

blh çdkj tc ijh{k.k vko'k A fcn ij gk rk q o q_0 d e/; fo|r cy dk eku

$$F_A = \frac{Kqq_0}{r^2}$$

pfd fcn B ,o A ijLij utnhd g vr% bl fLFkfr e ijh{k.k vko'k q_0 ij cy dk eku B o A fcn ij cyk d x.kkUkj ek/; d cjkcj ekuk tk ldrk gA vr% fcn B ,o A d chp ijh{k.k vko'k ij yxu oky cy dk ek/; eku

$$F_{BA} = \sqrt{F_B \times F_A}$$

$$= \sqrt{\frac{Kqq_0}{r_1^2} \times \frac{Kqq_0}{r^2}}$$

$$= \frac{Kqq_0}{r_1 r}$$

vr% fcn vko'k dk B l A rd foLFkkfir dju e fd;k x;k dk; = cy × njh BA

$$= \frac{Kqq_0}{r_1 r}(r_1 - r)$$

$$= Kqq_0\left(\frac{1}{r} - \frac{1}{r_1}\right)$$

blh çdkj fcn vko'k dk C l B rd foLFkkfir dju e fd;k x;k dk;

$$W_{CB} = Kqq_0\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

blh çdkj ,o vU; vYik'kk d foLFkkiu d fy, fd;k x;k dk; Hkh Kkr dj ldr gA

vr% ijh{k.k vko'k dk ∞ l A rd foLFkkfir dju e fd;k x;k dy dk;

$$W = W_{BA} + W_{CB} + \ldots\ldots\ldots\ldots\ldots$$

;k $$W = Kqq_0\left[\left(\frac{1}{r} - \frac{1}{r_1}\right) + \left(\frac{1}{r_1} - \frac{1}{r_2}\right) + \ldots\ldots + \left(-\frac{1}{\infty}\right)\right]$$

;k $$W = Kqq_0\left[\left(\frac{1}{r} - \frac{1}{\infty}\right)\right]$$

;k $$W = \frac{Kqq_0}{r}$$

vr% foHko dh ifjHkk"kk d vuqlkj fcn A ij foHko

$$V = \frac{W}{q_0}$$

;k $$V = \frac{Kq}{r}$$ ---¼8½

foHko dh Hkkfrd lkFkdrk

fdlh pkyd dk fo|r foHko] pkyd dh ml fo|r voLFkk dk çnf'kr djrk g ftl fd fdlh vU; pkyd l tkMu ij vko'k d çokg dh fn'kk dk irk py ldA /ku vko'k lno mPp foHko l fuEu foHko dh vkj çokfgr gkrk gA

fo|r f}/ko

nk leku ,o foijhr vko'kk dk og l;Dr fudk; ftud e/; njh vR;Yi gk] fo|r f}/ko dgykrk gA nlj 'kCnk e ;fn nk leku ,o foijhr vko'k ijLij vYi njh ij fLFkr gk rk vko'kk dk l;Dr fudk; f}èko dgykrk gA f}èko dk ekiu f}/ko vk?k.k l djr gA vko'k rFkk mud e/; njh dk x.kuQy f}/ko vk?k.k (p) dgykrk g] vFkkr

$$p = q \times d$$ ---¼9½

fo|r f}/ko vk?k.k ,d lfn'k jkf'k gkrh g] ftl dh fn'kk _.k vko'k l /ku vko'k dh vkj gkrh gA bl dk ek=d dyke ehVj gkrk gA fo|r f}/ko fudk; dk dy vko'k 'kU; gkrk gA HCl, H_2O bR;kfn fo|r f}/ko fudk; d mnkgj.k gA ijek.k e /ku vko'kk dk dUæ ukfHkd rFkk _.k vko'kk ¼byDVku½ dk dUæ likfr gku d dkj.k ; f}èko dh jpuk ugh djr gA yfdu ijek.k dk fo|r {k= e foLFkkfir dj fn;k tk; rk bl d /ku vko'k rFkk _.k vko'k d dUæk d e/; foLFkkiu mRiUu gk tkrk g ftl ijek.k f}/ko cu tkrk gA

fo|r f}/ko d dkj.k fdlh fcn ij fo|r {k= dh rhork ,o foHko dh x.kuk

fo|r f}/ko d dkj.k fdlh fcn P ij fo|r {k= dh rhork ,o foHko dh x.kuk nk fLFkfr;k e dh tkrh g&

(i) v{kh; fLFkfr

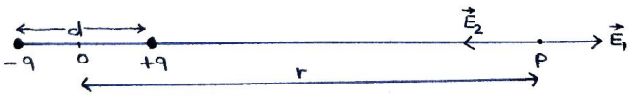
(ii) v{k d yEcor fLFkfr

f}/ko dh v{kh; fLFkfr e fdlh fcn ij fo|r {k= dh x.kuk

fp= 1-9 d vuqlkj ge f}/ko d dUæ O l r njh ij fLFkr ,d fcn P dh dYiuk djr g tk f}/ko d v{k ij fLFkr gA ekuk fd +q ,o –q vko'k feydj ,d f}/ko dh jpuk djr g ftud e/; njh d gA

fp=kuqlkj fcn P dh +q vko'k l njh = r-d/2

,o -q vko'k l njh = r+d/2



fp= 1-9

fcn P ij] +q ,o –q vko'kk d dkj.k fo|r {k= dh rhorkvk dk eku Øe'k% E_1 o E_2 gA

$$E_1 = \frac{+Kq}{\left(r-\frac{d}{2}\right)^2}$$ tgk $$E_2 = \frac{-Kq}{\left(r+\frac{d}{2}\right)^2}$$ rFkk

vr% fcn P ij ifj.kkeh rhork $E = E_1 + E_2$

$$= \frac{Kq}{\left(r-\frac{d}{2}\right)^2} - \frac{Kq}{\left(r+\frac{d}{2}\right)^2}$$

$$= Kq\left[\frac{1}{\left(r-\frac{d}{2}\right)^2} - \frac{1}{\left(r+\frac{d}{2}\right)^2}\right]$$

$$= Kq\left[\frac{2rd}{\left(r^2-\frac{d^2}{4}\right)^2}\right]$$

D;kfd E_1 o E_2 foijhr fn'kk e g rFkk $E_1 > E_2$

$$= Kq\left[\frac{2rd}{\left(r^2-\frac{d^2}{4}\right)^2}\right]$$

D;kfd $r >> d/2$ vr% r^2 dh ryuk e $d^2/4$ ux.; ekuu ij

$$E = Kq\left(\frac{2rd}{r^4}\right)$$

$$= Kq\left(\frac{2d}{r^3}\right)$$

lehdj.k ¼9½ dk ifjHkk"kkuqlkj

;k $E = \frac{2Kp}{r^3}$ ---¼10½

fo|r {k= E dh fn'kk f}/ko d v{k d vufn'k _.k vko'k l /ku vko'k d vufn'k gkxhA lehdj.k ¼10½] v{kh; fcn ij f}/ko d dkj.k mRiUu fo|r {k= dh rhork dk vfHk"V 0; td gA

f}/ko dh v{kh; fLFkfr e fdlh fcn ij fo|r foHko dh x.kuk% iu% fp= 1-9 d vuqlkj +q ,o -q vko'k d dkj.k fcn P ij foHko dk eku Øe'k% V_1 ,o V_2gk rk] foHko dh ifjHkk"kk l&

$$V_1 = \frac{Kq}{\left(r-\frac{d}{2}\right)}$$

rFkk $$V_2 = \frac{-Kq}{\left(r+\frac{d}{2}\right)}$$

fcn P ij ifj.kkeh foHko dk eku nkuk vko'kk ¼+q ,o -q½ d dkj.k mRiUu foHkok d ch txf.krh; ;kx d cjkcj gkxk] vFkkr

$$V = V_1 + V_2$$

;k $$V = \frac{Kq}{\left(r-\frac{d}{2}\right)} - \frac{Kq}{\left(r+\frac{d}{2}\right)}$$

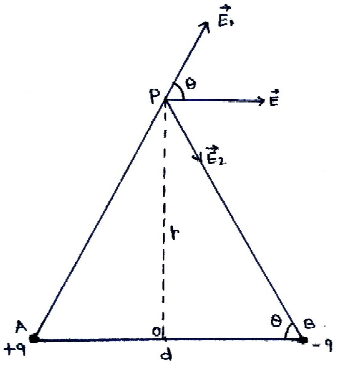
$$= Kq\frac{d}{\left(r^2-\frac{d^2}{4}\right)} \qquad = Kq\frac{d}{r^2}$$

¼D;kfd $r >> d/2$ vr% r^2 dh ryuk e $d^2/4$ dk ux.; ekuu ij½

;k $V = \frac{Kp}{r^2}$ ---¼11½

lehdj.k ¼11½ v{kh; fcn ij f}/ko d dkj.k mRiUu fo|r foHko dk vfHk"V 0; t d gA

f}/ko d v{k d yEcor j[kk ij fLFkr fcn ij fo|r {k= dh x.kuk% fp= 1-10 d vuqlkj ge f}/ko d eè; fcn l xtju okyh yEcor v{k d vufn'kr njh ij ,d fcn P dh dYiuk djr g ft l ij fo|r {k= dh x.kuk djuh gA



fp= 1-10

fp= l $AP^2 = OA^2 + OP^2 = BP^2$

$$AP = BP = \sqrt{r^2 + d^2/4}$$

;fn +q vko'k d dkj.k P fcn ij rhork dk eku E_1 rFkk –q vko'k d dkj.k P fcn ij rhork dk eku E_2 gk rk

$$E_1 = \frac{Kq}{AP^2}$$

$$= \frac{Kq}{\left(r^2 + \frac{d^2}{4}\right)} \quad \text{¼} \overrightarrow{AP} \text{ fn'kk d vufn'k½}$$

rFkk $E_2 = \frac{Kq}{BP^2}$

$$= \frac{Kq}{\left(r^2 + \frac{d^2}{4}\right)} \quad \text{¼} \overrightarrow{BP} \text{ fn'kk d vufn'k½}$$

vr% Li"V g fd E_1 o E_2 d eku ijLij cjkcj g yfdu fn'kk; fHkUu gA vr% E_1 o E_2 d ifj.kkeh eku dk Kkr dju d fy, AB d vufn'k ,o yEcor ?kVdk e fo;kft r dju ij %&

fp= 1-10 l Li"V g fd AB d vufn'k E_1o E_2 d ?kVd $E_1 \cos\theta$ o $E_2 \cos\theta$,d fn'kk e gku d dkj.k tM tk;x tcfd AB d yEcor E_1 o E_2 d ?kVd $E_1 \sin\theta$ o $E_2 \sin\theta$,d nlj d foijhr fn'kk e gku d dkj.k fujLr gk tk;xA vr% fcn P ij ifj.kkeh rhork

$$E = E_1 \cos\theta + E_2 \cos\theta$$

D;kfd $E_1 = E_2$

$$E = \frac{2Kq\cos\theta}{\left(r^2 + \frac{d^2}{4}\right)}$$

fp= 1-10 l $\cos\theta = \frac{OB}{PB} = \frac{d/2}{\sqrt{r^2 + d^2/4}}$

vr% $E = \frac{Kqd}{\left(r^2 + \frac{d^2}{4}\right)^{3/2}}$

;k $E = \frac{Kqd}{r^3}$ ¼D;kfd $r >> d/2$ vr% r^2 dh ryuk e $d^2/4$ dk ux.; ekuu ij½

;k $E = \frac{Kp}{r^3}$ ---¼12½

lehdj.k ¼12½ f}/ko d v{k d yEcor fdlh fcn ij fo|r {k= dh rhork dk vfHk"V 0; t d gA

f}/ko dh fuj{kh; j[kk ij fdlh fcn ij fo|r foHko dh x.kuk% fp= 1-10 d vuqlkj ekuk fd fcn P ij +q vko'k d dkj.k foHko dk eku V_1 rFkk -q vko'k d dkj.k foHko dk eku V_2 g vr% foHko dh ifjHkk"kk l

$$V_1 = \frac{Kq}{AP}$$

$$= \frac{Kq}{\sqrt{\left(r^2 + \frac{d^2}{4}\right)}}$$

rFkk $V_2 = \frac{Kq}{BP}$

$$= \frac{-Kq}{\sqrt{\left(r^2 + \frac{d^2}{4}\right)}}$$

vr% fcn P ij ifj.kkeh foHko &

$$V = V_1 + V_2$$

$$= \frac{Kq}{\sqrt{\left(r^2 + \frac{d^2}{4}\right)}} + \frac{-Kq}{\sqrt{\left(r^2 + \frac{d^2}{4}\right)}}$$

;k V=0

vFkkr f}/ko d v{k d yEcor fcn ij fo|r foHko dk eku 'kU; gkrk gA

egRoi.k fcUn

1- æ0;eku dh Hkkfr vko'k Hkh inkFk dk ey x.k gkrk g] ftl uk rk u"V fd;k tk ldrk g vkj uk gh mRiUu fd;k tk ldrk gA

2- oLrvk ij vko'k] vko'kk d iuforj.k d ifj.kkeLo:i çkIr gkrk gA

3- vko'k Dok.VhÑr gkrk gA bl Dok.Vk dk eku $e = 1.6 \times 10^{-19}$ dyke gkrk g] vFkkr fdlh oLr ij vko'k dk eku vko'k Dok.Vk d i.k x.kt d :ie gh 0;Dr fd;k tk ldrk gA

4- dyke cy vko'kk d e/; njh d ox d 0;RØekuikrh gku d dkj.k] 0;RØe ox cy dk mnkgj.k gA

5- fcn vko'k d pkjk vkj dk og {k=] ftle dkb vU; vko'k fo|r cy dk vuHko djrk g] fo|r {k= dgykrk gA

6- fo|r {k= e fLFkr fdlh fcn P ij ,dkd ijh{k.k vko'k ij yxu oky fo|r cy dk fo|r {k= dh rhork dgr gA

7- fo|r {k= dk fp=.k fo|r cy j[kkvk d }kjk fd;k tkrk gA fo|r cy j[kk, og dkYifud oØ gkr g ftld fdlh fcn ij [khph x;h Li'k j[kk ml fcn ij fo|r {k= dh fn'kk ¼cy dh fn'kk½ dk çnf'kr djrh gA

8- fo|r {k= e fdlh fcn ij ,dkd /ku vko'k dk vuUr l fo|r {k= e fd;k x;k dk; fo|r foHko dgykrk gA fo|r foHko ,d vfn'k jkf'k gkrh g rFkk bl V l çnf'kr djr gA

9- fo|r {k= e fLFkr nk fcnvk ij foHkok dk vrj foHkokrj dgykrk gA

10- nk leku ,o foijhr vko'kk dk og l;Dr fudk; ftle nkuk vko'kk d e/; njh vR;Yi gk] fo|r f}èko dgykrk gA f}/ko dk ekiu f}/ko vk?k.k l djr gA

11- ijek.k e/ku vko'kk dk dUæ rFkk _.k vko'kk dk dUæ likfr gku d dkj.k ; f}/ko dh jpuk ugh djr gA yfdu ijek.k dk fo|r {k= e foLFkkfir dj fn;k tk; rk bld /ku vko'k rFkk _.k vko'k d dUæk d e/; foLFkkiu mRiUu gk tkrk g ftll ijek.k f}èko cu tkrk gA

12- f}/ko d v{k d yEcor fdlh fcn ij fo|r foHko dk eku 'kU; gkrk gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- ltkrh; fcn vko'kk d e/; cy yxrk g&

¼v½ çfrd"k.k cy ¼c½ vkd"k.k cy

¼l½ ncy cy ¼n½ ukfHkdh; cy

2- vko'k d Dpk.Vk dk eku gkrk g&

¼v½ 1.6×10^{-19} dyke ¼c½ 1.6×10^{19} dyke

¼l½ 9×10^{9} dyke ¼n½ 9×10^{-9} dyke

3- dyke cy g&

¼v½ dUæh; cy ¼c½ lj{kh cy

¼l½ mi;Dr nkuk ¼n½ mi;Dr e l dkb ugh

4- fo|r cy j[kkvk dh fn'kk gkrh g&

¼v½ /ku vko'k l _.k vko'k dh vkj

¼c½ _.k vko'k l /ku vko'k dh vkj

¼l½ /ku o _.k vko'k d yEcor

¼n½ mi;Dr e dkb ugh

5- f}/ko vk?k.k dk ek=d gkrk g&

¼v½ okYV ¼c½ ty

¼l½ dyke ehVj ¼n½ U;Vu ehVj

6- f}/ko d v{k d yEcor fcn ij fo|r foHko dk eku gkrk g&

¼v½ /kukRed ¼c½ _.kkRed

¼l½ 'kU; ¼n½ vuUr

y?kÙkjkRed ç'u

1- D;k fo|r {k= e nk cy j[kk, ,d nlj dk dkV ldrh g\

2- D;k dyke dk fu;e ijekf.o; nfj;k d fy, Hkh lR; gA

3- fo|r f}/ko dk leku fo|r {k= e j[ku ij dy fdruk cy dk; djxkA

4- fo|r {k= dh rhork dh bdkb fyf[k;A

5- fdlh {k= e ;fn foHko fu;r g rk ogk fo|r {k= fdruk gkxk\

6- fo|r foHko dh ifjHkk"kk crkb;A foHko dh foek fyf[k;A

7- fo|r f}/ko vk?k.k dk ek=d o ifjHkk"kk fyf[k,A le>kb; fd ;g lfn'k jkf'k g vFkok vfn'kA

8- ;fn nk vkof'kr d.kk d chp dh njh vk/kh dj nh tk; rk nkuk d e/; cy fdruk gkxk\

fucU/kkRed i'u

1- dyke d fu;e dk le>kr g,] dyke cy dh fo'k"krkvk ij çdk'k Mkfy;A

2- foHko ,o foHkokrj dk ifjHkkf"kr dhft ,A fcn vko'k d dkj.k fo|r {k= e fLFkr fdlh fcn ij foHko dh x.kuk dhft ,A

3- fo|r f}/ko fdl dgr g\ f}/ko dh v{kh; fLFkfr e fdlh fcn ij fo|r foHko dh x.kuk dhft ,A

4- f}/ko dh fuj{kh; j[kk ij fdlh fcn ij fo|r foHko dh x.kuk dhft ,A

5- vko'k dh vo/kkj.kk dk le>kb,A vko'kk d v/;kjki.k fl)kUr ij çdk'k Mkfy,A

---

mÙkjekyk % 1 ¼v½ 2 ¼v½ 3 ¼l½ 4 ¼v½ ¼5½ l ¼6½ l

v/;k; & 2

fLFkj pEcfdh

(Magnetostatics)

pEcd dh ey vo/kkj.kk

pEcd ,l inkFk gkr g] tk Lor=rkiod yVdk; tku ij lno ,d gh fn'kk ¼mÙkj&nf{k.k½ e fLFkj gk tkr g rFkk ykg;Dr inkFkk dk viuh vkj vkdf"kr djr gA

pEcd nk çdkj d gkr g& 1- çkÑfrd pEcd] 2- Ñf=e pEcdA

çkÑfrd pEcd çÑfr e [kkuk l çkIr gkr gA bud v;Ld dk eXuVkbV dgr gA budk vkdkj o :i fuf'pr ugh gku d dkj.k bUg oKkfud ,o vul/kku dk;k d fy; ç;Dr ugh fd;k tkrk gA bue vkd"k.k {kerk Hkh vYi gkrh gA tcfd Ñf=e rjhdk l cuk; tku oky pEcd Ñf=e pEcd dgykr gA budk vkdkj o :i fuf'pr gku d dkj.k budk mi;kx fofHkUu dk;k e fd;k tkrk gA bl dkFk gh bue mPp vkd"k.k {kerk Hkh ik;h tkrh gA

pEcd e fuEu x.k ik; tkr g %&

1- ;g ykg;Dr inkFkk dk viuh vkj vkdf"kr djrk gA
2- Lor=rkiod yVdk; tku ij pEcd lno mÙkj nf{k.k fn'kk e fLFkj gkrh gA
3- çR;d pEcd e nk /ko ¼N ,o S½ ik; tkr gA ftUg vyx ugh fd;k tk ldrk gA
4- l tkrh; /kok d e/; çfrd"k.k cy yxrk g] tcfd fo tkrh; /ko ,d nlj dk vkdf"kr djr gA
5- pEcd dk xe dju] Bkdu&ihVu ;k fxjku ij bld pEcdh; x.k u"V gku yxr gA

pEcd l lcf/kr egRoi.k ifjHkk"kk,¡

1- **pEcdRo %** pEcd dk og x.k ftld dkj.k og Lor=rkiod yVdk; tku ij lno ,d gh fn'kk ¼N – S½ e fLFkj gk tkrh g rFkk ykg;Dr oLrvk dk viuh vkj vkdf"kr djrh g] pEcdRo dgykrk gA inkFkk e pEcdRo e[;r% byDVkuk dh v{kh; ,o pØ.k xfr d dkj.k ik;k tkrk gA
2- **pEcdh; /ko %** pEcd d nkuk fljk ij fLFkr o fcn tgk ij pEcdRo vf/kdre gkrk g] pEcdh; /ko dgykr gA pEcd e nk /ko gkr g& ¼1½ mÙkjh /ko (N)] ¼2½ nf{k.kh /ko (N)A pEcd dk mÙkjh /ko fljk] mÙkj fn'kk dk bfxr djrk g] bl /ku /ko Hkh dgr gA tcfd nf{k.kh /ko fljk] nf{k.k fn'kk dk bfxr djrk g rFkk bl _.k /ko Hkh dgr gA
3- **pEcdh; v{k %** pEcd d vnj nkuk /kok dk feyku okyh dkYifud v{k] pEcdh; v{k dgykrh gA
4- **pEcd dh çHkkodkjh yEckb %** pEcd d nkuk /kok d e/; dh njh] pEcd dh çHkkodkjh yEckb dgykrh gA tk pEcd dh okLrfod yEckb l dN de gkrh gA
5- **/ko çcyrk %** pEcd d fdlh /ko }kjk] pEcdh; inkFkk dk viuh vkj vkdf"kr dju dh {kerk /ko çcyrk dgykrh gA
6- **pEcdh; cy j[kk, %** fo|r {k= dh rjg] pEcdh; {k= dk Hkh dkYifud oØk }kjk çnf'kr fd;k tkrk gA ; dkYifud oØ pEcdh; cy j[kk, dgykrh gA pEcdh; cy j[kk, pEcdh; {k= dh fn'kk 0;Dr djrh g rFkk ; cn oØ gkrh gA pEcd d ckgj budh fn'kk N → S rFkk pEcd d vnj budh fn'kk S → N gkrh gA fo|r cy j[kkvk dh Hkkfr] pEcdh; cy j[kk, Hkh ,d&nlj dk çfrPNn ugh djrh gA bu cy j[kkvk d fdlh fcn ij [khph x;h Li'k j[kk] ml fcn ij pEcdh; {k= dh fn'kk dk 0;Dr djrh gA

7- **pEcdh; {k= %** fdlh pEcd d pkjk vkj dk og {k= ftle pEcdh; ijh{k.k /ko] cy vuHko djrk g] pEcdh; {k= dgykrk gA nlj 'kCnk e og {k= ftle pEcd dk çHkko vuHko fd;k tk ld] pEcdh; {k= dgykrk gA

8- **pEcdh; ¶yDl %** pEcdh; {k= e fdlh Hkh {k=Qy e l xtju okyh pEcdh; cy j[kkvk dh l[;k] pEcdh; ¶yDl φ dgykrh gA bldk ek=d ocj gkrk gA

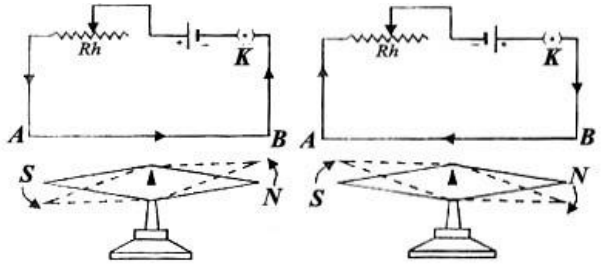
9- **pEcdh; çj.k %** pEcdh; {k= e ,dkd {k=Qy l yEcor xtju okyh pEcdh; cy j[kkvk dh l[;k pEcdh; çj.k B dgykrh g

$$B = \frac{\phi}{A}$$

bldk ek=d ocj@eh Vj² gkrk gA

vkjLVM dk ç;kx

pEcdh; {k= dh mRifÙk dk dkj.k tkuu dh ftKklk e vkjLVM u ,d ç;kx fd;kA bl i;kx e mUgku ,d èkkjkokgh pkyd rkj e cVjh l /kkjk çokfgr dj] /kkjkokgh pkyd rkj d lehi pEcdh; lb yku ij mRiUu fo{ki dk v/;;u fd;kA bl ç;kx dk fp= 2-1 e çnf'kr fd;k x;k gA



fp= 2-1

ç;kx d ç{k.k fuEu g&

¼v½ tc pkyd rkj e dkb /kkjk çokfgr ugh dh tkrh g rk mld lehi j[kh pEcdh; lb e dkb fo{ki mRiUu ugh gkrk gA

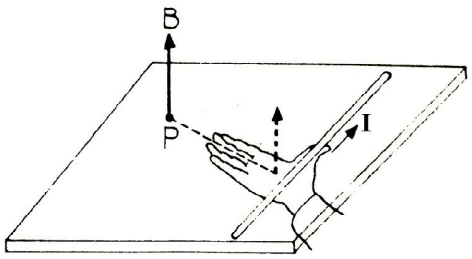
¼c½ tc pkyd rkj e /kkjk çokfgr dh tkrh g rk pEcdh; lb fo{kfir gk tkrh g rFkk /kkjk dh fn'kk foijhr dju ij pEcdh; lb foijhr fn'kk e fo{kfir gk tkrh gA rkj e /kkjk c<ku ij fo{ki dk eku c<rk gA

bll ;g Li"V gkrk g fd pEcdh; {k= d fy, fo|r /kkjk ¼xfreku vko'k½ mÙkjnk;h gkrh gA

/kkjkokgh pkyd d dkj.k mRiUu pEcdh; {k= dh fn'kk

/kkjkokgh pkyd d dkj.k mRiUu pEcdh; {k= dh fn'kk Kkr dju d fy, nk fu;ek dk çfriknu fd;k x;k gA

(i) **nk;h gFkyh dk fu;e %** bl fu;e d vulkj ;fn ge nk; gkFk dh gFkyh dk ijk Qyk dj bl çdkj j[k fd vxBk pkyd e çokfgr /kkjk dh fn'kk dk rFkk vxfy;k ml fcn dk bfxr dj ftl ij /kkjk d dkj.k pEcdh; {k= dh fn'kk Kkr djuh g rk gFkyh d i"B yEcor mij dh fn'kk pEcdh; {k= dh fn'kk dk 0;Dr djxhA



fp= 2-2 v

(ii) **eDloy dk nf{k.kkorh ip fu;e %** bl fu;e d vulkj nf{k.kkorh ip dk nk; gkFk l idMdj bl çdkj l ?keko fd ip dh ukd /kkjk dh fn'kk e vkx dh vkj c< rk ftl fn'kk e ip dk ?keku d fy, vxBk ?kerk g] ogh pEcdh; cy&j[kkvk dh fn'kk gkxhA

fp= 2-2 c

ck;k&lkoV dk fu;e

fdlh /kkjkokgh pkyd rkj d dkj.k mld pkjk vkj mRiUu pEcdh; {k= dh rhork dk eku Kkr dju d fy, ck;k&lkoV u ,d fu;e fn;k] ftld vulkj &

fdlh /kkjkokgh pkyd rkj d vYik'kΔl d dkj.k fdlh

çfk.k fcn P ij pEcdh; {k= ΔB dk eku

(i) pkyd e çokfgr /kkjk I d lekuikrh]

(ii) /kkjkokgh pkyd rkj d vYik'k dh yEckb d lekuikrh]

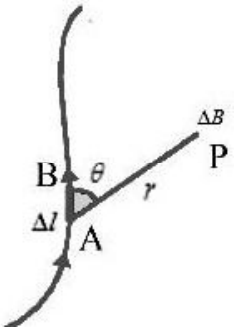
(iii) çfk.k fcn P d fLFkfr lfn'k $\vec{r}$,o /kkjkokgh pkyd rkj d vYik'k d e/; dk.k dh T;k $(\sin\theta)$ d lekuikrh rFkk

(iv) /kkjkokgh pkyd rkj d vYik'k l çfk.k fcn dh njh r d ox d 0;RØekuikrh gkrk gA

vFkkr $\Delta B \propto \frac{I\Delta l \sin\theta}{r^2}$

;k $\Delta B = \frac{\mu_0 I\Delta l \sin\theta}{4\pi r^2}$ ---¼1½

tgk $\frac{\mu_0}{4\pi}$,d lekuikrh fu;rkd gA



fp= 2-3

pEcdh; cy Hkh dyke cy dh Hkkfr 0;RØe ox cy dk mnkgj.k gA

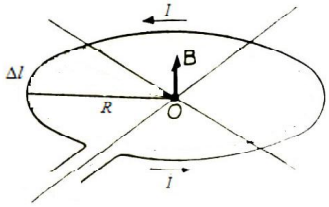
lehdj.k ¼1½ l Li"V g fd &

(i) tc $\theta = 0$ rk $\Delta B = 0$ vFkkr pkyd rkj d i"B ij pEcdh; {k= 'kU; gkrk gA

(ii) tc $\theta = 90°$ rk $\Delta B = \Delta B_{max} = \frac{\mu_0 I\Delta l}{4\pi r^2}$ vFkkr pkyd rkj d i"B d yEcor pEcdh; {k= dk eku vf/kdre gkrk gA

oÝkkdkj dMyh d dUn ij pEcdh; {k= dh x.kuk

fp= 2-4 d vuqlkj ekuk R f=T;k dh /kkjkokgh oÝkkdkj dMyh e /kkjk I çokfgr gk jgh gA ge bl dMyh d dUæ O ij pEcdh; {k= dk eku Kkr djuk gA bld fy, dMyh dh ifjf/k dk ge leku yckb Δl d NkV&NkV vYik'kk e foHkkftr dj yr gA vr% dMyh d dUn ij dy pEcdh;



fp= 2-4

{k= dk eku] bu lHkh vYik'kk d dkj.k dUæ ij mRiUu pEcdh; {k=k d ;kx d rY; gkxkA

ck;k&lkoV d fu;eku lkj Δl vYik'k d dkj.k dMyh d dUæ O ij pEcdh; {k=

$$\Delta B = \frac{\mu_0 I\Delta l \sin\theta}{4\pi R^2}$$

tgk θ vYik'k Δl ,o vYik'k Δl dk dMyh d dUæ O l feyku okyh j[kk d e/; dk dk.k g ¼oÝkkdkj dMyh dh fLFkfr e bldk eku 90° gkrk g½A

vr% $\Delta B = \frac{\mu_0 I\Delta l}{4\pi R^2}$

pfd dUæ O ij pEcdh; {k= dh fn'kk dMyh d ry d yEcor gA vr% dMyh d lHkh vYik'kk d fy, pEcdh; {k= dh fn'kk leku gkxhA vr% li.k dMyh d dkj.k] dMyh d dUæ pEcdh; {k=

$$B = \sum \Delta B = \sum \frac{\mu_0 I\Delta l}{4\pi R^2}$$

$$= \frac{\mu_0 I}{4\pi R^2}\sum \Delta l \qquad = \frac{\mu_0 I}{4\pi R^2} \times 2\pi R$$

;k $B = \frac{\mu_0 I}{2R}$ ---¼2½

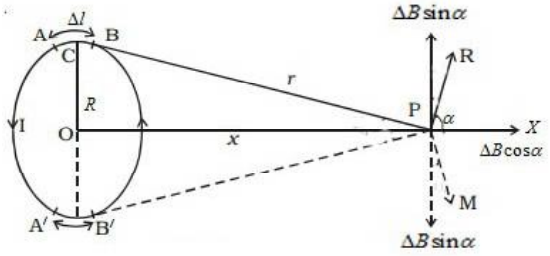
;fn dMyh N Qjk okyh gk rk

$$B = \frac{\mu_0 NI}{2R}$$ ---¼3½

lehdj.k ¼2½ o lehdj.k ¼3½ oÝkkdkj dMyh d dUæ ij pEcdh; {k= d vfHk"B 0;Tkd gA

oÝkkdkj dMyh d v{k ij pEcdh; {k= dh x.kuk

oÝkkdkj dMyh d v{k ij pEcdh; {k= dh x.kuk d fy, ge fp= 2-5 d vuqlkj ,d R f=T;k okyh /kkjkokgh



fp= 2-5

dMyh ij fopkj djr g ft le I /kkjk çokfgr gk jgh g rFkk dMyh Y-Z ry e fLFkr gA dMyh dh v{k ½X-v{k½ ij fLFkr ç{k.k fcn P ij pEcdh; {k= dk eku ck;k& lkoV d fu;e l fuEu çdkj Kkr fd;k tk ldrk g&

fp=ku lkj ekuk fd ç{k.k fcn dh dMyh d dUæ l njh x gA lfo/kk d fy, ge dMyh dk leku yckb Δl d vYik'kk e foHkkftr dj yr gA vr% fdlh ,d vYik'k Δl d dkj.k P fcn ij pEcdh; {k= $\Delta B = \frac{\mu_0 I \Delta l \sin\theta}{4\pi r^2}$

tgk r vYik'k l ç{k.k fcn dh njh gA

pfd dMyh d fy, $\theta = 90°$

vr% $\Delta B_{max} = \frac{\mu_0 I \Delta l}{4\pi r^2}$

;fn pEcdh; {k= ΔB v{k l α dk.k cukrk g rk pEcdh; {k= d m/ok/kj ?kVd $\Delta B \sin\alpha$ foijhr fn'kk e rFkk {kfr t ?kVd $\Delta B \cos\alpha$ dMyh dh v{k d vufn'k leku fn'kk e çkIr gkx vFkkr ifj.kkeh pEcdh; {k= X fn'kk d vufn'k çkIr gkxkA vr% ifj.kkeh pEcdh; {k=

$$B = \sum \Delta B \cos\alpha$$

;k $$B = \sum \frac{\mu_0 I \Delta l}{4\pi r^2} \cos\alpha$$

fp= 2-5 l $r^2 = R^2 + x^2$,o $\cos\alpha = \frac{R}{r}$

$$\therefore B = \frac{\mu_0 IR}{4\pi (R^2 + x^2)^{\frac{3}{2}}} \sum \Delta l$$

$$= \frac{\mu_0 IR}{4\pi (R^2 + x^2)^{\frac{3}{2}}} \times 2\pi R$$

$$B = \frac{\mu_0 IR^2}{2(R^2 + x^2)^{\frac{3}{2}}} \quad \text{---½4½}$$

;fn dMyh N Qjk okyh gk rk &

$$B = \frac{\mu_0 NIR^2}{2(R^2 + x^2)^{\frac{3}{2}}} \quad \text{---½5½}$$

leh dj.k ¼4½ o leh dj.k ½5½ oÝkkdkj dMyh d v{k ij pEcdh; {k= dk vfHk"B 0; t d gA

,fEi;j dk fu;e

,fEi;j d fu;e d vulkj fdlh cn iFk ij pEcdh; {k= dk j[kk lekdyu ¼ifjlpj.k½ dk eku] cn iFk }kjk ifjc) /kkjkvk d ch txf.krh; ;kx rFkk μ_0 d x.kuQy d rY; gkrk g] vFkkr

$$\int \vec{B}.d\vec{l} = \mu_0 \sum I \quad \text{---½6½}$$

¶yfex d nk; gkFk dk fu;e

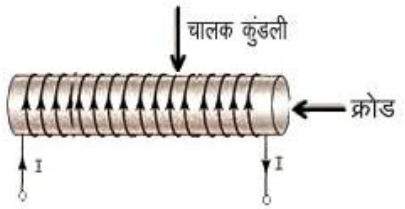
bl fu;e d vulkj ;fn ge viu nk; gkFk dk vxBk vkj mld ikl okyh nkuk vxfy;k dk ,d&nlj d yEcor bl çdkj l Qyk; fd igyh vxyh pEcdh; {k= dh fn'kk dk rFkk vxBk pkyd dh xfr dh fn'kk dk çnf'kr dj rk chp okyh vxyh pkyd e çfjr /kkjk dh fn'kk çnf'kr djxh] fp= ½2-6½A

fp= 2-6

परिनालिका में चुम्बकीय क्षेत्र

vpkyd inkFk l cuh [kk[kyh cyukdkj ufydk ij bldh yckb d vufn'k fo|r :) (insulated) rkjk dk ,d leku : i l yiV dj ifjukfydk dk fuek.k fd;k tkrk gA nlj 'kCnk e yEch cyukdkj /kkjkokgh dMyh dk ifjukfydk dgr g] fp= ½2-7½A

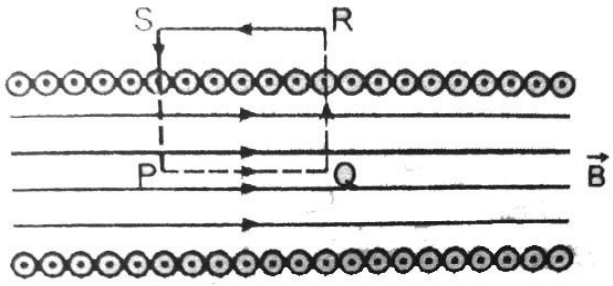
,d vkn'k ifjukfydk dh yEckb] mldh f=T;k dh ryuk e vR;f/kd gkrh gA ifjukfydk e /kkjk çokfgr dju



fp= 2-7

ij mld [kk[ky Hkkx e mPp pEcdh; {k= çkIr gkrk gA tcfd ifjukfydk d ckgj pEcdh; {k= yxHkx 'kU; gkrk gA

vkn'k ifjukfydk e pEcdh; {k= dk eku Kkr dju d fy, ge fp= 2-8 d vulkj ifjukfydk d vYik'k ij ,d vk;rkdkj cn yi PQRS dh dYiuk djr gA yi dh Hkqtk PQ dh yEckb gA ;fn ifjukfydk d ,dkd yEckb e Qjk dh l[;k n g rk yi PQRS e ifjc) dy Qjk dh l[;k nΔL rFkk ifjc) /kkjk dk eku nΔLI gkxkA tgk I ifjukfydk e çokfgr /kkjk gA



fp= 2-8

;fn ifjukfydk e mRiUu pEcdh; {k= B gk rk] ,fEi;j d fu;e l&

$$\int_{PQRS} \vec{B}.d\vec{l} = \mu_0 \sum I_n$$

;k $$\int_{PQRS} \vec{B}.d\vec{l} = \mu_0 n\Delta LI$$ ---¼7½

yfdu

$$\int_{PQRS} \vec{B}.d\vec{l} = \int_{P}^{Q} \vec{B}.d\vec{l} + \int_{Q}^{R} \vec{B}.d\vec{l} + \int_{R}^{S} \vec{B}.d\vec{l} + \int_{S}^{P} \vec{B}.d\vec{l}$$

∵QR ,o SP iFk ij pEcdh; {k= dh fn'kk] iFk d yEcor g vr% $\theta = 90°$,o $\cos 90° = 0$ gku d dkj.k

$$\int_{Q}^{R} \vec{B}.d\vec{l} = \int_{Q}^{R} \vec{B}.d\vec{l} = 0$$

,o ifjukfydk d ckgj pEcdh; {k= 'kU; gku d dkj.k $\int_{R}^{S} \vec{B}.d\vec{l} = 0$

vr% $$\int_{PQRS} \vec{B}.d\vec{l} = \int_{P}^{Q} \vec{B}.d\vec{l}$$

$$= B\int_{P}^{Q} dl \quad$$ ¼PQ iFk d fy; $\theta = 0$½

$$\int_{PQRS} \vec{B}.d\vec{l} = B\Delta L$$ ---¼8½

lehdj.k ¼7½ o lehdj.k ¼8½ dh ryuk dju ij

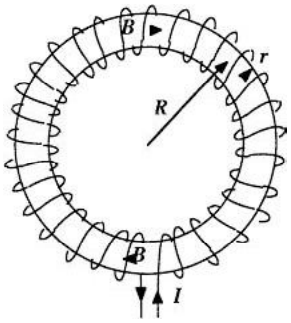
$$B\Delta L = \mu_0 n\Delta LI$$

$$B = \mu_0 nI$$ ---¼9½

lehdj.k ¼9½ ifjukfydk e mRiUu pEcdh; {k= dk vHkh"V 0; td gA

VkjkbM e pEcdh; {k=

;fn ifjukfydk dk oy; d :i ekM fn;k tk; rk çkIr vkÑfr VkjkbM dgykrh gA oLrr% VkjkbM ,d vrghu ifjukfydk gkrh g] ftle fo|r /kkjk çokfgr dju ij VkjkbM d vnj v{k d vufn'k lekUrj ldUæh; oÙkkdkj yik d :i e pEcdh; {k= mRiUu gkrk gA



fp= 2-9

ekuk fd ,d R f=T;k d VkjkbM e I /kkjk çokfgr gk jgh gA VkjkbM e Qjk dh dy l[;k N gA VkjkbM d v{k d çR;d fcn ij pEcdh; {k= $\vec{B}$ o $d\vec{l}$ lekrj gkr gA vr% ,fEi;j d fu;e l&

$$\int \vec{B}.d\vec{l} = \mu_0 \sum I$$

$$B\int dl = \mu_0 NI$$

;k $B(2\pi R) = \mu_0 NI$

;k $B = \dfrac{\mu_0 NI}{2\pi R}$

;fn VkjkbM dh ,dkd yEckb e Qjk dh l[;k n gk rk $n = \dfrac{N}{2\pi R}$

vr% $B = \mu_0 nI$ ---¼10½

lehdj.k ¼10½ VkjkbM e mRiUu pEcdh; {k= dk vHkh"V 0;tk gA

pEcdh; vfHkokg

pEcdh; vfHkokg dk nljk uke pEcdh; ¶yDl gA bl ϕ l fu:fir djr gA ,dkd {k=Qy l fuxr pEcdh; vfHkokg] pEcdh; çj.k B dgykrk gA lfn'k ldru e pEcdh; vfHkokg] pEcdh; çj.k ,o i"B {k=Qy lfn'k e xf.krh; lc/k fuEu çdkj l 0;Dr djr gA

$$\phi = \vec{B}.\vec{A}$$

;k $\phi = BA\cos\theta$

tgk θ pEcdh; çj.k lfn'k ,o i"B {k=Qy lfn'k d e/; dk.k gA

fdlh i"B l fuxr pEcdh; ¶yDl /kukRed ¶yDl rFkk çof'kr ¶yDl _.kkRed ¶yDl dgykrk gA pEcdh; ¶yDl vfn'k jkf'k gkrk gA

çÑfr d ey cyk dk ifjp; ,o ryuk

çkÑfrd ?kVukvk dh 0;k[;k dju d fy, vko';d cyk dk] çÑfr d ey cy dgr gA Hkkfrdh e çR;d d.k d vU; d.kk l çHkkfor gku dh çfØ;k vU;kU; fØ;k dgykrh gA cyk dh çÑfr ;k d.kk d e/; vU;kU; fØ;k d vk/kkj ij ey cyk dk fuEu pkj Hkkxk e oxhÑr fd;k x;k g %&

ey cyk dk ryukRed v/;;u

Ø-l-	x.k	x#Roh; cy	fo|r pEcdh; cy	ukfHkdh; cy	ncy cy
(a)	mnxe	nk æ0;ekuk d e/;	vkof'kr d.kk d e/;	U;fDyvkuk d e/;	l{e ey d.kk ¼ckl kuk d e/; ;k β {k;½
(b)	vuikyu fu;e	0;RØe ox fu;e	0;RØe ox fu;e	;dkok cy	Kkr ugh
(c)	çÑfr	vkd"k.k dh	vkd"k.k@çfrd"k.k	vkd"k.k ;k vR;Ur lehi nfj;k ij çfrd"k.k dh	vkd"k.k@ çfrd"k.k
(d)	çÑfr dh fuHkjrk	&	vko'kk dh çÑfr ij	ijkl ij	Kkr ugh
(e)	ijkl	nh?k ¼[kxkyh; nfj;k rd½	nh?k ¼dN fdeh rd½	y?k ¼eh- 10^{-15}m rd½	y?k ¼eh- 10^{-10}m rd½
(f)	lkif{kd çcyrk ;k lkeF; (a) ¼x#Roh; cy dk vk/kkj ekudj (b) ¼ukfHkdh; cy dk vk/kkj ekuu ij	1 10^{-39}	10^{36} 10^{-3}	10^{39} 1	10^{14} 10^{-25}
(g)	cyk dh mRifÙk dk dkj.k	xfoVku d.k dk vknku&çnku	QkVku uked d.k dk vknku&çnku	elku uked d.k dk vknku&çnku	ckl ku uked d.k dk vknku& çnku

1- x:Rokd"k.k cy ;k x:Roh; vU;kU; fØ;k

2- fo|r pEcdh; cy ;k fo|r pEcdh; vU;kU; fØ;k

3- ukfHkdh; cy ;k ukfHkdh; vU;kU; fØ;k

4- ncy cy ;k ncy vU;kU; fØ;k

x:Rokd"k.k cy ;k x:Roh; vU;kU; fØ;k % nk æ0;eku d.kk d e/; yxu okyk cy ¼vU;kU; fØ;k½ x:Rokd"k.k cy ¼vU;kU; fØ;k½ dgykrk gA bl cy dh çÑfr vkd"k.k dh gkrh g rFkk bl vU;kU; fØ;k d fy, mÙkjnk;h d.k xfoVku dgykrk gA ;g 0;RØe ox cy g rFkk xf.krh; :i e bldk eku $F = -\frac{Gm_1m_2}{r^2}$ gkrk gA bldh ijkl nh?k ¼[kxkyh; nfj;k rd½ gkrh gA ;g cy ukfHkdh; ijkl e o/k ugh jgrk gA

fo|r pEcdh; cy ;k fo|r pEcdh; vU;kU; fØ;k % nk vkof'kr d.kk d e/; yxu oky cy dk fo|r&pEcdh; cy dgr gA bl cy dh çÑfr vko'kk dh çÑfr ij fuHkj djrh gA bl vU;kU; fØ;k d fy, mÙkjnk;h d.k QkVku dgykrk gA x:Rokd"k.k cy dh Hkkfr ;g cy Hkh 0;RØe ox cy gA xf.krh; :i e bl cy dk eku $F = \frac{Kq_1q_2}{r^2}$ gkrk gA bldh ijkl x:Rokd"k.k cy dh ryuk e de ¼dN fdeh rd½ gkrh gA ;g Hkh nh?k ijkl cy dk mnkgj.k gA

ukfHkdh; cy ;k ukfHkdh; vU;kU; fØ;k % ukfHkdh; d.kk d e/; yxu okyk cy ¼vU;kU; fØ;k½ ukfHkdh; cy ¼vU;kU; fØ;k½ dgykrk gA bl cy dh çÑfr ukfHkdh; ijkl e vkd"k.k rFkk vkj lehi gku ij çfrd"k.k dh gkrh gA bl ;dkok cy $\left(F \propto e^{-\frac{r}{r_0}}\right)$ Hkh dgr gA ukfHkdh; vU;kU; fØ;k d fy, mÙkjnk;h d.k elku dgykr gA

ncy cy ;k ncy vU;kU; fØ;k % l{e ey d.kk ¼ckl ku d.kk½ d e/; ,o {k;] ncy cy dk mnkgj.k gA bldh çÑfr vkd"k.k ,o çfrd"k.k nkuk çdkj dh gkrh gA ;g y?k ijkl cy gA bl vU;kU; fØ;k d fy, mÙkjnk;h d.k ckl ku d.k dgykr gA

egRoi.k fcUn

1- pEcd ,l inkFk gkr g] tk Lor=rkiod yVdk; tku ij lno ,d gh fn'kk ¼mÙkj&nf{k.k½ e fLFkj gk tkr g rFkk ykg;Dr inkFkk dk viuh vkj vkdf"kr djr gA

2- çR;d pEcd e nk /ko ¼N ,o S½ ik; tkr gA ftUg vyx&vyx ugh fd;k tk ldrk gA

3- pEcdh; cy j[kk, pEcdh; {k= dh fn'kk 0;Dr djrh g rFkk ; cn oØ gkrh gA pEcd d ckgj budh fn'kk $N \rightarrow S$ rFkk pEcd d vnj budh fn'kk $S \rightarrow N$ gkrh gA fo|r cy j[kkvk dh Hkkfr] pEcdh; cy j[kk, Hkh ,d&nlj dk çfrPNn ugh djrh gA bu cy j[kkvk d fdlh fcn ij [khph x;h Li'k j[kk] ml fcn ij pEcdh; {k= dh fn'kk dk 0;Dr djrh gA

4- fdlh pEcd d pkjk vkj dk og {k= ftle pEcdh; ijh{k.k /ko] cy vuHko djrk g] pEcdh; {k= dgykrk gA

5- pEcdh; {k= e fdlh Hkh {k=Qy e l xtju okyh pEcdh; cy j[kkvk dh l[;k] pEcdh; ¶yDl ϕ dgykrh gA bldk ek=d ocj gkrk gA

6- pEcdh; {k= e ,dkd {k=Qy l yEcor xtju okyh pEcdh; cy j[kkvk dh l[;k pEcdh; çj.kB dgykrh gA

7- pEcdh; {k= d fy, fo|r /kkjk ½xfreku vko'k½ mÙkjnk;h gkrh gA

8- pkyd rkj d i"B d yEcor pEcdh; {k= dk eku vfèkdre gkrk gA

9- vpkyd inkFk l cuh [kk[kyh cyukdkj ufydk ij bldh yckb d vufn'k fo|r :) rkjk dk ,d leku :i l yiV dj ifjukfydk dk fuek.k fd;k tkrk gA

10- ifjukfydk e /kkjk çokfgr dju ij mld [kk[ky Hkkx e mPp pEcdh; {k= çkIr gkrk gA tcfd ifjukfydk d ckgj pEcdh; {k= yxHkx 'kU; gkrk gA

11- VkjkbM ,d vrghu ifjukfydk gkrh g] ftle fo|r èkkjk çokfgr dju ij VkjkbM d vnj v{k d vufn'k lekUrj ldUæh; oÙkkdkj yik d :i e pEcdh; {k= mRiUu gkrk gA

12- çkÑfrd ?kVukvk dh 0;k[;k dju d fy, vko';d cyk dk] çÑfr d ey cy dgr gA

vH;kl lkFk ç'u

oLrfu"B ç'u

1- pEcdh; ¶yDl dk ek=d g&

¼v½ ocj ¼2½ okYV

¼l½ ,fEi;j ¼n½ U;Vu

2- fo|r pEcdh; vU;kU; fØ;k d fy; mRrjnk;h d.k g
¼v½ QkVku ¼c½ xfoVku
¼l½ ckl ku ¼n½ byDVku

3- x:Rokd"k.k vU;kU; fØ;k d fy; mÙkjnk;h d.k g&
¼v½ QkVku ¼c½ xfoVku
¼l½ ckl ku ¼n½ byDVku

4- /kkjkokgh dMyh e Qjk dh l[;k c<ku ij pEcdh; {k= d eku e ---------- gkrk gA
¼v½ deh ¼c½ of)
¼n½ vifjoru ¼n½ mi;Dr e dkb ugh

5- pEcd d vUnj pEcdh; cy j[kkvk dh fn'kk gkrh g&
¼v½ S l N ¼c½ N l S
¼l½ N l N ¼n½ S l S

y?kÙkjkRed i'u

1- pEcd dk xe dju ij D;k gkrk g\

2- /kkjkokgh oŸkkdkj dMyh dh f=T;k de dju ij dMyh d dUæ ij pEcdh; {k= e D;k çHkko iMrk g\

3- pEcdh; cy j[kk, vkil e ,d&nlj dk D;k ugh dkVrh g\

4- pEcdh; {k= fdl dkj.k l mRiUu gkrk g\

5- pEcdh; cy j[kkvk dk iFk dl k gkrk g\

6- pEcdh; ¶yDl dh ifjHkk"kk nhft ,A

7- nk;h gFkyh d fu;e dk fyf[k,A

8- ,fEi;j d fu;e dk dFku dhft ,A

9- eDloy d nf{k.kkorh ip fu;e dk fyf[k,A

10- pEcdh; cy j[kkvk rFkk fo|r cy j[kkvk e nk vUrj crkb;A

fucU/kkRed ç'u

1- ck;k&lkoV fu;e dk çfriknu djr g, oŸkkdkj dMyh d dUæ ij pEcdh; {k= dh x.kuk dhft ,A

2- ,fEi;j d fu;e ij çdk'k Mkfy, rFkk oŸkkdkj dMyh d v{k ij pEcdh; {k= dh x.kuk dhft ,A

3- ifjukfydk e mRiUu pEcdh; {k= dh x.kuk dhft ,A

4- ¶yfex d nk; gkFk d fu;e dk mYy[k dhft ,A VkjkbM e mRiUu pEcdh; {k= dh x.kuk dhft ,A

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mÙkjekyk % 1 ¼v½ 2 ¼v½ 3 ¼c½ 4 ¼c½ 5 ¼v½

bdkb & II

v/;k; & 3

çfrjk/k ,o l/kkfj=

(Resistors and Capacitors)

ifrjk/k

tc fdlh pkyd d fljk ij foHkokrj vkjksfir fd;k tkrk g rk pkyd e mifLFkr eDr byDVku fuEu foHko l mPp foHko dh vkj xfr dju yxr gA pkyd e mifLFkr c) ijek.k ,o vk;u] bu eDr byDVkuk d iokg e ck/kk mRiUu djr g] ft l pkyd dk çfrjk/k dgr gA bl ldr R l çnf'kr fd;k tkrk g rFkk bldh bdkb vke Ω gkrh gA pkyd dk çfrjk/k fuEu dkjdk ij fuHkj djrk g %&

1- **pkyd dh yEckb ij %** pkyd dk çfrjk/k pkyd dh yEckb d lekuikrh gkrk g] vFkkr

$$R \propto l \qquad \text{---(1)}$$

2- **pkyd d vuçLFk dkV ij %** pkyd dk çfrjk/k] pkyd dh vuçLFk dkV {k=Qy d 0;RØekuikrh gkrk g] vFkkr

$$R \propto \frac{1}{A} \qquad \text{---(2)}$$

3- **pkyd d rki ij %** pkyd dk çfrjk/k] rki c<ku ij c<rk gA bldk dkj.k ;g g fd rki c<ku ij eDr byDVkuk dh xfrt Åtk c< tkrh g ft l l eDr byDVkuk dk ox c< tkrk g vkj eDr byDVkuk dh c) ijek.kvk@vk;uk l VDdj dh vkofr c< tkrh gA ifj.kkeLo:i eDr byDVkuk d çokg e vojk/k c< tkrk g rFkk budk /kkjk e ;kxnku de gk tkrk gA çk;kfxd ç{k.kk d vk/kkj ij pkydk e çfrjk/k dh rki ij fuHkjrk fuEu l= l nh tkrh g&

$$R_t = R_0(1+\alpha t) \qquad \text{---(3)}$$

tgk $R_0 0^oC$ rki ij pkyd dk çfrjk/k] α pkyd dk çfrjk/k rki x.kkd rFkk t pkyd dk rki (°C e½

4- **pkyd dh çÑfr ij %** pkyd dk çfrjk/k] pkyd d inkFk dh çÑfr ij fuHkj djrk gA

çfrjk/kdrk % mi;Dr lehdj.k (1) o lehdj.k (2) dk ,d lkFk fy[ku ij

$$R \propto \frac{\ell}{A}$$

;k $$R = \rho\frac{l}{A} \qquad \text{---(4)}$$

tgk ℓ ,d lekuikrh fu;rkd g ft l pkyd dk fof'k"V çfrjk/k ;k çfrjk/kdrk dgr gA lehdj.k (4) e $l=1$ eh Vj rFkk $A=1$ oxeh Vj gk rk

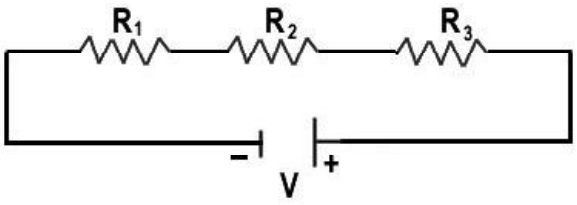
$$R = \rho$$

vFkkr pkyd dk fof'k"V çfrjk/k (çfrjk/kdrk] ,dkd yEckb ,o ,dkd vuçLFk dkV {k=Qy oky pkyd d çfrjk/k d rY; gkrk gA fof'k"V çfrjk/k (çfrjk/kdrk dk ek=d vke&eh Vj gkrk gA

çfrjk/kk dk l;ktu

fofHkUu ifjiFkk e ,d l vf/kd çfrjk/kk dk l;ktu nk çdkj l fd;k tkrk g %(i) J.kh Øe l;ktu] (ii) lekarj Øe l;ktuA

(i) **J.kh Øe l;ktu %** bl l;ktu e ,d çfrjk/k d vfre flj dk nlj çfrjk/k d çFke flj l l;kftr fd;k tkrk gA bl l;ktu e /kkjk çokfgr fd; tku ij çfrjk/kk d fljk ij okYVrk dk foHkktu gkrk g tcfd /kkjk dk eku fu;r jgrk gA bl l;ktu e rY; çfrjk/k dh x.kuk fuEu çdkj djr g %&



fp= 3-1

fp=ku lkj ekuk fd rhu çfrjks/k R_1, R_2 ,o R_3 J.kh Øe e ,d V okYV dh cVjh l tM gA ekuk fd ifjiFk e cgu okyh /kkjk dk eku I g rFkk çfrjks/kk d fljk ij /kkjk I d dkj.k mRiUu foHkokrj dk eku Øe'kk V_1, V_2 o V_3 g rk ifjiFk e okYVrk foHkktu l&

$$V = V_1 + V_2 + V_3 \qquad \text{---(5)}$$

vke d fu;e l çfrjks/k R_1 d fljk ij mRiUu foHkokrj $V_1 = IR_1$

blh çdkj R_2 o R_3 d fljk ij mRiUu foHkokrj Øe'kk $V_2 = IR_2$, $V_3 = IR_3$

vr% lehdj.k (5) l

$$V = IR_1 + IR_2 + IR_3$$

;k $$V = I(R_1 + R_2 + R_3) \qquad \text{---(6)}$$

;fn çfrjks/kk d l;ktu dk rY; çfrjks/k R gk rk

$$V = IR \qquad \text{---(7)}$$

lehdj.k (6) o lehdj.k (7) l

$$IR = I(R_1 + R_2 + R_3)$$

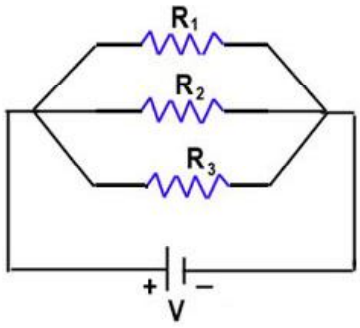
;k $$R = (R_1 + R_2 + R_3) \qquad \text{---(8)}$$

0;kid :i l ;fn n çfrjks/k J.kh Øe e tM gk rk&

$$R = (R_1 + R_2 + ... + R_n)$$

mi;Dr l Li"V g fd J.kh Øe l;ktu e rY; çfrjkèk dk eku] l;ktu e ç;Dr çfrjks/kk d ;kx d cjkcj gkrk gA

(ii) **lekarj Øe l;ktu %** bl l;ktu e ç;Dr lHkh çfrjks/kk d çFke flj ,d fcn rFkk vfre flj] nlj vU; fcn l tM gkr gA bl l;ktu e /kkjk çokfgr fd; tku ij lHkh çfrjks/kk d fljk ij foHkokrj dk eku leku jgrk g tcfd /kkjk dk foHkktu gkrk gA bl l;ktu d fy; rY; çfrjks/k dh x.kuk fuEu çdkj djr g %&



fp= 3-2

fp= 3-2 d vuqkj ekuk fd rhu çfrjks/k R_1, R_2, ,o R_3 lekarj Øe l;ktu e ,d V okYV dh cVjh l tM gA ekuk fd ifjiFk e cgu okyh /kkjk dk dy eku I rFkk çfrjks/kk e cgu okyh /kkjk dk Øe'kk I_1, I_2 o I_3 g rk ifjiFk e /kkjk foHkktu l &

$$I = I_1 + I_2 + I_3 \qquad \text{---(9)}$$

vke d fu;e l çfrjks/k R_1, R_2 o R_3 e çokfgr /kkjk dk eku Øe'kk $I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2}$ o $I_3 = \frac{V}{R_3}$ gkxkA

vr% lehdj.k (9) l

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \qquad \text{---(10)}$$

tgk çfrjks/kk d l;ktu dk rY; çfrjks/k R gA

;k $$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \qquad \text{---(11)}$$

0;kid :i e ;fn n çfrjks/k lekarj Øe e tM gk rk&

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + ... + \frac{1}{R_n} \qquad \text{---(12)}$$

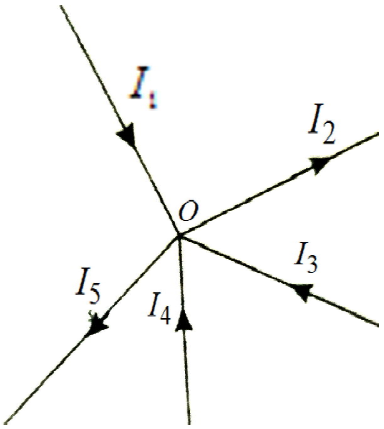
mi;Dr l Li"V g fd lekarj Øe l;ktu e rY; çfrjks/k dk 0;RØe l;ktu e ç;Dr çfrjks/kk d 0;RØek d ;kx d cjkcj gkrk gA

fdjpkQ d fu;e

fdjpkQ u lu 1842 e fo|r ifjiFkk d fo'y"k.k d fy, nk fu;ek dk çfriknu fd;k ftUg fdjpkQ d fu;e dgr gA fdjpkQ d fu;e fuEu g&

1- fdjpkQ dk çFke fu;e (/kkjk fu;e)
2- fdjpkQ dk f}rh; fu;e (okYVrk fu;e)

fdjpkQ dk çFke fu;e % bl fdjpkQ dk /kkjk fu;e Hkh dgr gA bl fu;e d vulkj fdlh ifjiFk d lfêk fcn¼tgk ,d l vf/kd 'kk[kk, tMh gk½ ij leLr /kkjkvk dk ch txf.krh; ;kx 'kU; gkrk g] vFkkr $\sum I = 0$



fp= 3-3

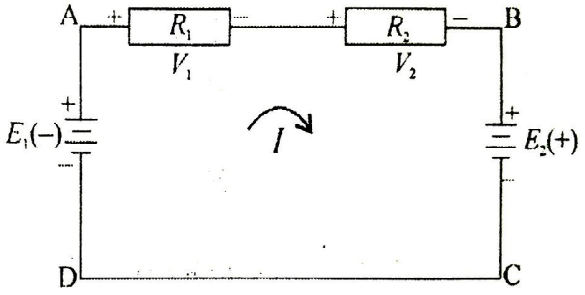
;fn lf/k dh vkj tku okyh /kkjk dk /kukRed rFkk lfêk l ckgj vku okyh /kkjk dk _.kRed fy;k tk; rk fp= 3-3 d vulkj /kkjk I_1, I_3 ,o I_4 /kukRed rFkk /kkjk I_2 o I_5 _.kRed gkxhA bl fLFkfr e fdjpkQ d /kkjk fu;e l&

$$I_1-I_2+I_3+I_4-I_5= 0$$

;k $I_1+I_3+I_4 = I_2+I_5$

nlj 'kCnk e /kkjk fu;e d vulkj fdlh lf/k e tku okyh /kkjkvk dk ;kx] lf/k l ckgj fudyu okyh /kkjkvk d ;kx d cjkcj gkrk gA fdjpkQ dk ;g fu;e vko'k lj{k.k d fl)kr ij vk/kkfjr gA

fdjpkQ dk f}rh; fu;e % bl fdjpkQ dk okYVrk fu;e Hkh dgr gA bl fu;e d vulkj ifjiFk tky d fdlh yi e fuf'pr fn'kk e pyr g, okYVrkvk dk ch txf.krh; ;kx 'kU; gkrk g] vFkkr $\sum V = 0$



fp= 3-4

;fn yi e fufn"V /kkjk dh fn'kk e okYVrk iru èkukRed o foijhr fn'kk e _.kRed fy;k tk; rk fp= 3-4 d vulkj E_2 çfrjk/k R_1 ,o R_2 ij okYVrkvk dk eku èkukRed ,o E_1 dk eku _.kRed gkxkA bl fLFkfr e fdjpkQ d okYVrk fu;e l&

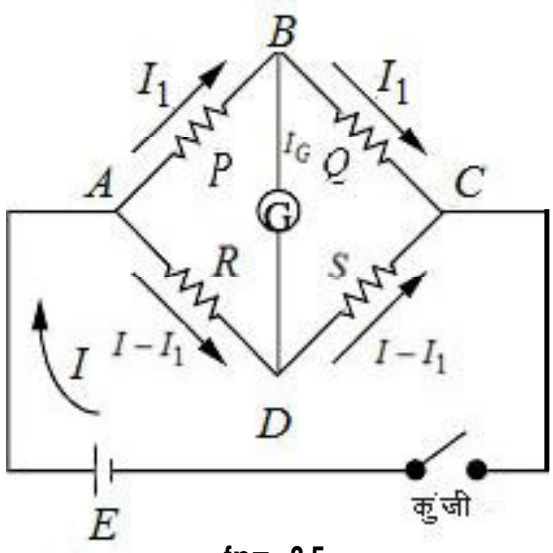
$$E_2+V_1+V_2-E_1=0$$

;k $IR_1+IR_2 = E_1-E_2$

;g fu;e Åtk lj{k.k fl)kr ij vk/kkfjr gA

0ghV LVku lr

pkYl 0ghVLVku u vKkr çfrjk/k dk eku Kkr dju d fy;] pkj çfrjk/kk d l;ktu dh ç;kfxd fof/k nh] ftl 0ghV LVku lr dgr gA bl fof/k e vKkr çfrjk/k S lfgr rhu vU; çfrjk/kk P, Q ,o R dk ,d prHkt d :i e tkMk tkrk gA fp= 3-5 e 0ghV LVku lr dk ifjiFk fp= n'kk;k x;k gA AB, BC, CD ,o *DA* lr dh pkj Hktk, ftue çfrjk/k Øe'kk P,Q,R ,o S yx gkr gA prHkt d fod.k AC e ,d ly E rFkk dth K rFkk fod.k BD e ,d /kkjkekih ç;Dr dh tkrh gA



fp= 3-5

/kkjkekih ifjiFk dh nk 'kk[kkvk ABC ,o ADC d eè; lr dh Hkkfr dk; dju dh otg l bl 0;oLFkk dk lr dgr gA ifjiFk e çfrjk/k P, Q ,o R Kkr çfrjk/k gkr g ftue l çfrjk/k R ifjorh çfrjk/k gkrk gA P rFkk Q d fdlh Kkr vuikr d fy, ifjorh çfrjk/k R dk bl çdkj lek;kftr djr g fd /kkjkekih e 'kU; fo{ki çkIr gk vFkkr /kkjkekih e dkb /kkjk çokfgr uk gkA bl fLFkfr dk 'kU; fo{ki dh fLFkfr dgr gA 'kU; fo{ki dh fLFkfr e lf/kBo D ij foHko dk eku leku gkrk gA bl fLFkfr dk lr d lryu fLFkfr dgr gA

lr d lryu fLFkfr dk çfrc/k Kkr dju d fy, ekuk fd ly l ifjiFk e dy /kkjk I çokfgr gk jgh gA ifjiFk dh fofHkUu lf/k;k A, B, C ,o D ij /kkjk dk foHkktu fp= 3-5 e n'kk;k x;k gA I_G /kkjkekih e çokfgr /kkjk gA

yi ABDA e fdjpkQ d okYVrk fu;e l&

$$I_1P + I_GG - (I-I_1)\,R=0$$

;k $I_1 (P+R) + I_GG = IR$ ---¼13½

tgk G /kkjkekih dk çfrjk/k gA

blh çdkj yi BCDB e fdjpkQ d okYVrk fu;e l&

$$(I_1-I_G)\,Q - (I-I_1+I_G)\,S-I_GG = 0$$

$$I_1 (Q+S) - I_G (Q+S+G) = IS \quad \text{---¼14½}$$

lr d lryu dh fLFkfr e $I_G = 0$ vr% lehdj.k ¼13½ o lehdj.k ¼14½ l

$$I_1 (P+R) = IR \quad \text{---¼15½}$$

,o $I_1 (Q+S) = IS$ ---¼16½

lehdj.k ¼15½ e lehdj.k ¼16½ l Hkkx nu ij&

$$\frac{P+R}{Q+S} = \frac{R}{S}$$

;k $PS+RS = QR+RS$

;k $PS=QR$

;k $\frac{P}{Q} = \frac{R}{S}$ ---¼17½

lehdj.k ¼17½ 0ghVLVku lr d fy, lryu voLFkk dk vfHk"V çfrc/k gA lehdj.k ¼17½ l vKkr çfrjk/k dk eku

$$S = \frac{QR}{P} \quad \text{---¼18½}$$

fo|r /kkfjrk

tc fdlh pkyd dk vkof'kr fd;k tkrk g rk mld foHko e of) gkrh gA foHko e of)] pkyd dk çnku fd; x; vko'k d lekuikrh gkrh g vFkkr

$$Q \propto V$$

;k $Q = CV$ ---¼19½

tgk C ,d lekuikrh fu;rkd g ftl pkyd dh fo|r /kkfjrk dgr gA oLrr% fo|r /kkfjrk] pkyd d vko'k lxg.k dh eki gkrh gA bldh bdkb QjM gkrh gA

l/kkfj=

nk pkydk dk ;Xe ftu ij foijhr vko'k gk rFkk vko'k dh i;kIr ek=k lfpr dju dh {kerk gk l/kkfj= dgykr gA l/kkfj= dh /kkfjrk dk eku lehdj.k ¼19½ l fn;k tkrk g vFkkr fdlh l/kkfj= dh /kkfjrk pkyd ij mifLFkr vko'k ,o nkuk pkyd ;Xek d e/; mRiUu foHkokrj d vuikr d cjkcj gkrh gA

$$C = \frac{Q}{V}$$

l/kkfj= dh /kkfjrk fuEufyf[kr dkjdk ij fuHkj djrh g&

1- **pkyd lyVk d {k=Qy ij %** l/kkfj= dh /kkfjrk lyVk d {k=Qy d lekuikrh gkrh g vFkkr $C \propto A$

2- **pkyd lyVk d e/; dh njh ij %** pkyd lyVk d e/; njh c<ku ij /kkfjrk dk eku ?kVrk g] rFkk njh de dju ij /kkfjrk dk eku c<rk g vFkkr l/kkfj= dh èkkfjrk lyVk d e/; njh d 0;RØekuikrh gkrh gA

$$C \propto \frac{1}{d}$$

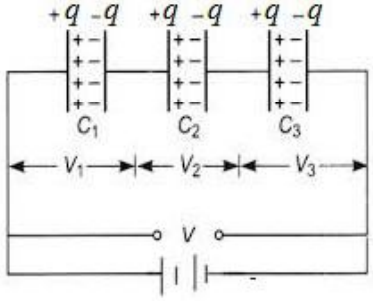
3- **pkyd lyVk d e/; mifLFkr ek/;e ij %** lèkkfj= dh /kkfjrk pkyd lyVk d e/; mifLFkr ek/;e d ijko/krkd K d lekuikrh gkrh gA

$$C \propto K$$

l/kkfj=k d l;ktu

fofHkUu ifjiFkk e ,d l vf/kd l/kkfj=k dk l;ktu nk çdkj l fd;k tkrk g% (i) J.kh Øe l;ktu] (ii) lekrj Øe l;ktuA

(i) **J.kh Øe l;ktu %** l/kkfj=k d J.kh Øe l;ktu e çFke l/kkfj= dh nljh lyV dk f}rh; l/kkfj= dh igyh lyV l tkMk tkrk gA fp= 3-6 e rhu l/kkfj=k C_1, C_2 ,o C_3 d J.kh Øe l;ktu ij V okYV dk fo|r lkr ç;Dr fd;k x;k gA



fp= 3-6

lkekU; r% l/kkfj= dh /kkfjrk

$$C = \frac{K\varepsilon_0 A}{d}$$ gkrh gA

ekuk fd fo|r lkr }kjk çFke l/kkfj= C_1 dh igyh lyV dk +q vko'k fn;k tkrk gA çj.k }kjk l/kkfj= C_1 dh nljh lyV ij +q vko'k ifjr gk tkrk g rFkk bldk Lor= vko'k – q f}rh; l/kkfj= C_2 dh igyh lyV ij pyk tkrk gA bl çdkj 'k"k lHkh l/kkfj=k dh igyh lyV ij +q vko'k rFkk nljh lyV ij -q vko'k mRiUu gk tkrk gA ;fn lèkkfj=k C_1, C_2 o C_3 dh lyVk d e/; foHkokrj Øe'k% V_1, V_2 o V_3 gk rk&

vc pfd rhuk l/kkfj=k ij vkjkfir uV foHkokrj V g vr%

$$V = V_1 + V_2 + V_3$$ ---¼20½

;fn rhuk l/kkfj=k d rY; /kkfjrk dk eku C gk rk

$$V = \frac{q}{C}$$ ---¼21½

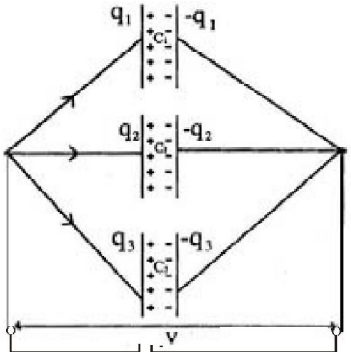
vr% lehdj.k ¼20½ o lehdj.k ¼21½ l

$$\frac{q}{C} = \frac{q}{C_1} + \frac{q}{C_2} + \frac{q}{C_3}$$

;k $$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$ ---¼22½

Li"V g fd l/kkfj=k d J.kh Øe l;ktu e rY; èkkfjrk dk 0;RØe] mu lHkh l/kkfj=k dh vyx&vyx èkkfjrkvk d 0;RØe d ;kx d cjkcj gkrk gA

(ii) **lekarj Øe l;ktu %** l/kkfj=k d lekarj Øe l;ktu e lHkh l/kkfj=k dh igyh lyVk dk ,d fcUnq l rFkk nljh lyVk dk vU; nlj fcUnq l tkMk tkrk gA fp= 3-7 e



fp= 3-7

rhu l/kkfj=k C_1, C_2 o C_3 d lekarj Øe l;ktu ij V okYV dk fo|r lkr ç;Dr fd;k x;k gA

ekuk fd fo|r lkr }kjk fcUnq A dk +q vko'k çnku fd;k tkrk gA ;g vko'k rhuk l/kkfj=k ij mudh /kkfjrk d vuUkj cV tkrk gA çj.k }kjk l/kkfj=k dh nljh lyVk ij cjkcj dk foijhr vko'k mRiUu gk tkrk gA ;fn l/kkfj=k ij vko'k dk eku q_1, q_2 o q_3 gk rk rhuk l/kkfj=k ij dy vko'k

$$q = q_1 + q_2 + q_3$$ ---¼23½

tgk $q_1 = C_1V, Q_2 = C_2V$,o $Q_3 = C_3V$

vr% $q = C_1V + C_2V + C_3V$ ---¼24½

;fn rhuk l/kkfj=k dh rY; /kkfjrk dk eku C gk rk

$$q = CV$$ ---¼25½

lehdj.k ¼24½ o ¼25½ l &

$$CV = C_1V + C_2V + C_3V$$

;k $C = C_1 + C_2 + C_3$ ---¼26½

Li"V g fd l/kkfj=k d lekarj Øe l;ktu e rY; èkkfjrk dk eku] mu lHkh l/kkfj=k dh vyx&vyx /kkfjrkvk d ;kx d rY; gkrk gA

egRoi.k fcUnq

1- pkyd e mifLFkr c) ijek.k ,o vk;u] eDr byDVkuk d çokg e ck/kk mRiUu djr g] ftl pkyd dk çfrjks/k dgr gA

2- pkyd dk çfrjk/k pkyd dh yEckb d lekuikrh rFkk pkyd dh vuçLFk dkV {k=Qy d 0;RØekuikrh gkrk gA

3- pkyd dk fof'k"B çfrjk/k ¼çfrjk/kdrk½ ,dkd yEckb ,o ,dkd vuçLFk dkV {k=Qy oky pkyd d çfrjks/k d rY; gkrk gA

4- ;fn n çfrjk/k J.kh Øe e tM gk rk rY; çfrjk/k $R = (R_1 + R_2 + ... + R_n)$

5- ;fn n ifrjk/k lekarj Øe e tM gk rk rY; çfrjk/k dk eku $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + ... + \frac{1}{R_n}$ l Kkr djr gA

6- fdjpkQ d /kkjk fu;e d vuUkj fdlh lf/k e tku okyh /kkjkvk dk ;kx] lf/k l ckgj fudyu okyh

èkkjkvk d ;kx d cjkcj gkrk gA ;g fu;e vko'k lj{k.k d fl)kr ij vk/kkfjr gA

7- fdjpkQ d okYVrk fu;e d vulkj ifjiFk tky d fdlh yi e fuf'pr fn'kk e pyr g; okYVrkvk dk chtxf.krh; ;kx 'kU; gkrk gA;g fu;e Åtk lj{k.k fl)kr ij vk/kkfjr gA

8- vKkr çfrjk/k dk eku Kkr dju d fy;] pkj çfrjkèkk d l;ktu dh çk;kfxd fof/k dk 0ghV LVku lr dgr gA 'kU; fo{ki dh fLFkfr e lf/k B o D ij foHko dk eku leku gkrk gA bl fLFkfr dk lr d lryu fLFkfr dgr gA

9- fo|r /kkfjrk] pkyd d vko'k lxg.k dh eki gkrh gA bldh bdkb QjM gkrh gA

10- nk pkydk dk ;Xe ftu ij foijhr vko'k gk rFkk vko'k dh i;kIr ek=k lfpr dju dh {kerk gk l/kkfj= dgykr gA

11- l/kkfj=k d J.kh Øe l;ktu e rY; /kkfjrk dk eku C gk rk $\frac{1}{C}=\frac{1}{C_1}+\frac{1}{C_2}+\frac{1}{C_3}$

12- l/kkfj=k d lekrj Øe l;ktu e rY; /kkfjrk C dk eku] mu lHkh l/kkfj=k dh vyx&vyx /kkfjrkvk d ;kx d rY; gkrk gA

vH;kIkFk ç'u

oLrfu"B ç'u

1- pkyd rkj dk çfrjk/k fuHkj djrk g&
½1½ yEckb ½2½ vuiLFk dkV
½3½ rki ½4½ mi;Dr lHkh

2- pkydk dk çfrjk/k rki c<ku ij&
½v½ c<rk g ½c½ ?kVrk g
½l½ vifjofrr jgrk g ½n½ pj?kkrkdh c<rk g

3- fdjpkQ dk /kkjk fu;e vk/kkfjr g&
½v½ lox lj{k.k ½c½ Åtk lj{k.k
½l½ vko'k lj{k.k ½n½ dk.k; lox lj{k.k

4- 0ghV LVku lr e lryu dh fLFkfr e /kkjkekih l çokfgr /kkjk dk eku gkrk g&
½v½ 'kU;
½c½ vf/kdre
½l½ dN Hkh gk ldrk g
½n½ çR;korh

5- l/kkfj= dh /kkfjrk fuHkj djrh g&
½v½ lyVk d {k=Qy ij
½c½ lyVk d e/; njh ij
½l½ ek/;e d ijko|rkd ij
½n½ mi;Dr lHkh

y?kUkjkRed i'u

1- çfrjk/k dh bdkb fy[kkA

2- J.kh Øe e tM nk çfrjk/kk d fy, rY; çfrjk/k dk eku fy[kkA

3- fdjpkQ dk og fu;e tk Åtk lj{k.k fl)kr ij fuHkj djrk g] fy[kkA

4- J.kh Øe e tM nk l/kkfj=k d fy, rY; /kkfjrk dk eku fy[kkA

5- lekUrj Øe e tM nk l/kkfj=k dh rY; /kkfjrk dk eku ?kVd l/kkfj=k dh ryuk e vf/kd gkrk g vFkok de gkrk g] crkb;\

6- J.kh Øe l;ktu o lekUrj Øe l;ktu d fy; rY; çfrjk/k dh x.kuk dk l= nhft,A

7- fdjpkQ d çFke fu;e dk mYy[k dhft,A

8- 0ghV LVku lr dk fl)kr D;k g\

9- l/kkfj=k d lekUrj Øe l;ktu d fy, rY; /kkfjrk dh x.kuk dk l= nhft,A

fucU/kkRed i'u

1- pkyd dk çfrjk/k fdu&fdu dkjdk ij fuHkj djrk g\ fof'k"V çfrjk/k dk ifjHkkf"kr dhft,A

2- çfrjk/kk d J.kh Øe ,o lekUrj Øe l;ktu e rY; çfrjk/k dh 0;RifÙk dhft,A

3- 0ghV LVku lr D;k g\ bld fy, lryu voLFkk d çfrc/k dk 0;RiUu dhft,A

4- fdjpkQ d çFke ,o f}rh; fu;e dk le>kb;A

5- l/kkfj= d J.kh Øe ,o lekUrj Øe l;ktu e rY; /kkfjrk dh 0;RifÙk dhft,A

---

mÙkjekyk % 1 ½n½ 2 ½v½ 3 ½l½ 4 ½v½ ½5½ n

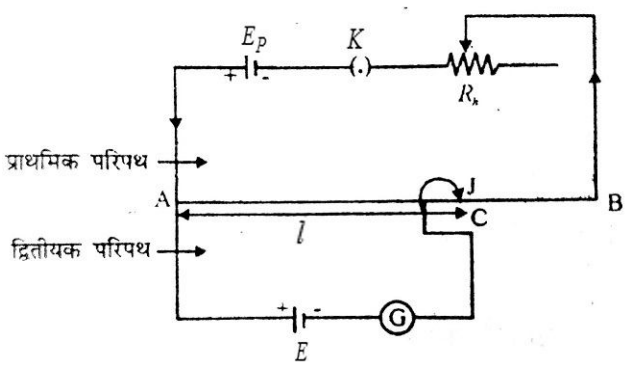
v/;k; & 4

foHkoekih

(Potentiometer)

foHkoekih

fo|r ifjiFk e fdlh vo;o ¼tl çfrjks/k] ly] lekfj=] bR;kfn½ d fljk ij foHkokrj dk ekiu dju gr ç;Dr midj.k foHko ekid dgykrk gA foHkoekih ,d ,lk midj.k g tk ifjiFk e 'kU; fo{ki fof/k ij dk; djrk g vFkkr ftl le; foHkoekih foHkokrj dk ekiu djrk g] ml le; ;g ifjiFk l dkb /kkjk xg.k ugh djrk gA foHkoekih }kjk ekfir foHkokrj dk ekiu ;FkkFk ¼ifj'k)½ gkrk gA

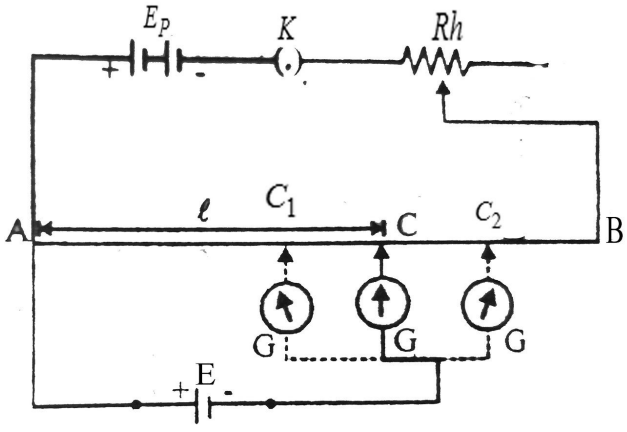


fp= 4-1

foHkoekih d vko';d vo;o fp= 4-1 e çnf'kr fd;s x; gA foHkoekih dk e[; vo;o ,d 1000 leh ¼10 ehVj½ yEck çfrjks/k rkj AB gkrk gA bl rkj dk 1 ehVj yEckb d lekrj nl Qjk d :i e S vkÑfr e ekMdj ydMh d lery vk/kkj ¼iê½ ij dl nr gA bl rkj dh çfrjks/kdrk dk eku mPp ,o çfrjks/k rki x.kkd dk eku U;u gkrk gA lkekU;r% exuht ;k dkLVUVu feJ /kkr dk rkj foHkoekih e ç;Dr fd;k tkrk gA rkj d lekrj Øe e yEckb d ekiu gr iê ij ,d ehVj Ldy yxk fn;k tkrk gA 'kU; fo{ki dh fLFkfr dk ekiu dju d fy, ,d foHkoekih dth J dke e yh tkrh gA foHkoekih e 'kU; fo{ki çf{kr dju d fy, èkkjkekih G dk mi;kx djr gA

foHkoekih dk fl)kr ,o dk;fof/k

fp= 4-2 e çnf'kr ifjiFk e AB foHkoekih dk rkj g] ftld flj A l ,d Kkr fo|r okgd cy dh cVjh E_p dk /ku Vfeuy rFkk _.k Vfeuy dk dth rFkk /kkjk fu;=d Rh d lkFk J.kh Øe e tkMr g, foHkoekih d nlj flj B d lkFk tkMdj ,d ifjiFk r;kj djr gA ;g ifjiFk foHkoekih dk e[; ;k çkFkfed ifjiFk dgykrk gA



fp= 4-2

vc ftl ly dk fo|r okgd cy Kkr djuk g] ml d mPp foHko ¼/ku Vfeuy½ dk foHkoekih rkj d Aflj l tkMdj rFkk fuEu foHko ¼_.k Vfeuy½ dk /kkjkekih d }kjk fol ih dth J l tkMr gA foHkoekih dk ;g ifjiFk f}rh;d ifjiFk dgykrk gA vKkr fo|r okgd cy ;k foHkokrj ftldk ekiu foHkoekih l fd;k tkrk g] ml lno f}rh;d

ifjiFk e gh tkMk tkrk gA ekuk fd vKkr ly dk fo|r okgd cy E gA çkFkfed ifjiFk dh dth K dk ncku l ly E_p d fo|r okgd cy d dkj.k foHkoekih d li.k rkj ij ,d leku :i l foHkoiru gk tkrk gA foHkoekih d rkj dh ,dkd yEckb ij foHko iru d eku dk foHkoekih dh foHko ço.krk (x) dgr gA ekuk fd foHkoekih d rkj dh dy yEckb L ij ly E_p d dkj.k mRiUu foHkokrj ¼foHko iru½ dk eku V_p g foHkoekih rkj dk çfrjk/k R ,o /kkjk fu;U=d dk çfrjk/k ux.; ekur g rk foHko ço.krk dh ifjHkk"kk l &

$$x = \frac{V_p}{L} \qquad \text{---¼1½}$$

$$= \frac{IR}{L}$$ ¼vke d fu;e l $V_p = IR$, tgk I foHkoekih d rkj e ly E_p d dkj.k çokfgr /kkjk gA½

;k $x = I\sigma$ ---¼2½

tgk $\sigma = \frac{R}{L}$ foHkoekih d ,dkd yEckb d rkj dk çfrjk/k gA

vc ;fn foHkoekih d rkj ij fcn A l *l* njh ij dkb vU; fcn C y rk A rFkk C d e/; foHkokrj dk eku&

$V_{AC} = xl$

f}rh;d ifjiFk e folih dth J dk foHkoekih d rkj ij fdlh fcn C_1 ij ncku ij fuEu rhu fLFkfr;k lHko g ¼&

(i) ;fn ifjiFk e /kkjk AC_1E fn'kk e çokfgr gk rk èkkjkekih e fo{ki ck;h vkj gkxkA bl fLFkfr e V<E gkxkA

(ii) ;fn ifjiFk e /kkjk AEC_2 fn'kk e çokfgr gk rk èkkjkekih e fo{ki nk;h vkj gkxkA bl fLFkfr e V>E gkxkA

(iii) ;fn ifjiFk e /kkjk çokfgr ugh gk vFkkr /kkjkekih e fo{ki 'kU; gkxkA bl foHkoekih dh lryu voLFkk dgr g rFkk folih dth dh fLFkfr fcn C lryu fcn dgykrk gA lryu fcn dh foHkoekih rkj d Aflj l njh lryu yckb (*l*) dgykrh gA

vr% foHkoekih dh lryu voLFkk e

vKkr fo|r okgd cy (E) = lryu yckb ij foHko iru

$= xl$

vFkkr vKkr fo|r okgd cy ¾ foHko ço.krk × lryu yckb

foHkoekih d mi;kx

foHkoekih 'kU; fo{ki fof/k ij vk/kkfjr midj.k g tk fd foHkokrj dk ;FkkFkrk l ekiu djrk gA bld vfrfjDr foHkoekih d vU; mi;kx fuEu g ¼&

1- çkFkfed lyk d fo|r okgd cyk dh ryuk dju e]

2- çkFkfed ly d vkrfjd çfrjk/k d ekiu e]

3- okYVehVj ,o vehVj d v'kkdu ,o v'k'kk/ku e]

4- rkih; fo|r okgd cy Kkr dju eA

foHkoekih }kjk ly dk vkrfjd çfrjk/k Kkr djuk

tc fdlh ly dk ifjiFk e tkMk tkrk g rk ly e mifLFkr fo|r vi?kV; ¼foy;u½ d vk;u byDVkMk ¼dFkkM ,o ,ukM½ d e/; çokfgr gkr gA ly d vnj çokfgr vk;uk ,o fo|r vi?kV; d v.kvk d e/; l?kVVk ¼VDdj½ d dkj.k vk;uk d çokg e vojk/k mRiUu gkrk g] ft l ly dk vkrfjd çfrjk/k dgr gA bl r ldr l çnf'kr fd;k tkrk g rFkk bldh bdkb vke gkrh gA

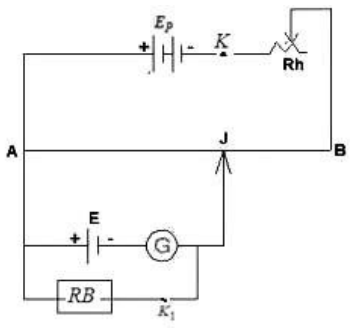
ly d vkrfjd çfrjk/k Kkr dju dk l= fuEu g&

$$r = \left(\frac{E - V}{V}\right) R \qquad \text{---¼4½}$$

tgk E ly dk fo|r okgd cy rFkk V cn ifjiFk d le; ly d Vfeuyk ij ekih x;h okYVrk dk eku gA R ifjiFk dk çfrjk/k gA

ly dk vkrfjd çfrjk/k] ly l çokfgr /kkjk d lkFk ifjofrr gkrk jgrk g] vFkkr ;g fu;r ugh gkrk gA vkn'k ly dk vkrfjd çfrjk/k 'kU; gkrk gA

çkFkfed ly dk vkrfjd çfrjk/k Kkr dju d fy, foHkoekih lcl mi;Dr midj.k g D;kfd foHkoekih 'kU; fo{ki ¼vfo{ki½ fl)kUr ij vk/kkfjr gku d dkj.k 'kU; fo{ki dh fLFkfr e ly l dkb /kkjk xg.k ugh djrk gA foHkoekih }kjk ly dk vkrfjd çfrjk/k Kkr dju dk ifjiFk fp= 4-3 e çnf'kr fd;k x;k gA



fp= 4-3

foHkoekih d e[; ifjiFk e ly E_p dth K rFkk /kkjk fu;=d Rh dk J.khØe e l;kftr dj foHkoekih d rkj d fljk A rFkk B l tkMr gA ftl ly dk vkrfjd çfrjk/k Kkr djuk gkrk g] ml f}rh;d ifjiFk e ifjiFk fp= 4-3 d vulkj /kkjkekih ,o flj A d e/; ç;Dr djr gA bl vKkr vkrfjd çfrjk/k oky ly E d fljk ij lekrj Øe e çfrjk/k ckDl RB ,o dth K_1dk l;kftr fd;k tkrk gA /kkjkekih d nlj flj dk fo lih dth J l tkMk tkrk gA

dk;; fof/k

loçFke e[; ifjiFk dh dth K dk cn (ON) rFkk f}rh;d ifjiFk dh dth K_1 dk [kyk (OFF) j[kr gA bl le; ly E [ky ifjiFk e gkrk gA ;fn bl fLFkfr e lryu yckb dk eku l_1 rFkk foHko ço.krk dk eku x gk rk l_1 lryu yEckb l lcf/kr foHkokUrj dk eku

$$E = xl_1 \qquad \text{---¼5½}$$

D;kfd vKkr vkrfjd çfrjk/k okyk ly E, bl fLFkfr e [ky ifjiFk e gkrk g vr% lryu yEckb l lcf/kr foHkokrj dk eku] ly d fo|r okgd cy E d rY; gkxkA

vc f}rh;d ifjiFk e R vke dk çfrjk/k] çfrjk/k ckDl dh lgk;rk l ç;Dr dj dth K_1dk cn (ON) djr gA bl fLFkfr e ly E l ckÁ çfrjk/k R e /kkjk çokfgr gkrh gA ftl dkj.k çfrjk/k R d fljk ij foHkokrj V mRiUu gkrk gA bl fLFkfr e foHkoekih dh lryu yEckb dk eku l_2 gk rk çfrjk/k R d fljk ij mRiUu foHkokrj dk eku

$$V = xl_2 \qquad \text{---¼6½}$$

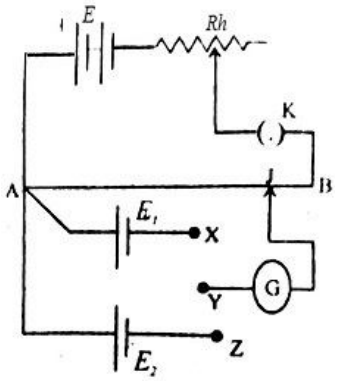
lehdj.k ¼5½ o lehdj.k ¼6½ l Øe'k% E o V d eku lehdj.k ¼1½ e ç;Dr dju ij&

$$r = \left(\frac{xl_1 - xl_2}{xl_2}\right)R = \left(\frac{l_1 - l_2}{l_2}\right)R \qquad \text{---¼7½}$$

ç;kx }kjk R d vyx&vyx ekuk d fy, l_1 o l_2 d çf{k.k ydj lehdj.k ¼7½ dh lgk;rk l çkFkfed ly dk vkrfjd çfrjk/k Kkr dj fy;k tkrk gA

foHkoekih }kjk lyk d fo|r okgd cyk dh ryuk djuk % foHkoekih }kjk nk ikFkfed lyk d fo|r okgd cyk dh ryuk dk ifjiFk fp= 4-4 e çnf'kr fd;k x;k gA

ifjiFk e lpk;d ly E, /kkjk fu;=d Rh rFkk dth K dk foHkoekih d rkj AB d lkFk J.kh Øe e tkMdj e[; ifjiFk dh jpuk dh tkrh gA ftu çkFkfed lyk ¼E_1



fp= 4-4

o E_2½ d fo|r okgd cyk dh ryuk djuh gkrh g] mUg foHkoekih d f}rh;d ifjiFk e fp=ku lkj ç;Dr fd;k tkrk gA XYZ ,d f}ekxh dth gA

dk;; fof/k

loçFke e[; ifjiFk dh dth K rFkk f}ekxh dth d XY lyx dk cn ¼ON½ dj ly E_1 l lcf/kr lryu yEckb l_1 Kkr djr gA ;fn foHkoekih dh foHkoço.krk dk eku x gk rk foHkoekih d fl)kr l &

$$E_1 = xl_1 \qquad \text{---¼8½}$$

vc e[; ifjiFk dh dth K dk cn (ON) fLFkfr e j[kdj f}ekxh dth d YZ lyx dk cn ¼ON½ dj ly E_2 l lcf/kr lryu yEckb l_2 Kkr dh tkrh gA bl fLFkfr e f}ekxh dth dk lyx XY [kyk ¼OFF½ fLFkfr e jgrk gA vr% foHkoekih d fl)kr l

$$E_2 = xl_2 \qquad \text{---¼9½}$$

lehdj.k ¼8½ ,o lehdj.k ¼9½ l&

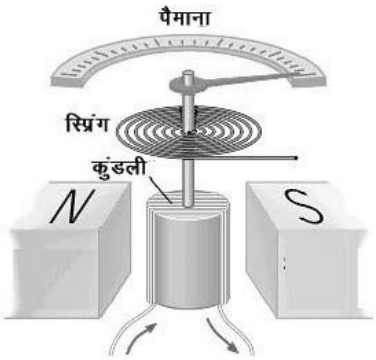
$$\frac{E_1}{E_2} = \frac{l_1}{l_2} \qquad \text{---¼10½}$$

/kkjk fu;=d dh fofHkUu fLFkfr;k e l_1 ,o l_2 d çf{k.k ydj] lehdj.k ¼10½ dh lgk;rk nkuk çkFkfed lyk d fo|r okgd cyk dk vuikr Kkr dj mue ryuk dh tkrh gA

/kkjkekih

fdlh cn ifjiFk e vko'kk d çokg ¼/kkjk½ dh fn'kk Kkr dju d midj.k dk /kkjkekih dgr gA /kkjkekih dk fp= 4-5 v e çnf'kr fd;k x;k gA ifjiFk e bl G l n'kk;k tkrk g rFkk ifjiFk e ftl 'kk[kk e /kkjk dh fn'kk çf{kr djuh gkrh g] ml 'kk[kk e J.kh Øe e i;Dr fd;k

fp= 4-5 v



fp= 4-5 c

tkrk gA /kkjkekih dh vkrfjd cukoV dk fp= 4-5 c e n'kk;k x;k gA ble fo|r:) rkc d le:i rkj dh cuh dMyh d e/; e cyukdkj eyk;e ykg ØkM (Soft iron core) gkrk g tk dMyh dk Li'k ugh djrk gA ;g dMyh ?kMuky vkÑfr d cyukdkj vory pEcdh; èkok N-S d e/; fjDr LFkku e vofLFkr jgrh gA dMyh e tc /kkjk çokfgr gkrh g rk dMyh e pEcdh; {k= mRiUu gkrk g] tk fd ckÁ pEcdh; {k= dh mifLFkfr e dMyh e cy&vk?k.k mRiUu djrk g] ft ld ifj.kkeLo:i dMyh e ?k.ku gkrk gA bl dMyh d lkFk ,d gYdk ldrd tMk gkrk g] tk dMyh d ?k.ku dh fn'kk ,o mld ifjek.k d vulkj èkkjkekih e yx Ldy ij fo{kfir gkrk gA

çkjHk e tc /kkjkekih e dkb /kkjk çokfgr ugh gkrh g rk ldrd dh fLFkfr bl çdkj l p;fur dh tkrh g fd ldrd /kkjkekih d e/; e jgA bl fLFkfr dk /kkjkekih dk 'kU; fcn dgr gA ldrd bl 'kU; fcn d nk;h rFkk ck;h vkj fo{kfir gku d fy, Lor= jgrk gA ft l fn'kk e dMyh e ¼ifjiFk e½ /kkjk çokfgr gkrh g ldrd mlh fn'kk e 'kU; fcn d lki{k fo{kfir gk tkrk gA bl çdkj /kkjkekih }kjk ge ifjiFk e cgu okyh /kkjk dh fn'kk Kkr dj ldr gA bld lkFk gh ldrd }kjk fo{ki d eku dk Kkr dj /kkjk d eku dh Hkh x.kuk dh tk ldrh gA T;knk /kkjk d eku d fy, ldrd T;knk fo{kfir gkrk g tcfd vYi /kkjk d fy, ldrd e fo{ki vYi gkrk gA

/kkjkekih nk çdkj dh gkrh g %&

(i) **py pEcd /kkjkekih %** bl çdkj dh /kkjkekih e èkkjk çokfgr dju ij pEcd xfreku gkrk g rFkk dMyh fLFkj jgrh gA ble ldrd pEcd l tMk jgrk gA

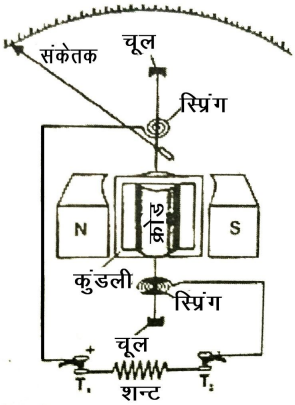
(ii) **py dMyh /kkjkekih %** bl çdkj dh /kkjkekih e èkkjk çokfgr dju ij dMyh xfreku gkrh g rFkk pEcd fLFkj jgrh gA ble ldrd dMyh l tMk jgrk gA py dMyh /kkjkekih nk çdkj dh gkrh gA

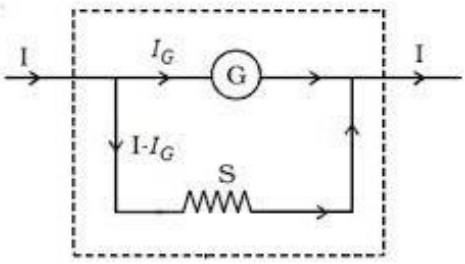
(i) dhyfdr dMyh /kkjkekih

(ii) fuyfcr dMyh /kkjkekihA

vehVj ,o okYVehVj

vehVj % l)kfUrd :i l vehVj ,d vYi çfrjk/k okyh dhyfdr dMyh /kkjkekih g ft ldk mi;kx ifjiFk e /kkjk d ekiu e fd;k tkrk gA bl ifjiFk e /kkjkekih dh Hkkfr J.kh Øe e tkMk tkrk gA bl ifjiFk fp= e ldr A l çnf'kr fd;k tkrk gA fn"V /kkjk d ekiu d fy, ç;Dr vehVj Mh-lh- vehVj rFkk çR;orh /kkjk d ekiu d fy, ç;Dr vehVj] ,-lh- vehVj dgykr gA vehVj e ç;Dr ldrd e mRiUu fo{ki] vehVj e çokfgr /kkjk d lekuikrh gA vehVj l /kkjk dk ekiu fd;k tkrk g vr% ;g vko';d g fd vehVj dk çfrjk/k U;ure gk ft l fd vehVj e çokfgr /kkjk dk ekiu ;FkkFkrk l fd;k tk ldA vkn'k vehVj dk çfrjk/k 'kU; gkrk gA tl fd io e crk;k tk pdk g fd vehVj l)kfrd :i l /kkjkekih gh g rFkk èkkjkekih dk dN u dN çfrjk/k gkrk gA vr% bl ifjiFk e J.kh Øe e tkMu ij ifjiFk d çHkkoh çfrjk/k e of) gk tkrh g ft l ifjiFk e /kkjk d eku e deh gk tkrh gA ifj.kkeLo:i èkkjk dk ;FkkFk ekiu /kkjkekih l ugh fd;k tk ldrk gA bl =fV dk nj dju ¼de dju½ d fy, ge èkkjkekih d lekrj Øe e ,d vYi çfrjkèk yxk nr g] ft l 'kV çfrjk/k S dgr g ¼fp= 4-6½A /kkjkekih vkj 'kV çfrjkèk d l;ktu l çkIr ;fDr dk çHkkoh çfrjk/k vR;Ur vYi gk tkrk g rFkk bl fLFkfr e ifjiFk dh /kkjk dk ekiu 'k) :i l fd;k tk ldrk gA bl ;fDr dk vehVj dgr gA





fp= 4-6

/kkjkekih dk vehVj e :ikrj.k ,o v'kkdu % tc /kkjkekih d lekrj Øe e 'kV çfrjk/k ç;Dr fd;k tkrk g rk ifjiFk dh /kkjk dk vf/kdre Hkkx bl 'kV çfrjk/k l xtj tkrk g tcfd /kkjk dk vYi Hkkx /kkjkekih e yxh dMyh e l xtjrk gA vehVj e yx ieku dk bl çdkj l v'kkfdr fd;k tkrk g fd bldk ikB;kd ifjiFk dh dy /kkjk d eku dk çnf'kr djA

/kkjkekih dk vehVj e ifjofrr ¼:ikrj.k½ dju d fy, ekuk fd /kkjkekih dk çfrjk/k G gA bl /kkjkekih dk ekuk I ,fEi;j rd dh /kkjk ijkl e :ikrfjr dju d fy, ekuk fd mi;Dr 'kV çfrjk/k dk eku S gA ;fn ifjiFk e çokfgr /kkjk I e l /kkjkekih e çokfgr /kkjk dk eku I_G rFkk 'kV çfrjk/k l çokfgr /kkjk dk eku I_S gk rk fp= 4-6 e fdjpkQ d /kkjk fu;e l&

$$I = I_G + I_S \qquad \text{---¼11½}$$

pfd çfrjk/k G ,oS lekrj Øe e tM g vr% bud fljk ij foHkokrj dk eku leku gkxkA ;fn /kkjkekih d fljk ij foHkokrj dk eku V_G rFkk 'kV ifrjk/k d fljk ij foHkokrj dk eku V_S gk

rk $V_G = GI_G$

,o $V_S = SI_S$

yfdu $V_G = V_S$

vFkkr $GI_G = SI_S$ ---¼12½

;k $S = G\dfrac{I_G}{I_S}$

vr% $S = G(\dfrac{I_G}{I - I_G})$ ---¼13½

iu% lehdj.k ¼12½ l &

;k $S(I - I_G) = GI_G$

;k $I_G = (\dfrac{S}{G+S})$ ---¼14½

,o iu% lehdj.k ¼12½ l &

$$I_S = \frac{G}{S} I_G$$

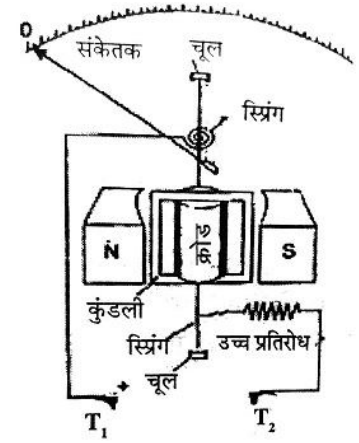
;k $\dfrac{I_S}{I_G} = \dfrac{G}{S}$ ---¼15½

blh çdkj $\dfrac{I_S}{I} = \dfrac{G}{G+S}$ ---¼16½

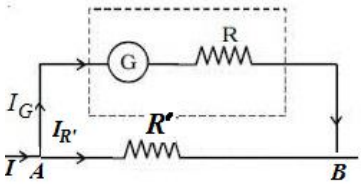
;fn G ,o I_G dk eku Kkr gk rk lehdj.k ¼13½ l bfPNr ijkl ¼o l I ,fEi;j½ d vehVj d fy, 'kV çfrjks k dk mi;Dr eku dh x.kuk dj /kkjkekih d lekrj Øe e tkMu ij /kkjkekih dk vehVj e :ikrj.k gk tkrk gA bl :ikrfjr /kkjkekih d ieku dk v'kkdu fuEu çdkj fd;k tkrk g&

tc ifjiFk e çokfgr /kkjk eku I gkrk g rk bl :ikrfjr /kkjkekih d ieku ij ldrd i.k&fo{ki dk çnf'kr djxkA bl fLFkfr e /kkjkekih e çokfgr /kkjk dk eku I_G gkrk gA blfy, I_G dk i.k fo{ki /kkjk Hkh dgr gA ieku ij i.k fo{ki dh fLFkfr dk fpfUgr dj fy;k tkrk gA vc 'kU; fo{ki dh fLFkfr l i.k fo{ki dh fLFkfr dk le l[;k d n Hkkxk e cjkcj foHkkftr dj fy;k tkrk gA ieku e bl çdkj çkIr çR;d Hkkx dh /kkjk dk eku $\dfrac{I}{n}$,fEi;j gkrk gA

okYVehVj % l)kfUrd :i l okYVehVj ,d mPp ifrjk/k okyh dhyfdr dMyh /kkjkekih g ftldk mi;kx ifjiFk d fdUgh nk fcnvk d e/; foHkokrj dk Kkr dju e fd;k tkrk gA bl ifjiFk e mu nk fcnvk d lekrj Øe e tkMk tkrk g ftud e/; foHkokrj Kkr djuk gA bl ifjiFk fp= e V l çnf'kr fd;k tkrk gA fn"V foHkokrj d ekiu d fy, Mh-lh-okYVehVj rFkk çR;korh foHkokrj d ekiu d fy, ,-lh- okYVehVj ç;Dr fd; tkr gA



okYVehVj e ç;Dr ldrd e mRiUu fo{ki] nkuk fljk d e/; mRiUu foHkokrj d lekuikrh gkrk g ¼-: fo{ki ∝ èkkjk] rFkk foHkokrj ∝ /kkjk vr% fo{ki foHkokrj½A



fp= 4-7

pfd /kkjkekih dk Lo; dk çfrjk/k gkrk g vr% bl çk;kfxd çfrjks k rkj d nkuk fljk ¼tgk ij foHkokrj dk ekiu djuk g½ d lekrj Øe e tkMu ij] çfrjk/k rkj l çokfgr /kkjk d eku e deh vk tkrh g] ifj.kkeLo:i

çfrjkèk rkj d fljk ij mRiUu foHkokrj dk ;FkkFkrk l ekiu /kkjkekih l ugh fd;k tk ldrk gA bl =fV dk nj ¼de½ dju d fy, /kkjkekih d J.kh Øe e mPp çfrjk/k yxk nr g ¼fp= 4-7½A ft l dkj.k /kkjkekih vkj mPp çfrjk/k d J.kh Øe l;ktu l çkIr ;fDr dk çHkkoh çfrjk/k mPp gk tkrk g rFkk ;g çk;kfxd rkj e çokfgr /kkjk ,o ml ij mRiUu foHkokrj dk çHkkfor ugh djrk gA bl l;Dr ;fDr dk okYVehVj dgr g okYVehVj e dMyh e çokfgr /kkjk dk eku vR;Ur vYi gkrk gA vkn'k okYVehVj dk çfrjk/k vuUr gkrk gA

/kkjkekih dk okYVehVj e :ikrj.k ,o v'kkdu% tc /kkjkekih d J.kh Øe e mPp çfrjk/k ç;Dr fd;k tkrk g rk bl çdkj cuh l;Dr ;fDr dk çfrjk/k mPp gk tkrk gA

bl fLFkfr e çk;kfxd rkj d nkuk fljk d lekrj Øe e bl l;Dr ;fDr ¼okYVehVj½ dk tkMu ij vf/kdk'k /kkjk çk;kfxd rkj e l gh çokfgr gkrh g rFkk l;Dr ;fDr dk mPp çfrjk/k gku d dkj.k bl ;fDr e l çokfgr /kkjk dk eku vR;Ur vYi gkrk gA nlj 'kCnk e okYVehVj e mifLFkr dMyh ¼/kkjkekih½ e l çokfgr /kkjk dk eku vR;Yi gkrk gA

/kkjkekih dk okYVehVj e :ikrfjr dju d fy, ge ,d /kkjkekih ft ldk çfrjk/k G g] yr gA ekuk fd bl èkkjkekih dk o l V okYV foHkokrj dh okYVrk ijkl e :ikrfjr djuk gA bld fy, ekuk fd mi;Dr mPp çfrjkèk dk eku R gA

fcn A o B d e/; çk;kfxd çfrjk/k R' d fljk ij mRiUu foHkokrj Kkr dju d fy, ge bl :ikrfjr èkkjkekih dk çk;kfxd çfrjk/k d lekrj Øe e fp= 4-7 d vulkj tkM nr gA fp= l Li"V g fd

$$I = I_{R'} + I_G$$

tgk $I_{R'}$ çk;kfxd çfrjk/k e l çokfgr /kkjk dk eku g rFkk I_G :ikrfjr /kkjkekih l çokfgr /kkjk gA

pfd çfrjk/k G ,o R J.kh Øe e g vr% A o B d fljk ij foHkokrj dk eku R o G ij mRiUu foHkokrjk d ;kx d rY; gkxk vFkkr

$$V = V_R + V_G$$

;k $$= (R + G)I_G$$

$$\therefore I_G = (\frac{V}{R+G}$$

;k $$\frac{V}{I_G} = R +$$

;k $$R = \frac{V}{I_G}$$ ---¼17½

;fn G ,o I_G dk eku Kkr gk rk lehdj.k ¼17½ l bfPNr ijkl ¼o l V okYV½ d okYVehVj d fy, mPp çfrjk/k R dk mi;Dr eku dh x.kuk dj /kkjkekih d J.kh Øe e tkMu ij /kkjkekih dk okYVehVj e :ikrj.k gk tkrk gA bl :ikrfjr /kkjkekih d ieku dk v'kkdu fuEu çdkj fd;k tkrk g&

tc A flj ij çokfgr /kkjk dk eku I gkrk g rk èkkjkekih dh dMyh e çokfgr /kkjk dk eku I_G gkxk rFkk bl fLFkfr e /kkjkekih e yxk ldrd i.k&fo{ki çnf'kr djxkA ieku ij i.k fo{ki dh fLFkfr dk fpfUgr dj fy;k tkrk gA vc 'kU; fo{ki dh fLFkfr l i.k&fo{ki dh fLFkfr dk le l[;k e n Hkkxk e cjkcj foHkkft r dj yr gA ieku ij bl çdkj çkIr çR;d Hkkx dh okYVrk dk eku $\frac{V}{n}$ okYV gkrk gA

egRoi.k fcUn

1- foHkoekih ,d ,lk midj.k g tk ifjiFk e 'kU; fo{ki fof/k ij dk; djrk g vFkkr ftl le; foHkoekih foHkokrj dk ekiu djrk g] ml le; ;g ifjiFk l dkb /kkjk xg.k ugh djrk gA foHkoekih }kjk ekfir foHkokrj dk ekiu ;FkkFk ¼ifj'k)½ gkrk gA

2- foHkoekih e 10 ehVj yEck çfrjk/kh rkj gkrk gA bl rkj dh çfrjk/kdrk dk eku mPp ,o çfrjk/k rki x.kkd dk eku U;u gkrk gA lkekU;r% exuht ;k dkLVUVu feJ /kkr dk rkj foHkoekih e ç;Dr fd;k tkrk gA

3- foHkoekih d rkj dh ,dkd yEckb ij foHko iru d eku dk foHkoekih dh foHko ço.krk (x) dgr gA

4- tc fdlh ly dk ifjiFk e tkMk tkrk g rk ly e mifLFkr fo|r vi?kV; ¼foy;u½ d vk;u byDVkMk ¼dFkkM ,o ,ukM½ d e/; çokfgr gkr gA ly d vnj çokfgr vk;uk ,o fo|r vi?kV; d v.kvk d e/; l?kVVk ¼VDdj½ d dkj.k vk;uk d çokg e vojk/k mRiUu gkrk g] ftl ly dk vkrfjd çfrjk/k dgr gA

5- fdlh cn ifjiFk e vko'kk d çokg ¼/kkjk½ dh fn'kk Kkr dju d midj.k dk /kkjkekih dgr gA

6- /kkjkekih nk çdkj dh gkrh g %&

(i) **py pEcd /kkjkekih %** bl çdkj dh /kkjkekih e /kkjk çokfgr dju ij pEcd xfreku gkrk g rFkk dMyh fLFkj jgrh gA ble ldrd pEcd l tMk jgrk gA

(ii) **py dMyh /kkjkekih %** bl çdkj dh /kkjkekih e /kkjk çokfgr dju ij dMyh xfreku gkrh g rFkk pEcd fLFkj jgrh gA ble ldrd dMyh l tMk jgrk gA py dMyh /kkjkekih nk çdkj dh gkrh gA

(a) dhyfdr dMyh /kkjkekih

(b) fuyfcr dMyh /kkjkekihA

7- vehVj ,d vYi çfrjk/k okyh dhyfdr dMyh /kkjkekih g ftldk mi;kx ifjiFk e /kkjk d ekiu e fd;k tkrk gA bl ifjiFk e /kkjkekih dh Hkkfr J.kh Øe e tkMk tkrk gA

8- okYVehVj ,d mPp çfrjk/k okyh dhyfdr dMyh èkkjkekih g ftldk mi;kx ifjiFk d fdUgh nk fcnvk d e/; foHkokrj dk Kkr dju e fd;k tkrk gA bl ifjiFk e mu nk fcnvk d lekrj Øe e tkMk tkrk g ftud e/; foHkokrj Kkr djuk gA

vH;klkFk ç'u

oLrfu"B i'u

1- ifjiFk e nk fcnvk d e/; foHkokrj d ;FkkFk ekiu d fy, ç;Dr midj.k g&

¼v½ foHkoekih

¼c½ okYVehVj

¼l½ fuokr ufydk okYVehVj

¼n½ okYVkehVj

2- foHkoekih d rkj dh yckb gkrh g&

¼v½ 1 ehVj ¼c½ 10 ehVj

¼l½ 100 ehVj ¼n½ 1000 ehVj

3- /kkjkekih dk mi;kx fd;k tkrk g&

¼v½ /kkjk dh fn'kk Kkr dju e

¼c½ çfrjk/k Kkr dju e

¼l½ foHkokrj Kkr dju e

¼n½ /kkjk d eku dk Kkr dju e

4- vkn'k vehVj dk ifrjk/k gkrk g&

¼v½ 0 ¼c½ vuUr

¼l½ dN Hkh ¼n½ _.kkRed

5- okYVehVj dk ifjiFk e yxk;k tkrk g&

¼v½ lekUrj Øe e ¼c½ J.kh Øe e

¼l½ nkuk rjg l ¼n½ mi;Dr e dkb ugh

y?kqÙkjkRed i'u

1- foHkoekih fdl fl)kr ij dk; djrh g\

2- foHkoekih d nk vuç;kx fyf[k,A

3- /kkjkekih dk vehVj e ifjofrr dju d fy, D;k djr g\

4- vehVj o okYVehVj e fdl dk çfrjk/k vf/kdre gkrk g\

5- vehVj dk ifjiFk e fdl çdkj tkMk tkrk g\

6- foHkoekih dh cukoV le>kb;A

7- ly e vkrfjd çfrjk/k dk dkj.k fyf[k,A

8- vehVj d v'kkdu l vkidk D;k vfHkçk; g\

9- v'kkdu ,o v'k'kk/ku l vki D;k le>r g\

fucU/kkRed i'u

1- foHkoekih d fl)kr ,o dk;fof/k dk le>kb;A

2- foHkoço.krk fdl dgr g\ foHkoekih }kjk ly d vkrfjd çfrjk/k dk fdl çdkj Kkr fd;k tkrk g\

3- foHkoekih }kjk lyk d fo|r okgd cyk dh ryuk fdl çdkj dh tkrh g\

4- /kkjkekih dk vehVj e :ikrj.k fdl çdkj fd;k tkrk g\

5- /kkjkekih dk okYVehVj e :ikrj.k fdl çdkj fd;k tkrk g\

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mÙkjekyk % 1 ¼v½ 2 ¼c½ 3 ¼v½ 4 ¼n½ 5 ¼v½

bdkb & III

v/;k; & 5

fo|r pEcdh; çj.k

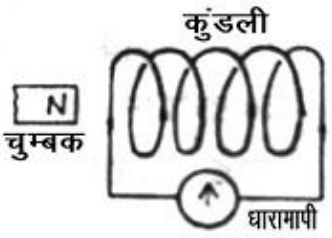
(Electromegnetic Induction)

fo"k; ço'k

lu 1820 e vkjLVM u viu ç;kxk e ;g çf{kr fd;k fd tc fdlh pkyd e fo|r /kkjk çokfgr djr g rk pkyd d pkjk vkj pEcdh; {k= mRiUu gk tkrk gA vkjLVM dh bl [kkt d yxHkx nl o"k i'pkr QjkM u bldk foijhr çHkko çf{kr fd;k vFkkr pEcdh; {k= }kjk fo|r /kkjk dh mRifÙk lHko gA QjkM d viu ç;kx dh fofHkUu fLFkfr;k e ç{k.kk d vk/kkj ij çkIr ifj.kke fuEu g&

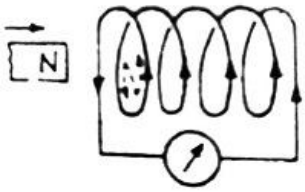
fp= 5-1 e ,d pkyd dMyh l /kkjkekih tMk g rFkk dMyh d lehi ,d nM pEcd fLFkr gA QjkM u viu ç;kx e dMyh ,o nM pEcd dh lki{k xfr dh db fLFkfr;k d ç{k.k fy; tk bl çdkj g&

1- tc dMyh ,o nM pEcd d e/; dkb lki{k xfr ugh gkrh g] vFkkr nkuk fLFkj j[k gkr g rk /kkjkekih e dkb fo{ki çkIr ugh gkrk g vFkkr dMyh e dkb /kkjk çokfgr ugh gkrh g] fp= 5-1¼v½A



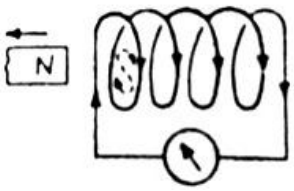
fp= 5-1¼v½

2- tc pEcd d /ko N oky flj dk dMyh dh vkj xfr djok;h tkrh g rk /kkjkekih e fo{ki nk;h vkj çkIr gkrk gA bl fLFkfr e dMyh e /kkjk çokfgr gkrh g] fp= 5-1¼c½A



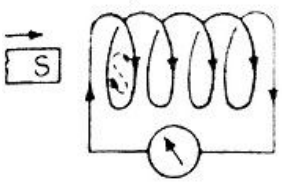
fp= 5-1¼c½

3- tc pEcd d /ko N dk dMyh l nj y tk;k tkrk g rk /kkjkekih e fo{ki foijhr fn'kk ¼ck;h vkj½ çkIr gkrk g] fp= 5-1¼l½A



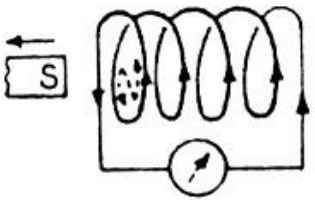
fp= 5-1¼l½

4- tc pEcd d /ko S dk dMyh dh vkj xfr djok;h tkrh g rk /kkjkekih e fo{ki ck;h vkj çkIr gkrk g] fp= 5-1¼n½A



fp= 5-1¼n½

5- tc pEcd d /ko S dk dMyh l nj y tk;k tkrk g rk /kkjkekih e fo{ki nk;h vkj çkIr gkrk g] fp= 5-1¼;½A



fp= 5-1¼;½

6- tc pEcd dk fLFkj j[k] dMyh dk xfr djok;h tkrh g rk /kkjkekih e fo{ki çkIr gkrk gA dMyh dk pEcd d ikl yku ij /kkjkekih e çkIr fo{ki dh fn'kk] dMyh dk pEcd l nj y tku dh fLFkfr e çkIr fo{ki dh fn'kk d foijhr gkrh gA

7- pEcd vFkok dMyh d pky e of) dju ij /kkjkekih d fo{ki e of) gkrh gA

8- dMyh e Qjk dh l[;k e of) dju rFkk ¼vFkok½ pEcd dh lkeF; c<ku ij] /kkjkekih e fo{ki e of) gkrh gA

9- dMyh dk vkdkj c<ku ij Hkh /kkjkekih d fo{ki e of) gkrh gA

mi;Dr ç{k.kk l ;g fu"d"k fudyrk g fd dMyh ,o pEcd d e/; lki{k xfr gku ij dMyh e /kkjk çokfgr gkrh g vFkkr dMyh d fljk ij fo|r okgd cy mRiUu gkrk g] ft l çfjr fo|r okgd cy dgr gA bl çfjr fo|r okgd cy d dkj.k dMyh e çokfgr /kkjk çfjr /kkjk dgykrh gA dMyh d fljk ij mRiUu çfjr fo|r okgd cy dk eku dMyh d çfrjk/k ij fuHkj ugh djrk gA bl çdkj dMyh ,o pEcd d e/; lki{k xfr d dkj.k dMyh d fljk ij çfjr fo|r okgd cy mRiUu gku dh ?kVuk] fo|r pEcdh; çj.k dgykrh gA

QjkM u viu mi;Dr ifj.kkek dh 0;k[;k dMyh e pEcdh; ¶yDl e ifjoru d vk/kkj ij dh] ft ld vulkj pkyd dMyh l lEc) pEcdh; ¶yDl e ifjoru gku ij dMyh d fljk ij çfjr fo|r okgd cy mRiUu gkrk g rFkk çfjr fo|r okgd cy dk eku ¶yDl e ifjoru dh nj d lekuikrh gkrk gA

QjkM d fu;e

QjkM u viu fo|r pEcdh; çj.k d ç;kxk l çkIr ç{k.kk d vk/kkj ij nk fu;e çfrikfnr fd;] ftUg QjkM d fo|r pEcdh; çj.k d fu;e dgr gA

1- **çFke fu;e %** tc fdlh dMyh vFkok fo|r ifjiFk l lEc) pEcdh; ¶yDl e ifjoru gkrk g rk ml ifjiFk e fo|r okgd cy ifjr gkrk gA ;fn ifjiFk ^cn* gk rk ifjiFk e çfjr /kkjk Hkh cgrh gA ;g /kkjk rc rd cgrh jgrh g tc rd ifjiFk l lEc) pEcdh; ¶yDl e ifjoru gkrk jgrk gA

2- **f}rh; fu;e %** ifjiFk e çfjr fo|r okgd cy (ε) dk eku ifjiFk l lEc) pEcdh; ¶yDl e ifjoru dh nj $\frac{\Delta\phi}{\Delta t}$ d lekuikrh gkrk gA

$$\varepsilon \propto \frac{\Delta\phi}{\Delta t}$$

;k $$\varepsilon = \frac{d\phi}{dt} \qquad (dt \to 0)$$ ---¼1½

yt dk fu;e

QjkM d fu;e l ifjr fo|r okgd cy dk ifjek.k rk Kkr fd;k tk ldrk g ijr fn'kk Kkr ugh dh tk ldrh gA çfjr fo|r okgd cy dh fn'kk Kkr dju d fy, yt u ,d fu;e çfrikfnr fd;k ft ld vulkj fo|r pEcdh; çj.k }kjk fdlh cn ifjiFk e çfjr fo|r okgd cy vkj çfjr èkkjk dh fn'kk bl çdkj gkrh g fd og mu dkj.kk ¼pEcdh; ¶yDl e ifjoru½ dk fojk/k djrh g] ftud dkj.k og mRiUu gkrh gA

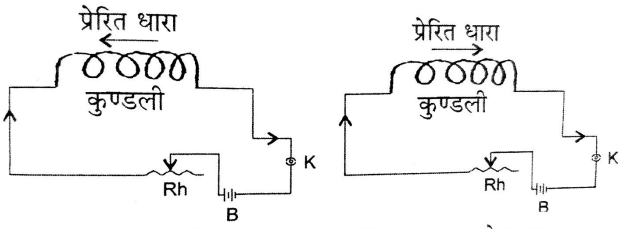
QjkM d fu;e e yt d fu;e dk lekfgr dju ij çfjr fo|r okgd cy

$$\varepsilon = -\frac{d\phi}{dt}$$ ---¼2½

Loçj.k

tc fdlh ifjiFk ¼dMyh½ l lEc) /kkjk dk eku fujrj ifjoru'khy gk rk ifjiFk ¼dMyh½ l lEc) pEcdh; ¶yDl dk eku Hkh /kkjk d vu:i ifjoru'khy gkrk jgrk gA pEcdh; ¶yDl e ifjoru d dkj.k ifjiFk e çfjr fo|r okgd cy mRiUu gkrk g] ft ldh fn'kk yt d fu;ekulkj bl çdkj gkrh g fd og mu dkj.kk dk fojk/k djrh g ft ld dkj.k og mRiUu gk jgk gA

fp= 5-2 e tc dMyh e e[; /kkjk d eku e of) dh tkrh g rk çfjr /kkjk e[; /kkjk d foijhr fn'kk e çokfgr gkrh g rFkk e[; /kkjk d ?kVku ij çfjr /kkjk e[; /kkjk dh fn'kk e çokfgr gkrh gA nlj 'kCnk e nkuk fLFkfr ;k e çfjr /kkjk] e[; /kkjk dk fojk/k djrh gA



fp= 5-2

fdlh dMyh e /kkjk d eku e ifjoru d dkj.k dMyh d fljk ij mRiUu çfjr okgd cy dh ifj?kVuk dk Loçj.k dgr gA bl çfjr fo|r okgd cy dk fojk/kh fo|r okgd cy Hkh dgr gA ekuk fdlh dMyh e ifjoru'khy /kkjk çokfgr dh tk jgh g rFkk fdlh le; t ij dMyh e çokfgr /kkjk dk eku i gk rk dMyh l lEc) pEcdh; ¶yDl

$$\phi \propto i$$

;k $\phi = Li$ ---¼3½

tgk L ,d lekuikrh fu;rkd g] ftl dMyh dk Loçj.k x.kkd ;k LoçjdRo dgr gA bldk ek=d gujh gkrk gA

QjkM d fu;e l dMyh e çfjr fo|r okgd cy

$$\varepsilon = -\frac{d\phi}{dt}$$

$$\varepsilon = -\frac{d(Li)}{dt}$$

;k $\varepsilon = -L\frac{di}{dt}$ ---¼4½

lehdj.k ¼3½ l ;fn dMyh l lEc) /kkjk dk eku ,dkd gk rk

$$\phi = L$$

vFkkr dMyh dk Loçj.k x.kkd ;k LoçjdRo vkfdd :i l ml pEcdh; ¶yDl d eku d cjkcj gkrk g tk d.Myh e ,dkd /kkjk d çokfgr dju ij lEc) gkrk gA

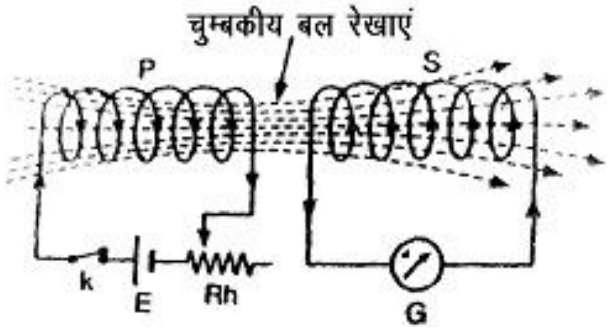
lehdj.k ¼4½ l Hkh LoçjdRo x.kkd dk ifjHkkf"kr fd;k tk ldrk gA ;fn dMyh l lEc) /kkjk d gkl dh nj $-\frac{di}{dt}$,dkd gk rk

$$L = \varepsilon$$

vFkkr dMyh dk Loçj.k x.kkd vkfdd :i l ml çfjr fo|r okgd cy d eku d cjkcj gkrk g tk dMyh e /kkjk d gkl dh nj ,dkd gku ij dMyh d fljk ij mRiUu gkrk gA

vU;kU; çj.k

fp= 5-3 d vulkj tc nk dMfy;k ¼P o S½ dk ijLij utnhd j[kdj ,d dMyh ¼S½ e ifjorh /kkjk çokfgr dh tkrh g rk bl dMyh ¼P½ d pkjk vkj mRiUu pEcdh; {k= d eku e ifjoru gkrk gA ;g ifjorh pEcdh; {k= utnhd j[kh dMyh ¼S½ l lEc) gkrk g rk bl dMyh ¼S½ l lEc) pEcdh; ¶yDl e ifjoru gkrk g] ftl dkj.k bl dMyh ¼S½ d fljk ij ifjr fo|r okgd cy mRiUu gkrk gA nlj 'kCnk e ,d dMyh e ifjorh /kkjk çokfgr fd; tku ij mld ikl j[kh vU; dMyh d fljk ij çfjr fo|r okgd cy mRiUu gku dh ?kVuk vU;kU; çj.k dgykrh gA



fp= 5-3

vU;kU; çj.k x.kkd dh x.kuk d fy, ekuk fd çFke dMyh P e fdlh le; t ij çokfgr /kkjk i_1 d dkj.k f}rh;d dMyh S d çR;d Qj l lEc) pEcdh; ¶yDl çkFkfed dMyh e çokfgr /kkjk d eku d lekuikrh gkrk g vFkkr

$$\phi_2 \propto i_1$$

;k $\phi_2 = Mi_1$ ---¼5½

tgk M ,d lekuikrh fu;rkd g ftl nkuk dMfy;k d e/; vU;kU; çj.k x.kkd ;k vU;kU; çjdRo dgr gA bldk ek=d gujh gkrk gA

;fn f}rh;d dMyh l lEc) pEcdh; ¶yDl e ifjoru dh nj $\frac{d\phi_2}{dt}$ gk rk QjkM d fu;ekulkj f}rh;d dMyh d fljk ij mRiUu çfjr fo|r okgd cy

$$\varepsilon_2 = -\frac{d\phi_2}{dt}$$ ---¼6½

lehdj.k ¼5½ l ϕ_2 dk eku lehdj.k ¼6½ e çfrLFkkfir dju ij&

$$\varepsilon_2 = -\frac{d(Mi_1)}{dt}$$

;k $\varepsilon_2 = -M\frac{di_1}{dt}$ ---¼7½

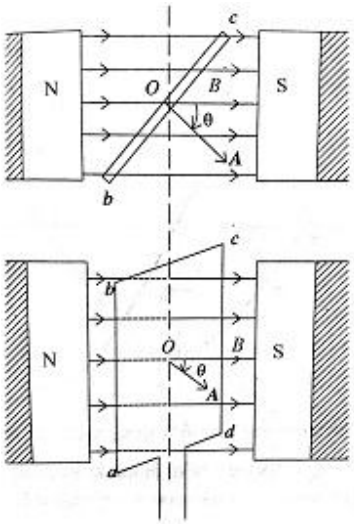
vr% ;fn ikFkfed dMyh e ifjorh /kkjk d gkl dh nj ,dkd gk rk

vFkkr utnhd j[kh nk dMfy;k d e/; vU;kU; ij.k x.kkd dk vkfdd eku f}rh;d dMyh d fljk ij mRiUu ml çfjr fo|r okgd cy d eku d cjkcj gkrk g tk fd çkFkfed dMyh e /kkjk d gkl dh nj ,dkd gku ij çfjr gkrk gA

dMfy;k d e/; eyk;e ykg dh cyukdkj ØkM j[ku ij vU;kU; çjdRo d eku e of) gk tkrh gA

pEcdh; {k= e dMyh dk ?k.ku

pEcdh; {k= e tc dMyh dk j[kk tkrk g rk pEcdh; ¶yDl dMyh l ikfjr gkrk gA ;fn dMyh dk pEcdh; {k= e mldh ?k.ku v{k d ikfjr fu;r dk.kh; ox l ?k.ku djk;k tk; rk dMyh l ikfjr pEcdh; ¶yDl d eku e



fp= 5-4

yxkrkj ifjoru gkrk g ft ld dkj.k dMyh d fljk ij çfjr fo|r okgd cy mRiUu gkrk gA ;g çfjr fo|r okgd cy ifjorh gku d dkj.k çfjr çR;korh fo|r okgd cy dgykrk gA çR;korh /kkjk tfu= blh fl)kr ij dk; djrk gA

fp= 5-4 e ,d /kkjkokgh vk;rkdkj dMyh abcd ft le Qjk dh l[;k N g] le:i pEcdh; {k= B e O d ikfjr v{k d lki{k fu;r dk.kh; ox ω l ?k.ku xfr dj jgh gA vr% t le; e dMyh ωt dk.k l ?ke tk;xhA ekuk fd dMyh l fuxr ¶yDl dk eku ϕ_B gk rk

$$\phi_B = N(\vec{B}.\vec{A})$$

tgk $\vec{A}$ dMyh dk i"Bh; lfn'k dgykrk g ft ldh fn'kk lno dMyh d ry d yEcor jgrh gA vr% t le; ij dMyh l fuxr ¶yDl dk eku

$$\phi_B = NBA\cos\omega t \qquad (\theta = \omega t)$$

tc dMyh dk ry pEcdh; {k= d lekrj gkrk g rk ml fLFkfr e $\vec{B}$ o $\vec{A}$,d nlj d yEcor gkr gA bl fLFkfr e dMyh l ikfjr ¼fuxr½ ¶yDl dk eku vf/kdre gkrk g] vFkkr

$$(\phi_B)_{max} = NBA = \phi_0 \qquad (\because \vec{A} \perp \vec{B})$$

$$\therefore \phi_B = \phi_0 \cos\omega t$$ ---¼8½

lehdj.k ¼8½ l Li"V g fd le:i pEcdh; {k= e ?k.ku xfr dj jgh dMyh l ikfjr ¶yDl le; ij fuHkj djrk g rFkk bldh çÑfr çR;korh gkrh gA

iu% lehdj.k ¼8½ l QjkM d fu;ekulkj dMyh d fljk ij mRiUu çfjr fo|r okgd cy

$$\varepsilon - \frac{d\phi_B}{dt}$$

$$\varepsilon = -\frac{d(\phi_0 \cos\omega t)}{dt}$$

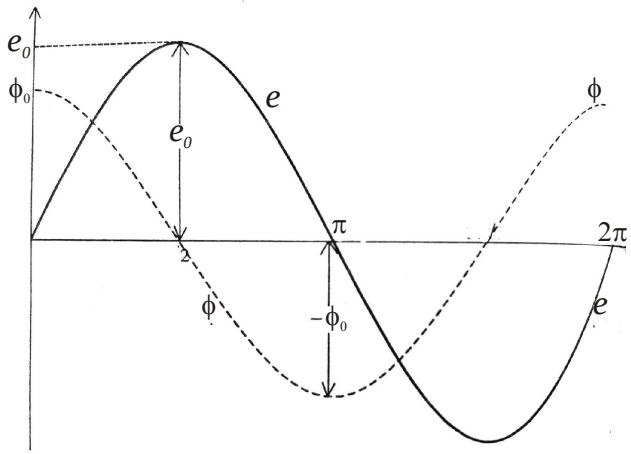
$$\varepsilon = \omega\phi_0 \sin\omega t$$

$$\varepsilon = \omega\, NBA \sin\omega t$$

$$\varepsilon = e_0 \sin\omega t$$ ---¼9½

tgk $\varepsilon_0 = \omega NBA$ ---¼10½

lehdj.k ¼9½ dMyh d fljk ij mRiUu çR;korh çfjr fo|r okgd cy d eku dk 0;Dr djrh g] rFkk çfjr fo|r okgd cy d vf/kdre eku dk n'kkrk gA lehdj.k ¼8½ ,o lehdj.k ¼9½ dk le; ¼ωt½ d lkFk xkQh; fu:i.k fp= 5-5 e n'kk;k x;k gA



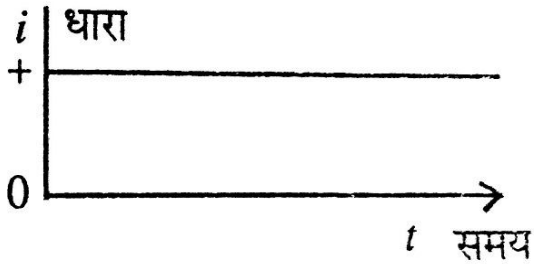
fp= 5-5

mi;Dr oØ l Li"V g fd le:i pEcdh; {k= e ?k.ku djrh dMyh l ikfjr pEcdh; ¶yDl ,o dMyh d fljk ij mRiUu fo|r okgd cy le; d lkFk vkorh :i l ifjofrr gkr g rFkk ftl le; dMyh l ikfjr ¶yDl dk eku vf/kdre gkrk g rk dMyh d fljk ij çfjr fo|r okgd cy dk eku U;ure gkrk g rFkk tc ¶yDl dk eku U;ure gkrk g rc fo|r okgd cy dk eku vf/kdre gkrk gA

fn"V ,o çR;korh /kkjk,

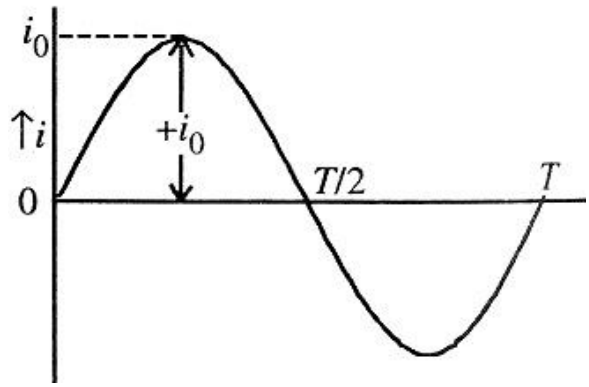
fdlh pkyd rkj e vko'k d çokg dh nj dk fo|r èkkjk dgr gA fo|r /kkjk dk ek=d ,Eih;j gkrk gA fo|r /kkjk dk le; dh fuHkjrk d vk/kkj ij nk Hkkxk e oxhÑr fd;k x;k g &

1- **fn"V /kkjk %** fn"V /kkjk og /kkjk gkrh g ftldk ifjek.k ,o fn'kk le; ij fuHkj ugh djrk gA nlj 'kCnk e fn"V /kkjk fu;r eku dh ,dfn'kh; /kkjk gkrh gA fp= 5-6 e fn"V /kkjk dk le; d lkFk vkj[k n'kk;k x;k gA



fp= 5-6

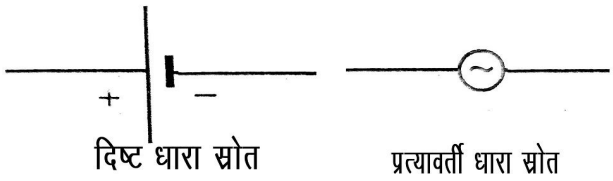
2- **çR;korh /kkjk %** çR;korh /kkjk og /kkjk gkrh g tk le; d lkFk vkorh :i l ifjorh gkrh jgrh gA nlj 'kCnk e çR;korh /kkjk dh fn'kk ,o ifjek.k nkuk le; d lkFk ifjofrr gkr gA fp= 5-7 e çR;korh /kkjk dk le; d lkFk vkj[k n'kk;k x;k gA



fp= 5-7

çR;korh /kkjk l lEc) okYVrk çR;korh okYVrk dgykrh g rFkk bl $V = V_0 \sin \omega t$ l 0;Dr fd;k tkrk gA V_0 çR;korh okYVrk dk f'k[kj eku ¼vk;ke½ dk 0;Dr djrk g rFkk çR;korh okYVrk dh vkofr dgykrh gA gekj n'k e fo|r LV'ku l çkIr çR;korh okYVrk dh vkofr 50Hz gkrh gA çR;korh okYVrk ;k /kkjk dk ,d pØ ijk dju e yxk le; vkordky ¼T½ dgykrk g rFkk bldk eku $T = \frac{2\pi}{\omega}$ gkrk gA

fn"V /kkjk lkr ,o çR;korh /kkjk lkr dk ifjiFk e fuEu ldrk d }kjk fu:fir fd;k tkrk g] fp= 5-8



fp= 5-8

çR;korh /kkjk ,o okYVrk dk rkR{kf.kd] vklr] ox ekè; ey ,o f'k[kj eku %&

(i) **rkR{kf.kd eku %** fdlh le; t ij çR;korh /kkjk ;k okYVrk dk eku] rkR{kf.kd eku dgykrk gA

çR;korh /kkjk d fy, bldk eku

$$I = I_0 \sin \omega t$$

rFkk çR;korh okYVrk d fy, bldk eku

$$V = V_0 \sin \omega t$$

(ii) **vkSlr eku %** çR;korh okYVrk rFkk /kkjk dk ,d i.kZ pØ ¼vkor dky½ e vkSlr eku 'kU; gkrk gA D;kfd fp= 5-7 l Li"V g fd çR;korh okYVrk /kkjk dk eku vk/k pØ d fy, /kukRed rFkk 'k"k vk/k pØ d fy, _.kkRed ¼foijhr fn'kk e½ gkrk g vr% ,d i.kZ pØ d fy, dy eku 'kU; ikSlr gkrk gA bl Øe'k $\overline{V}$ rFkk $\overline{I}$ l çnf'kr djr gA

$$\overline{V} = \frac{\int_0^T V dt}{\int_0^T dt}$$

(iii) **ox ek/; ey eku %** çR;korh okYVrk d fy, ,d i.kZ pØ e ox ek/; ey eku fuEu çdkj Kkr fd;k tkrk gA

$$V_{rms} = \sqrt{\overline{V}^2}$$

$$= \sqrt{\frac{\int_0^T V^2 dt}{\int_0^T dt}}$$

$$= \sqrt{\frac{\int_0^T V_0^2 \sin^2 \omega t dt}{[t]_0^T}}$$

$$= V_0 \sqrt{\frac{\int_0^T \sin^2 \omega t dt}{[t]_0^T}}$$

$$= V_0 \sqrt{\frac{1}{2}}$$

;k $V_{rms} = 0.707 V_0$ ---¼11½

blh çdkj $I_{rms} = 0.707\ I_0$ ---¼12½

gekj n'ks e fo|qr LV'ku l çkSlr ?kjy okYVrk dk ox ek/; ey eku 220 okYV gkrk gA

(iv) **f'k[kj eku %** çR;korh okYVrk ;k /kkjk dk vfèkdre eku f'k[kj okYVrk ;k f'k[kj /kkjk dgykrk gA bl Øe'k V_0 ,o I_0 l 0;Dr djr gA

VkSlQkej dh ljpuk ,o dk;ç.kkyh

çR;korh okYVrk d eku dk vf/kd ;k de dju d fy, ge VkSlQkej dk mi;ksx djr gA VkSlQkej vU;kU; çj.k d fl)kUr ij dk; djrk g blfy, ;g fn"V /kkjkvk ¼fu;r èkkjk½ d fy, mi;Dr ugh gA dk; d vk/kkj ij VkSlQkej nk çdkj d gkr g&

1- **mPpk;h VkSlQkej %** fuEu çR;korh okYVrk dk mPp çR;korh okYVrk e cnyu d fy, ç;Dr VkSlQkej mPpk;h VkSlQkej dgykr gA

2- **vipk;h VkSlQkej %** mPp çR;korh okYVrk dk fuEu çR;korh okYVrk e cnyu d fy, ç;Dr VkSlQkej vipk;h VkSlQkej dgykr gA

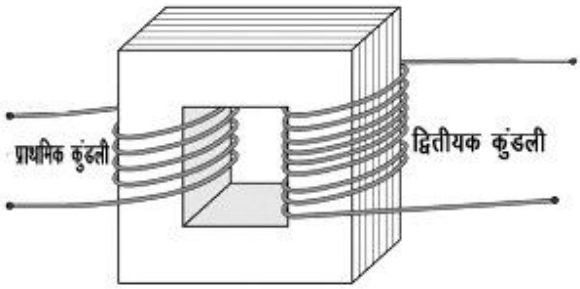
ljpuk % VkSlQkej d e[;r% rhu Hkkx gkr g&

(i) ykg&pEcdh; inkFkZ dh ØkM

(ii) rkc dh ikFkfed dMyh

(iii) rkc dh f}rh;d dMyh

VkSlQkej dh ØkM dPp ykg ¼ykg pEcdh; inkFkZ½ dh fo|qr:) ifÙk;k l cuk;h tkrh gA ftl Hkkoj /kkjk, de mRiUu gkA ØkM dh mifLFkfr e pEcdh; cy j[kk, dfUær gkdj Åtk d {k; dk U;wu dj nrh gA ØkM pEcdh; cy j[kkvk d fy, cn o lxe iFk çnku djrh gA ØkM ykg pEcdh; inkFkZ dh cuh gku dh otg l VkSlQkej e 'kfFkY; gkfu 'kU; gkrh g ¼fp= 5-9½A



fp= 5-9

ØkM dh lEe[k Hkktkvk ij rkc d rkj dh dMfy;k yiVh tkrh gA ftl dMyh ij çR;korh okYVrk vkjkfir dh tkrh g ml çkFkfed dMyh P dgr g rFkk ftl dMyh ij fuxe okYVrk çkSlr gkrh g ml f}rh;d dMyh S dgr gA

dk;ç.kkyh % ekuk fd VkSlQkej dh çkFkfed dMyh e Qjk dh l[;k N_P rFkk f}rh;d dMyh e Qjk dh l[;k N_S gA tc çkFkfed dMyh d fljk ij çR;korh okYVrk

vkjkfir dh tkrh g rk çkFkfed dMyh e çR;korh /kkjk çokfgr gku yxrh g ft ld dkj.k çkFkfed dMyh l lc) ¶yDl d eku e ifjoru gku yxrk gA ;fn çkFkfed dMyh l lc) ¶yDl e ifjoru dh nj $\frac{\Delta\phi}{\Delta t}$ gk rk çkFkfed dMyh e çfjr fo|r okgd cy dk eku gkxk&

$$\varepsilon_P = -N_P \frac{\Delta\phi}{\Delta t} \qquad \text{---¼13½}$$

;fn VkIQkej e pEcdh; ¶yDl dh gkfu dk 'kU; eku fy;k tk; rk ;gh ¶yDl f}rh;d dMyh l Hkh lEc) gkxk ft ld ifj.kkeLo:i f}rh;d dMyh d fljk ij vU;kU; çj.k d dkj.k leku vkofr dh çR;korh okYVrk mRiUu gkxh vFkkr

$$\varepsilon_S = -N_S \frac{\Delta\phi}{\Delta t} \qquad \text{---¼14½}$$

lehdj.k ¼13½ o lehdj.k ¼14½ l

$$\frac{\varepsilon_P}{\varepsilon_S} = \frac{N_P}{N_S} \qquad \text{---¼15½}$$

,d vkn'k VkIQkej d fy, dMfy;k dk çfrjk/k ux.; ,o Åtk gkfu 'kU; gkrh gA vr% bl fLFkfr e çkFkfed dMyh d fljk ij vkjkfir çR;korh okYVrk V_p dk eku çfjr fo|r okgd cy ε_p d cjkcj gkrk gA blh çdkj tc f}rh;d dMyh d fljk ij çfjr fo|r okgd cy ε_S dk eku] f}rh;d dMyh d fljk dk [kyk j[k eki x; foHkokrj V_s d cjkcj gkxkA vr% lehdj.k ¼15½ l&

$$\frac{\varepsilon_S}{\varepsilon_P} = \frac{N_S}{N_P} = \frac{V_S}{V_P} = r \text{ ¼ifj.keu vuikr½} \qquad \text{---¼16½}$$

;fn $N_s > N_p$ vFkkr f}rh;d dMyh e Qjk dh l[;k çkFkfed dMyh e Qjk dh l[;k l vf/kd gk rk bl fLFkfr e r>1gkxkA bl çdkj dk VkIQkej mPpk;h VkIQkej $(V_s > V_p)$ dgykrk g rFkk ;fn $N_s < N_p$ rk bl fLFkfr e r<1 gkxk] bl çdkj dk VkIQkej vipk;h VkIQkej $(V_s < V_p)$ dgykrk gA

VkIQkej d }kjk doy okYVrk d eku e ifjoru gkrk gA vkn'k VkIQkej d fy, 'kfDr dk eku vifjofrr jgrk g vFkkr

$$P_p = P_s$$

;k $V_p I_p = V_s I_s$

;k $$\frac{V_P}{V_S} = \frac{I_S}{I_P} \qquad \text{---¼17½}$$

lehdj.k ¼16½ o lehdj.k ¼17½ l &

$$r = \frac{\varepsilon_S}{\varepsilon_P} = \frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$$

VkIQkej dh n{krk fuEu çdkj l Kkr dh tkrh g&

$$\eta = \frac{\text{f}}{\text{çkFkfed d.Myh dk nh x;h Åtk}} \times 100\%$$

;k $$\eta = \frac{V_S I_S}{V_P I_P} \times 100\% \qquad \text{---¼18½}$$

vkn'k VkIQkej e fdlh Hkh çdkj dh fo|r Åtk dh gkfu ugh gkrh g vFkkr $V_s I_s = V_p I_p$,l vkn'k VkIQkej dh n{krk 100% gkrh gA yfdu 0;kogkfjd :i l VkIQkej dh n{krk 90% l 98% rd dh gkrh g ft ldk dkj.k VkIQkej e fo|r Åtk dh gkfu gA

VkIQkej e fo|r Åtk dh gkfu d e[; dkj.k

1- **rke gkfu %** VkIQkej dh dMfy;k rke /kkrq d rkjk dh cuh gkrh g ftudk çfrjk/k 'kU; ugh gkrk gA bl fLFkfr e dMyh d çfrjk/k d dkj.k fo|r 'kfDr dk {k; (I^2R) gkrk gA bl rke gkfu dgr gA

2- **Hkoj /kkjk gkfu %** VkIQkej dh çkFkfed dMyh e çR;korh /kkjkvk d dkj.k ¶yDl e ifjoru gkrk g rk ØkM e Hkh fo|r okgd cy çfjr gk tkrk g ft ld dkj.k ØkM e Hkoj /kkjk, çokfgr gkrh g] rFkk ØkM e Å"ek d :i e 'kfDr dk {k; gkrk gA bl Hkoj /kkjk gkfu dgr gA bl gkfu dk U;wu dju d fy, ØkM dk ykg&pEcdh; inkFk dh iryh jkf/kr ifê;k d :i e cuk;k tkrk g rFkk ftu ij okfu'k dk yiu dj fn;k tkrk gA bl fLFkfr e ØkM dk çfrjk/k mPp gk tku d dkj.k Hkoj /kkjkvk d eku e deh vk tkrh gA

3- **'kfFkY; gkfu %** dMfy;k e çR;korh pEcdh; {k= d dkj.k çR;koru d çR;d vkordky e ,d 'kfFkY; yi i.k gk tkrk gA ft l l 'kfDr {k; gkrh jgrh gA bl gkfu dk 'kfFkY; gkfu dgr gA bl U;wu dju d fy, ge ØkM gr ,l inkFk dk p;u djr g ft ld fy, 'kfFkY; yi dk {k=Qy U;wu gkA

'kfDr dk njLFk lpj.k

fo|r 'kfDr d tfu= LFky l mi;kx LFky rd lpj.k dk 'kfDr dk njLFk lpj.k dgr gA fo|r dk mRiknu ftl txg ij fd;k tkrk g ml tfu= LFky dgr gA ; tfu= LFky mi;kx LFky l cgr njh ij gkr gA bud lpj.k d fy, dcYl dk mi;kx fd;k tkrk gA fo|r d lpj.k gr çR;korh fo|r /kkjk gh ç;Dr dh tkrh g D;kfd fn"V /kkjk d lpj.k d le; 'kfDr {k;] çR;korh /kkjk lpj.k dh ryuk e vf/kd gkrk gA çR;korh /kkjk d lpj.k e 'kfDr {k; dk de dju d fy, çR;korh /kkjk dk mPp okYVrk ij tfu= LFky l çf"kr djr gA bld fy, ge mPpk;h VkIQkej dk mi;kx djr gA mi;kx LFky ij pfd de okYVrk (220 Volt) dh vko';drk gkrh g vr% vipk;h VkIQkej dh lgk;rk l mPp okYVrk dk okfNr okYVrk e ifjofrr dj mi;kx LFky rd Hktk tkrk gA 'kfDr d lpj.k gr ç;Dr dcy dk iky ;k ehukjk d lgkj vFkok tehu d vnj Hkfexr ykbu fcNkdj ,d LFkku l nlj LFkku ij lpkfjr fd;k tkrk gA bu ykbuk d e/; e vko';drkulkj lj{kk midj.kk dk Hkh yxk;k tkrk g ftl fdlh Hkh vkikrdkyhu ifjfLFkfr e tu&/ku dh gkfu l cpk tk ld rFkk fuc/k :i l 'kfDr dk lpj.k gk ldA

çR;korh /kkjk tfu= ;k Mk;uek

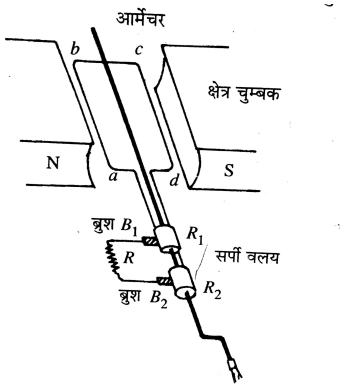
çR;korh /kkjk tfu= fo|r pEcdh; çj.k d fl)kr ij dk; dju okyh ;fDr g tk ;kf=d Åtk dk fo|r Åtk e ifjofrr djrk gA tfu= d e[;r% fuEu Hkkx gkr g&

1- **vkepj %** vR;f/kd Qjk okyh rkc d fo|rjk/kh rkj dh ,d dMyh abcd dk uje ykg d ØkM ij yiVk tkrk g ftl vkepj dgr gA uje ykg dh ØkM dMyh e ¶yDl c<ku d dke vkrh gA

2- **{k= pEcd %** fp= 5-10 e bl N, S l çnf'kr fd;k x;k gA {k= pEcd d /ko vory gkr g rFkk LFkkb mPp pEcdh; {k= mRiUu djr gA vkepj d v{k dk pEcdh; cy j[kkvk d yEcor j[kdj nkuk pEcdh; /kok d e/; ?kek;k tkrk gA

3- **lih oy; %** vkepj dMyh d nkuk fljk dk /kkr d lih oy; R_1 ,o R_2 l tkMk tkrk gA lih oy; ,o vkepj dh 0;oLFkk bl çdkj dh gkrh g fd tc आर्मेचर घुमाया जाता है तो सर्पी वलय R_1 ,o R_2 Hkh dUæh; v{k d lki{k ?k.ku djr gA

4- **c'k %** fp= 5-10 e bUg B_1 o B_2 l n'kk;k x;k gA c'k dkcu d cu gkr g rFkk fLFkj jgr gA ; ?kf.kr lih oy; R_1 rFkk R_2 ij ncko ndj lno lEid e jgr gA ckÁ ykM R e /kkjk bu c'kk l gkdj çkIr gkrh gA



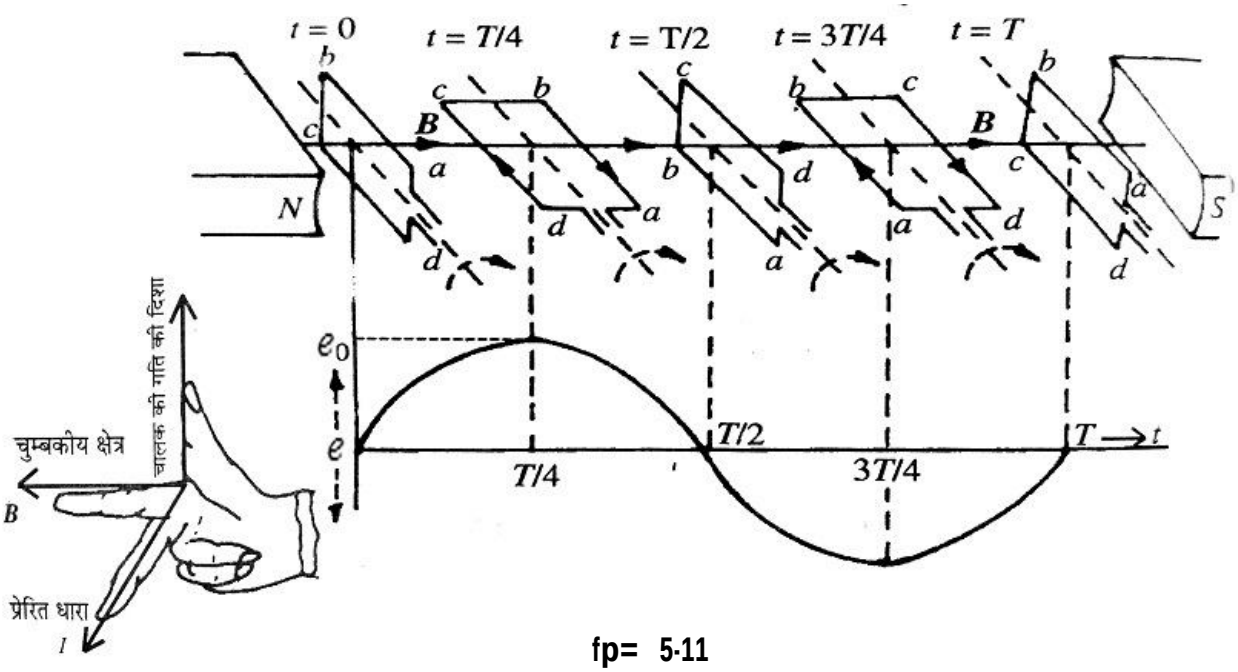
fp= 5-10

dk;ç.kkyh % tc vkepj dMyh dk ;kf=d dk; djd pEcdh; {k= e ?kek;k tkrk g rk dMyh l lc) ¶yDl e T;koØh; ifjoru gkrk g ¼vuPNn 5-6 e bl le>k;k x;k g½ bll dMyh e /kkjk çfjr gkrh gA fp= 5-11 e tfu= dh dk;ç.kkyh dk vkj[k d }kjk le>k;k x;k gA

çkjHk e t=0 ij vkepj abcd Å/ok/kj fLFkfr e ,o ab Hktk mij dh vkj gA t=0 l t=T/2 rd ab Hktk uhp dh vkj rFkk cd Hktk Åij dh vkj xfr djrh gA ¶yfex d nk, gkFk d fu;e l bl le; vrjky e /kkjk dh fn'kk vkepj dMyh e dcba d vufn'k gkxhA tcfd t=0 rFkk t=T/2 le; ij dMyh m/ok/kj gku d dkj.k vkepj dMyh dh Hktk ab ,o cd pEcdh; {k= d vufn'k gkxhA bl fLFkfr l xtjr le; pEcdh; ¶yDl d ifjoru dh nj 'kU; gkrh g rFkk bu fLFkfr;k e çfjr fo|r okgd cy dk eku 'kU; gkxkA

iu% t=T/4 rFkk t=3T/4 ij vkepj {kfrt fLFkfr e gkrk gA bl fLFkfr l xtjr le; pEcdh; ¶yDl d ifjoru dh nj vf/kdre gkrh g rFkk bu fLFkfr;k e çfjr fo|r okgd cy dk eku vf/kdre yfdu foijhr fn'kkvk e çkIr gkrk g ¼¶yfex d fu;eulkj t=T/2 l t=T le; vrjky e /kkjk dh fn'kk vkepj dMyh e abcd d vufn'k gkxh½A

fp= 5-11 l Li"V g fd çR;korh /kkjk tfu= l çkIr okYVrk 0 l T/2 le;krjky e 'kU; l vf/kdre rFkk vfèkdre l 'kU; /kukRed fn'kk e rFkk T/2 l T le;kUrjky e ;g ifjoru _.kkRed fn'kk e çkIr gkrk gA ykM d fljk ij fo|r okgd cy $\varepsilon = \varepsilon_0 \sin \omega t$ çkIr gkrk gA

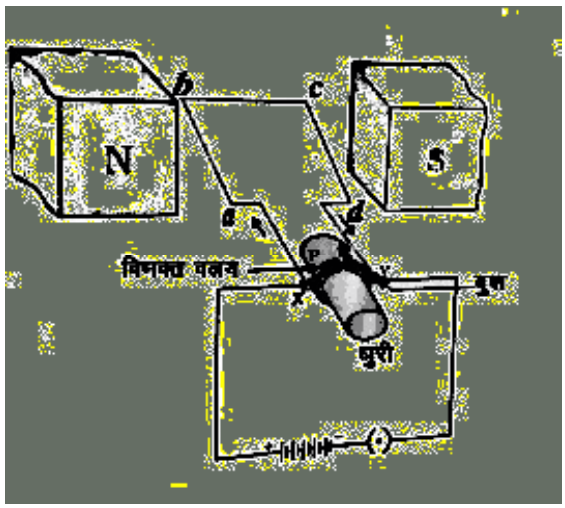


fp= 5-11

fo|r ekVj

pEcdh; {k= e /kkjkokgh pkyd ¼dMyh½ ij cy;Xe d dkj.k mRiUu pkyd ¼dMyh½ dh ?k.ku xfr d fl)kr ij dk; dju okyh og ;fDr tk fo|r Åtk dk ;kf=d Åtk e ifjofrr djrh g] fo|r ekVj dgykrh gA fp= 5-12 e fo|r ekVj dh vkrfjd ljpuk dk n'kk;k x;k gA fp=ku lkj fo|r ekVj e rkc d fo|rjk/kh rkj dh ,d vk;rkdkj dMyh abcd dk çcy {k= pEcd d /kok (N o S) d e/; bl çdkj j[kk tkrk g fd bl dh Hktk, ab rFkk cd pEcdh; {k= dh fn'kk d yEcor gkA dMyh d nkuk fljk dk Øe'k% foHkDr oy; d nk v/kHkkxk P rFkk Q l tkMk tkrk gA foHkDr oy; d vnj dh lrg fo|rjk/kh gkrh g rFkk ,d /kjh l tMh gkrh gA oy; d v/kHkkx P rFkk Q d ckgjh pkyd lrg dk fLFkj pkyd c'k Øe'k% X rFkk YLi'k djr gA

ekuk fd çkjHk e dMyh dk a fljk cVjh d /ku /ko rFkk d fljk cVjh d _.k /ko l tMk gA ifj.kkeLo:i dMyh e /kkjk dh fn'kk abcd gkxhA nlj 'kCnk e Hktk ab rFkk cd e /kkjk ,d nlj d foijhr fn'kk e iokfgr gkxhA vr% ¶yfex d nk; gkFk d fu;ekulkj Hktk ab ij uhp dh vkj rFkk Hktk cd ij Åij dh vkj cy yxrk g] vFkkr dMyh e ,d cy ;Xe dk; djrk g tk dMyh rFkk /kjh dk okekor fn'kk e ?k.ku djkrk gA dMyh d vk/k ?k.ku d i'pkr foHkDr oy; P dk lid c'k Y rFkk Q dk lid c'k X l gk tkrk gA bl fLFkfr e dMyh e fo|r /kkjk foijhr fn'kk dcba d vufn'k çokfgr gkrh gA bl fLFkfr e Hktk ab rFkk cd ij yxu oky cyk dh fn'kk Hkh io fLFkfr d foijhr gk tkrh g vFkkr ab Hktk ij vc Åij dh vkj rFkk cd Hktk ij uhp dh vkj cy dk; djxk tk dMyh rFkk /kjh dk iu% okekor fn'kk e ?k.ku d fy, cy ;Xe çnku djrk gA



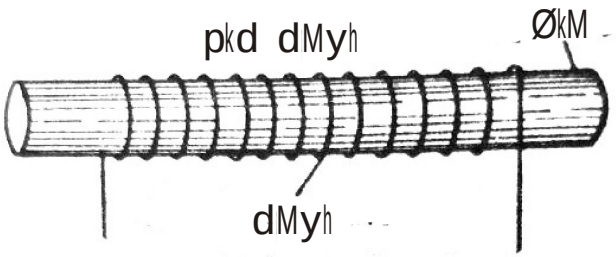
fp= 5-12

nlj 'kCnk e çR;d vk/k ?k.ku d i'pkr dMyh e /kkjk dh fn'kk mRØfer gku dk ;g Øe nkgjkrk jgrk g] yfdu gj fLFkfr e dMyh e mRiUu cy ;Xe dh fn'kk bl çdkj

jgrh g fd dMyh rFkk /kjh dk ?k.ku fujrj ,d gh fn'kk ¼okekor ;k nf{k.kkor½ e gkrk jgA bl çdkj fo|r ekVj dh lgk;rk l fo|r Åtk dk ;kf=d Åtk e ifjofrr fd;k tkrk gA

pkd dMyh

fn"V /kkjk dk fu;f=r dju d fy, /kkjk fu;=d dk mi;kx fd;k tkrk gA yfdu /kkjk fu;=d dh dMyh dk çfrjk/k (R) gku d dkj.k I^2R fo|r Åtk çfr ld.M Å"ek d :i e {k; gkrh jgrh gA çR;korh /kkjk dk fu;f=r dju d fy, ,lh ;fDr ftle fo|r Åtk dk gkl ux.; gk] pkd dMyh dgr gA pkd dMyh vf/kd Loçjdro (L) rFkk vYi çfrjk/k (R) dh dMyh gkrh g tk rkc d ekV fo|rjk/kh rkj d vud Qjk dk iVfyr ykg ØkM ij yiV dj cuk;h tkrh g] fp= ¼5-13½A



fp= 5-13

Qjk dh l[;k mPp gku d dkj.k dMyh dk Loçjdro mPp rFkk rkc d rkj dk vuçLFk dkV vf/kd gku d dkj.k] ml dk çfrjk/k vYi gkrk gA pkd dMyh e ØkM dk vko';drkulkj dMyh d vnj okfNr njh rd f[kl dk dj dMyh dh çfrck/kk $Z = \sqrt{R^2 + \omega^2 L^2}$ dk fu;f=r fd;k tkrk gA D;kfd çjdRo L dk eku] dMyh d vnj ØkM dh fLFkfr ij fuHkj djrk gA ØkM dMyh d vnj ftruk vf/kd njh rd çfo"V gkxk] L dk eku Hkh mruk vf/kd gkxkA nlj 'kCnk e pkd dMyh e ØkM dk vkx ihN dj çR;korh /kkjk dh çcyrk ¼vk;ke½ dk fu;f=r fd;k tkrk gA

pkd dMyh dk mi;kx doy çR;korh /kkjkvk dk fu;f=r dju d fy, fd;k tkrk gA D;kfd fn"V /kkjkvk d fy, dk ω eku 'kU; gkrk gA bl fLFkfr e fn"V /kkjkvk d fy, pkd dMyh dh çfrck/kk (Z) pkd dMyh d çfrjk/k (R) d rY; gkxh tk fd R d vYi eku gku d dkj.k vYi gkxhA vr% fn"V /kkjkvk d fy, pkd dMyh dk fu"çHkkoh Hkh dgk tk ldrk gA

'kfDrfoghu /kkjk

fo|r ifjiFk e Åtk d 0;; dh nj dk 'kfDr dgr gA bl P l n'kkr gA bldk eku ifjiFk e cgu okyh /kkjk ,o okYVrk d x.kuQy d cjkcj gkrk g vFkkr

$$P = V \times I$$

'kfDr dk ek=d okV gkrk gA çR;korh /kkjk ,o okYVrk d fy, rkR{kf.kd /kkjk o okYVrk dk eku] tc doy 't) çfrjk/k mifLFkr gk&

$$I = I_0 \sin \omega t \qquad \text{---¼19½}$$

$$V = V_0 \sin \omega t \qquad \text{---¼20½}$$

∴ ifjiFk e rkR{kf.kd 'kfDr {k;

$$P = V_0 \sin \omega t \times I_0 \sin \omega t$$

$$= V_0 I_0 \sin^2 \omega t \qquad \text{---¼21½}$$

vr% ifjiFk e ,d çR;korh pØ d fy, 'kfDr {k; dk vkl r eku

$$\overline{P} = V_0 I_0 (\sin^2 \omega t)_{av}$$

$$= \frac{V_0 I_0}{2} \qquad D;kfd \ (\sin^2 \omega t)_{av} = \frac{1}{2}$$

;k $\overline{P} = V_{rms} \times I_{rms}$ ---¼22½

;fn ,l çR;korh ifjiFk dh dYiuk dh tk; ftle 't) çjd ;k 't) l/kkfj= tMk gvk gk rk bl fLFkfr e èkkjk ,o okYVrk dk eku lehdj.k ¼19½ ,o lehdj.k ¼20½ l ugh fn;k tk ldrkA D;kfd bl fLFkfr e nkuk d e/; dykrj mifLFkr jgrk gA vr% bl fLFkfr e okYVrk ,o /kkjk dk eku Øe'k%

$$V = V_0 \sin \omega t \qquad \text{---¼23½}$$

$$I = I_0 \sin (\omega t - \phi) \qquad \text{---¼24½}$$

∴ fdlh {k.k ifjiFk e vkl r 'kfDr {k; dk eku

$$\overline{P} = V_0 I_0 [\sin \omega t \times \sin (\omega t - \phi)]_{av}$$

$$= \frac{V_0 I_0}{2} \cos\phi$$

$$\overline{P} = V_{rms} \times I_{rms} \times \cos\phi \qquad \text{---¼25½}$$

tgk $\cos\phi$ ifjiFk dk 'kfDr x.kkd dgykrk gA

;fn ifjiFk e doy 'k) l/kkfj= ;k 'k) çjdRo tMk gvk gk vkj çfrjk/k dk eku 'kU; gk rk , l ifjiFk d fy, ϕ dk eku 90^0 gkrk gA vr% lehdj.k ¼25½ l vklr 'kfDr dk eku 'kU; çkIr gkxkA bl ifjiFk e cgu okyh /kkjk dk dk;ghu ;k 'kfDrghu /kkjk dgr gA D;kfd bl /kkjk d lxr ifjiFk e fdlh Hkh çdkj dk 'kfDr {k; ugh gkrk gA pfd okLro e fdlh Hkh ifjiFk dk çfrjk/k 'kU; gkuk lHko ugh g vFkkr 'kfDr {k; dk 'kU; gkuk dYiuk ek= g] vr% 'kfDrfoghu /kkjk ;k dk;ghu /kkjk ,d ek= dYiuk gA

/kkjk ,o foHko d e/; dyk lc/k

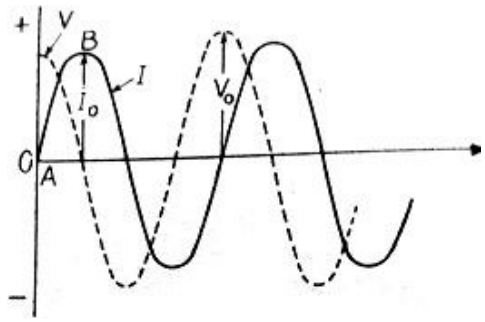
tc ifjiFk e doy 'k) çfrjk/k gkrk g rk bl fLFkfr e /kkjk ,o foHko d rkR{kf.kd eku Øe'k% lehdj.k ¼19½ o lehdj.k ¼20½ l fn; tkr gA ftul Li"V g fd /kkjk ,o foHko nkuk leku dyk e gkr gA yfdu 'k) çjd ;k 'k) l/kkfj= dh mifLFkfr e /kkjk ,o foHko d e/; leku dyk ugh jg ikrh g] rFkk bue dykrj ϕ mRiUu gk tkrk gA

1- 'k) çjd dh fLFkfr e /kkjk ,o foHko d eè; dyk lc/k % fp= 5-14 d vulkj ge ,d çR;korh okYVrk lkr dk fdlh 'k) çjd dMyh L l tkMr g rk dMyh d fljk ij ,d çR;korh fojk/kh foHko çfjr gk tkrk g ftldk eku /kkjk d ifjoru dh nj d lekuikrh gkrk gA ;fn dMyh dk çfrjk/k ux.; gk rk okYVrk lkr l vkjkfir foHkokrj lno fojk/kh foHkokrj d cjkcj o foijhr gkrk g ftll fd og ifjiFk e /kkjk cuk; j[krk gA

fp= 5-14

fp= 5-15 e ifjiFk e cgu okyh /kkjk rFkk okYVrk oØ dk vkjf[kr fd;k x;k gA

oØ l Li"V g fd ftl {k.k /kkjk I 'kU; gkrh g ¼fcn A½ ml {k.k /kkjk d cnyu dh nj $(\frac{\Delta I}{\Delta t})$ vf/kdre gkrh g ¼D;kfd A fcn ij oØ dk <ky vf/kdre g½ bl fLFkfr e foHkokrj V dk eku vf/kdre gkrk g ¼D;kfd $V \propto \frac{\Delta I}{\Delta t}$ ½ rFkk ftl {k.k /kkjk vfèkdre gkrh g ¼fcn B½] ml {k.k oØ



fp= 5-15

dk <ky 'kU; gku d dkj.k foHkokrj V dk eku 'kU; gkrk gA nlj 'kCnk e /kkjk ,o foHkokrj d e/; dyk 'kU; uk gkdj 90° gkrh gA oØk l Li"V g fd okYVrk oØ d f'k[kj] /kkjk oØ d f'k[kj l igy iMr gA bll irk pyrk g fd doy 'k) çjdRo oky çR;korh ifjiFk e okYVrk V /kkjk I l dyk e 90° vkx jgrh gA bl fp= 5-16 e lfn'k&vkj[k }kjk Hkh çnf'kr fd;k x;k gA

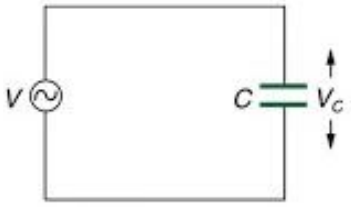
fp= 5-16

vr% okYVrk ,o /kkjk d rkR{kf.kd eku

$$V = V_0 \sin \omega t \quad \text{---¼26½}$$

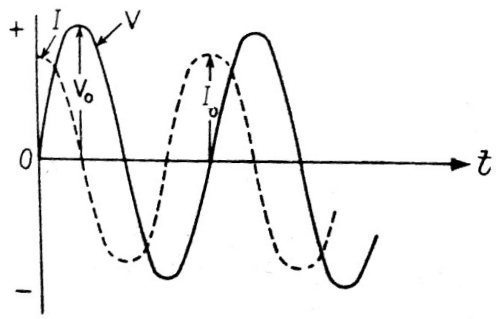
$$I = I_0 \sin (\omega t - 90°) \quad \text{---¼27½}$$

2- 'k) l/kkfj= dh fLFkfr e /kkjk ,o foHko d e/; dyk lc/k % fp= 5-17 d vulkj ge ,d çR;korh okYVrk lkr dk fdlh 'k) l/kkfj= ftldh /kkfjrk dk eku



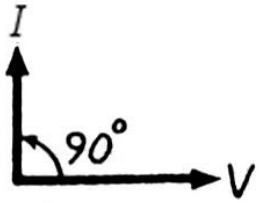
चित्र 5.17□

C g l tkMr gA bl fLFkfr e /kkjk ,o okYVrk d vkj[k fp= 5-18 e çnf'kr gA



fp= 5-18

oØk l Li"V g fd /kkjk ,o okYVrk leku dyk e ugh gA ftl {k.k foHkokrj 'kU; gkrk g ml {k.k foHkokrj d cnyu dh nj $(\frac{\Delta V}{\Delta t})$ vf/kdre gkrh g vr% ifjiFk e cgu okyh èkkjk I $\{\frac{\Delta q}{\Delta t} = \frac{\Delta (CV)}{\Delta t} = C\frac{\Delta V}{\Delta t}\}$ dk eku Hkh vfèkdre gkrk gA ftl {k.k foHkokrj dk eku vf/kdre gkrk g ml {k.k $(\frac{\Delta V}{\Delta t})$ dk eku 'kU; gku d dkj.k ifjiFk e èkkjk dk eku 'kU; çkIr gkrk gA bl çdkj Li"V g fd 'k) lèkkfj= oky ifjiFk e okYVrk ,o /kkjk d e/; dyk 'kU; uk gkdj 90° gkrh gA oØk l Li"V g fd okYVrk oØ d f'k[kj] /kkjk oØ d f'k[kj d ckn e iMr gA bll irk pyrk g fd okYVrk] /kkjk l dyk e 90° ihN jgrh gA bl fp= 5-19 e lfn'k vkj[k }kjk Hkh n'kk;k x;k gA



fp= 5-19

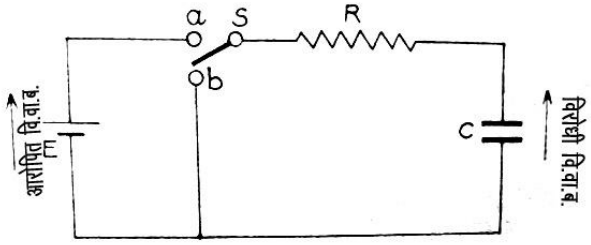
vr% okYVrk ,o /kkjk d rkR{kf.kd eku

$$V = V_0 \sin(\omega t - 90°) \quad \text{---¼28½}$$

$$I = I_0 \sin \omega t \quad \text{---¼29½}$$

l/kkfj= dk vko'ku ,o fujko'ku

l/kkfj= e vko'ku ,o fujko'ku dh çfØ;k dk le>u d fy, ge ,d lekrj lyV l/kkfj= ftl dh /kkfjrk C g dk J.kh Øe e ,d çfrjks/k R rFkk fLFkj fo|r okgd cy E okyh cVjh l fp= 5-20 d vulkj tkMr gA



fp= 5-20

1- l/kkfj= dk vko'ku % loiFke ekuk fd l/kkfj= ij vko'k dh ek=k 'kU; gA vc ge dth a-s dk cn rFkk a-b dk [kyk j[kr gA bl fLFkfr e l/kkfj= e /kkjk çokfgr gku yxrh g rFkk bldk vko'ku çkjHk gku yxrk gA vko'ku dh fLFkfr e l/kkfj= dh lyVk ij fojks/kh fo|r okgd cy mRiUu gku yxrk gA tc fojks/kh fo|r okgd cy dk eku] vkjksfir fo|r okgd cy E d cjkcj gk tkrk g rk bl fLFkfr e ifjiFk l cgu okyh /kkjk dk eku 'kU; gk tkrk g rFkk l/kkfj= i.k :i l vkof'kr gk tkrk gA

;fn vko'ku d le; fdlh {k.k t ij l/kkfj= ij vko'k dk eku Q o /kkjk dk eku I gk rk&

$$E - \frac{Q}{C} = IR$$

;k $$E - \frac{Q}{C} = R\frac{dQ}{dt}$$

ftl l fdlh {k.k l/kkfj= ij vko'k dk eku

$$Q = Q_0(1 - e^{-\frac{t}{RC}}) \quad \text{---¼30½}$$

tgk Q_0 l/kkfj= ij i.k vko'ku dh fLFkfr e vko'k dk vf/kdre eku gA

lehdj.k ¼30½ l Li"V g fd l/kkfj= d vko'ku d le; vko'k pj?kkrkdh :i l c<rk gA

2- l/kkfj= dk fujko'ku % l/kkfj= d i.k vko'ku d i'pkr dth a-s dk [kyk j[k rFkk b-s dk cn dju ij l/kkfj= dk çfrjks/k R d }kjk fujko'ku gkuk çkjHk gk tkrk gA bl fLFkfr e çkjHk e fujko'ku /kkjk dk eku vf/kdre gkrk g] yfdu tl&tl l/kkfj= dh lyVk d e/; foHkokrj

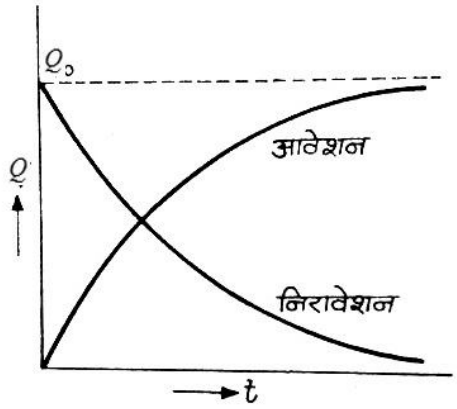
de gkrk tkrk g] fujko'ku /kkjk {kk.k gkrh tkrh g rFkk i.k fujko'ku dh fLFkfr e bldk eku Hkh 'kU; gk tkrk gA

fujko'ku dh fLFkfr e fdlh {k.k l/kkfj= ij vko'k dk eku Q rFkk /kkjk dk eku I gk rk&

$$\frac{Q}{C} = RI_0$$

;k $$Q = Q_0 e^{-\frac{t}{RC}}$$ ---¼31½

lehdj.k ¼31½ l Li"V g dh l/kkfj= d fujko'ku d le; vko'k pj?kkrkdh : i l ?kVrk gA fp= 5-21 e l/kkfj= d vko'ku ,o fujko'ku d le; vko'k dk le; d lkFk ifjoru oØ n'kk;k x;k gA



fp= 5-21

çfrck/kk ,o çfrjk/k dh vo/kkj.kk

fdlh çR;korh /kkjk ifjiFk] ftle çfrjk/k R çjd dMyh L rFkk l/kkfj= C l;kftr gk rk bl l;ktu }kjk mRiUu uV çfrjk/k] çfrck/kk dgykrk gA bl Z l fu:fir djr gA

$$Z = R + jX = R + j(X_L - X_c)$$

çfrck/kk ,d lfEeJ Hkkfrd jkf'k gkrk g ftldk okLrfod Hkkx çfrjk/k rFkk dkYifud Hkkx çfr?kkr dgykrk gA çfr?kkr] çjd ,o l/kkfj= d dkj.k mRiUu çfrck/kk d eku dk 0;Dr djr gA çjd dMyh d dkj.k mRiUu çfr?kkr] çj.kh; çfr?kkr dgykrh gA

$$X_L = \omega L$$

rFkk l/kkfj= d dkj.k mRiUu çfr?kkr] /kkfjrh; çfr?kkr dgykrh gA

$$X_C = \frac{1}{\omega C}$$

nlj 'kCnk e çfrck/kk dk og ?kVd ftle /kkjk o okYVrk ,d dyk e ugh gkr g çfr?kkr dgykrk gA

egRoi.k fcUn

1- dMyh ,o pEcd d e/; lki{k xfr gku ij dMyh e /kkjk çokfgr gkrh g vFkkr dMyh d fljk ij fo|r okgd cy mRiUu gkrk g] ftl çfjr fo|r okgd cy dgr gA bl çfjr fo|r okgd cy d dkj.k dMyh e çokfgr /kkjk çfjr /kkjk dgykrh gA dMyh d fljk ij mRiUu çfjr fo|r okgd cy dk eku dMyh d çfrjks/k ij fuHkj ugh djrk gA çfjr fo|r okgd cy mRiUu gku dh ;g ?kVuk fo|r pEcdh; çj.k dgykrh gA

2- QjkM d fo|r pEcdh; çj.k d fu;e d vulkj ifjiFk e çfjr fo|r okgd cy ¼ε½ dk eku ifjiFk l lEc) pEcdh; ¶yDl e ifjoru dh nj $\frac{\Delta\phi}{\Delta t}$ d lekuikrh gkrk gA

3- yt d fu;e d vulkj fo|r pEcdh; çj.k }kjk fdlh cn ifjiFk e çfjr fo|r okgd cy vkj çfjr ekkjk dh fn'kk bl çdkj gkrh g fd og mu dkj.kk dk fojk/k djrh g] ftud dkj.k og mRiUu gkrh gA

4- fdlh dMyh e /kkjk d eku e ifjoru d dkj.k dMyh d fljk ij mRiUu çfjr okgd cy dh ifj?kVuk dk Loçj.k dgr gA

5- ,d dMyh e ifjorh /kkjk çokfgr fd; tku ij mld ikl j[kh vU; dMyh d fljk ij çfjr fo|r okgd cy mRiUu gku dh ?kVuk vU;kU; çj.k dgykrh gA

6- le:i pEcdh; {k= e ?k.ku djrh dMyh l ikfjr pEcdh; ¶yDl ,o dMyh d fljk ij mRiUu fo|r okgd cy le; d lkFk vkorh : i l ifjofrr gkr g rFkk ftl le; dMyh l ikfjr ¶yDl dk eku vfèkdre gkrk g rk dMyh d fljk ij çfjr fo|r okgd cy dk eku U;ure gkrk g rFkk tc ¶yDl dk eku U;ure gkrk g rc fo|r okgd cy dk eku vf/kdre gkrk gA

7- çR;korh okYVrk d eku dk vf/kd ;k de dju d fy, ge VklQkej dk mi;kx djr gA VklQkej vU;kU; çj.k d fl)kr ij dk; djrk g blfy, ;g fn"V ekkjkvk ¼fu;r /kkjk½ d fy, mi;Dr ugh gA

8- VklQkej dh çkFkfed dMyh e çR;korh /kkjkvk d dkj.k ¶lyDl e ifjoru gkrk g rk ØkM e Hkh fo|r okgd cy çfjr gk tkrk g ftld dkj.k ØkM e Hkoj /kkjk, çokfgr gkrh g] ftld dkj.k ØkM e m"ek d :i e 'kfDr dk {k; gkrk gA bl Hkoj /kkjk gkfu dgr gA

9- fo|r 'kfDr dk tfu= LFky l mi;kx LFky rd lpj.k dk 'kfDr dk njLFk lpj.k dgr gA

10- çR;korh /kkjk tfu= fo|r pEcdh; çj.k d fl)kr ij dk; dju okyh ;fDr g tk ;kf=d Åtk dk fo|r Åtk e ifjofrr djrh gA

11- pEcdh; {k= ij /kkjkokgh pkyd ¼dMyh½ ij cy ;Xe d dkj.k mRiUu pkyd ¼dMyh½ dh ?k.ku xfr d fl)kr ij dk; dju okyh og ;fDr tk fo|r Åtk dk ;kf=d Åtk e ifjofrr djrh g] fo|r ekVj dgykrh gA

12- çR;korh /kkjk dk fu;f=r dju d fy, ,lh ;fDr ftle fo|r Åtk dk gkl ux.; gk] pkd dMyh dgr gA pkd dMyh vf/kd Loçjd Ro (L) rFkk vYi çfrjks/k (R) dh dMyh gkrh g tk rkc d ekV fo|rjk/kh rkj d vud Qjk dk iVfyr ykg ØkM ij yiV dj cuk;h tkrh gA

13- 'k) çjd Ro oky çR;korh ifjiFk e okYVrk V /kkjk I l dyk e 90° vkx jgrh g tcfd 'k) l/kkfj= oky ifjiFk e okYVrk V /kkjk I l dyk e 90° ihN jgrh gA

14- vko'ku d le; fdlh {k.k l/kkfj= ij vko'k dk eku

$$Q = Q_0(1-e^{-\frac{t}{RC}})$$ gkrk gA

15- fujko'ku d le; fdlh {k.k l/kkfj= ij vko'k dk eku

$$Q = Q_0 e^{-\frac{t}{RC}}$$ gkrk gA

16- fdlh çR;korh /kkjk ifjiFk] ftle çfrjk/k R çjd dMyh L rFkk l/kkfj= C l;kftr gk rk bl l;ktu }kjk mRiUu uV çfrjk/k] çfrck/kk dgykrk gA çjd dMyh d dkj.k mRiUu çfr?kkr] çj.kh; çfr?kkr dgykrh g rFkk l/kkfj= d dkj.k mRiUu çfr?kkr] /kkfjrh; çfr?kkr dgykrh gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- Hkkjr e çR;korh /kkjk dh vkofr gkrh g&
¼v½ 50 gVt ¼c½ 150 gVt
¼l½ 220 gVt ¼n½ 100 gVt

2- Loçj.k ij ØkM dk D;k çHkko iMrk g&
¼v½ c< tkrk g ¼c½ ?kV tkrk g
¼l½ vifjofrr jgrk g ¼n½ mi;Dr e l dkb ugh

3- pEcdh; ¶lyDl dk eku fdu ?kVdk ij fuHkj djrk g &
¼v½ pEcdh; çj.k
¼c½ dMyh dk {k=Qy
¼l½ pEcdh; çj.k rFkk dMyh d {k=Qy d e/; dk.k
¼n½ mi;Dr lHkh

4- y t dk fu;e fdl Hkkfrd jkf'k d lj{k.k ij vk/kkfjr g\
¼v½ Åtk ¼c½ lox
¼l½ vko'k ¼n½ dk.kh; lox

5- fo|r ekVj dk dk; g&
¼v½ fo|r Åtk dk ;kf=d Åtk e ifjoru
¼c½ fo|r Åtk dk m"eh; Åtk e ifjoru
¼l½ ;kf=d Åtk dk fo|r Åtk e ifjoru
¼n½ m"eh; Åtk dk fo|r Åtk e ifjoru

y?kqÙkjkRed i'u

1- Loçj.k x.kkd dh ifjHkk"kk nhft,A
2- fo|r pEcdh; çj.k d QjkM d fu;e fyf[k,A
3- ,d pØ d fy, çR;korh /kkjk dk vklr eku fdruk gkrk g\
4- VklQkej fn"V ifjiFk e dke D;k ugh djrk g\
5- çR;korh /kkjk dk f'k[kj eku fdruk gkrk g\
6- fo|r pEcdh; çj.k l vki D;k le>r g\
7- çR;korh /kkjk e rkR{kf.kd eku l vki D;k le>r g\
8- 'kfDr d njLFk fopj.k l vkidk D;k vfHkçk; g\
9- VklQkej dh ØkM iVfyr D;k gkrh g\
10- VklQkej dh n{krk l D;k vfHkçk; g\

fucU/kkRed i'u

1- vkjLVM d çk;kfxd ifj.kkek dh foopuk djr g,] QjkM e fu;ek dk çfriknu dhft,A
2- vU;kU; çj.k D;k g\ nk dMfy;k d e/; vU;kU; çj.k x.kkd dk Kkr dhft,A
3- pEcdh; {k= e dMyh d ?k.ku l mRiUu çfjr fo-ok-cy dk le>kr g, fl) dhft, fd çfjr fo-ok-cy dk eku le; ij fuHkj djrk gA

4- çR;korh /kkjk d rkR{kf.kd] vkSlr ,o ox ek/; ey eku l vki D;k le>r g\

5- VkSlQkej dh dk;ç.kkyh ,o bld mi;kx dk le>kb;A

6- fo|r ekVj dh dk;ç.kkyh ,o bld mi;kx dk fyf[k,A

7- VkSlQkej e mRiUu fo|r Åtk gkfu;k dh foopuk dhft ,A

8- pkd dMyh D;k gkrh g\ bldk mi;kx dgk fd;k tkrk g\ 'kfDrfoghu /kkjk l vki D;k le>r g\

9- /kkjk ,o foHko d e/; dyk lc/k dh foopuk dhft ,&

(i) 'k) çjdRo dh fLFkfr e

(ii) 'k) l/kkfj= dh fLFkfr e

10- l/kkfj= d vko'ku ,o fujko'ku ij çdk'k Mkfy ,A

mÙkjekyk % 1 ¼v½ 2 ¼v½ 3 ¼n½ 4 ¼v½ 5 ¼v½

bdkb & IV

v/;k; & 6

ijek.k fl)kr

(Atomic Thoery)

ijek.k fl)kr dk mnHko

lu 1800 l io æ0; (matter) d lnHk e nk'kfudk (philosphars) dk ;g er Fkk fd çR;d inkFk] NkV&NkV d.kk l feydj cuk gA ftudh ey ljpuk dk le>ku d fy, ml le; rd mud ikl dkb çk;kfxd çek.k ugh FkkA loçFke 1803 e MkYVu u ijek.k fl)kr (Atomic theory) d fy, ,d ekMy çLrr fd;kA ftld vulkj &

(i) çR;d inkFk NkV&NkV d.kk l feydj cuk gkrk g] ftl ijek.k (atom) dgr gA

(ii) ijek.k vfoHkkT; gkrk g] vFkkr bldk Hkkfrd vFkok jklk;fud fof/k l foHkktu fd;k tkuk lHko ugh gA

(iii) ,d gh rRo (element) d leLr ijek.k leku gkr g] tcfd fHkUu&fHkUu rRok d ijek.kvk d x.k (property) fHkUu&fHkUu gkr gA

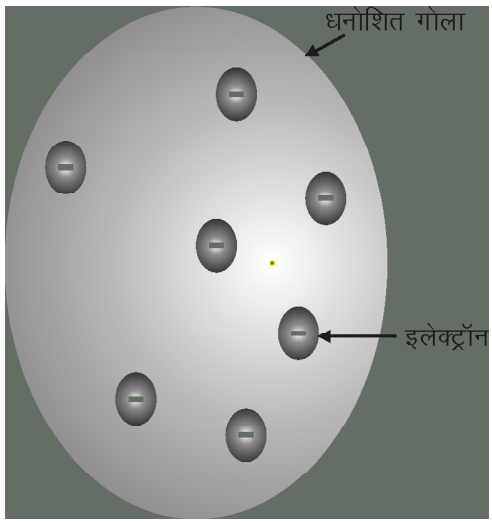
(iv) ijek.k LFkk;h rFkk fo|r mnklhu gkr gA

MkYVu d i'pkr 1815 e çkmV u ijek.k fl)kr d fy, viuk ekMy çLrr fd;k] ftle çkmV u ;g ifjdYiuk dh fd lHkh rRo gkbMktu ijek.k l cu gkr gA çkmV dk ;g ekMy vud ijek.kvk d ijek.k Hkkj (atomic weight) dh if"V dju e foQy jgkA

dkykrj e t- t- Vkelu }kjk byDVku rFkk cdjy }kjk jfM;k&,fDVork dh [kkt l irk pyk fd çR;d rRo e _.k&vkof'kr d.k ¼byDVku½ Hkh gkr gA pfd ijek.k fo|r mnklhu gkrk g] bldk vfHkik; ;g gvk fd ijek.k e _.k vkof'kr d.kk ¼byDVku½ d cjkcj gh /kuko'k ektn gkuk pkfg;] ftll fd ijek.k dk uV ¼dy½ vko'k 'kU; jgA

ijek.k d vnj bu vkof'kr d.kk d forj.k d lc/k e ml le; rd dkb Kku ugh FkkA 1897 e lcl igy Vkelu u ijek.k dk ekMy fn;k ftle vkof'kr d.kk d forj.k d ckj e crk;k x;kA bl ekMy e Vkelu u crk;k fd ijek.k 10^{-10} ehVj f=T;k dk ,d fo|r /kukof'kr Bkl xkyk g] ftle /kuko'k lekxh :i l forfjr jgrk gA ijek.k dk fo|r mnklhu cuk; j[ku d fy; i;kIr l[;k e byDVku bl xky e txg&txg /kl jgr gA fp= 6-1 e Vkelu ekMy dk çfr:i n'kk;k x;k gA bl ekMy }kjk rkik;fud mRl tu] çdk'k fo|r çHkko tlh Hkkfrd ?kVukvk dk vklkuh l le>k;k tk ldk yfdu ijek.kvk d LiDVe] α&d.kk d çdh.ku ç;kx d ifj.kkek dh if"V bl ekMy d }kjk ugh le>k;h tk ldhA

1911 e jnjQkM u viu α&çdh.ku ç;kx }kjk ;g fu"d"k fudkyk fd ijek.k dk vf/kdk'k Hkkx vnj l [kk[kyk gkrk g rFkk ijek.k dk /kuko'k ,d vR;r NkV LFkku e] ijek.k d dUæ ij gh dfUær gkrk g ftl ukfHkd dgr gA ukfHkd dh f=T;k 10^{-15} ehVj dkfV dh gkrh g] tk fd ijek.k



fp= 6-1 % Vkelu ekMy dk çfr:i

fp= 6-2 % jnjQkM dk ijek.k ekMy

d vkdkj ¼10&10 eh Vj½ d nl gtkjo Hkkx d cjkcj gkrh gA ijek.k dk fo|r mnklhu cuk; j[ku d fy, mifLFkr /kuko'k ¼çkVku½ dh l[;k d cjkcj byDVku] ukfHkd d pkjk vkj cn d{kkvk e ifjØek djr jgr gA jnjQkM d bl ekMy }kjk fofHkUu Hkkfrdh; ?kVukvk d çk;kfxd ifj.kkek dh if"V dh x;h yfdu bl ekMy }kjk ijek.kvk d LFkkf;Ro dk le>k;k ugh tk ldk vkj u gh ijek.kvk d jf[ky LiDVe dh 0;k[;k dh tk ldhA jnjQkM d ijek.k ekMy dk fp= 6-2 e n'kk;k x;k gA

ckj dk ijek.k fl)kr

lu 1913 e çk- uhy ckj u jnjQkM d ijek.k ekMy e mifLFkr nk"kk dk v/;;u dj] jnjQkM ekMy dh dfe;k dk nj fd;kA bld fy; ckj u Dok.Ve Hkkfrdh d eDl lykd d fl)kr dk jnjQkM EkkMy e ç;Dr dj fuEu rhu ifjdYiuk, (postulates) nh &

1- byDVku ukfHkd d pkjk vkj doy mUgh LFkk;h ,o oÙkkdkj d{kkvk e ifjØek djrk g ft le mldk dk.kh; lox $\frac{h}{2\pi}$ dk i.k x.kt gkA bl ckj dk DokVe çfrc/k Hkh dgr gA vFkkr

$$mvr = \frac{nh}{2\pi}$$

tgk m- byDVku dk æ0;eku] v- byDVku dk ox] r- ifjØe.k d{kk dh f=T;k] n- 1, 2, 3, .../ku i.kkd gA

2- byDVku dk ukfHkd d pkjk vkj oÙkkdkj d{kk e ifjØek dju d fy, vko';d vfHkdUæh; cy] ukfHkd o byDVku d e/; yxu oky vkd"k.k cy l çkIr gkrk gA

fp= 6-3

$$\frac{mv^2}{r} = \frac{KZe^2}{r^2}$$

tgk $K = \frac{1}{4\pi \in_0}$, Z- ijek.k Øekd rFkk e- byDVku vko'k gA

3- LFkk;h d{kkvk e ifjØek djr le; byDVku dh Åtk dk {k; ugh gkrk gA byDVku Åtk dk vo'kk"k.k ;k mRltu rc gh djrk g tc og ,d d{kk l nljh d{kk e lØe.k djA

tc byDVku fuEu d{kk l mPp d{kk e lØe.k djrk g rk byDVku }kjk QkVku d :i e Åtk vo'kkf"kr gkrh g rFkk mPp d{kk l fuEu d{kk e lØe.k d le; byDVku }kjk QkVku d :i e Åtk mRlftr gkrh gA bl fp= 6-3 e n'kk;k x;k gA

ckj d ijek.k fl)kr l gkbMkt u ijek.k dh f=T;k ,o byDVku dh Åtk

gkbMkt u ijek.k dk ijek.k Øekd Z = 1 gkrk gA vr% ckj d ijek.k fl)kr dh çFke ,o f}rh; ifjdYiuk l&

$$mvr = \frac{nh}{2\pi} \qquad ...(1)$$

rFkk $\frac{mv^2}{r} = \frac{Ke^2}{r^2}$ ...(2)

¿pfd gkbMkrq ijek.k d fy, Z=1À

;k $mv^2r = Ke^2$

;k $$v^2 = \frac{Ke^2}{mr} \quad ...(3)$$

lehdj.k ¼1½ dk ox dju ij

$$m^2v^2r^2 = \frac{n^2h^2}{4\pi^2}$$

;k $$v^2 = \frac{n^2h^2}{4\pi^2m^2r^2} \quad ...(4)$$

lehdj.k ¼3½ o ¼4½ dh ryuk dju ij

$$\frac{Ke^2}{mr} = \frac{n^2h^2}{4\pi^2m^2r^2}$$

;k $$r = \frac{n^2h^2}{4\pi^2mKe^2} \quad ...(5)$$

lehdj.k ¼5½ gkbMkrq ijek.k dh d{kk dh f=T;k d eku dk 0;Dr djrh gA iuk lehdj.k ¼5½ l

$r \propto n^2$

¼tgk n, gkbMkrq ijek.k dh d{k l[;k dk 0;Dr djrk gA½

;k $r_1 : r_2 : r_3 :: 1 : 4 : 9$

lehdj.k ¼5½ e iFke d{kk fd f=T;k Kkr dju d fy;

$n = 1,\ m = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$C,

j[k gy dju ij

$r_1 = 5.3 \times 10^{-11}$ m

iuk lehdj.k ¼2½ e lehdj.k ¼1½ dk Hkkx nu ij &

$$v = \frac{2\pi Ke^2}{nh} \quad ...(6)$$

$$= \frac{2.2 \times 10^6}{n} m/sec.$$

;k $v \propto \frac{1}{n}$

rFkk $v_1 = 2.2 \times 10^{-6}$ m/sec.

;k $\frac{v_1}{c} = \frac{2.2 \times 10^6}{3 \times 10^8} = \frac{1}{137}$

lehdj.k ¼6½ LFkk;h d{kk e byDVku d ox dk 0;Dr djrh gA

LFkk;h d{kk e byDVku dh Åtk dh x.kuk fuEu idkj dh tkrh g &

fdlh Hkh LFkk;h d{kk e byDVku dh dy Åtk E, mldh xfrt Åtk K.E. ,o fLFkfrt Åtk U d rY; gkrh gA

∵ byDVku dh xfrt Åtk K.E. = ½ mv^2

;k $$K.E. = \frac{Ke^2}{r} \quad ...(7)$$

¼f}rh; ifjdYiuk $\frac{mv^2}{r} = \frac{KZe^2}{r^2}$ l½

rFkk ukfHkd l r njh ij byDVku dh fLFkfrt Åtk

$$U = \frac{-Ke^2}{r} \quad ...(8)$$

¼_.kkRed fpUg] byDVku o ukfHkd d e/; vkd"k.k dk 0;Dr djrk gA½

vr% byDVku dh dy Åtk

$E = K.E. + U$

$$= \frac{1}{2}\frac{Ke^2}{r} - \frac{Ke^2}{r}$$

$$E = \frac{1}{2}\frac{Ke^2}{r}$$

lehdj.k ¼5½ l r dk eku j[ku ij

$$E_n = \frac{-me^4}{8\epsilon_0^2 h^2 n^2} \quad ...(9)$$

;k $E_n = \frac{-13.6}{n^2}$

tgk E_n, no d{k e gkbMkrq ijek.k d fy, byDVku dh dy Åtk d eku dk 0;Dr djrk gA byDVku dh dy Åtk dk _.kkRed eku] byDVku o ukfHkd d e/; vkd"k.k cy dk n'kkrk gA

lehdj.k ¼9½ l n_1 o n_2 Åtk Lrjk dh Åtkvk dk eku Øe'k% E_{n_1} o E_{n_2} gk rk &

$$En_1 = \frac{-me^4}{8\epsilon_0^2 h^2 n_1^2} \quad ,o \quad En_2 = \frac{-me^4}{8\epsilon_0^2 h^2 n_2^2}$$

pfd byDVku d fy, $\frac{me^4}{8\epsilon_0^2 h^2}$ dk eku 13-6 gkrk g ft l fjMcx (R_H) dgr gA vr% n_2 o Lrj ¼mPp Lrj½ l n_1 o Lrj ¼fuEu Lrj½ e byDVku d lØe.k l mRlftr Åtk dk eku&

$$En_2 - En_1 = -R_H\left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right]$$

;k $En_2 - En_1 = \bullet R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ ...(10)

yfdu eDl lykd d dok.Ve fl)kr d vulkj] mRlftr Åtk] QkVku d :i e gkrh g] vFkkr

$$En_2 - En_1 = h\nu \qquad ...(11)$$

tgk ν mRlftr QkVku dh vkofr gA vr% lehdj.k ¼10½ o ¼11½ l &

$$h\nu = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

;k $\nu = \frac{R_H}{h}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ ...(12)

;fn ν vkofr d lxr QkVku dh rjx n/; dk eku λ gk rk

$$\nu = \frac{c}{\lambda} = \frac{R_H}{h}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

;k $\frac{1}{\lambda} = \frac{R_H}{hc}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ ...(13)

$\frac{1}{\lambda}$ dk rjx l[;k dgr gA $\frac{R_H}{hc}$ dk eku 1.097×10^7 çfr ehVj gkrk gA bl R l 0;Dr djr g] ;g fjMcx fu;rkd gA

vr% lehdj.k ¼13½ l

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \qquad ...(14)$$

gkbMkt u ijek.k dk o.kØe ,o Dok.Ve l[;k,

ckj d ijek.k fl)kr dh lcl cMh lQyrk gkbMkt u d jf[ky o.kØe ¼LiDVe½ dk Li"Vhdj.k FkkA gkbMkt u d LiDVe dk loçFke ckej u fo'y"k.k fd;k FkkA bl LiDVe e çkIr j[kkvk dk Øe'k% $H_\alpha, H_\beta, H_\gamma$ dgr gA ; ckej J.kh dh j[kk, dgykrh gA ckej J.kh dh db LiDVeh j[kk,] LiDVe d n'; Hkkx e gkrh gA gkbMkt u d LiDVe e ckej J.kh d vfrfjDr vU; Jf.k;k Hkh ik;h tkrh g tk fd LiDVe d vn'; Hkkx e ik;h tkrh gA ftue ykbeu J.kh] LiDVe d ijkcxuh Hkkx e rFkk ik'pu] cdV o Q.M J.kh] LiDVe d vojDr Hkkx e ik;h tkrh gA bu lHkh Jf.k;k dh rjx n/; lehdj.k ¼14½ d }kjk nh tkrh gA

(i) ykbeu J.kh% ykbeu J.kh d fy, $n_1 = 1$

$n_2 = 2,3,4, ...$

$$\frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n_2^2}\right]$$

(ii) ckej J.kh% ckej J.kh d fy, $n_1 = 2$

$n_2 = 3,4,5, ...$

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n_2^2}\right]$$

(iii) ik'pu J.kh% ik'pu J.kh d fy, $n_1 = 3$

$n_2 = 4,5,6, ...$

$$\frac{1}{\lambda} = R\left[\frac{1}{3^2} - \frac{1}{n_2^2}\right]$$

(iv) cdV J.kh% cdV J.kh d fy, $n_1 = 4$

$n_2 = 5,6,7, ...$

$$\frac{1}{\lambda} = R\left[\frac{1}{4^2} - \frac{1}{n_2^2}\right]$$

(v) Q.M J.kh% Q.M J.kh d fy, $n_1 = 5$

$n_2 = 6,7,8, ...$

$$\frac{1}{\lambda} = R\left[\frac{1}{5^2} - \frac{1}{n_2^2}\right]$$

gkbMktu ijek.k d fofHkUu Åtk Lrjk l lcf/kr Jf.k;k dk fp= 6-4 e n'kk;k x;k gA

fp= 6-4 % gkbMktu dk o.kZe

LiDVeh Jf.k;k dk Øe c<u ij rjx n/; dk eku c<rk g vFkkr

$$\lambda_{Q.M} > \lambda_{cdV} > \lambda_{ik'pu} > \lambda_{ckej} > \lambda_{ykbeu}$$

Dok.Ve l[;k, % fdlh ijek.k e byDVku dh fLFkfr ¼d{kd½ Åtk] dk.kh; lox] pØ.k o pEcdh; {k= dh mifLFkfr e byDVku d vfHkfoU;kl dk i.kr;k 0;Dr dju d fy, vko';d Hkkfrd l[;kvk dk Dok.Ve l[;k, dgr gA

Dok.Ve l[;k, fuEu pkj gkrh g &

(i) **e[; Dok.Ve l[;k** % bl n l 0;Dr djr g rFkk bldk eku 1 l ∞ rd dN Hkh i.kkd gk ldrk gA ;g byDVku l ukfHkd d e/; dh njh] d{kd d vkdkj o byDVku d Åtk Lrj dk çnf'kr djrh gA

(ii) **d{kh; dk.kh; lox Dok.Ve l[;k** % bl ℓ l 0;Dr djr g rFkk bldk eku 0 l (n-1) rd gkrk g] vFkkr bld dy ekuk dh l[;k n d eku d cjkcj gkrh gA ;g Dok.Ve l[;k byDVku d d{kh; dk.kh; lox d lkFk&lkFk mid{kdk dk Hkh 0;Dr djrh gA

(iii) **pEcdh; Dok.Ve l[;k** % bl m l 0;Dr djr g] rFkk bld eku $-\ell$ l $+\ell$ rd gk ldr gA bld vfèkdre ekuk dh dy l[;k $(2\ell+1)$ gkrh gA ;g Dok.Ve l[;k pEcdh; {k= dh mifLFkfr e byDVku dh d{kkvk d vfHkfoU;kl dk 0;Dr djrh gA

d{kh; dk.kh; lox Dok.Ve l[;k	mid{kd
$\ell = 0$	s (Sharp)
$\ell = 1$	p (Principal)
$\ell = 2$	d (Diffuse)
$\ell = 3$	f (Fundamental)

(iv) **pØ.k Dok.Ve l[;k** % bl s l 0;Dr djr g rFkk bld doy nk gh eku lHko gA ;g byDVku d viu v{k ij pØ.k fd fn'kk dk 0;Dr djrh gA bld eku +½ ;k –½ gkr gA

Dok.Ve l[;k d vk/kkj ij mid{kdk dk oxhdj.k lkj.kh ¼6-1½ e n'kk;k x;k gA

lkj.kh 6-1 % mid{kdk dk oxhdj.k

n	ℓ	mid{kd				
		0	1	2	3	4
K	1	1s				
L	2	2s	2p			
M	3	3s	3p	3d		
N	4	4s	4p	4d	4f	
O	5	5s	5p	5d	5f	5g

ikyh viotu fl)kr

ikyh d viotu fl)kr d vuqkj fdlh ijek.k e mifLFkr fdUgh nk byDVkuk d fy, pkjk dok.Ve l[;kvk dk eku leku ugh gk ldrk gA

bl fl)kr d vk/kkj ij nk byDVkuk dh vf/kdre rhu Dok.Ve l[;k, gh leku gk ldrh g vFkkr ,d d{kd e mifLFkr byDVkuk dh vf/kdre l[;k doy nk gh gk ldrh gA gkbMktu e ,d byDVku gku d dkj.k ;g fl)kr bl ij ykx ugh gkrk gA bl fl)kr dh lgk;rk l ijek.kvk d byDVkfud foU;kl dh 0;k[;k dh tkrh gA

ijek.kvk d byDVkfud foU;kl

ijek.kvk dh fofHkUu d{kkvk e byDVkuk d forj.k ¼byDVkfud foU;kl½ d fu;e fuEu g &

(i) **(n+ ℓ) fu;e** % bl fu;e d vuqkj byDVku loçFke ml d{kd ;k mid{kd e ço'k djxk ftld fy, (n+ ℓ) dk eku U;ure gkA ;fn fdUgh nk mid{kdk d

fy, (n+ℓ) dk eku leku gk ¼tl 3d ,o 4p½ rk bl fLFkfr e byDVku ml mid{kd e ço'k djxk ft ld fy, n dk eku U;ure gk ¼tl 3d ,o 4p e l igy byDVku 3d e ço'k djxkA½

(ii) **g.M dk fu;e** % bl fu;e d vulkj leku d{kk d d{kd rc rd ;fXer ugh gkr g] tc rd fd çR;d d{kd e ,d&,d byDVku u pyk tk,A leLr v;fXer byDVkuk dk pØ.k leku gkrk gA v/kifjr rFkk i.kifjr d{kd viu fudVorh d{kdk dh ryuk e vf/kd LFkk;h gkr gA

(iii) **vkQck fl)kr** % bl fl)kr d vulkj byDVku d{kdk e c<rh gb Åtk d Øe e ço'k djr g (s<p<d<f) vFkkr byDVku igy lcl de Åtk oky d{kd e tkrk gA

byDVku d fofHkUu d{kdk e tku d Øe dk fuEu fp= 6-5 d }kjk le>k;k tk ldrk g &

fp= 6-5

bl vk/kkj ij ijek.k e byDVkfud foU;kl dk Øe fuEu çdkj gkxk&1s, 2s 2p, 3s, 3p, 4s, 3d, 4p, 5s, ...

dN ijek.kvk d byDVkfud foU;klk dk lkj.kh 6-2 e çnf'kr fd;k x;k gA

egRoi.k fcUn

1- MkYVu d ijek.k fl)kr d vulkj iR;d inkFk NkV&NkV d.kk l feydj cuk gkrk g] ftl ijek.k dgr gA ijek.k vfoHkkT;]LFkk;h rFkk fo|r mnklhu gkr gA

2- Vkelu d ijek.k ekMy d vulkj ftle ijek.k ,d fo|r /kukof'kr Bkl xkyk g] ftle /kuko'k lekxh :i l forfjr jgrk gA byDVku bl xky e txg&txg /kl jgr gA

3- jnjQkM d ijek.k ekMy d vulkj ijek.k dk vfèkdk'k Hkkx vnj l [kk[kyk gkrk g rFkk ijek.k dk /kuko'k ,d vR;r NkV LFkku e] ijek.k d dUæ ij gh dfUær gkrk g rFkk byDVku] ukfHkd d pkjk vkj cn d{kkvk e ifjØek djr jgr gA

4- ckj dh ifjdYiuk, &

i. byDVku ukfHkd d pkjk vkj doy mUgh LFkk;h ,o oÙkkdkj d{kkvk e ifjØek djrk g ftle ml dk dk.kh; lox dk i.k x.kt gkA

ii. byDVku dk ukfHkd d pkjk vkj oÙkkdkj d{kk e ifjØek dju d fy, vko';d vfHkdUæh; cy] ukfHkd o byDVku d e/; yxu oky vkd"k.k cy l çkIr gkrk gA

iii. LFkk;h d{kkvk e ifjØek djr le; byDVku dh Åtk dk {k; ugh gkrk gA byDVku Åtk dk vo'kk"k.k ;k mRl tu rc gh djrk g tc og ,d d{kk l nljh d{kk e lØe.k djA

5- gkbMkt tu d LiDVe e ckej J.kh dh LiDVeh j[kk,] LiDVe d n'; Hkkx e gkrh g tcfd ykbeu J.kh] LiDVe d ijkcxuh Hkkx e rFkk ik'pu] cdV o Q.M J.kh] LiDVe d vojDr Hkkx e ik;h tkrh gA

6- ijek.k e byDVku dh fLFkfr] Åtk] dk.kh; lox] pØ.k o pEcdh; {k= dh mifLFkfr e byDVku d vfHkfoU;kl dk i.kr;k 0;Dr dju d fy, vko';d Hkkfrd l[;kvk dk Dok.Ve l[;k, dgr gA

Dok.Ve l[;k, pkj gkrh g &

i. e[; Dok.Ve l[;k

ii. d{kh; dk.kh; lox Dok.Ve l[;k

iii. pEcdh; Dok.Ve l[;k

iv. pØ.k Dok.Ve l[;k

7- ikyh d viotu fl)kr d vulkj fdlh ijek.k e mifLFkr fdUgh nk byDVkuk d fy, pkjk Dok.Ve l[;kvk dk eku leku ugh gk ldrk gA

8- (n+*l*) d fu;e d vulkj byDVku loçFke ml d{kd ;k mid{kd e ço'k djxk ft ld fy, (n+*l*) dk eku U;ure gkA

9- g.M d fu;e d vulkj leku d{kk d d{kd rc rd ;fXer ugh gkr g] tc rd fd çR;d d{kd e ,d&,d byDVku u pyk tk,A

lkj.kh 6-2 % fofHkUu ijek.kvk d byDVkfud vfHkfoU;kl

परमाणु	इलेक्ट्रोनिक अभिविन्यास	
1 H	$1s^1$	$1s^{\uparrow}$
2 He	$1s^2$	$1s^{\uparrow\downarrow}$
3 Li	$1s^2 2s^1$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow}\ 2p$
4 Be	$1s^2 2s^2$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p$
5 B	$1s^2 2s^2 2p^1$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow}$
6 C	$1s^2 2s^2 2p^2$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow}\ 2p^{\uparrow}$
7 N	$1s^2 2s^2 2p^3$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow}\ 2p^{\uparrow}\ 2p^{\uparrow}$
8 O	$1s^2 2s^2 2p^4$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow}\ 2p^{\uparrow}$
9 F	$1s^2 2s^2 2p^5$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow}$
10 Ne	$1s^2 2s^2 2p^6$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}$
11 Na	$1s^2 2s^2 2p^6 3s^1$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow}\ 3p$
12 Mg	$1s^2 2s^2 2p^6 3s^2$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p$
13 Al	$1s^2 2s^2 2p^6 3s^2 3p^1$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow}$
14 Si	$1s^2 2s^2 2p^6 3s^2 3p^2$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow}\ 3p^{\uparrow}$
15 P	$1s^2 2s^2 2p^6 3s^2 3p^3$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow}\ 3p^{\uparrow}\ 3p^{\uparrow}$
16 S	$1s^2 2s^2 2p^6 3s^2 3p^4$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow}\ 3p^{\uparrow}$
17 Cl	$1s^2 2s^2 2p^6 3s^2 3p^5$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow}$
18 Ar	$1s^2 2s^2 2p^6 3s^2 3p^6$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}$
19 K	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3d\ 4s^{\uparrow}\ 4p$
20 Ca	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$	$1s^{\uparrow\downarrow}\ 2s^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 2p^{\uparrow\downarrow}\ 3s^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3p^{\uparrow\downarrow}\ 3d\ 4s^{\uparrow\downarrow}\ 4p$

10- vkQck fl)kr d vulkj byDVku igy lcl de Åtk oky d{kd e tkrk gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- ijek.k dk uV fo|r vko'k dk eku gkrk gA

¼v½ 'kU; ¼c½ /kukRed

¼l½ _.kRed ¼n½ vur

2- ijek.k d vkdkj dh dkfV gkrh g &

¼v½ 10^{-15} ehVj ¼c½ 10^{15} ehVj

¼l½ 10^{-10} ehVj ¼n½ 10^{10} ehVj

3- ijek.k d ukfHkd o byDVku d e/; cy dh çÑfr gkrh g &

¼v½ çfrd"k.k

¼c½ vkd"k.k

¼l½ çfrd"k.k ,o vkd"k.k nkuk rjg dh

¼n½ mnklhu

4- e[; Dok.Ve l[;k çnf'kr djrh g &
¼v½ byDVku d pØ.k dh fn'kk
¼c½ byDVku d Åtk Lrj
¼l½ byDVku d vkdkj
¼n½ byDVku d dk.kh; lox

5- ijek.k d fdUgh nk byDVkuk d fy, vf/kdre Dok.Ve l[;kvk dk eku tk leku gk ldr g&
¼v½ 1 ¼c½ 2
¼l½ 3 ¼n½ 4

y?kÙkjkRed ç'u

1- MkYVu d ijek.k fl)kr d ekMy d vk/kkj ij ijek.k d nk x.k fyf[k;A

2- gkbMktu ijek.k d o.kØe dh e[;&e[; Jf.k;k fyf[k,A

3- ikyh dk viotu fl)kr dk dFku dhft,A

4- g.M dk fu;e fyf[k;A

5- fuEu d{kdk dk fuEu Åtk Lrj l mPp Åtk Lrj d c<r Øe e 0;ofLFkr dhft,A
1s, 2s, 3s, 2p, 3d, 3p

fucU/kkRed ç'u

1- ckj d ijek.k fl)kr dk le>kr g, gkbMktu ijek.k dh lHkh d{kk dh f=T;k ,o Åtk dk ifjdyu dhft;A

2- gkbMktu ijek.k d o.kØe dk le>kb;A

3- Dok.Ve l[;k, D;k gkrh g\ le>kb;A

4- ijek.kvk dh fofHkUu d{kkvk e byDVkuk d forj.k d fu;ek dk mnkgj.k lfgr Li"V dhft;A

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mÙkjekyk % 1 ¼v½ 2 ¼l½ 3 ¼c½ 4 ¼c½ ¼5½ l

v/;k; & 7
/kukRed fdj.k
(Positive Rays)

/kukRed fdj.k

lu 1886 e xkYMLVhu u viu fol tu ufydk ç;kx e fNæ ;Dr dFkkM i;Dr dju ij ;g ik;k fd dFkkM d ihN fol tu ufydk d dkp ij çfrnhlrh mRié gkrh gA tk fd dFkkM fdj.kk }kjk mRié çfrnhlrh l fHké gA bu fdj.kk dk /kukRed ;k /ku fdj.k dgr gA

fol tu ufydk e ,ukM rFkk dFkkM d e/; xl d ijek.k dFkkM fdj.kk l Vdjku ij vk;fur gk tkr gA ftld QyLo:i ufydk e /kuk;u o byDVku ;Xe dk fuek.k gkrk gA ijek.kvk l fudy ; byDVku] dFkkM fdj.kk d lkFk ,ukM dh vkj xeu djr g tcfd /kuk;u] fNfær dFkkM d fNæk l ikj fudy dj nljh vkj py tkr gA ; vk;uk dk i t gh /kukRed fdj.k dgykrh gA fp= 7-1e bl çnf'kr fd;k x;k gA

/kukRed fdj.kk d fuEufyf[kr x.k gkr g &

1- /kukRed fdj.k xl d /ku vk;uk l cuh gkrh gA
2- ; fdj.k fo|r ,o pEcdh; {k=k l fo{kfir ¼çHkkfor½ gkrh g rFkk fo{kfir gku dh fn'kk dFkkM fdj.kk l foijhr rFkk ryukRed de fo{kfir gkrh gA

fp= 7-1

3- budk ox dFkkM fdj.kk dh vi{kk cgr de gkrk gA
4- ; fdj.k lh/kh j[kk e xeu djrh gA
5- ; çfrnhflr ,o LQjnhflr mRiUu djrh gA
6- ; QkVkxkfQd lyV dk çHkkfor djrh gA
7- bu fdj.kk d fy, e/m dk eku byDVku dh ryuk e cgr de çkIr gkrk gA fHkUu&fHkUUk xl k e cgr de çkIr /ku fdj.kk d e/m dk eku Hkh fHkUUk&fHkUUk çkIr gkrk gA
8- /kukRed fdj.kk dh çÑfr fo|r&pEcdh; rjx çÑfr ugh gkrh gA
9- /kukRed fdj.k iryh ,Y;ehfu;e ifÙk;k dk Hkn dj Ckkgj fudy tkrh gA

leLFkkfud

Vkel u u /kukRed fdj.kk d v/;;u l irk yxk;k fd çÑfr e dN ,l rRo Hkh ik; tkr g ftud ijek.kvk d æ0;eku fHkUUk&fHkUUk gkr g yfdu jkl k;fud x.k] byDVkuk dh l[;k o ljpuk leku gkrh gA ,l rRok d ijek.k leLFkkfud dgykr gA nlj 'kCnk e leLFkkfud ,d gh rRo d o fHkUUk&fHkUUk ijek.k gkr g ftud fy, ijek.k Øekd (Z) leku o ijek.k Hkkj (A) fHkUUk&fHkUUk gkrk gA

Vkel u u fu;ku xl ¼ijek.k Hkkj 20-2½ d fy, æ0;eku LiDVkxkQ }kjk nk vyx&vyx ijoy; QkVkxkQh lyV ij çkIr fd;A ftl l ;g fu"d"k fudkyk x;k fd fu;ku e nk çdkj d ijek.k g ftudk ijek.k Hkkj Øe'k% 20 vkj 22 gA bl ç;kx e ijoy;k dh rhork dk ekiu dj ;g Hkh Kkr fd;k fd ijek.k Hkkj 20 oky ijek.k 90% rFkk ijek.k Hkkj 22 oky ijek.k 10% gA bu fofHkUUk ijek.k Hkkj oky ijek.kvk dk jkl k;fud fof/k }kjk vyx fd;k tkuk lHko ugh g

D;kfd bud jklk;fud x.k leku gkr gA dkykrj e ifj'k) æ0;eku LiDVkxkQ d }kjk ;g Hkh irk yxk;k tk pdk g fd fu;ku e ,d rhljk leLFkkfud ¼ijek.k Hkkj 21½ Hkh gkrk gA

blh çdkj Dykjhu d nk leLFkkfud ¼ijek.k Hkkj 35 ,o 37½ çÑfr e 3¼1 d vuikr e ik; tkr gA çR;d leLFkkfudk dk ijek.k Hkkj ,d i.kkd l[;k gkrh gA yfdu çÑfr e fdlh Hkh rRo d leLFkkfud ,d fo'k"k vuikr e gkr g vr¼ ,l rRok d ijek.k Hkkj çk;¼ fHkUUkk e çkIr gkr gA tl Dykjhu dk ijek.k Hkkj

$$\frac{(3\times 35)+(1\times 37)}{(3+1)}=35.5$$

bl idkj leLFkkfudk dh [kkt }kjk fHkUUkkRed ijek.k Hkkj dh folxfr nj gk xbA

lkj.kh ¼7-1½ e dN çe[k rRok d leLFkkfudk dk n'kk;k x;k gA

lkj.kh 7-1 ¼ çe[k rRok d leLFkkfud

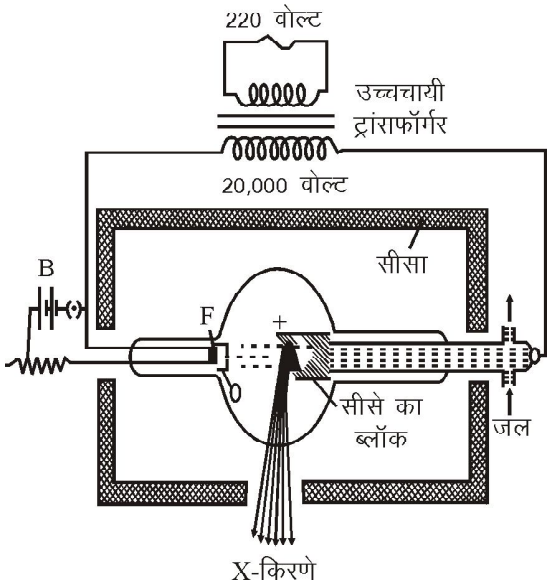
leLFkkfud		ijek.k Øekd (Z)	æ0;eku l[;k (A)	çkVku (P)	U;Vku (n)
gkbMkt tu	$_1H^1$	1	1	1	0
	$_1H^2$	1	2	1	1
	$_1H^3$	1	3	1	2
yhfFk;e	$_3Li^6$	3	6	3	3
	$_3Li^6$	3	7	3	4
vkDlhtu	$_8Oi^{16}$	8	16	8	8
	$_8Oi^{17}$	8	17	8	9
	$_8Oi^{18}$	8	18	8	10
Dykjhu	$_{17}Cl^{35}$	17	35	17	18
	$_{17}Cl^{37}$	17	37	17	20
;jfu;e	$_{92}U^{235}$	92	235	92	143
	$_{92}Ul^{238}$	92	238	92	146

X-fdj.kk dh mRifÙk

lu 1895 e teu oKkfud jktu u X-fdj.kk dh [kkt dhA mUgku viu ç;kx e çf{kr fd;k fd mPp ox l Pkyu okyh dFkkM fdj.k tc mPPk ijek.k Hkkj oky /kkr l Vdjkrh g rk vn';] vYi rjx n/; (λ=1A°) o mPp Åtk (E=10^3eV) dh fo|r pEcdh; rjx mRiUUk gkrh gA ftUg X-fdj.k dgr gA jktu d uke ij bUg jktu fdj.k Hkh dgr gA jktu dh bl [kkt ij 1901 e Hkkfrdh dk ukcy ijLdkj fn;k x;kA

X-fdj.kk dk mRiknu

X-fdj.kk d mRiknu d fy, dfyt ufydk mi;kx e ykb tkrh gA ;g ,d dBkj dkp dh xkykdkj cYcuek ufydk gkrh g ftle yxHkx 10^6 mm Hg nkc j[kk tkrk gA bl ufydk e nk ufy;k yxh gkrh gA ,d uyh e VxLVu dk fQykeV F yxk gkrk g bl fQykeV dk cVjh l tkMdj] ble /kkjk çokfgr djr gA /kkjk çokg l fQykeV xe gku yxrk g rFkk rkik;fud çHkko d dkj.k fQykeV l byDVku mRlftr gku yxr gA mRlftr byDVkuk dh l[;k] fQykeV d rki ij fuHkj djrh gA fQykeV d pkjk vkj ekfyCMue dk ,d cyu C gkrk g] ftl fQykeV d lki{k _.kkRed foHko ij j[kk tkrk gA cyu C d dkj.k] fQykeV l mRlftr byDVku ,d fdj.k it d :i e ifjofrr gk tkr gA bl fdj.k it dk y{; ij vkifrr djoku l igy mPp çR;korh okYVrk ¼20000 okYV½ l Rofjr djkr gA ftl l dh fdj.k it mPPk ox l y{; ij Vdjkrk g vkj X-fdj.kk dk mRiknu gkrk gA y{; d :i e fQykeV d Bhd lkeu rkc dk ,d Cykd gkrk g ftle mPPk ijek.k Hkkj okyh /kkr ¼VxLVu vFkok ekfyCMue½ dk VdMk yxk gkrk g bl VdM ij gh fdj.k it vkifrr gkdj X-fdj.kk dk mRiUUk djrk g] bl çfr&dFkkM Hkh dgr gA çfr dFkkM dk xe gku l cpku d fy, ble BM ty dh /kkjk çokfgr dh tkrh gA



fp= 7-2

dfyt ufydk l çkIr X-fdj.kk dh rhork fQykeV e çokfgr /kkjk d eku e of) dj c<k;h tkrh gA tcfd X-fdj.kk dh Hknu {kerk ufydk d fljk ij vkjkfir foHkokrj dk c<kdj] c<k;h tkrh gA

X-fdj.k nk çdkj dh gkrh g &

1- **dBkj X- fdj.k** % bu X-fdj.kk dh rjx n/; de (10Å l 0.1Å)] rFkk Hknu {kerk vf/kd gkrh gA

2- **en X-fdj.k** % bu fdj.kk dh rjx n/; vf/kd (10Å l 100Å) rFkk Hknu {kerk de gkrh gA

X-fdj.kk d x.k ,o mi;kx

X-fdj.kk d ie[k x.k fuEufyf[kr g&

1- X- fdj.k] çdk'k rjxk dh rjg fo|r pEcdh; çÑfr dh gkrh gA

2- fuokr e X-fdj.kk dk ox] çdk'k rjxk d leku 3×10^8 m/sec gkrk gA

3- budh rjx nè; ¼1Å dkfV½] çdk'k rjxk dh rjx nè; dh ryuk e cgr de gkrh gA

4- fo'k"k ifjfLFkfr;k e X-fdj.k] 0;frdj.k] fooru] èko.k çnf'kr djrh gA

5- X-fdj.k fo/kr ,o pEcdh; {k=k l çHkkfor ugh gkrh gA

6- X-fdj.k vukof'kr gkrh g] yfdu ftl xl ¼ek/;e½ e l xtjrh g mudk vk;fudj.k dj nrh gA

7- X-fdj.k QkVkxkQh lyV dk çHkkfor djrh gA

8- /kkr dh iryh pknj] ekl&mÙkdk dk ; ikj dj tkrh gA

9- /kkr dh ekVh pknj] gfì;k dk ikj dju e vleFk jgrh gA

10- lhlk (Pb), X-fdj.kk d fy, vPNk vo'kk"kd gA

X-fdj.kk d mi;kx fuEu g &

1- **'kY; fpfdRlk e** % 'kY; fpfdRlk d {k= e X-fdj.kk dk cgr mi;kx fd;k tkrk gA X-fdj.k ekl&mÙkdk dk ikj dj tkrh g yfdu vf/kd ?kuRo okyh oLrvk ¼gfì;k] ykgk] /kkr½ bR;kfn dk ikj ugh dj ikrh gA X-fdj.kk d bl x.k dk mi;kx e yr g, X-fdj.kk }kjk 'kjhj d Hkhrj VVh gb gìh] /kl h gb xkyh] iFkjh bR;kfn dk irk yxk;k tkrk gA QQMk dk X-ray jfM;kxkQ }kjk {k; jkx dh igpku dh tkrh gA

2- **fofdj.k fpfdRlk e** % X-fdj.kk }kjk fofdj.k fpfdRlk d {k= e jkx funku fd;k tkrk gA tc fdlh jkxh d iV d vnj dh tkudkjh X-fdj.k }kjk yuh gkrh g rk jkxh dk $BaSO_4$ dk ?kky fiyk dj] ml dk X-ray fy;k tkrk gA bl fLFkfr e X-fdj.k $BaSO_4$ d Hkkjh ijek.k cfj;e l foofrr gk tkrh gA iV d ftl&ftl Hkkx e ;g inkFk igprk g] mu Hkkxk dk QkVkxkQ lyV ij vk tkrk gA ftu Hkkxk e ;g inkFk ugh igp ikrk g] mu Hkkxk dk QkVkxkQ lyV ij ugh vkrk gA bl QkVkxkQ dk v/;;u dj MkDVj iV e vk;h :dkoV dh igpku djrk gA

3- **ç;kx'kkyk e** % ç;kx'kkyk e fofHkUUk vUo"k.k dk;k e X-fdj.kk dk mi;kx fd;k tkrk gA bud }kjk fØLVyk dh T;kfefr dk fu/kkj.k] v.kvk d l?kVu dk fu/kkj.k fd;k tkrk gA

4- **0;olk; e** % X-fdj.kk dk mi;kx 0;olk; d {k= e vlyh&udyh dh igpku e fd;k tkrk gA

5- **tkllh e** % dLVe vf/kdkjh X-fdj.kk d }kjk] 'kjhj e vFkok cDlk e fNkdj yk;h x;h eY;oku oLrvk] gfFk;kjk dh tkp djr gA

n0; rjx

Hkkfrdh e çdk'k dk ijkoru] vioru] fooru] /ko.k] 0;frdj.k bR;kfn çdk'k dh rjxh; çÑfr dk n'kkr g] tcfd çdk'k fo|r çHkko] ØkEiVu çHkko] theu çHkko] jeu çHkko bR;kfn çdk'k dh d.kh; çÑfr dk n'kkr gA

mi;Dr çk;kfxd ?kVukvk d vk/kkj ij ;g dgk tk ldrk g fd çdk'k dh dkb fuf'pr çÑfr ugh gkrh gA dN çk;kfxd ?kVukvk e ;g rjx dh Hkkfr 0;ogkj djrk g rFkk dN ?kVukvk e ;g d.kk ¼QkVku½ dh Hkkfr 0;ogkj djrk gA çdk'k dh bl çÑfr dk }r çÑfr dgr gA

Mh ckXyh vo/kkj.kk

çdk'k d }r Lo:i dk nf"Vxkpj djr g, Mh ckXyh u æ0; d.kk e rjx çÑfr dh ifjdYiuk çLrr dhA Mh ckXyh d vulkj xfreku æ0; d.k d lkFk rjx lEc) gkrh g] ftUg æ0; rjx ;k Mh&ckXyh rjx dgr gA bu æ0; rjxk dh çÑfr çkf;drk fl)kr ij vk/kkfjr g vr% bUg çkf;d rjx Hkh dgr gA bu æ0; rjxk e fuEu fo'k"krk, ik;h tkrh g &

1- ; rjx çR;d xfr'khy d.k l lEc) gkrh gA

2- æ0; rjx] rjx leg d :i e leg ox l lpfjr gkrh gA

3- æ0; rjxk dh rjx n/;] d.k d lox d 0;RØekuikrh gkrh gA

4- æ0; rjxk dk dyk ox] çdk'k ox l Hkh vf/kd gkrk gA

5- æ0; rjx] fuokr e Hkh xeu djrh gA

6- æ0; rjxk dh çÑfr fo|r pEcdh; rjxk dh rjg ugh gkrh gA

Mh ckXyh rjx n/; d l= dh x.kuk fuEu çdkj dh tkrh g &

vkbUlVhu d æ0;eku&Åtk lEc/k d vuqkj

$E = mc^2$ ...(1)

rFkk eDl lykd d DokVe fu;ekuqkj QkVku dh Åtk

$E = h\nu$ ...(2)

vr% lehdj.k ¼1½ o ¼2½ l

$mc^2 = h\nu$ vkofr $\nu = \frac{c}{\lambda}$

$= h\frac{c}{\lambda}$ tgk c-çdk'k dk ox rFkk çdk'k dh rjx n/; gA

;k $\lambda = \frac{h}{mc}$

$\lambda = \frac{h}{p}$ ...(3)

tk fd Mh ckXyh rjx n/; dk vfHk"B l= gA lehdj.k ¼3½ l

$\lambda \propto \frac{1}{p}$

Li"V g fd Hkkjh d.kk d fy, p dk eku vf/kd gku d dkj.k mudh lcf/kr Mh ckXyh rjx n/; λ dk eku vR;Yi gkrk gA ;gh dkj.k g fd Hkkjh d.kk e rjxh; çÑfr nf"Vxkpj ugh gkrh gA blh çdkj l{e d.kk d fy, p dk eku vR;Yi gku d dkj.k mudh lcf/kr Mh ckXyh rjx dk eku ç{k.kh; gkxkA ;gh dkj.k g fd l{e d.kk e rjxh; çÑfr nf"Vxkpj gkrh gA

Mohlu tej ç;kx ¼Mh&ckXyh ifjdYiuk dk çk;kfxd lR;kiu½ % Mh&ckXyh ifjdYiuk dk çk;kfxd lR;kiu djus d fy, Mohlu rFkk tej uked nks oKkfudk u fØLVy ij en byDVkuk d fooru dk v/;;u fd;kA Mohlu tej ç;kx dh çk;kfxd 0;oLFkk fuEu fp= 7-3 e n'kk;h x;h g &

bl midj.k d e[;r% rhu Hkkx gkrh g &

1- **byDVku xu (F)** % rkik;fud mRltu fof/k }kjk] byDVku xu l bfPNr Åtk d byDVkuk dk ckjhd fdj.k it d :i e çkIr fd;k tkrk gA

fp= 7-3

2- **fufdy fØLVy (C)** % byDVku xu l ikIr byDVku it dk fufdy fØLVy ij vkifrr djok;k tkrk gA fufdy fØLVy] vkifrr byDVku it dk foofrr djrk gA

3- **vk;uu d{k (D)** % fufdy fØLVy l foofrr byDVku it dk llfpr dju d fy, vk;uu d{k dke e fy;k tkrk gA ;g vk;uu d{k fufdy fØLVy d lki{k fofHkUu dk.k ij foofrr byDVku dh rhork dk ekiu djrk gA

çk;kfxd fooj.k ,o lR;kiu % fufdy fØLVy] byDVku it d fy, ,d f=fofe; xfVx dh Hkkfr 0;ogkj djrk gA Mohlu&tej u byDVku rhork I, fooru dk.k ϕ o Rojd foHko V d fHkUu&fHkUu ekuk d fy, ç{k.k fy; ftudk xkQh; fp=.k fp= 7-4 e çnf'kr gA

fp= 7-4

mDr ç{k.kk l ;g fu"d"k fudyk fd 50° fooru dk.k rFkk 54 okYV Rojd foHko ij I-V oØ e rh{.kre mHkkj çkIr gkrk gA pfd bl ç;kx e byDVku dk fooru gkrk g vr% ;g byDVku dh rjxh; çÑfr dk n'kkrk gA bl fLFkfr e byDVku dh Mh ckxyh rjx n/; dk eku

$$\lambda=\frac{12.27}{\sqrt{V}}=1.67\,\text{Å}$$ çkIr gkrk gA

iu% cx d fu;ekulkj fooru dh 'kr l

$$D\sin\phi= n\lambda$$

tgk D, fØLVy tkyd d nk yxkrkj ijek.kvk d eè; dh njh g ¼fudy fØLVy d fy, D = 2.15A°½ rFkk çFke dkfV d fooru d fy, n=1yu ij

$$\lambda=2.15\sin 50^{\circ}$$

;k $\lambda=1.65\,\text{Å}$

mi;Dr nkuk fof/k;k l λ dk eku yxHkx leku çkIr gkrk g tk fd Mh ckxyh fl)kr dh if"V djrk gA

ckj d{kd

Mh ckxyh d vulkj ijek.k e byDVku dh d.kh; çÑfr d lkFk mle rjxh; çÑfr Hkh lEc) gkrh gA vr% byDVku ukfHkd d pkjk vkj rjx leg e vçxkeh rjxk dk fuek.k djr g, oÙkkdkj d{kkvk e ifjØe.k djr gA bu oÙkkdkj d{kkvk d doy o gh eku lHko gkr g ftudh d{kkvk dh dy yckb ¼ifjf/k½ byDVku dh rjx n/; dh i.k x.kt gkrh g] ftl l fd ,d i.k d{k pØ i'pkr rjx leku dyk e gkA

vFkkr Mh ckxyh d vulkj LFkk;h d{kkvk d fy, &

$2\pi r_n = n\lambda$ tgk r_n: LFkk;h noh d{kk dh f=T;k g rFkk n ,d /ku i.kkd gA

Mh&ckxyh rjx n/; $\lambda = \frac{h}{mv}$ l

$2\pi r_n = \frac{nh}{mv_n}$ tgk v_n-noh d{kk e byDVku d ox dk eku gA

;k $mv_n r_n = \frac{h}{2\pi}$

;g ckj d{kk d fy, vfHk"V çfrc/k gA tk bl ckr dk 0;Dr djrk g fd byDVku] ijek.k d vnj ukfHkd d pkjk

fp= 7-5

vkj mUgh d{kkvk e ifjØe.k djrk g ftud fy, byDVku dk dk.kh; lox dk i.k x.kt gkA ;g ckj dk DokVe çfrcèk Hkh dgykrk gA mi;Dr l Li"V g fd çFke d{kk (n=1) e ,d rjx] f}rh; d{k (n=2) e nk rFkk noh d{kk e n rjx curh gA fp= 7-5 e ijek.k d d{kh; byDVkuk dh rjxk dk fp=.k n'kk;k x;k gA

egRoi.k fcUn

1- /kukRed fdj.k xl d /ku vk;uk l cuh gkrh gA

2- /kukRed fdj.kk d fy, e/m dk eku byDVku dh ryuk e cgr de çkIr gkrk gA

3- leLFkkfud ,d gh rRo d o fHkUUk&fHkUUk ijek.k gkr g ftud fy, ijek.k Øekd (Z) leku o ijek.k Hkkj (A) fHkUUk&fHkUUk gkrk gA

4- mPp ox l Pkyu okyh dFkkM fdj.k tc mPPk ijek.k Hkkj oky /kkr l Vdjkrh g rk vn';] vYi rjx n/; o mPp Åtk dh fo|r pEcdh; rjx mRiUUk gkrh gA ftUg X-fdj.k dgr gA

5- X-fdj.k nk çdkj dh gkrh g & ¼1½ dBkj X-fdj.k ¼2½ en X-fdj.k

6- Mh ckxyh d vulkj ijek.k e byDVku dh d.kh; çÑfr d lkFk mle rjxh; çÑfr Hkh lEc) gkrh gA byDVku ukfHkd d pkjk vkj rjx leg e vçxkeh rjxk dk fuek.k djr g, oÙkkdkj d{kkvk e ifjØe.k djr gA bu oÙkkdkj d{kkvk d doy o gh eku lHko

gkr g ftudh d{kkvk dh dy yckb ¼ifjf/k½ byDVku dh rjx n/; dh i.k x.kt gkrh g] ft ll fd ,d i.k d{k pØ i'pkr rjx leku dyk e gkA

vH;klkFk ç'u

oLrfu"B ç'u

1- /ku fdj.kk dh [kkt dh &
¼v½ xkYMLVhu }kjk ¼c½ Vkelu }kjk
¼l½ dyht }kjk ¼n½ U;Vu }kjk

2- /ku fdj.kk dk ox gkrk g &
¼v½ çdk'k d ox l T;knk
¼c½ çdk'k d ox l de
¼l½ çdk'k d ox d cjkcj
¼n½ vur

3- leLFkkfud ukfHkd o ukfHkd gkr g ftud fy, &
¼v½ Z o A leku gkr g
¼c½ Z leku o A vyx&vyx
¼l½ Z vyx&vyx o A leku
¼n½ Z o A nkuk vyx&vyx

4- Dykjhu d leLFkkfudk dk vuikr gkrk g &
¼v½ 1:4 ¼c½ 2:3
¼l½ 3:1 ¼n½ 3:4

5- X-fdj.kk d mRiknu d fy, dke e ykr g &
¼v½ dfyt ufydk ¼c½ jcj ufydk
¼l½ pknh dh ufydk ¼n½ rkc dh ufydk

y?kqkjkRed i'u

1- /ku fdj.kk d dkb nk x.k fyf[k,A
2- leLFkkfud ukfHkdk dh ifjHkk"kk nhft ,A
3- X-fdj.kk d çdkj fyf[k,A
4- X-fdj.kk d mi;kx ij çdk'k Mkfy,A
5- æ0; rjxk dh }r çÑfr mnkgj.k ndj le>kb;A
6- æ0; rjxk dh nk fo'k"krk, fyf[k,A

fuc/kkRed ç'u

1- /kukRed fdj.k D;k gkrh g\ budh 0;ifÙk ,o x.k/kek ij çdk'k Mkfy;A
2- X-fdj.kk d mRiknu ij çdk'k Mkyr g, bud x.k/kek dk fyf[k,A
3- X-fdj.kk dk mi;kx fdu&fdu {k=k e fd;k tkrk g\ foLrkjiod fyf[k,A
4- Mfolu tej ç;kx }kjk Mh ckxyh vo/kkj.kk dk çk;kfxd lR;kiu dhft ,A
5- ckj&d{kk d çfrcU/k foLrkjiod le>kb;A vko';d fp= nhft ,A

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mÙkjekyk % 1 ¼v½ 2 ¼c½ 3 ¼c½ 4 ¼l½ ¼5½ v

v/;k; & 8

jfM;k/kferk

(Radioactivity)

ifjHkk"kk

jfM;k/kferk dh [kkt lu 1896 e Ýkalhlh oKkfud gujh cdjy u dh FkhA ckn e fi;j D;jh ,o ejh D;jh u fipcyM v;Ld l jfM;e rRo e Hkh jfM;k/kferk ik; tku dh [kkt dj ;g fu"d"k fudyk fd Hkkjh rRok ¼Z=82 l mPp ijek.k Øekd½ d ijek.kvk d ukfHkdk e ;g fof'k"V x.k ik;k tkrk g fd o Lor% gh vn'; fdj.kk ¼fofdj.kk½ dk mRlftr dj uohu ukfHkdk dk fuek.k djr gA

Hkkjh ukfHkdk d Lor% gh bl çdkj vn'; fdj.kk ¼fofdj.kk½ d mRlftr gkr jgu dh ifj?kVuk dk jfM;kèkferk dgr g rFkk ,l inkFk jfM;k/keh inkFk dgykr gA bu jfM;k/keh inkFk e l Lor% fudyu okyh fdj.kk dk jfM;kèkeh fofdj.k dgr gA

jfM;k/kferk dh çfØ;k ,d ukfHkdh; çfØ;k gkrh g ftl ij Hkkfrd ,o jklk;fud ifjoru dk dkb vlj ugh gkrk gA ;g ,d ;knfPNd ifj?kVuk gkrh g ftl ij çkf;drk d fu;ek dk ikyu gkrk gA

,YQk] chVk ,o xkek fdj.kk d x.k ,o foHkn

oKkfud jnjQkM u jfM;k/keh inkFkk l mRlftr gku oky fofdj.kk dk fo|r ,o pEcdh; {k= e v/;;u dj irk yxk;k fd jfM;k/keh fofdj.k rhu çdkj d gkr gA mUgku jfM;k/keh inkFk dk lhl dh ekVh nhokjk oky ckDl e j[kk rFkk ckDl e cu ,d ckjhd fNæ l fudyu okyh fofdj.kk dk nk lyVk d e/; fLFkj fo|r {k= l xtkj dj ;g çf{kr fd;k fd ,d fofdj.k _.k lyV dh vkj rFkk nljh fofdj.k /ku lyV dh vkj rFkk rhljh fofdj.k fcuk fo{kfir g, lhèkh fudy tkrh gA ¼fp= 8-1½

bl ç{k.k l jnjQkM u fu"d"k fudkyk fd igyh çdkj dh fdj.k /kukof'kr g] bUg ,YQk fdj.k (α-rays) dgk x;k] nljh çdkj dh fdj.k _.kof'kr g] ftUg chVk fdj.k (β-rays) dgk x;k tcfd rhljh çdkj dh fdj.k tk fd fo|r {k= l çHkkfor g, fcuk lh/kh fudy x;h] vFkkr bu fdj.kk ij dkb vko'k ugh gA bu fdj.kk dk γ-fdj.k dgk x;kA

pEcdh; {k= dh mifLFkfr e α&fdj.k ck;h vkj] β&fdj.k nk;h vkj rFkk γ&fdj.k fcuk fo{kfir g, fudy tkrh gA

fp= 8-1

fp= 8-2

fo|r ,o pEcdh; {k=k e ;g çHkko Hkh ifjyf{kr fd;k x;k fd α&fdj.k] β&fdj.kk dh vi{kk de fo{kfir gkrh gA ftl ;g fu"d"k fudyrk g fd α&d.k] β&d.kk dh ryuk e Hkkjh gkr gA

α&d.kk d x.k

1- α&d.k /kukof'kr d.k gkr gA bu ij +2*e* vko'k gkrk g rFkk bldh ljpuk ghfy;e ukfHkd ½2 ikVku] 2 U;Vku½ d leku gku d dkj.k bl $_2He^4$ l 0;Dr djr gA

2- α&d.k dk æ0;eku] He- ukfHkd d æ0;eku d cjkcj 6.67×10^{-27} fd-xk- gkrk gA

3- α&d.k] fo|r {k= ,o pEcdh; {k= nkuk e fo{kfir gkr gA

4- bu d.kk dk ox] çdk'k d ox dk 1@10o Hkkx l de gkrk gA

5- α&d.kk dh Hknu {kerk] β&d.k o γ&fdj.kk dh ryuk e vYi gkrh gA

6- α&d.k xl ek/;e e ço'k dj mUg vk;fur dj nrh gA budh vk;uu {kerk β&d.k o γ&fdj.kk dh ryuk e vf/kdre gkrh gA

7- α&d.k QkVkxkQh lyV dk çHkkfor dj nr g rFkk fdlh inkFk l Vdjku ij Å"ek mRiUu djr gA

8- α&d.k ftd lYQkbM in ij çfrnhflr mRiUu djr gA

9- α&d.kk dk o.kØe fofoDr j[kh; o.kØe gkrk gA

β&d.kk d x.k

1- fdj.k nk çdkj d d.kk dk it gkrh g&

(i) β^- &d.k % ;g _.kkof'kr byDVku gkrk gA ftl ij vko'k -l*e* o æ0;eku 9.1×10^{-31} kg gkrk gA

(ii) β^+&d.k % ;g /kukof'kr byDVku ¼ikftVku½ gkrk gA ftl ij vko'k +l*e* o æ0;eku 9.1×10^{-31} fd-xk- gkrk gA

2- β&d.k] fo|r {k= ,o pEcdh; {k= nkuk e fo{kfir gkr gA

3- bu d.kk dk ox] çdk'k d ox ijkl 0.01c l 0.99c d e/; gkrk gA

4- β&d.kk dh Hknu {kerk] α&d.kk dh Hknu {kerk l 100 xuk vf/kd gkrh g] yfdu γ&fdj.kk dh Hknu {kerk dk 1@100ok Hkkx gkrh gA

5- β&d.k xlk e ço'k dj vk;uhdj.k çHkko n'kkr gA budh vk;uhdj.k {kerk] α&d.kk dh ryuk e 1@100ok rFkk γ&fdj.kk dh ryuk e 100 xuk vf/kd gkrh gA

6- β&d.k QkVkxkQh lyV dk çHkkfor djr g rFkk fdlh inkFk l Vdjku ij Å"ek mRiUu djr gA

7- β&d.k ftd lYQkbM in ij çfrnhflr mRiUu djr gA

8- β&d.kk dk o.kØe lrr gkrk gA

γ&fdj.kk d x.k

1- γ&fdj.k fo|r {k= ,o pEcdh; {k= nkuk l çHkkfor ugh gkrh gA

2- γ&fdj.k fuokr e çdk'k d ox c l xeu djrh gA

3- γ&fdj.kk dh vk;uu {kerk] α&d.kk ,o β&d.kk dh ryuk e vYi gkrh gA

4- γ&fdj.kk dh Hknu {kerk] α&d.kk ,o β&d.kk dh ryuk e mPp gkrh gA

5- γ&fdj.k QkVkxkQh lyV dk çHkkfor djrh gA

6- γ&fdj.k ftd lYQkbM in ij çfrnhflr mRiUu djrh gA

7- γ&fdj.kk dk o.kØe jf[ky&fofoDr gkrk gA

vo{k; d fu;e

jfM;k/keh ijek.kvk d ukfHkdk d Lor% fo?kVu dh ifj?kVuk dk jfM;k/keh vo{k; ;k jfM;k/keh fo?kVu dgr gA jfM;k/keh vo{k; dh nj] jfM;k/keh inkFk dh lfØ;rk dgykrh gA jfM;k/keh fo?kVu ,d ;knfPNd ifj?kVuk g rFkk bldh nj dk fdlh Hkh Hkkfrd vFkok jlk;fud fof/k }kjk çHkkfor ugh fd;k tk ldrk gA jnjQkM ,o lkMh u jfM;k/keh vo{k; dk v/;;u dj fuEufyf[kr fu;e çfrikfnr fd; &

1- jfM;k/keh ijek.kvk d ukfHkd Lor% fo?kfVr gkr jgr g rFkk mud ukfHkdk l α&d.k] β&d.k o γ&fdj.k Lor% mRlftr gkrh gA
2- jfM;k/keh vo{k; ;knfPNd gkrk gA
3- jfM;k/keh ukfHkdk d vo{k; dh nj ¼vFkkr çfr ld.M fo?kfVr ukfHkdk dh l[;k½ ml {k.k inkFk e mifLFkr vfo?kfVr jfM;k/keh ukfHkdk dh l[;k d lekuikrh gkrh gA

;fn fdlh {k.k jfM;k/keh inkFk e mifLFkr ijek.kvk ¼ukfHkdk½ dh l[;k N gk rFkk dt le; e fo?kfVr ijek.kvk ¼ukfHkdk½ dh l[;k dN gk rk jnjQkM & lkMh d fu;eku lkj ukfHkdk d fo?kVu dh nj &

$$-\frac{dN}{dt}\alpha N$$

;k $\frac{dN}{dt} = -\lambda N$

tgk _.kkRed fpUg fo?kVu dk n'kkrk g rFkk λ ,d lekuikrh fu;rkd g ftl {k;kd dgr gA mi;Dr fu;e dk fuEu çdkj Hkh fy[kk tk ldrk g &

$N=N_0e^{-\lambda t}$ tgk N_0, $t=0$ le; ¼çkjEHk e½ ij vfo?kfVr ukfHkdk ¼ijek.kvk½ dh l[;k gA

;fn $t=\frac{1}{\lambda}$ rk jnjQkM lkMh d mi;Dr fu;e l

vFkkr {k;kd dk eku le; d ml eku dk 0;RØe gkrk g ftl e inkFk] fo?kVu }kjk viu çkjfHkd ek=k (N_0) dk $\frac{1}{e}$;k 38.6%ok Hkkx jg tk,A

jfM;k/keh inkFk d fy, fo?kfVr ukfHkdk dh l[;k o le; d e/; oØ pj?kkrkdh çkIr gkrk g tcfd log N o t d e/; oØ ,d ljy j[kk çkIr gkrh gA ljy j[kk dh ço.krk {k;kd d eku dk n'kkrh gA

fp= 8-3

v) vk;

jfM;k/keh vo{k; çfØ;k l jfM;k/keh inkFk d vfo?kfVr ijek.kvk ¼ukfHkdk½ dh l[;k yxkrkj ?kVrh jgrh gA og le;kUrjky ftld vUrxr fdlh jfM;k/keh inkFk dh ek=k jfM;k/keh fo?kVu d QyLo:i ?kVdj viu çkjfEHkd eku dh vk/kh jg tkrh g] ml jfM;k/keh inkFk dh v) vk; dgykrh gA bl T l 0;Dr djr gA

ifjHkk"kkulkj $t=T$ ¼v) vk;½ ij ij vfo?kfVr ukfHkdk dh l[;k dk eku] çkjfHkd le; ij vfo?kfVr ukfHkdk dh l[;k d vk/kk gkrk gA vr% jnjQkM lkMh fu;e e $t=T$ ij $N=\frac{N_0}{2}$ j[ku ij

$$\frac{N_0}{2}=N_0e^{-T\lambda}$$

;k $e^{-\lambda T}=1/2$;k $\lambda T=\log_e 2$

;k $T=\frac{2.303\log_{10}2}{\lambda}=\frac{0.693}{\lambda}$

ek/; vk;

jfM;k/keh vo{k; ,d ;knfPNd ?kVuk gA fdlh Hkh jfM;k/keh ukfHkd d {k; ¼fo?kVu½ dk le; 'kU; l ydj vuUr rd dN Hkh gk ldrk gA vr% lHkh ukfHkdk dh vk; d vklr dk jfM;k/keh inkFk dh ek/; vk; vFkok vklr vk; dgr gA bl τ l çnf'kr djr gA jfM;k/keh inkFk dh vklr vk; ¼τ½ {k;kd ¼λ½ d 0;RØe d cjkcj gkrh g] vFkkr

$$\tau=\frac{1}{\lambda}$$

v) vk; ,o ek/; vk; e lc/k

jfM;k/keh inkFk dh v) vk; d l= l

$$T=\frac{0.693}{\lambda}$$

rFkk ek/; vk; d l= l

$$\tau=\frac{1}{\lambda}$$

vr% mijkDr nkuk l=k l

$$T=0.693\times \tau$$

tk fd v) vk; ,o ek/; vk; e vfHk"B lc/k gA

jfM;k/keh inkFkk d mi;kx

jfM;k/keh inkFkk d e[; mi;kx fuEu g &

1- **vk;dky Kku dju e %** jfM;k/kferk dk mi;kx thok'e] iFoh dh vk;] ,frgkfld dky[k.M dh oLrvk d le; dh tkudkjh çkIr dju d fy, fd;k tkrk gA bl fof/k dk dkcu MfVx fof/k dgr gA
2- **oKkfud vul/kkuk e %** fofHkUu oKkfud vul/kkuk e jfM;k/keh inkFkk dk mi;kx fd;k tkrk gA
3- **fpfdRlk {k= e %** Co^{60} dlj fpfdRlk e] P^{32} [ku dh chekjh e] I^{181} Fkkbjkbd d mipkj e] Na^{24} jDr dkf'kdkvk d mipkj eA
4- **Ñf"k {k= e**
5- **HkxHk foKku e**
6- **ijkrRo 'kkL= e**

egRoi.k fcUn

1- Hkkjh ukfHkdk d Lor% gh vn'; fdj.kk ¼fofdj.kk½ d mRlftr gkr jgu dh ifj?kVuk dk jfM;k/kferk dgr g rFkk ,l inkFk jfM;k/keh inkFk dgykr gA bu jfM;k/keh inkFk e l Lor% fudyu okyh fdj.kk dk jfM;k/keh fofdj.k dgr gA
2- jfM;k/keh fo?kVu ,d ;knfPNd ifj?kVuk gA
3- jfM;k/keh ukfHkdk d vo{k; dh nj ml {k.k inkFk e mifLFkr vfo?kfVr jfM;k/keh ukfHkdk dh l[;k d lekuikrh gkrh gA
4- og le;kUrjky ftld vUrxr fdlh jfM;k/keh inkFk dh ek=k jfM;k/keh fo?kVu d QyLo:i ?kVdj viu çkjfEHkd eku dh vk/kh jg tkrh g] ml jfM;k/keh inkFk dh v) vk; dgykrh gA
5- jfM;k/keh ukfHkdk dh vk; d vklr dk jfM;k/keh inkFk dh ek/; vk; vFkok vklr vk; dgr gA

vH;klkFk ç'u

oLrfu"B ç'u

1- jfM;k/kferk ik;h tkrh g &
¼v½ lHkh ukfHkdk e ¼c½ gYd ukfHkdk e
¼l½ Hkkjh ukfHkdk e ¼n½ mi;Dr e l dkb ugh
2- jfM;k/keh ?kVuk g &
¼v½ ukfHkdh; ¼c½ ijekf.od
¼l½ vk.kfod ¼n½ mi;Dr e l dkb ugh
3- X fdj.k gkrh g &
¼v½ _.kkof'kr ¼c½ /kukof'kr
¼l½ mnklhu ¼n½ mi;Dr e l dkb ugh
4- γ&fdj.kk dh Hknu {kerk gkrh g &
¼v½ α rFkk β dh ryuk e vf/kd
¼c½ α rFkk β rFkk dh ryuk e de
¼l½ α l vf/kd o β l de
¼n½ α l de o β l vf/kd
5- jfM;k/keh inkFkk dk mi;kx gkrk g&
¼v½ vk; vdu e ¼c½ fpfdRlk e
¼l½ Ñf"k e ¼n½ mi;Dr lHkh e

y?kUkjkRed i'u

1- fo|r {k= e jfM;k/keh fofdj.kk d 0;ogkj dk fyf[k,A

2- γ&fdj.kk d nk x.k fyf[k,A

3- v) vk; fdl dgr g\

4- ek/; vk; dk ifjHkkf"kr dhft ;A

5- jfM;k/keh inkFkk d nk mi;kx fyf[k,A

fucU/kkRed ç'u

1- ,YQk] chVk ,o xkek fdj.kk d x.k/ke fyf[k,A

2- jfM;k/keh vo{k; D;k g\ jfM;k/keh vo{k; d jnjQkM lkMh fu;e dk 0;RiUu dhft ,A

3- v) vk; ,o ek/; vk; dk ifjHkkf"kr djr g, mud e/; lc/k LFkkfir dhft ,A

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mÙkjekyk % 1 ¼l½ 2 ¼v½ 3 ¼c½ 4 ¼v½ ¼5½ n

bdkb & v

v/;k; & 9

inkFkk d pEcdh; x.k

(Magnetic Property of Matter)

ifjHkk"kk,

og inkFk tk Lor=rkiod yVdku ij lno ,d gh fn'kk ¼mÙkj&nf{k.k½ e fLFkj gk tkrk g rFkk ykg;Dr oLrvk dk viuh vkj vkdf"kr djrk g] pEcd dgykrk gA pEcd nk çdkj d gkr g &

1- **çkÑfrd pEcd** % çkÑfrd pEcd çÑfr e ik; tkr g] eXuVkbV b l dk mnkgj.k gA bu pEcdk dk vkdkj fuf'pr ugh gku d lkFk&lkFk budk pEcdRo vYi gku d dkj.k budk oKkfud dk;k e mi;kx lhfer gkrk gA

2- **Ñf=e pEcd** % Ñf=e pEcdk dk Ñf=e <x l bfPNr vkdkj o i;kIr pEcdRo d lkFk cuk;k tkrk gA budk çk;kfxd ,o oKkfud mi;kx fofHkUu {k=k e fd;k tkrk gA Ñf=e pEcdk d fuek.k e ykg] bLikr] fufdy bR;kfn dk mi;kx fd;k tkrk gA

pEcdk d dN çe[k x.k fuEu g &

1- pEcd ykg;Dr oLrvk dk viuh vkj vkdf"kr djrk gA

2- pEcd d nk /ko gkr gA Lor=rkiod pEcd yVdku ij tk fljk mÙkj fn'kk dh vkj gkrk g ml mÙkjh /ko rFkk tk fljk nf{k.k fn'kk dh vkj gkrk g ml nf{k.kh /ko dgr gA

3- pEcd d nkuk /kok dh çcyrk leku gkrh gA

4- pEcd d nkuk /kok dk vyx&vyx ugh fd;k tk ldrk gA

5- pEcd d fotkrh; /kok e vkd"k.k rFkk l tkrh; /kok e çfrd"k.k ik;k tkrk gA

6- pEcdh; cy j[kk, cn oØ d :i e gkrh gA pEcd d ckgj budh fn'kk rFkk pEcd d vnj budh fn'kk $N \rightarrow S$ gkrh gA

pEcdh; {k=

fdlh pEcd d pkjk vkj dk og {k= ftle fdlh pEcdh; lb ij cy&vk?k.k vkjkfir gkrk g] rFkk pEcdh; lb fo{kfir gk tkrh g pEcdh; {k= dgykrk gA pEcdh; {k= e fdlh Hkh {k=Qy l xtju okyh cy j[kkvk dh l[;k dk pEcdh; ¶yDl ¼ϕ½ dgr gA rFkk pEcdh; {k= e ,dkd yEcor {k=Qy e l xtju oky pEcdh; ¶yDl dk pEcdh; çj.k (B) dgr gA pEcdh; ¶yDl ,o pEcdh; çj.k e fuEu lc/k gkrk g $\phi = \vec{B}.\vec{A}$

tgk A¶yDl l lcf/kr {k=Qy gA

pEcdh; ¶yDl dh bdkb ocj gkrh gA tcfd pEcdh; çj.k dh bdkb ocj@ehVj^2 gkrh gA bl pEcdh; ¶yDl èkuRo Hkh dgr gA

pEcdh; ikjxE;rk

pEcdh; ikjxE;rk] pEcdh; inkFk dk vfHkyk{kf.kd x.k gkrh gA ftl lhek rd pEcdh; cy j[kk, fdlh ekè;e e ço'k dj ldrh g og ml ek/;e dh ikjxE;rk dgykrh gA pEcdh; ikjxE;rk dk ek=d ocj çfr ,Eih;j ehVj gkrk gA fHkUu&fHkUu inkFkk d fy, bldk eku fHkUu&fHkUu gkrk gA

ek/;e dh pEcdh; ikjxE;rk (μ) ,o fuokr dh pEcdh; ikjxE;rk (μ_0) dk vuikr] vkif{kd ikjxE;rk (μ_r) dgykrk gA

$$\mu_r = \frac{\mu}{\mu_o}$$

gok d fy, vkif{kd ikjxE;rk dk eku bdkb gkrk gA

pEcdu {k= ¼pEcdh; {k= dh rhork½ $\vec{H}$

pEcdu {k=] fuokr e mRiUu pEcdh; çj.k B_0 dk og Hkkx g tk doy okLrfod ckÁ /kkjkvk d dkj.k gkrk gA bl H l 0;Dr djr gA ;g lfn'k jkf'k gkrh g ft ldh fn'kk pEcdh; çj.k dh fn'kk gkrh gA fuokr e pEcdh; çj.k (B_0) rFkk fuokr dh pEcdh; ikjxE;rk dk vuikr pEcdu {k= dh rhork H dgykrh gA

$$H=\frac{B_0}{\mu_o}$$

fdlh vU; ek/;e d fy, pEcdu {k= dh rhork dk eku

$$H=\frac{B}{\mu}$$

pEcdh; {k= dh rhork dh bdkb ,Eih;j çfr ehVj gkrh gA

pEcdh; vk?k.k M

fdlh pEcd d fy, pEcdh; vk?k.k dk eku mldh yEckb ¼nkuk /kok d e/; njh½ rFkk /ko çcyrk d x.kuQy d cjkcj gkrk gA bldk ek=d ,Eih;j ehVj² gkrk gA

pEcdu rhork I

pEcdh; {k= e ,dkd vk;ru d pEcdh; vk?k.k dk pEcdu rhork dgr gA

$$I=\frac{M}{V}$$

;g lfn'k jkf'k gkrh g ft ldk ek=d ,Eih;j çfr ehVj gkrk gA

pEcdh; çofÙk ¼lonu'khyrk½ (χ ;k K½

fdlh inkFk e pEcdu rhork I rFkk pEcdh; {k= dh rhork H d vuikr dk pEcdh; çofÙk ;k pEcdh; lonu'khyrk dgr gA

$$\chi=\frac{I}{H}$$

;g foekghu Hkkfrd jkf'k gkrh g rFkk inkFk dh çÑfr ij fuHkj djrh gA bldk eku /kukRed vFkok _.kkRed dN Hkh gk ldrk gA pEcdh; çofÙk ¼lonu'khyrk½ inkFk dk fdlh pEcdh; {k= }kjk pEcfdr fd; tku dk ekiu gkrk gA fHkUu&fHkUu bdkb;k e pEcdh; çofÙk dk fuEu çdkj l Hkh 0;Dr fd;k tkrk g &

(a) vk;ru pEcdh; çofÙk $\chi_v=\frac{I}{H}=\chi$

(b) æ0;eku vFkok fof'k"V pEcdh; çofÙk $(\chi_m)=\frac{\chi_v}{\rho}$

tgk ρ inkFk dk ?kuRo gA

(c) xke v.k ¼ekyj½ pEcdh; çofÙk $(\chi_{mw})=\chi_m\times M_w$

tgk M_w xke v.kHkkj

gok d fy, pEcdu çofÙk dk eku 'kU; gkrk gA

pEcdh; ikjxE;rk ,o fo|r'khyrk e lc/k

ge tkur g fd fuokr d fy, pEcdh; ikjxE;rk

$\mu_0=4\pi\times10^{-7}$ U;Vu@,fEi;j²

rFkk $\frac{1}{4\pi\in_0}=9\times10^9$ U;Vu&ehVj²@dyke²

;k fo|r'khyrk $\in_0=\frac{1}{36\pi\times10^9}$ dyke²@U;Vu&ehVj²

vr% $\mu=\mu_0(1+\chi)$ ¼$\frac{dyke}{fEi;j\&ehVj}$½²

$=\frac{1}{9\times10^{16}}$ ¼ehVj@ld.M½&2

$=\frac{1}{¼3x10^8\ ehVj@ld.M½^2}$

;k $\mu_0\epsilon_0=\frac{1}{c^2}$

tgk c: çdk'k dk fuokr e ox dk eku gA ehVj@ld.M

pEcdh; çofÙk ¼lonu'khyrk½ rFkk pEcdh; ikjxE;rk d e/; lc/k

tc fdlh ykg pEcdh; inkFk dk ckÁ pEcdh; {k= e j[kk tkrk g rk ckÁ {k= d çHkko e inkFk ,d pEcd dh Hkkfr dk; djrk gA bl fLFkfr e pEcdh; {k= dk dy eku d lekuikrh gkrk gA vr%

$\vec{B}=\mu_0(\vec{H}+\vec{M})$

$=\mu_0(H+\chi H)\quad\because M=\chi H$

$=\mu_0(1+\chi)H$

yfdu $\vec{B}=\mu\vec{H}$

ryuk dju ij $\mu=\mu_0(1+\chi)$

;k $\therefore \frac{\mu}{\mu_0}=\mu_r=1+\chi$

tk fd vfHk"B lEc/k gA

inkFkk dk oxhdj.k

inkFkk e pEcdRo dk ey dkj.k mud ijek.kvk e mifLFkr vko'kk ¼byDVku] çkVku½ dh xfr gA fofHkUu inkFkk d ijek.kvk] v.kvk e bu vko'kk dh l[;k ,o mudh 0;oLFkk e fHkUurk d dkj.k mud pEcdh; x.kk e fHkUurk ik;h tkrh gA

QjkM u fofHkUu inkFkk dk pEcdh; {k= e v/;;u dj mUg rhu Hkkxk e oxhÑr fd;k &

¼1½ çfrpEcdh; inkFk

¼2½ vupEcdh; inkFk

¼3½ ykgpEcdh; inkFk

1- **çfrpEcdh; inkFk** % ,l inkFk ftUg pEcdh; {k= e j[k tku ij {k= d foijhr fn'kk e vR;Yi pEcdRo mRiUu gk tkrk g] çfr pEcdh; inkFk dgykr gA Bi, Cu, Hg, Pb, Ag, Au, He çfrpEcdh; inkFk d mnkgj.k gA bu inkFkk d fy, pEcdh; çofÙk dk eku _.kRed ,o vYi gkrk gA rFkk pEcdh; çofÙk] pEcdu {k= dh rhork ij fuHkj ugh djrh gA vleku pEcdh; {k= e j[k tku ij ; rho {k= l de rhork oky {k= dh vkj xeu djr gA

2- **vupEcdh; inkFk** % ,l inkFk ftul pEcdh; {k= e j[k tku ij {k= dh fn'kk e vYi pEcdRo mRiUu gk tkrk g vupEcdh; inkFk dgykr gA Na, Mn, Pt, $CuCl_2$ vupEcdh; inkFkk d mnkgj.k gA bu inkFkk d fy, pEcdh; çofÙk dk eku vYi ,o /kukRed gkrk gA tcfd pEcdh; çofÙk] pEcdu {k= dh rhork H ij fuHkj ugh djrh gA vleku pEcdh; {k= e bUg j[ku ij ; rho {k= dh vkj xeu djr gA

vupEcdh; inkFk dh NM dk nk pEcdh; /kok d e/; yVdku ij] NM dh v{k ?kedj pEcdh; {k= d lekrj gk tkrh gA

tc fdlh ifrpEcdh; inkFk dh NM dk pEcdh; /kok d e/; yVdkr g rk NM ?kedj pEcdh; {k= d yEcor gk tkrh gA

3- **ykgpEcdh; inkFk** % ,l inkFk ftUg pEcdh; {k= e j[k tku ij {k= dh fn'kk e çcy :i l pEcfdr gk tkr g] ykg pEcdh; inkFk dgykr gA Fe, Ni, Co, Gd bR;kfn ykg pEcdh; inkFkk d mnkgj.k gA bu inkFkk d fy, pEcdh; çofÙk /kukRed ,o mPp gkrh g rFkk pEcdu {k= H ij fuHkj djrh gA vleku pEcdh; {k= e j[k tku ij ; vupEcdh; inkFkk dh Hkkfr rho {k= dh vkj xeu djr gA

; inkFk pEcd }kjk vkdf"kr gkr gA bu inkFkk e vupEcdh; inkFkk d lHkh x.k ik; tkr g yfdu bue x.kk dh çcyrk vupEcdh; inkFkk dh ryuk e vR;fèkd gkrh gA

egRoi.k fcUn

1- og inkFk tk Lor=rkiod yVdku ij lno ,d gh fn'kk e fLFkj gk tkrk g rFkk ykg;Dr oLrvk dk viuh vkj vkdf"kr djrk g] pEcd dgykrk gA

2- pEcd d pkjk vkj dk og {k= ftle pEcdh; lb fo{kfir gk tkrh g pEcdh; {k= dgykrk gA pEcdh; {k= e xtju okyh cy j[kkvk dh l[;k dk pEcdh; ¶yDl (ϕ) dgr g rFkk pEcdh; {k= e ,dkd yEcor {k=Qy e l xtju oky pEcdh; ¶yDl dk pEcdh; çj.k (B) dgr gA

3- ftl lhek rd pEcdh; cy j[kk, fdlh ek/;e e ço'k dj ldrh g og ml ek/;e dh ikjxE;rk dgykrh gA

4- pEcdh; {k= e ,dkd vk;ru d pEcdh; vk?k.k dk pEcdu rhork dgr gA

5- pEcdu rhork I rFkk pEcdh; {k= dh rhork H d vuikr dk pEcdh; çofÙk ;k pEcdh; lonu'khyrk dgr gA

6- fofHkUu inkFkk dk pEcdh; {k= e 0;ogkj d vk/kkj ij rhu Hkkxk e oxhÑr fd;k x;k g &

¼1½ vupEcdh; inkFk

¼2½ çfrpEcdh; inkFk

¼3½ ykgpEcdh; inkFk

vH;kl lkFk ç'u

oLrfu"B ç'u

1- fdlh pEcd d nkuk /kok dk /ko lkeF; &

¼v½ cjkcj gkrk g ¼c½ vleku gkrk g

¼l½ 'kU; gkrk g ¼n½ mi;Dr e l dkb ugh

2- pEcdh; vk?k.k dk ek=d g &
¼v½ ocj ¼c½ ocj@eh Vj²
¼l½ ,Eih;j@eh Vj ¼n½ ,Eih;j@eh Vj²

3- ykgpEcdh; inkFkk dh pEcdh; çofÙk gkrh g&
¼v½ 'kU; ¼c½ /kukRed ,o vYi
¼l½ /kukRed ,o çcy ¼n½ _.kRed ,o çcy

4- pEcdh; {k= g&
¼v½ vfn'k {k= ¼c½ lfn'k {k=
¼l½ mi;Dr nkuk ¼n½ mi;Dr e l dkb ugh

5- pEcdh; {k= dh rhork H dk eku gkrk g &
¼v½ B/μ ¼c½ B/μ_0
¼l½ $B\mu$ ¼n½ μ_0/B

y?kUkjkRed i'u

1- pEcdh; x.kk d vk/kkj ij inkFk dk fdru Hkkxk e oxhÑr fd;k x;k gA
2- vupEcdh; inkFkk d nk x.k fyf[k,A
3- çfrpEcdh; inkFkk dh ifjHkk"kk nhft ,A
4- pEcdh; ¶yDl dh ifjHkk"kk nhft ,A
5- pEcdh; ikjxE;rk fdl dgr g\

fucU/kkRed i'u

1- fVli.kh fyf[k,A
(i) pEcdh; {k= ($\vec{B}$) ,o pEcdu {k= dh rhork ($\vec{H}$)
(ii) pEcdh; ikjxE;rk ,o fo|r'khyrk

2- ykgpEcdh; ,o vupEcdh; inkFkk d x.k/kek dk ryukRed foopu dhft ,A
3- pEcdh; x.kk d vk/kkj ij inkFkk dk oxhdj.k dhft ,A

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mÙkjekyk % 1 ¼v½ 2 ¼n½ 3 ¼l½ 4 ¼c½ ¼5½ v

v/;k; & 10

v)pkyd

(Semiconductor)

fo|r pkydrk d vk/kkj ij inkFkk dk rhu Hkkxk e oxhÑr fd;k x;k g &

1- **pkyd** % o inkFk gkr g tk lkekU; rki ij fo|r dk pkyu djr g] tl& leLr /kkr,A budh pkydrk mPp ,o çfrjk/kdrk yxHkx 'kU; gkrh gA

2- **dpkyd** % o inkFk gkr g tk lkekU; rki ij fo|r dk pkyu ugh djr g] tl& lykfLVd] ydMh vkfnA budh pkydrk yxHkx 'kU; ,o çfrjk/kdrk dk eku mPp gkrk gA

3- **v)pkyd** % çÑfr e dN ,l inkFk Hkh ik; tkr g] ftudh pkydrk dk eku pkydk dh ryuk e de rFkk dpkydk dh ryuk e vf/kd gkrk gA ,l inkFkk dk v)pkyd i)kFk dgr gA v)pkyd inkFk nk çdkj d gkr g &

(i) ut v)pkyd (Intrinisc Semiconductor)

(ii) viæ0;h v)pkyd (Extrinisc Semiconductor)

Bkl k e Åtk cM

Bkl k e fo|r pkydrk dh ?kVuk dk le>u d fy, vk/kfud Hkkfrdh e Åtk cM fl)kr fn;k x;kA ftld vulkj Bkl k d ijek.kvk d e/; vR;Ur de njh ($\sim 10^{-10}$m) gku d dkj.k bud ijek.k vkil e vU;kU; fØ;k (mutal interaction) dju yxr gA bl vU;kU; fØ;k d QyLo#i ijek.k d Åtk Lrjk dk foHkktu gku yxrk gA ftruh l[;k e ijek.k vukU; fØ;k djr g] çR;d ijek.k dk Åtk Lrj mru gh Åtk Lrjk d leg e foHkkftr gk tkrk gA foHkkftr Åtk Lrjk d e/; Åtk vUrjky bruk de gkrk g fd ; yxHkx lrr Åtk Lrjk dk leg eku tk ldr gA Bkl k e bu Åtk Lrjk d leg dk Åtk cM dgr gA vr% Bkl k e ijek.k Åtk Lrj d LFkku ij Åtk cM ik; tkr gA

mnkgj.kkFk lkfM;e ijek.k e $1s^2, 2s^2, 2p^6, 3s^1$ byDVkfud foU;kl gku d dkj.k Bkl lkfM;e e lkfM;e ijek.k d lHkh 1s d{kd vkil e vfr0;kfir gkdj ,d Åtk cM dk fuek.k djr g] ftl 1s cM dgr gA bl cM e lkfM;e ijek.k d 1s d{kd l lcf/kr byDVku jgr gA ;fn Bkl lkfM;e e lkfM;e e n lkfM;e ijek.k mifLFkr gk rk bu n ijek.k d 1s d{kd l lcf/kr 2n byDVku] 1s cM e mifLFkr jgr gA blh çdkj 2s, 2p ,o 3s d{kd vfr0;kfir gkdj Øe'k% 2s, 2p ,o 3s cM dk fuek.k djr g] ftue byDVkuk dh l[;k Øe'k% 2n, 6n ,o n gkrh gA

ijek.kvk d e/; njh

fp= 10-1

lkj.kh 10-1 % pkyd] v)pkyd o dpkyd e ryuk

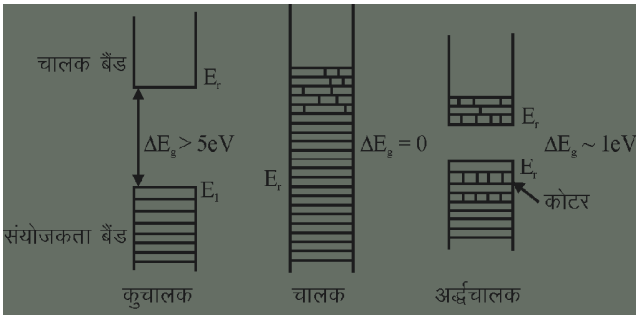
Ø-l-	x.k	pkyd	v)pkyd	dpkyd
1-	fo|r pkydrk	vR;f/kd	pkyd o dpkyd d e/;	ux.;
2-	çfrjks/kdrk	ux.;	pkyd o dpkyd d e/;	vR;f/kd
3-	Åtk vUrjky	'kU; ;k vR;Yi	pkydk l vf/kd ijUr dpkydk l de	vR;f/kd
4-	/kkjk çokg	eDr byDVkuk d dkj.k	eDr byDVku rFkk eDr dkVjk d dkj.k	ux.;
5-	lkekU; rki ij l;kth c.M rFkk pkyu c.M dh fLFkfr	l;kth c.M rFkk pkyu c.M i.kr% Hkj g, gkr g ;k pkyu c.M FkkMk [kkyh gkrk g	l;kth c.M FkkMk [kkyh rFkk pkyu c.M FkkMk Hkjk gvk	l;kth c.M i.k Hkjk gvk rFkk pkyu c.M ijk [kkyh
6-	rki c<ku ij pkydrk ij çHkko	pkydrk de gkrh g	pkydrk c<rh g	pkydrk c<rh g

pfd lkfM;e ijek.k d 1s, 2s ,o 2p d{kd e mifLFkr byDVku pkyu e Hkkx ugh yr g] doy ckÁ d{kd (3s) l lcf/kr byDVku gh pkydrk d fy, mÙkjnk;h gkr gA vr% ckÁ d{kdk 3s ¼l;kth d{kd½ d vfr0;kiu l cuu okyh cM l;kth cM (Valancy band) dgykrh g] tk fd v)ifjr jgrh gA bl cM d Åij ,d vU; cM gkrh g] ft l pkyu cM (Conduction band) dgr gA l;kth cM d uhp] leLr cM] i.k ifjr gkr gA tc byDVku l;kth cM l pkyu cM e tkr g rk Bkl fo|r dk pkyu djr gA l;kth cM ,o pkyu cM d e/; d Åtk vrjky dk oftr Åtk vrjky ΔE_g dgr gA pkydk e oftr Åtk vrjky dk eku 'kU; gkrk g vFkkr l;kth cM ,o pkyu cM d e/; dkb vrjky ugh ik;k tkrk gA vr% pkydk e l;kth cM]pkyu cM dh rjg 0;ogkj djrk gA pkydk e pkyu cM e eä byDVkuk dh l[;k vf/kd gku d dkj.k ; vkl kuh l fo|r /kkjk dk pkyu djr gA

dpkydk e oftr Åtk vrjky dk eku vR;f/kd (ΔE_g>5eV) gkrk g] ft l dkj.k l;kth cM e mifLFkr byDVku] pkyu cM e ugh vk ikr gA ,l inkFk fo|r pkyu d çfr mnkl hu jgr gA

v)pkydk e oftr Åtk dk eku dpkydk dh ryuk e de (ΔE_g~1eV) gkrk gA bu inkFkk dk rki c<ku ij] l;kth cM e mifLFkr byDVkuk dh Åtk c< tku l ; pkyu cM e lØe.k dj fo|r pkyu dk çnf'kr djr gA pkyu cM e byDVku d tku ij] l;kth cM e byDVku dh deh mRiUu gk tkrh g] ft l gky ;k dkVj dgr gA gky ij byDVku d cjkcj yfdu /kukRed vko'k ekuk tkrk gA pkyd] dpkyd ,o v)pkydk e Åtk vrjky fp= 10-2 e n'kk;k x;k gA

v)pkydk dk rki c<ku ij pkydrk d eku e of) gkrh g tcfd pkydk dk rki c<ku ij pkydrk d eku e deh gkrh gA dpkydk dk rki c<ku ij pkydrk d eku ij fuEu rki ij dkb çHkko ugh iMrk g yfdu mPp rkik ij ; fo|r dk pkyu çkjHk dj nr gA bl dpkydk dk Hkstu dgr gA pkyd] v)pkyd o dpkydk dh ryuk fuEu lkj.kh 10-1 e nh x;h gA



fp= 10-2

v)pkyd

v)pkydk dh pkydrk] pkyd ,o dpkyd inkFkk d e/; ik;h tkrh gA lkekU; rki ij v)pkydk dh pkydrk dk eku cgr de gkrk gA budh pkydrk e of) rki d vfrfjDr] v'kf) feykdj Hkh dh tk ldrh gA v'k) ijek.k feykdj ikIr v)pkydk dh pkydrk dk eku 'k) v)pkydk dh ryuk e db x.kk gkrk gA bl vk/kkj ij v)pkydk dk nk Hkkxk e oxhÑr fd;k x;k g &

1- **ut v)pkyd %** çÑfr e 'k) :i e ik; tku oky v)pkydk dk ut v)pkyd dgr gA tefu;e] flfydu] ut v)pkydk d mnkgj.k gA

ut v)pkyd d ijek.k vkil e lgl;kth c/kk }kjk tM jgr gA tc rki e of) dh tkrh g rk dN byDVku Åtk ikdj lgl;kth c/kk l eä gk tkr g rFkk c/k e byDVku dh deh gk tkrh gA lgl;kth cèk e mRiUu byDVku dh ;g deh gky dgykrh g] ;g ,d /kukof'kr d.k dh Hkkfr 0;ogkj djrh gA ut v)pkydk e nk idkj d eä vko'k ik; tkr g %

1- eä byDVku % ; pkyu cM e fLFkr gkr gA

2- eä gky % ; l;kth cM e fLFkr gkr gA

bl idkj v)pkydk e fo|r /kkjk d iokg e eä byDVku o gkyk nkuk dk ;kxnku gkrk gA ut v)pkyd e eä byDVku o gkyk dh l[;k cjkcj gkrh gA

tl& tl rki c<k;k tkrk g rk eä byDVku o gkyk dh l[;k e of) gkrh gA vr% rki d lkFk pkydrk c<rh g o çfrjk/kdrk de gkrh gA v)pkydk dk çfrjk/kdrk rki x.kd (α) _.kkRed gkrk gA

2- **viæ0;h v)pkyd %** lkekU; rki ij ut v)pkydk dh pkydrk cgr de gkrh gA vr% ut v)pkydk e v'kf) ijek.kvk dk feyk dj mudh pkydrk e of) dh tkrh gA bl çdkj çkIr v)pkyd viæ0;h v)pkyd dgykr gA v'kf) ijek.kvk dh çÑfr d vk/kkj ij viæ0;h v)pkydk dk nk Hkkxk e oxhÑr fd;k x;k g&

(i) P-çdkj d v)pkyd

(ii) N-çdkj d v)pkyd

P-çdkj d v)pkyd % tc ut v)pkydk e vkor lkj.kh d rrh; leg d rRok dh v'kf) feyk nh tkrh g rk bl fLFkfr e çkIr v)pkyd P-çdkj d v)pkyd dgykr gA bu v)pkydk dh 0;k[;k fuEu g &

tc fdlh ut v)pkyd ¼flfydu½ e rrh; leg ¼tl& ckjku] xfy;e] bfM;e½ d ijek.k dh v'kf) feykr g rk P-çdkj dk v)pkyd çkIr gkrk gA pfd flfydu d 'k) ijek.k d cká d{kd e pkj byDVku ik; tkr gA rrh; leg d ijek.k dh v'kf) feyku ij rrh; leg d ijek.k ckjku] d cká d{kd e mifLFkr rhu byDVku] flfydu d rhu ijek.kvk l lgl;kth cèk cuk yr gA tcfd pkFk flfydu ijek.k d lkFk lgl;kth c/k cuku e ,d fjfDrrk mRiUu gk tkrh g] ftl gky dgr gA ;g gky ,d iMkh flfydu ijek.kvk d lgl;kth c/kk l vkIkuh l ,d byDVku xg.k dj yrk gA ;g v'k) ijek.k ,d byDVku xg.k dj c) _.kk;u e ifjofrr gk tkrk gA bl çdkj rrh; leg dk çR;d v'k) ijek.k fcuk byDVku eä fd; ,d vfrfjä gky vko'k okgd d :i e mRiUu djrk gA rrh; leg d ijek.k }kjk ,d byDVku flfydu l Lohdkj dj lgl;kth c/k cuku d dkj.k] bl leg dh v'kf) dk Lohdkjh v'kf) Hkh dgr gA bl çdkj cu v)pkydk e gky ¼/kuko'k fjfDrrk½ pkydrk d fy, mÙkjnk;h gku d dkj.k bUg P-çdkj d v)pkyd dgr gA fp= 10-3 e P-çdkj d v)pkyd e gky cuu dh çfØ;k n'kk;h x;h gA

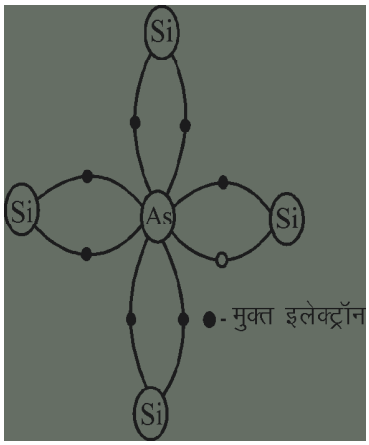
fp= 10-3

N-çdkj d v)pkyd % tc ut v)pkydk e vkor lkj.kh d ipe leg d ijek.kvk ¼vkIkfud] ,UVheuh½ dh v'kf) feyk nh tkrh g rk çkIr v)pkyd N-çdkj d v)pkyd dgr gA

bu v)pkydk dh 0;k[;k fuEu çdkj g &

fdlh ut v)pkyd ¼mnkgj.kkFk flfydu½ e ipe leg d ijek.k ¼mnkgj.kkFk& vkIkfud] ,UVheuh½ dh v'kf) feyk nh tkrh g rk çkIr v)pkyd N-çdkj dk v)pkyd gkrk gA ge tkur g fd flfydu d 'k) ijek.k d cká d{kd e pkj byDVku mifLFkr jgr gA ble ipe leg vFkkr vkIkfud dh v'kf) feyku ij vkIkfud d ijek.k d cká d{kd e mifLFkr ikp byDVkuk e l pkj byDVku rk flfydu d pkj ijek.kvk d ,d&,d cká byDVku l feydj lgl;kth c/k dk fuek.k dj yr g rFkk ikpok byDVku ¼vkIkfud ijek.k d cká d{kd dk½ 'k"k jg tkrk gA ;g 'k"k byDVku vkIkuh l Åtk ikdj eä gk tkrk gA

bl çdkj ikpo leg dk çR;d v'k) ijek.k fcuk gky mRiUu fd; ,d vfrfjä byDVku vko'k okgd d :i e mRiUu djrk gA vr% v'k) ijek.k byDVku eä dj c) èkuk;u e ifjofrr gk tkrk gA bl çdkj ipe leg dh v'kf) dk nkrk v'kf) Hkh dgr gA fp= 10-4 e N-çdkj d v)pkyd e c/k 0;oLFkk dk çnf'kr fd;k x;k gA



fp= 10-4

P çdkj d v)pkyd o N çdkj d v)pkydk dh ryuk % P çdkj d v)pkyd o N çdkj d v)pkydk dh ryuk lkj.kh 10-2 e dh xb gA

P-N lf/k v)pkyd Mk;kM

;fn nk foijhr çdkj d viæ0;h v)pkyd (P o N) dk ijek.oh; :i l tkM fn;k tkrk g rk çkIr ;fDr P-N v)pkyd Mk;kM dgykrh gA ;g nk Vfeuy ;fDr gkrh g] ft ldk mi;kx e[;r% fn"Vdkjh ifjiFkk e fd;k tkrk gA v)pkyd] Mk;kM cuku d fy, tefu;e fØLVy d ,d Hkkx e rrh; leg dh v'kf) feykdj P-çHkkx dk fuek.k fd;k tkrk g rFkk nlj Hkkx e ipe leg dh v'kf) feykdj N-çHkkx dk fuek.k fd;k tkrk gA fØLVy e og LFkku tgk P rFkk N çHkkx vkil e feyr g] ml P-N lfèk (P-N junction) dgr gA

v)pkyd d P-çHkkx e cgl [;d vko'k okgd gky gkr g rFkk N-çHkkx e cgl [;d vko'k okgd byDVku gkr gA Mk;kM d nkuk çHkkxk e cgl [;d vko'k okgdk dh lkærk ¼?kuRo½ vyx&vyx gku d dkj.k ; vko'k okgd lf/k ij ,d çHkkx l nlj çHkkx e ,d nlj l l;ktu (Recombination) dj foylr gk tkr gA ;g fØ;k lcl igy lf/k d fudV {k= e gkrh gA vr% P-N lf/k d nkuk vkj vR;Yi {k= e eä vko'k okgdk dk vHkko gk tkrk g vkj doy c) vk;u ¼P dh vkj _.kk;u o N dh vkj èkuk;u½ cp tkr gA bl {k= dk vo{k; ijr dgr gA vo{k; ijr e c) vk;uk d dkj.k ,d fo|r {k= mRiUu gk tkrk g ft ldh fn'kk N l P dh vkj gkrh gA bl fo|r {k= d dkj.k eä vko'k okgdk ij folj.k dh foijhr fn'kk e fo|r cy yxrk gA vo{k; ijr }kjk mRiUu foHkokUrj dk foHko jkf/kdk dgr gA

fp= 10-5

vo{k; ijr dh pkMkb Mk;kM d çfrjk/k d eku dk 0;Dr djrh gA cká foHkokrj vkjkfir dj bl ijr dh pkMkb d eku e] ifjoru fd;k tk ldrk gA

P-N lf/k Mk;kM dh vfHkufr

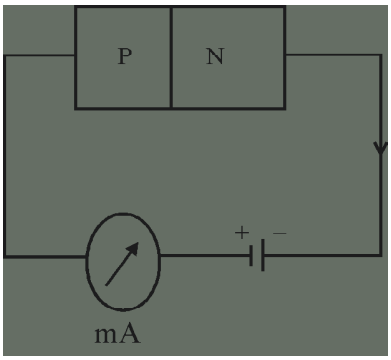
P-N lf/k Mk;kM dk cká okYVrk lk= l tkMu dk rjhdk vfHkufr dgykrk gA ifjiFk e P-N lf/k Mk;kM dh vfHkufr nk çdkj l dh tkrh g &

(i) vx vfHkufr (ii) i'p vfHkufr

lkj.kh 10-2

P çdkj d v)pkyd	**N çdkj d v)pkyd**
P çdkj d v)pkyd ut v)pkyd e rrh; leg dh v'kf) ¼ckjku] xfy;e] bfM;e½ feyku ij çkIr gkr gA	N çdkj dk v)pkyd ut v)pkyd e ikpo leg dh v'kf) ¼QkLQkjl] vkIfud] ,Vheuh½ feyku ij çkIr gkr gA
P çdkj d v)pkyd e gky cgl [;d o byDVku vYil [;d vko'k okgd gkr gA	N çdkj d v)pkyd e byDVku cgl [;d o gky vYil [;d vko'k okgd gkr gA
P çdkj d v)pkyd e c) _.kk;u ik; tkr gA	N çdkj d v)pkyd e c) /kuk;u ik; tkr gA

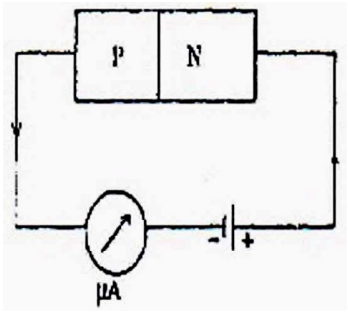
1- **vx vfHkufr** % tc lf/k Mk;kM d P-çHkkx dk cVjh d èku Vfeuy l rFkk N-çHkkx dk cVjh d _.k Vfeuy l tkMk tkrk g rk bl çdkj dh vfHkufr dk vx vfHkufr ¼fp= 10-6½ dgr gA



fp= 10-6 % vx vfHkufr

lf/k Mk;kM ij vx vfHkufr yxku ij P-çHkkx d cgl[;d vko'k okgd gky cVjh d _.k Vfeuy vFkkr N-çHkkx dh vkj xeu djr gA tcfd N-çHkkx d cgl[;d vko'k okgd byDVku cVjh d /ku Vfeuy vFkkr P-çHkkx dh vkj xeu djr gA bl fLFkfr e nkuk çHkkxk d cgl[;d vko'k okgd d.k lf/k dk ikj djr g ,o ifjiFk e fo|r /kkjk dk çokg djr gA QyLo:i lf/k dh ekVkb ¼vo{k; ijr dh pkMkb½ de gk tkrh g vFkkr Mk;kM dk çfrjk/k ($10^2\Omega$) de gk tkrk gA

2- **i'p vfHkufr** % tc lf/k Mk;kM d P-çHkkx dk cVjh d _.k Vfeuy l rFkk N-çHkkx dk cVjh d /ku Vfeuy l tkMk tkrk g rk bl çdkj dh vfHkufr dk i'p vfHkufr ¼fp= 10-7½ dgr gA bl çdkj dh vfHkufr l P- çHkkx d cgl[;d vko'k okgd gky cVjh d _.k Vfeuy dh vkj vkdf"kr gkr g rFkk N-çHkkx d cgl[;d vko'k okgd byDVku cVjh d /ku Vfeuy dh vkj vkdf"kr gkr gA bl fLFkfr e cgl[;d vko'k okgd d.k lf/k dk ikj ugh dj ikr g rFkk foHko jkf/kdk ¼vo{k; ijr½ dh pkMkb c< tkrh gA ifj.kker% vf/kd foHkokUrj vkjkfir dju ij Hkh ifjiFk l vYi /kkjk (μA) çokfgr gkrh gA i'p vfHkufr dk çfrjk/k vR;f/kd ($10^6\Omega$) gkrk gA



fp= 10-7 % i'p vfHkufr

P-N lf/k Mk;kM d vx o i'p vfHkufr dh ryuk lkj.kh 10-3 e n'kkb x;h g &

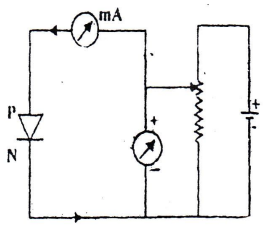
P-N lf/k Mk;kM d vfHkyk{kf.kd oØ

lf/k Mk;kM d okYVrk rFkk /kkjk d e/; [khp x; oØ P-N lf/k Mk;kM d vfHkyk{kf.kd oØ dgykr gA ; vfHkyk{kf.kd oØ nk çdkj d gkr g &

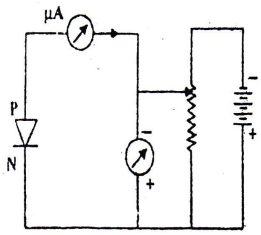
1- vx vfHkufr vfHkyk{kf.kd oØ

2- i'p vfHkufr vfHkyk{kf.kd oØ

vx vfHkufr vfHkyk{kf.kd oØ çkIr dju d fy, çk;kfxd ifjiFk fp= 10-8 e n'kk;k x;k gA tc vkjkfir okYVrk dk eku 'kU; l /khj&/khj c<k;k tkrk g rk çkjHk e Mk;kM l çokfgr gku okyh /kkjk dk eku cgr de gkrk g rFkk tc vkjkfir okYVrk dk eku foHko jkf/kdk d eku d



fp= 10-8 % vx vfHkufr



fp= 10-9 % i'p vfHkufr

lkj.kh 10-3

vx vfHkufr	i'p vfHkufr
Mk;kM d P-flj dk cVjh d mPp foHko ¼+Vfeuy½ l N flj dk fuEu foHko ¼–Vfeuy½ l tkMr gA	Mk;kM d P- flj dk cVjh d fuEu foHko ¼–Vfeuy½ l o N flj dk mPp foHko ¼+Vfeuy½ l tkMr gA
vx vfHkufr e vo{k; ijr dh pkMkb o foHko jkf/kdk dk eku de gk tkrk gA	i'p vfHkufr e vo{k; ijr dh pkMkb o foHko jkf/kdk dk eku c< tkrk gA
vx vfHkufr e Mk;kM l /kkjk cgl[;d vko'k okgdk d dkj.k çkfgr gkrh gA vr% /kkjk dk eku mA¼10^{-3}A½ dkfV dk gkrk gA	i'p vfHkufr e Mk;kM l /kkjk vYi l[;d vko'k okgdk d dkj.k çokfgr gkrh gA vr% /kkjk dk eku μA ¼10^{-6}A½ dkfV dk gkrk gA
vx vfHkufr e Mk;kM dk çfrjk/k de ¼$10^2\Omega$½ dkfV dk gkrk gA	i'p vfHkufr e Mk;kM dk çfrjk/k mPp ¼$10^6\Omega$½ dkfV dk gkrk gA

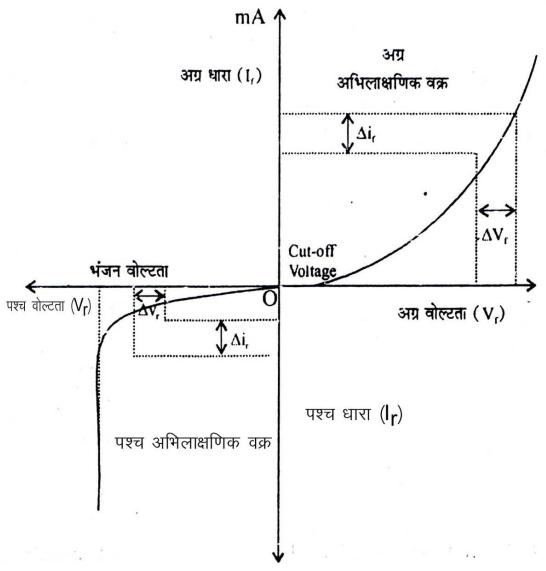
cjkcj gk tkrk g] rc bl fLFkfr e /kkjk d eku e rth l ifjoru gku yxrk g D;kfd bl fLFkfr e cgl [;d vko'k okgd d.k lf/k dk ikj dju yx tkr gA ftl okYVrk ij /kkjk d eku e rth l ifjoru gku yxrk g] ml Mk;kM dh çkjfHkd okYVrk dgr gA flfydku Mk;kM d fy, bldk eku 0.7Volt gkrk gA vx vfHkufr vfHkyk{kf.kd oØ fp= 10-10 e çnf'kr gA

i'p vfHkufr vfHkyk{kf.kd oØ çkIr dju d fy, çk;kfxd ifjiFk fp= 10-9 e n'kk;k x;k gA i'p vfHkufr 0;oLFkk e vo{k; ijr dh pkMkb e of) gk tku d QyLo:i ifjiFk l cgu okyh /kkjk dk eku cgr vYi çkIr gkrk gA bl vfHkufr e /kkjk vYil [;d vko'k okgdk }kjk cgrh gA pfd fLFkj rki ij Mk;kM e vYil [;d vko'k okgdk d mRiUu gku dh nj fu;r jgrh g vr% i'p vfHkufr e cgu okyh /kkjk dk eku Hkh fu;r jgrk g vFkkr /kkjk dk eku vfHkufr okYVrk ij fuHkj ugh djrk gA bl /kkjk dk i'p lrlr /kkjk dgr gA i'p vfHkufr e tc okYVrk dk eku mPp dj fn;k tkrk g rk /kkjk d eku e vpkud rth l of) gku yxrh gA ;g ?kVuk lf/k Mk;kM dk Hktu dgykrh gA lf/k Mk;kM d Hktu dh ;g ?kVuk ftl okYVrk ij gkrh g] ml Hktu okYVrk dgr gA bl çdkj Mk;kM d vfHkyk{kf.kd odk ¼fp= 10-10½ l Li"V g fd Mk;kM d okYVrk o /kkjk e xkQ ljy j[kk ugh gkrk gA vFkkr Mk;kM vke d fu;e dk ikyu ugh djrk g vkj ;g ,d vj[kh; ;fDr gA

lf/k Mk;kM e Hktu nk idkj l gk ldrk g &

(i) tuj Hktu (Zener Break down)

(ii) ,oyk'k Hktu (Avalanche Break down)



fp= 10-10 % P-N lf/k Mk;kM d vfHkyk{kf.kd oØ

tuj Hktu (Zener Break down) % i'p vfHkufr 0;oLFkk e tc i'p okYVrk d eku e of) dh tkrh g rk mPp okYVrk l lf/k ij mRiUu mPp fo|r {k= d dkj.k lgl;kth c/k VVu yxr gA ftl dkj.k Mk;kM e eDr vko'k okgdk dh l[;k e rth l of) gku yxrh g rFkk ifjiFk e /kkjk d eku e rth l of) gkrh gA bl çdkj dh Hktu çfØ;k dk tuj Hktu dgr gA

,oyk'k Hktu (Avalanche Break down) % i'p vfHkufr voLFkk e mPp okYVrk e lf/k ij mRiUu mPp fo|r {k= d dkj.k vYil [;d vko'k okgdk dh Åtk e of) gkrh gA ; mPp Åtk d vko'k okgd Mk;kM e xfr dju d QyLo:i Mk;kM e lgl;kth c/kk dk rkMdj eDr vko'k okgdk dk viuh Åtk çnku djr gA eDr vko'k okgd Åtk ikdj vU; lgl;kth c/kk dk rkMr g ,o ;g çfØ;k fujrj pyrh jgrh gA bl çfØ;k d nkjku Mk;kM e eDr vko'k okgdk dh l[;k e vpkud of) gk tkrh g rFkk ifjiFk e /kkjk d eku e of) gkrh gA bl çdkj dh Hktu çfØ;k ,oyk'k Hktu dgykrh gA

Mk;kM dk çfrjk/k (Resistance of a Diode)

Mk;kM dk çfrjk/k fu;r ugh gkrk gA bldk eku vkjkfir okYVrk ij fuHkj djrk gA vx vfHkufr voLFkk e Mk;kM dk çfrjk/k de rFkk i'p vfHkufr voLFkk e Mk;kM dk çfrjk/k vf/kd gkrk gA vr% Mk;kM d fy, LFkfrd çfrjk/k dh vi{kk xfrd çfrjk/k vf/kd egRoi.k gA Mk;kM d vfHkyk{kf.kd oØ l LFkfrd o xfrd çfrjk/k Kkr fd;k tkrk gA

Mk;kM d vfHkyk{kf.kd oØ e fdlh fcn ij okYVrk rFkk /kkjk dk vuikr Mk;kM dk LFkfrd (dc) çfrjk/k dgykrk gA vx vfHkufr voLFkk d fy, dc çfrjk/k dk R_f rFkk i'p vfHkufr voLFkk d fy, dc çfrjk/k dk R_r l 0;Dr djr gA

$$R_f = \frac{V_f}{I_f} \qquad \text{rFkk}$$

tcfd nk fcUnvk d e/; okYVrk vkj /kkjk vrjky d vuikr dk xfrd (ac) çfrjk/k dgr gA

vx xfrd çfrjk/k $r_f = \frac{\Delta V_f}{\Delta I_f}$ rFkk

i'p xfrd xfrjk/k $r_r = \frac{\Delta V_r}{\Delta I_r}$

egRoi.k fcUn

1- fo|r pkydrk d vk/kkj ij inkFkk dk rhu Hkkxk e oxhÑr fd;k x;k g &
   i. pkyd % lkekU; rki ij fo|r dk pkyu djr gA budh pkydrk mPp ,o çfrjk/kdrk yxHkx 'kU; gkrh gA
   ii. dpkyd % lkekU; rki ij fo|r dk pkyu ugh djr gA budh pkydrk yxHkx 'kU; ,o çfrjkèkdrk dk eku mPp gkrk gA
   iii. v)pkyd % ftudh pkydrk dk eku pkydk dh ryuk e de rFkk dpkydk dh ryuk e vf/kd gkrk gA v)pkyd inkFk nk çdkj d gkr g &
      a. ut v)pkyd
      b. vin0;h v)pkyd
2- Bkl k e Åtk Lrjk d leg dk Åtk cM dgr gA
3- cká d{kdk d vfr0;kiu l cuu okyh cM l;kth cM dgykrh gA bl cM d Åij ,d vU; cM gkrh g] ftl pkyu cM dgr gA l;kth cM d uhp] leLr cM] i.k ifjr gkr gA tc byDVku l;kth cM l pkyu cM e tkr g rk Bkl fo|r dk pkyu djr gA l;kth cM ,o pkyu cM d e/; d Åtk vrjky dk oftr Åtk vrjky ΔE_g dgr gA
4- v)pkydk dk rki c<ku ij pkydrk d eku e of) gkrh g tcfd pkydk dk rki c<ku ij pkydrk d eku e deh gkrh gA dpkydk dk rki c<ku ij pkydrk d eku ij fuEu rki ij dkb çHkko ugh iMrk g yfdu mPp rkik ij ; fo|r dk pkyu çkjHk dj nr gA bl dpkydk dk Hkstu dgr gA
5- v'kf) ijek.kvk dh çÑfr d vk/kkj ij viæ0;h v)pkydk dk nk Hkkxk e oxhÑr fd;k x;k g &
   i. çdkj d v)pkyd % tc ut v)pkydk e vkor lkj.kh d rrh; leg d rRok dh v'kf) feyk nh tkrh g rk bl fLFkfr e çkIr v)pkyd P-çdkj d v)pkyd dgykr gA
   ii. N-çdkj d v)pkyd % tc ut v)pkydk e vkor lkj.kh d ipe leg d rRok dh v'kf) feyk nh tkrh g rk bl fLFkfr e çkIr v)pkyd N-çdkj d v)pkyd dgykr gA
6- nk foijhr çdkj d viæ0;h v)pkyd ¼P o N½ dk ijek.oh; :i l tkM fn;k tkrk g rk çkIr ;fDr P-N v)pkyd Mk;kM dgykrh gA
7- P-N lf/k Mk;kM dk cká okYVrk lkr l tkMu dk rjhdk vfHkufr dgykrk gA ifjiFk e P-N lf/k Mk;kM dh vfHkufr nk çdkj l dh tkrh g &
   (i) vx vfHkufr (ii) i'p vfHkufr
8- lf/k Mk;kM e Hkstu nk idkj l gk ldrk g &
   (i) tuj Hkstu (ii) ,oyk'k Hkstu

vH;kl kFk ç'u

oLrfu"B ç'u

1- dpkydk e &
   ¼v½ l;kth cM byDVku l vkf'kd Hkjk g
   ¼c½ pkyu cM byDVku l vkf'kd Hkjk g
   ¼l½ pkyu cM byDVku l Hkjk g vkj l;kth cM fjä g
   ¼n½ pkyu cM fjä g vkj l;kth cM byDVku l Hkjk g
2- ,d fo|rjk/kh inkFk og gkrk g&
   ¼v½ ftle cgr vf/kd eä byDVku gkr g
   ¼c½ ftld cká d{k e ,d byDVku gkrk g
   ¼l½ ftle lyXu ijek.kvk e ;g l;ktd cU/k mifLFkr gkr g
   ¼n½ ftle eä byDVkuk dh l[;k ux.; gkrh g
3- /kkrvk e fo|r pkydrk dk dkj.k &
   ¼v½ çkVku ¼c½ eä byDVku
   ¼l½ cfU/kr byDVku ¼n½ vk;u
4- pkydk e /kkjk okgd gkr g &
   ¼v½ gky
   ¼c½ eä byDVku
   ¼l½ byDVku o gky nkuk
   ¼n½ /ku vk;u
5- o inkFk ftud l;kth cM vk/k Hkj gk &
   ¼v½ pkyd ¼c½ dpkyd
   ¼l½ v)pkyd ¼n½ mi;Dr lHkh
6- Åtk cM ik, tkr g &
   ¼v½ flQ ,d v.k d fy,
   ¼c½ eä byDVku d fy,
   ¼l½ ,d byDVku d fy,
   ¼n½ cgr l ijek.kvk d fy,

y?kÙkjkRed ç'u

1- v)pkyd dh ifjHkk"kk nhft,A

2- Åtk vrjky fdl dgr gA

3- PN vx ,o i'p vfHkufr e çfrjk/k dk eku fdruk gkrk gA

4- P çdkj d v)pkydk dk ifjHkkf"kr dhft,A

5- ut v)pkyd fdl dgr gA

fucU/kkRed ç'u

1- fo|r pkydrk d vk/kkj ij Bkl dk foLrr oxhdj.k dhft,A

2- Åtk cM fl)kr d vk/kkj ij Bkl e Åtk cM vrjky dk le>kb;A

3- v)pkydk dk ifjHkkf"kr dj ut ,o 'k) v)pkydk dk le>kb;A

4- PN vfHkufr l vkidk D;k vfHkçk; gA vfHk"V ifjiFk j[kkfp= [khpdj le>kb;A

5- P rFkk N çdkj d v)pkydk dh 0;k[;k dhft;A

---

mÙkjekyk % 1 ¼n½ 2 ¼n½ 3 ¼c½ 4 ¼v½ 5 ¼n½ 6 ¼n½

v/;k; & 11

fn"Vdkjh

(Rectifier)

fn"Vdkjh

çR;korh /kkjk (AC) dk fn"V /kkjk (DC) e ifjofrr dju d fy, ftu ifjiFkk dk mi;kx fd;k tkrk g] mUg fn"Vdkjh ifjiFk dgr gA P-N lf/k Mk;kM ,d fn'kh; ;fä g] ;g doy ,d fn'kk e /kkjk dk çokg djrk g ¼vx vfHkufr e½] tcfd foijhr fn'kk e /kkjk d çokg e mPp çfrjk/k mRiUu djrk g ¼i'p vfHkufr e½A Mk;kM d blh x.k dk mi;kx fn"Vdkjh e djr gA fn"Vdkjh ifjiFk nk çdkj d gkr g&

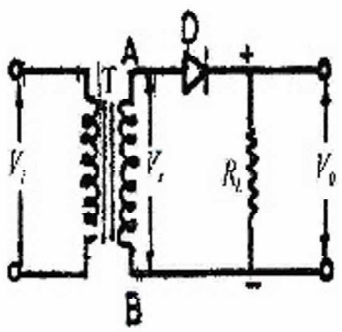
1- v) rjx fn"Vdkjh (Half wave Rectifier)

2- i.k rjx fn"Vdkjh (Full wave Rectifier)

v) rjx fn"Vdkjh (Half wave Rectifier)

v) rjx fn"Vdkjh e fuo'kh çR;korh okYVrk d doy vk/k pØ dk gh mi;kx gkrk gA

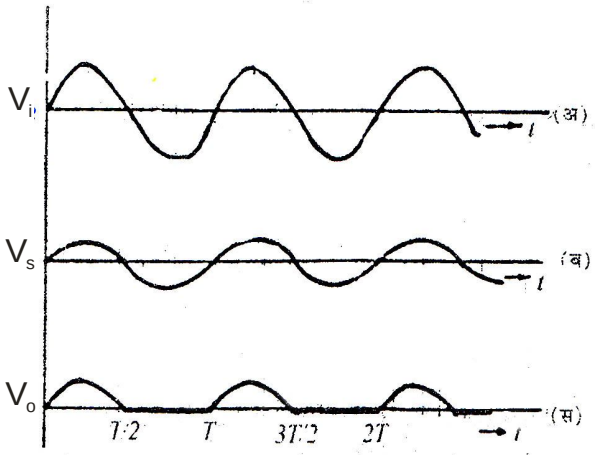
fp= 11-1 e T ,d VklQkej g] ftldh çkFkfed d.Myh ij çR;korh fuo'k okYVrk $V_i=V_P \sin \omega t$ vkjkfir dh x;h gA VklQkej (T) dh f}rh;d d.Myh d ,d flj A ij Mk;kM D rFkk J.khØe e ykM çfrjk/k R_L yxkdj ykM çfrjk/k d nlj flj dk VklQkej dh d.Myh d nlj flj B l tkMk x;k gA V_S VklQkej dh f}rh;d d.Myh ij çR;korh okYVrk dk eku gA ykM R_L d fljk ij fuxr Lineku fn"V okYVrk dk eku V_0 gA



fp= 11-1

dk; fof/k % fp=kulkj ¼fp= 11-1½ ekuk fd fuo'kh çR;korh okYVrk d çFke v) pØ d fy, VklQkej dh f}rh;d d.Myh dk A fljk /kukRed g rk bl fLFkfr e Mk;kM D vx vfHkufr e gkxkA Qyr% Mk;kM /kkjk d ekx e vYi çfrjk/k mRiUu djxkA bl fLFkfr e ykM e vkl kuh l /kkjk çokfgr gk tkrh g rFkk ykM d fljk ij fuxe okYVrk V_0 ikIr gkxhA

fuo'kh okYVrk d f}rh; v)pØ d fy,] f}rh;d d.Myh dk A fljk vc _.kkRed gkxkA bl fLFkfr e Mk;kM D i'p vfHkufr e jgxkA bl voLFkk e Mk;kM dk çfrjks/k mPp gku d dkj.k ykM çfrjk/k R_L e l çokfgr /kkjk dk eku ux.; ¼yxHkx 'kU;½ gkxkA fp= ¼11-2½ e fuo'kh çR;korh okYVrk d lki{k çkIr fuxe okYVrk dk le; d lkFk vkyf[kr fd;k x;k gA Li"V g fd fuxr okYVrk ,d fn'kh; vo';g ijUr le; d lkFk vkorh :i ; ifjofrr gk jgh gA



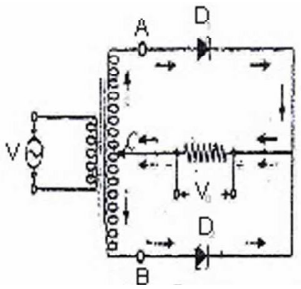
fp= 11-2

bl çdkj d fn"Vdkjh e fuo'kh ldr d doy vk/k pØ dk gh fn"Vdj.k gkrk g vr% bl v) rjx fn"Vdkjh dgr gA v) rjx fn"Vdkjh dh vf/kdre n{krk 40.6% o mfedk x.kkd 1.21 gkrk gA

i.k rjx fn"Vdkjh (Full wave Rectifier)

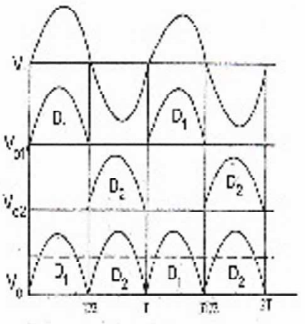
i.k rjx fn"Vdkjh e fuo'kh çR;korh okYVrk d nkuk v) pØk d nkjku fuxr /kkjk çkIr gkrh gA i.k rjx fn"Vdkjh e nk P-N lf/k Mk;kMk dk mi;kx fd;k tkrk gA

bl fn"Vdkjh e çR;korh fuo'kh okYVrk dk ,d VkIQkej dh çkFkfed d.Myh d fljk d chp yxk;k x;k gA f}rh;d d.Myh d fljk A vkj B dk Mk;kMk D_1 o D_2 d P fljk l tkMk x;k g rFkk N- flj ijLij tM gkrk gA ykM çfrjks/k R_L dk Mk;kMk d N- fljk dk tkMu oky rkj rFkk f}rh;d d.Myh d eè; Vfeuy C d chp tkMk x;k g ¼fp= 11-3½A



fp= 11-3

dk;fof/k % çR;korh fuo'kh okYVrk d fdlh v) pØ d nkjku ekuk f}rh;d d.Myh dk fljk A Vfeuy C d lki{k /kukRed g rFkk fljk B _.kkRed g rk bl fLFkfr e] Mk;kM D_1 vx vfHkufr e rFkk Mk;kM D_2 i'p vfHkufr e gkxk vFkkr Mk;kM D_1 e /kkjk (I_1) dk çokg gkrk g] ijUr Mk;kM D_2 l ughA vr% /kkjk] Mk;kM D_1 ykM çfrjk/k R_L rFkk f}rh;d d.Myh d Åijh v) Hkkx e rhjk }kjk n'kk;h xb fn'kk e çokfgr gkrh gA fuo'kh okYVrk d nlj v) pØ d nkjku] f}rh;d d.Myh dk fljk A Vfeuy C d lki{k _.kkRed rFkk B /kukRed gk tkrk gA vc] Mk;kM D_1 i'p vfHkufr e rFkk Mk;kM D_2 vx vfHkufr e gkxkA bl fLFkfr e /kkjk (I_2), Mk;kM D_2 ykM çfrjk/k R_L rFkk f}rh;d d.Myh d fupy v) &Hkkx e fcUnkdj (dotted) rhjk }kjk n'kk;h xb fn'kk e çokfgr gkrh gA Li"V g fd Mk;kM D_1 vkj Mk;kM D_2 e ckjh&ckjh l /kkjk çokfgr gkrh g rFkk fuo'kh okYVrk d nkuk v) pØk d nkjku ykM çfrjk/k R_L e èkkjk ,d fn'kk e gh çkIr gkrh gA bl fn"Vdkjh l çkIr fuxe /kkjk rFkk okYVrk dk fuo'kh okYVrk d lxr rjx çk: i fp= 11-4 e n'kk;k x;k gA i.k rjx fn"Vdkjh dh vf/kdre n{krk 81.2% o mfedk x.kkd 0.48 gkrk gA bl çdkj i.k rjx fn"Vdkjh v/k rjx fn"Vdkjh dh ryuk e vf/kd n{krk l dke djrk gA



fp= 11-4

egRoi.k fcUn

1- çR;korh /kkjk (AC) dk fn"V /kkjk (DC) e ifjofrr dju d fy, ftu ifjiFkk dk mi;kx fd;k tkrk g] mUg fn"Vdkjh ifjiFk dgr gA
2- fn"Vdkjh ifjiFk nk çdkj d gkr g &
   i. v) rjx fn"Vdkjh (Half wave Rectifier)
   ii. i.k rjx fn"Vdkjh (Full wave Rectifier)
3- v) rjx fn"Vdkjh e fuo'kh çR;korh okYVrk d doy vk/k pØ dk gh mi;kx gkrk gA
4- v) rjx fn"Vdkjh dh vf/kdre n{krk 40.6% o mfedk x.kkd 1.21 gkrk gA
5- i.k rjx fn"Vdkjh e fuo'kh çR;korh okYVrk d nkuk v) pØk d nkjku fuxr /kkjk çkIr gkrh gA i.k rjx fn"Vdkjh e nk P-N lf/k Mk;kMk dk mi;kx fd;k tkrk gA
6- i.k rjx fn"Vdkjh dh vf/kdre n{krk 81.2% o mfedk x.kkd 0.48 gkrk gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- dpkydk e &
   ¼v½ l;kth cM byDVku l vkf'kd Hkjk g
   ¼c½ pkyu cM byDVku l vkf'kd Hkjk g
   ¼l½ pkyu cM byDVku l Hkjk g vkj l;kth cM fjä g
   ¼n½ pkyu cM fjä g vkj l;kth cM byDVku l Hkjk g
2- ,d fo|rjk/kh inkFk og gkrk g &
   ¼v½ ftle cgr vf/kd eä byDVku gkr g
   ¼c½ ftld cká d{k e ,d byDVku gkrk g
   ¼l½ ftle lyXu ijek.kvk e ;g l;ktd cU/k mifLFkr gkr g
   ¼n½ ftle eä byDVkuk dh l[;k ux.; gkrh g
3- /kkrvk e fo|r pkydrk dk dkj.k &
   ¼v½ ikVku ¼c½ eä byDVku
   ¼l½ cfU/kr byDVku ¼n½ vk;u

4- pkydk e /kkjk okgd gkr g &
¼v½ gky
¼c½ eä byDVku
¼l½ byDVku o gky nkuk
¼n½ /ku vk;u

5- o inkFk ftud l;kth cM vk/k Hkj gk &
¼v½ pkyd ¼c½ dpkyd
¼l½ v)pkyd ¼n½ mi;Dr lHkh

6- Åtk cM ik, tkr g &
¼v½ flQ ,d v.k d fy,
¼c½ eä byDVku
¼l½ ,d byDVku d fy,
¼n½ cgr l ijek.kvk d utnhd (Ånjh ij) j[ku ij

y?kÙkjkRed i'u

1- v)pkyd dh ifjHkk"kk nhft ,A
2- Åtk vrjky fdl dgr gA
3- PN vx ,o i'p vfHkufr e çfrjk/k dk eku fdruk gkrk gA
4- P çdkj d v)pkydk dk ifjHkkf"kr dhft ,A
5- ut v)pkyd fdl dgr gA

fucU/kkRed i'u

1- fo|r pkydrk d vk/kkj ij Bkl k dk foLrr oxhdj.k dhft ,A
2- Åtk cM fl)kr d vk/kkj ij Bkl k e Åtk cM vrjky dk le>kb;A
3- v)pkydk dk ifjHkkf"kr dj ut ,o 'k) v)pkydk dk le>kb;A
4- PN vfHkufr l vkidk D;k vfHkçk; gA vfHk"V ifjiFk j[kkfp= [khpdj le>kb;A
5- P rFkk N çdkj d v)pkydk dh 0;k[;k dhft ;A

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mÙkjekyk % 1 ¼n½ 2 ¼n½ 3 ¼c½ 4 ¼v½ ¼5½ n

bdkb & VI

v/;k; & 12

jklk;fud vkc/ku

(Chemical Bonding)

Hkfedk

mRÑ"V xlk d vfrfjä çÑfr e ik; tku oky lHkh rÙo LorU= voLFkk e u jgdj vkf.od voLFkk e jgr g vFkkr rÙo d ijek.k vkil e l;ä gkdj ;k vU; rÙok d ijek.kvk d lkFk l;kx dj v.k cukr gA v.k ;k rk leku ijek.k ¼leijekf.od½ (Homoatomic) oky gkr g ;k fofHkUu ijek.k ¼fo"ke ijekf.od½ (Heteroatomic) oky gkr gA vr% nk ;k nk l vf/kd ijek.kvk dk cfU/kr djd v.k dk fuek.k dju okyk vkd"k.k cy gh jklk;fud vkc/k (Chemical Bond) dgykrk gA vkid efLr"d iVy ij ;g ç'u nLrd n jg gkx fd ijek.k l;kx D;k djr g] v.k LFkk;h D;k gkr g tcfd ijek.k ugh vkj fofHkUu inkFkk d v.kvk e mifLFkr cy dh çÑfr D;k gkrh g\ bl v/;k; e ge bu lHkh ç'uk d mÙkjk dk rFkk fofHkUu inkFkk d v.kvk e mifLFkr vkcèk d çdkjk dk v/;;u djxA

v"Vd fu;e (Octet Rule)

lu 1916 e th-,u- ybl (G.N. Lewis) o dkly (Kossel) u dgk fd mRÑ"V xlk d vfrfjä vU; rÙok d ijek.kvk d l;ktdrk dk'k e vkB l de byDVkuk dk iuforj.k djd viuk v"Vd i.k dju ¼vFkok ckáre ;k l;kth dk'k e vkB byDVku j[ku½ ;k H, Li, Be vkfn d lUnHk e f}d (Duplet) ;k M;lyV i.k dju ¼l;kth dk'k½ e nk byDVku j[ku d Øe e fudVLFk mRÑ"V xl tlk LFkk;h foU;kl çkIr dju dk ç;kl djr gA vr% l;ktdrk dk'k (Valence shell) e vkB byDVku çkIr djuk gh v"Vd fu;e gA

ybl vkj dkly u crk;k fd ijek.k viuk v"Vd i.k dj LFkk;h mRÑ"V xl foU;kl dk vftr dju d fy, fuEufyf[kr çdkj l l;ktu djr g&

,d ;k vf/kd byDVku dk ,d ijek.k l nlj ijek.k ij i.k LFkkukUrj.k }kjk vk;fud vkc/k curk gA byDVku d lgHkktu }kjk lgl;ktd vkc/k rFkk milgl;ktd vkc/k curk gA

अष्टक नियम की सीमाएँ (Limitations of Octet Rule)

lkekU;r% v"Vd fu;e vud ;kfxdk ,o vf/kdk'k dkcfud ;kfxdk dh ljpukvk dk le>u e mi;kxh gkrk g] fQj Hkh v"Vd fu;e d dN viokn bl çdkj g&

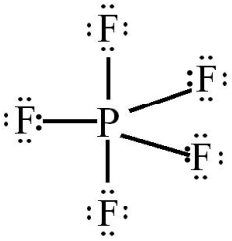
(i) **vi.k v"Vd oky ;kfxd ¼byDVku U;u ;kfxd½** cgr l ,l ;kfxd Kkr g ftud ckáre dk'k e vkB byDVku lHkh de byDVku gkr g] ,l ;kfxdk dk byDVku U;u ;kfxd dgr g&

tl& LiCl, BF_3, $AlCl_3$, BCl_3, $ZnCl_2$, BeH_2 vkfn

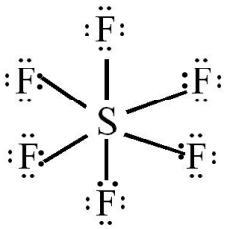
$Li:Cl$, $H:Be:H$, $Cl:\overset{Cl}{B}:Cl$ bu ;kfxdk d l;ktdrk dk'k e Øe'kk 2] 4 rFkk 6 byDVku gA

(ii) **çlkfjr v"Vd oky ;kfxd** % vkor lkj.kh d rhlj rFkk bld vkx d vkork d rÙok e vkc/ku d fy, 3s rFkk 3p d{kdk d vfrfjä 3d d{kd Hkh miyC/k gkr gA bu rÙok d vud ;kfxdk e dUæh; ijek.k d pkjk vkj vkB l vf/kd byDVku gkr g bUg çlkfjr v"Vd oky ;kfxd dgr gA

tl& PF_5, SF_6, IF_7, XeF_4 vkfn



P ijek.k d pkjk vkj 10e- g



S ijek.k d pkjk vkj 12e- g

fo"ke byDVku ;ä Lih'kht

,l ;kfxd ftue dy byDVkuk dh l[;k fo"ke(Odd) gkrh g v"Vd d fu;e dk ikyu ugh djrA

tl& $\dot{N} = \ddot{O}$	$\ddot{O} = \overset{+}{N} - \ddot{O}:^{-}$
ukbfVd vkDlkbM e	ukbVktu MkbvkDlkbM
,d v;fXer byDVku	e ,d v;fXer byDVku

vk;fud ;k o|rl;ktd vkc/k

(Ionic or Electrovalent Bond)

,d ijek.k l nlj ijek.k ij ,d ;k vf/kd byDVkuk d i.k LFkkukUrj.k l vk;fud ;k o|rl;ktd vkc/k dk fuek.k gkrk gA ;g /kkr vkj v/kkr ijek.kvk d e/; fufer gkrk gA /kkr ijek.k viu l;kth dk'k e mifLFkr ,d ;k vf/kd byDVku R;kx dj /kuk;u dk fuek.k djr g tcfd v/kkr ijek.k byDVku xg.k djd _.kk;u dk fuek.k djr gA foijhr vkof'kr vk;u ,d&nlj dh vkj vkd"k.k cy }kjk ijLij tM jgr gA foijhr vkof'kr vk;uk d e/; fLFkj o|rvkd"k.k cy dk vk;fud ;k o|rl;ktd vkcèk dgr gA

vk;fud vkc/k cuu d fy, 'kr

(i) ijek.k dh vk;uu ,UFkYih dk eku ftruk de gkxk èkuk;u mruk vklkuh l cuxkA

(ii) ijek.k dh byDVku yfC/k ,UFkYih dk eku ftruk _.kRed gkxk _.kk;u vklkuh l cuxkA

(iii) vk;fud ;kfxd cuu d fy, tkyd Åtk dk eku vfèkd gkuk pkfg,A

o|rl;ktdrk (Electrovalency)

byDVku dh og l[;k tk vkc/k fuek.k d fy, dkb ijek.k ;k rk R;kxrk g ;k xg.k djrk g] o|rl;ktdrk dgykrk gA vk;fud vkc/k d fuek.k dk fuEufyf[kr mnkgj.k }kjk le>k;k tk ldrk gA

½1½ lkfM;e DykjkbM (NaCl) dk fuek.k (Formation of Sodium Chloride) : lkfM;e ijek.k (Z = 11) e doy ,d l;kth byDVku (2, 8,1) gA blh çdkj Dykjhu ijek.k (Z = 17) e lkr l;kth byDVku (2, 8, 7) gA lkfM;e ijek.k ,d byDVku R;kx dj Na^+ ¼èkuk;u½ dk fuek.k djrk gA bl R;kx x; byDVku dk Dykjhu ijek.k xg.k djd Cl^- _.kk;u e cny tkrk gA ; nkuk foijhr vkof'kr vk;u ijLij vkdf"kr gkdj NaCl dk fuek.k djr gA

$$\underset{(2,8,1)}{\dot{N}a} + \underset{(2,8,7)}{\cdot\dot{C}l:} \longrightarrow \underset{(2,8)}{[Na^+]}\underset{(2,8,8)}{[:\dot{C}l:^-]}$$;k (NaCl)

½2½ eXuhf'k;e DykjkbM dk fuek.k (Formation of Magnesium Chloride) : eXuhf'k;e ijek.k (Z = 12) e nk l;kth byDVku (2, 8, 2) gA Dykjhu ijek.k (Z = 17) e lkr l;kth byDVku (2, 8, 7) gA vc eXuhf'k;e ijek.k nkuk l;kth byDVku R;kxuk pkgrk g fdUr Dykjhu ijek.k doy ,d byDVku xg.k dju dh fLFkfr e gkrk g] vFkkr bu R;kx x; byDVku dk nk Dykjhu ijek.k xg.k dj eXuhf'k;e DykjkbM dk fuek.k djr gA

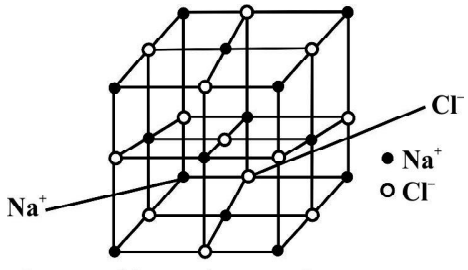
$$\underset{(2,8,2)}{\dot{M}g} + \underset{(2,8,7)}{\dot{C}l:} + \underset{(2,8,7)}{\dot{C}l:} \longrightarrow \underset{(2,8)}{[Mg]^{2}}\underset{(2,8,8)}{[:\dot{C}l:]}\underset{(2,8,8)}{[:\dot{C}l:]}$$;k ($MgCl_2$)

vk;fud ;kfxdk d vfHkyk{kf.kd x.k

(Characteristics Properties of Ionic Compounds)

½1½ Hkkfrd voLFkk (Physical State) : vk;fud ;kfxd çk;% Bkl gkr g D;kfd o fLFkj o|rvkd"k.k cy }kjk ,d fuf'pr 0;oLFkk e ldfyr gkr g ftl fØLVy tkyd (Crystal Lattice) dgr gA tl& lkfM;e DykjkbM ?ku ljpuk (Cubic Structure) e ik;k tkrk gA ¼fp= 12-1½

ftle ,d Na^+ vk;u Ng Cl^- vk;uk rFkk ,d Cl^- vk;u Ng /kuk;uk l f?kjk jgrk gA ¼leUo; l[;k&6½A



fp= 12-1 % lkfM;e DykjkbM dk fØLVy tkyd

(2) **xyukd ,o DoFkukd** (Melting and Boiling Points) : çcy vrjkvkf.od cyk dh mifLFkfr d dkj.k vk;fud ;kfxdk d xyukd ,o DoFkukd mPp gkr gA

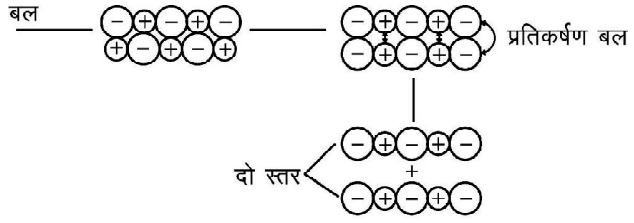
(3) **o|r pkydrk** (Electrical Conductivity) : vk;fud ;kfxd lxfyr rFkk tyh; foy;u e vk;uk dh fuf'pr 0;oLFkk dk lekIr dj nr g ft le vk;u vfHkxeu d fy, Lor= gk tkr g vkj o|r dk lpkyu djr gA

(4) **dBkjrk vkj Hkxj çÑfr** (Hardness and Brittle Nature) : vk;fud ;kfxdk e vk;uk dh fufcM ldfyr 0;oLFkk d dkj.k çk;% dBkj gkrh gA vk;fud ;kfxdk e çR;d vk;u] foijhr vkof'kr vk;uk l f?kjk jgrk g t l gh cká cy yxkr g rk vk;fud fØLVy dh ijr ,d&nlj ij fQly tkrh g] ft l l leku vko'k oky vk;u lehi vk tkr g rFkk çfrd"k.k c< tkrk g ¼fp= 12-2½ blfy, vk;fud ;kfxd Hkxj çÑfr çnf'kr djr gA

(5) **foy;rk** (Solubility) : vk;fud ;k o|rl ;ktd ;kfxd lkekU;r% ty tl /koh; foyk;dk e foy; gkr gA okLro e bl çdkj d foyk;dk d /koh; v.k fØLVyh; Bklk d vk;uk d lkFk vUr%fØ;k dj yr g] ft ld ifj.kkeLo:i Åtk eä gkrh gA ;fn foyk;d ty gk rk eä gb bl Åtk dk ty;ktu Åtk (Hydration energy) dgr gA vk;fud ;kfxd] cUthu] dkcu VVkDykjkbM t l dkcfud foyk;dk e foy; ugh gkr] D;kfd ; v/koh; çÑfr d gkr gA

(6) **vk;fud vfHkfØ;k,** (Ionic Reactions) : tyh; foy;u e vk;fud ;kfxd vk;uk e fo;kftr gk tkr g] vr% vk;fud vfHkfØ;k, rho xfr l lEiUu gkrh gA mnkgj.k d fy, tc NaCl o $AgNO_3$ d tyh; foy;u dk feyk;k tkrk g rk AgCl dk 'or vo{ki rjUr gh cu tkrk gA

(7) **vnf'kd** (Non-Directional) : vk;fud vkc/k vnf'kd gkr gA



fp= 12-2 % vk;fud ;kfxdk dh Hkxj çÑfr

(8) **mPp ?kuRo** (High Density) : vk;fud ;kfxdk e fLFkj o|rvkd"k.k cy d dkj.k vk;u ,d&nlj d lehi vk tkr gA ft l l çfr bdkb vk;ru e vk;uk dh l[;k c< tkrh g] ft ld QyLo:i ;kfxdk dk ?kuRo c< tkrk gA

(9) **le:irk** (Isomorphism) : vud vk;fud ;kfxd leku byDVkfud foU;kl d dkj.k le:irk çnf'kr djr gA tl& NaF rFkk MgO ;gk Na^+, F^-, Mg^{2+}, O^{2-} dk byDVku foU;kl leku gA

lgl;ktd vkc/k (Covalent Bond)

yUxE;j u ybl d lg;kx l lgl;ktd vkc/k dh 0;k[;k dh(bud vulkj nk leku vFkok fHkUu&fHkUu ijek.kvk d e/; byDVkuk d lgHkkrtu }kjk fufeZr vkc/k dk lgl;ktd vkc/k dgr gA

bl vkc/k e yxHkx leku fo|r_.kkRedrk oky nk ijek.k ;k ,d gh rÙo d nk ijek.k byDVkuk dk lk>k dj lgl;ktd vkcU/k dk fuek.k djr gA

lgl;ktd v.kvk d mnkgj.k %

(1) **leijekf.od v.k** (Homoatomic Molecules) : lcl ljyre v.k gkbMkrtu (H_2) g] ft le Hkkx yu oky nkuk gkbMkrtu ijek.kvk e ,d byDVku gkrk gA ;g leku :i l bl byDVku ;Xe dk lgHkkftr djr g rFkk nkuk mRÑ"V xl (He) dk byDVkfud foU;kl çkIr djr gA

$$\dot{H} + \dot{H} \longrightarrow H:H \qquad ;k \qquad H-H$$

lgHkkftr byDVku ;Xe

leijekf.od v.kvk d dN vU; mnkgj.k fuEufyf[kr g&

Dykjhu v.k (Cl_2) e nkuk Dykjhu ijek.kvk ($Z = 17$) d l;kth dk'k e lkr byDVku gkr g vkj çR;d e ,d l;kth byDVku dh deh gkrh gA ; ,d byDVku ;Xe dk lgHkkrtu djr g] ft le çR;d d }kjk ,d byDVku dk ;kxnku fd;k tkrk g&

$$:\dot{C}\dot{l}\cdot + \cdot\dot{C}\dot{l}: \rightarrow :\dot{C}\dot{l}:\dot{C}\dot{l}: \qquad ;k \qquad Cl–Cl$$

lgHkkftr byDVku ;Xe

(2) **fo"keijekf.od v.k** (Heteroatomic Molecules) : lgl;ktd vkc/k fuek.k e Hkkx yu oky v.k e ;fn ijek.k fHkUu gkr g rk ; fo"keijekf.od v.k dgykr gA

fo"keijekf.od v.kvk d dN mnkgj.k fuEufyf[kr g&

ty v.k (H_2O) H Ö H H:Ö:H ;k H—O—H

eFku v.k (CH_4) 4Ḣ Ċ H:Ċ:H ;k H−C−H

vf/kdre lgl;kstdrk (Maximum Covalency)

fdlh rÙo }kjk cuk; tk ldu oky vf/kdre lgl;kstd vkc/kk dh l[;k dk vf/kdre lgl;kstdrk dgr gA

ifjoru'khy l;kstdrk (Variable Valency)

;fn dkb rÙo ,d l vf/kd lgl;kstdrk çnf'kr djr g rk bl rÙo dh ifjoru'khy l;kstdrk dgr gA tl& QkLQkjl PCl_3 o PCl_5 cukrk gA ;gk QkLQkjl +3, +5 l;kstdrk çnf'kr djrk gA

lgl;kstd ;kfxdk d vfHkyk{kf.kd x.k (Characteristics, Properties of Covalent Compounds)

½1½ **Hkkfrd voLFkk** (Physical State) : lgl;kstd ;kfxd lkekU;r% v/koh; (Non Polar) vFkok cgr de /koh; gkr gA bu ;kfxdk dh Bkl ;k no voLFkk bud v.kvk d e/; mifLFkr ncy ok.MjokYl cyk d dkj.k gkrh gA

xl & O_2,N_2, Cl_2

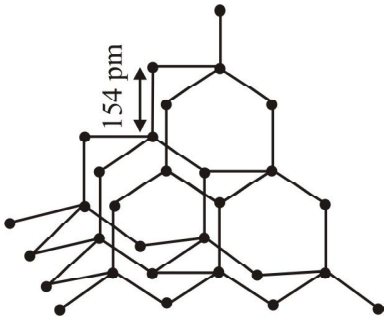
æo & Br_2 ¼ok"i'khy æo½

Bkl & ghjk] xQkbV] S_8, P_4

½2½ **fØLVy ljpuk** (Crystal Structure) : lgl;kstd ;kfxd lkekU;r% NkV&NkV fØLVy d :i e gkr gA yfdu dN lgl;kstd ;kfxdk dh ljpuk bruh fo'kky fØLVyh; gkrh g fd o vlk/kkj.k :i l dBkj gkr g] tl & ghjk] flfydk] SiC, AlN vkfnA

ghjk (Diamond) : ghj e dkcu ijek.k ,d&nlj l sp^3 ldfjr pr"Qydh; :i l pkj vU; dkcu ijek.k l cf/kr gkr gA bl çdkj cgr l pr"Qyd ijLij ln< :i l xFk jgr g ¼fp= 12-3½A ;gh dkj.k g fd ghjk lgl;kstd ;kfxd gkr g, Hkh dBkj gA

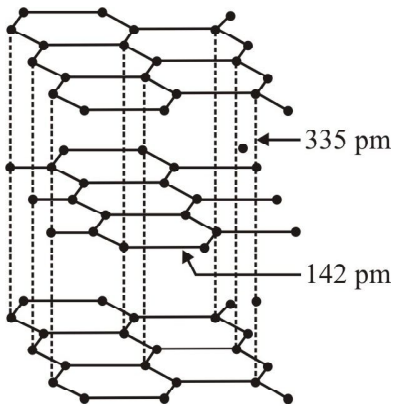
xQkbV (Graphite) : ;g ,d ijrnkj ljpuk d :i e ik;k tkrk gA ble dkcu ijek.k sp^2 ldfjr voLFkk e gkr g vkj ijLij ,d fu;fer "kVHkt d #i e tMdj pknj ¼'khV½ d leku ijr cukr g] tk ijLij ,d&nlj l 3.35 Å dh njh ij ok.MjokYl cyk }kjk fLFkj jgrh gA çR;d dkcu ijek.k ij ,d LorU= byDVku jgrk g ftl xfr'khy (mobile) byDVku dgr gA ;g byDVku ijrk d yEcor *p*-d{kdk e mifLFkr jgrk gA bu xfr'khy ;k eDr byDVkuk d dkj.k xQkbV ,d lgl;kstd ;kfxd gkr g, Hkh o|r dk lpkyd g vkj byDVkM cuku d dke vkrk gA



fp= 12-3 % ghj dh ljpuk

pfd xQkbV fo'kky v.k d :i e jgrk g vr% bldk xyukd mPp gkrk gA ijrh; ljpuk dh ijrk d eè; ncy ok.MjokYl cy gku d dkj.k ijr ,d&nlj ij vklkuh l fQly tkrh g ¼fp= 12-4½A blfy, ;g eyk;e o fpduk gkrk gA bl x.k d dkj.k gh bldk ?kfM;k e 'k"d Lugdk (Lubricants) d :i e mi;kx fd;k tkrk gA

½3½ **xyukd vkj DoFkukd** (Melting Points and Boiling Points) : lgl;kstd ;kfxdk d e/; ncy vkd"k.k cy tl& f}/ko vkd"k.k] gkbMkstu vkc/k] ok.MjokYl cy vkfn gkr g] ftUg rkMu d fy, vf/kd Åtk dh vko';drk ugh gkrh gA blfy, bud xyukd ,o DoFkukd çk;% de gkr gA ghjk vkj xQkbV] tl fo'kky v.kvk e vud v.k ,d&nlj e xFk :i e ik, tku d dkj.k bud xyukd ,o DoFkukd d eku vi{kÑr vf/kd gkr gA



fp= 12-4 % xQkbV dh ljpuk

lkj.kh 12-1 % vk;fud rFkk lgl;kstd ;kfxdk e ryuk

Øe l-	x.k	vk;fud ;kfxd	lgl;kstd ;kfxd
1.	Hkkfrd voLFkk	çk;% Bkl ¼tl & $CaCl_2$, NaCl $MgCl_2$)	Bkl & ghjk] xQkbV æo & Br_2 ¼ok"i'khy æo½ xl & (O_2, N_2, Cl_2)
2.	fØLVy ljpuk	foifjr vkof'kr vk;uk l cu	ijek.kvk l cu gkr gA
3.	vkc/k çÑfr	vk;fud vkc/k e vfn'kkRed x.k	lgl;kstd vkc/k e fn'kkRed x.k
4.	leko;ork	çnf'kr ugh djr	çnf'kr djr gA
5.	vkc/kk dh n<rk	vkc/k n< gku d dkj.k Hkxj çÑfr çnf'kr djr gA	vkc/k vi{kkÑr ncy gku l en] dkey rFkk xyuh; gkr gA
6.	xyukd o DoFkukd	mPp	fuEu ¼dN vioknk dk NkMdj½
7.	foy;rk	/koh; foyk;dk (H_2O, $CHCl_3$) e foy;	v/koh; foyk;dk(C_6H_6, CS_2, CCl_4) e foy;
8.	pkydrk	æfor ;k foy; voLFkk e o|r d lpkyd	o|r d dpkyd viokn & xQkbV
9.	jklk;fud vfHkfØ;k'khyrk	rho xfr l lEiUu gkrh g	en xfr l lEiUu gkrh g
10.	le:irk	çnf'kr djr g	çnf'kr ugh djr g

¼4½ **ok"i'khyrk** (Volatility) : v.kvk d e/; ncy vkd"k.k cy d dkj.k gh lkekU;r% ; ;kfxd cgr ok"i'khy gkr gA

¼5½ **o|r pkydrk** (Electrical Conductivity) : çk;% lgl;kstd inkFk o|r dk pkyu ugh djr g ¼xQkbV d vykok½ D;kfd bue eDr byDVku ;k vk;u vuifLFkr gkr g ijUr dN ;kfxd tk foyk;dk e ?kydj vk;u nr g o|r pkydrk n'kkr gA

tl % HCl, H_2SO_4, HNO_3

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

dN ;kfxd Lor% vk;uu }kjk o|r dk pkyu djr gA

tl % H_2O, NH_3

$$H_2O + H_2O \rightarrow H_3O^+ + OH^-$$

$$NH_3 + NH_3 \rightarrow NH_4^+ + NH_2^-$$

xQkbV e çR;d dkcu ijek.k d ikl ,d eDr byDVku gkrk g] vr% ;g o|r /kkjk dk pkyu djrk gA

¼6½ **foy;rk** (Solubility) : fdlh ;kfxd dh foy;rk e lkekU;rk ,d fl)kUr ykx gkrk g & leku] leku dk ?kksyrk g (Like dissolves Like) vFkkr vk;fud ;kfxd /koh; foyk;dk e foy; gkr g rFkk lgl;kstd ;kfxd v/koh; foyk;dk (C_6H_6, CS_2, CCl_4) e foy; gkr gA lkekU;r;k ; ty e v?kyu'khy o dkcfud foyk;dk e ?kyu'khy gkr gA ble Hkh fo'kky v.k tl ghjk] xQkbV] tk fd fdlh Hkh foyk;d e foy; ugh gkr g] viokn gh gA

¼7½ **jklk;fud vfHkfØ;k'khyrk** (Chemical Reactivity) : lgl;kstd ;kfxdk dh vfHkfØ;k, vkf.od çÑfr gku d dkj.k /kheh xfr l lEiUu gkrh gA bu vfHkfØ;kvk e dN ijku vkc/k VVr g rFkk u; vkc/k cur gA bu vfHkfØ;kvk dk xfrt v/;;u vklkuh l fd;k tk ldrk gA

¼8½ **vkc/k dh çÑfr** (Nature of Bond) : d{kdk d vfr0;kiu d dkj.k vkc/k n< ,o fn'kkRed gkr gA

¼9½ **leko;ork** (Isomerism) : o ;kfxd ftudk v.kl= leku gk fdUr ljpukRed l= ;k f=foe foU;kl fHkUu&fHkUu gk leko;oh dgykr g] vkj bl ifj?kVuk dk leko;ork dgr gA lgl;kstd ;kfxd çk;% leko;ork çnf'kr djr gA

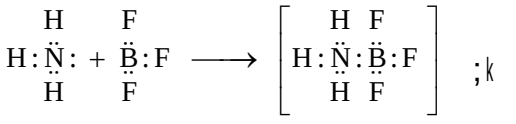
milgl;ktd vkc/k (Coordinate Bond)

;g ,d fo'k"k çdkj dk lgl;ktd vkc/k gkrk g ft le nk ijek.k lk> d byDVku ;Xe }kjk c/k jgr gA bl byDVku ;Xe ij nkuk ijek.k dk leku lk>k gkrk g] ijUr lk> dk byDVku ;Xe doy ,d gh ijek.k }kjk fn;k tkrk gA

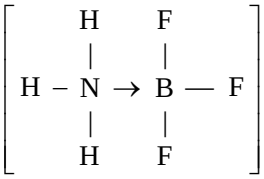
byDVku ;Xe nu okyk ijek.k nkrk ijek.k dgykrk g] xg.k dju okyk ijek.k xkgh ijek.k dgykrk gA bl vkcaèk dk rhj (→) d fpUg l çnf'kr djr gA rhj dk 'kh"k xkgh dh vkj rFkk iN nkrk dh vkj gkrh gA

mnkgj.k 1 % vekfu;e eyd (NH_4^+)

mnkgj.k 2 % ckjku Vkb¶yvkjkbM dk vekfu;k d lkFk ;kxkRikn &



;k



vU; mnkgj.k BF_4^-, SO_4^{2-}, H_2O_2, O_3, SO_2, SO_3, Al_2Cl_6 vkfnA

1- **vkcU/k dh çÑfr %** milgl;ktd ;kfxd e vk;fud rFkk lgl;ktd vkc/k d y{k.k gkr gA

2- **foy;rk %** milgl;ktd ;kfxd lkekU;r% vkf'kd :i l /koh; gku d dkj.k ty e vYi foy; yfdu dkcfud foyk;dk e foy; gkr gA

3- **xyukd ,o DoFkukd %** milgl;ktd ;kfxdk d xyukd ,o DoFkukd lgl;ktd ;kfxdk l vf/kd ,oe vk;fud ;kfxdk l fuEu gkr gA

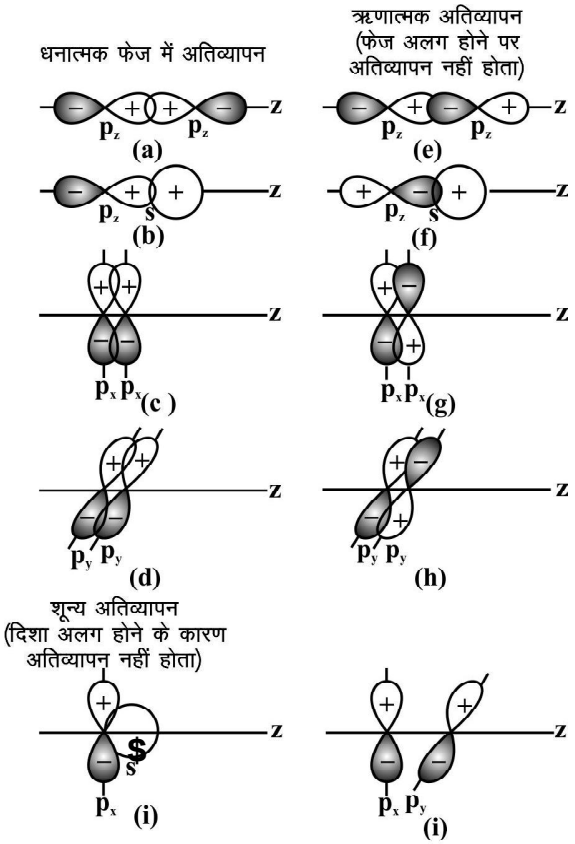
4- milgl;ktd vkcU/k fn'kkRed çÑfr d gkr gA vr% leko;fo;k d ik, tku dh lEHkkouk jgrh gA

ijek.k d{kdk dk vfr0;kiu

vfr0;kiu (Overlapping)

tc nk ijek.k ,d & nlj d fudV vkr g] rk mud byDVku vHk ,d & nlj d ukfHkdk d çfr vkdf"kr gkr gA nkuk ijek.kvk d ijekf.od d{kdk dk vkf'kd vrHknu gk tkrk gA bld QyLo:i byDVku l;fXer gk tkr gA bl ijek.k d{kd vfr0;kiu dgr gA vfr0;kiu dh lhek lgl;kth vkc/k dh çcyrk dk çnf'kr djrh gA nk ijek.kvk d e/; vf/kd vfr0;kiu çcy vkc/k d cuu dk çnf'kr djrk gA vfr0;kiu l r= dh Åtk e deh vkrh gA vr% foyfxr ijek.kvk dh ryuk e v.k T;knk LFkkb gkr gA

ijek.k d{kdk d vfr0;kiu d ifj.kkeLo:i çfr eky eDr gb Åtk dh ek=k dk vkc/k Åtk dgr gA tc nk ijek.k] v.k fuek.k d fy, lehi vkr g rc mud d{kdk dk vfr0;kiu /kukRed] _.kkRed ;k 'kU; gk ldrk gA ;g d{kd rjx Qyu d vk;ke dh fndLFkku e fn'kk vkj fpUg ¼Qt½ ij fuHkj djrk gA vxj vkc/k fuek.k d fy, d{kdk dk fpUg vkj fn'kk ,d leku gkrh g] ml /kukRed vfr0;kiu dgr gA tc d{kdk d fpUg foijhr vkj fn'kk leku gkrh g] rk bl _.kkRed vfr0;kiu dg g] tcfd ijekf.od d{kdk dh fn'kk vyx gku d dkj.k vfr0;kiu ugh gkrk g] bl 'kU; vfr0;kiu dgr g ¼fp= 12-5½A



fp= 12-5 % s rFkk p ijek.k d{kdk (j) /kukRed] _.kkRed rFkk 'kU; vfr0;kiu

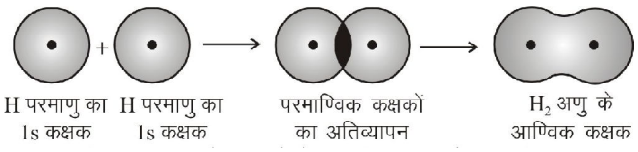
d{kdk d vfr0;kiu d vk/kkj ij lgl ;kth vkc/k nk çdkj d gkr g &

1- flXek (σ) vkcU/k 2- ikb (π) vkcU/k

1- **flXek (σ) vkcU/k** % og vkcU/k tk vkc/kh d{kdk d vrukfHkdh; v{k ij fljokj (Head on) ;k lev{kh; vfr0;kiu l cur gk] mUg flXek (σ) vkc/k dgr gA

(i) **s - s vfr0;kiu** % bl çdkj d vfr0;kiu e ijek.kvk d s d{kd ijLij vfr0;kiu djd vkf.od d{kd cukr gA ijUr s d{kd dk vkdkj xkykdj gku d dkj.k ;g vfr0;kiu fn'kkRed ugh gkrk gA

tl gkbMkt u H_2 v.k e ¼fp= 12-6½



fp= 12-6 % gkbMkt u v.k e ijekf.od d{kdk dk vfr0;kiu

(ii) **s - p vfr0;kiu** % tc fdlh ijek.k dk v)ifjr s d{kd nlj ijek.k d v)ifjr p d{kd l vfr0;kiu djrk g] rc ;g vfr0;kiu s-p vfr0;kiu dgykrk gA bl vfr0;kiu l σ vkcèk curk gA ;g fn'kkRed vkc/k gA dN e[; mnkgj.k HCl, NH_3, H_2O e s - p vfr0;kiu gkr gA

tl & HCl ¼fp= 12-7½

fp= 12-7 % gkbMkt u DykjkbM (HCl) v.k e ijekf.od d{kdk dk vfr0;kiu

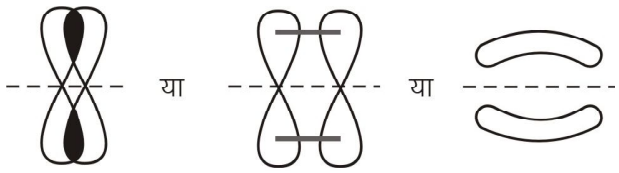
(iii) **p - p vfr0;kiu** % ;g nk çdkj l ldrk g rFkk nkuk gh fn'kkRed vkc/k gA

lev{kh; vfr0;kiu % tc nk v)ifjr d{kd ,d gh v{k ij vfr0;kiu djr g] rk lev{kh; vfr0;kiu dgykrk gA tl Cl_2 e ¼fp= 12-8½

2- **ikb (π) vkcU/k** % og vkcU/k tk vkc/kh d{kdk d vrukfHkdh; v{k ycor ¼likf'od½ rFkk lekukrj

fp= 12-8 % Dykjhu (Cl_2) v.k e p-p ijekf.od d{kdk dk vfr0:kiu

vfr0;kiu l cur gk mUg ikb vkc/k dgr gA ¼fp= 12-9½



fp= 12-9 % *p* d{kdk dk lkf'od vfr0;kiu

ldj.k (Hybridisation)

yxHkx leku Åtk yfdu fHkUu vkÑfr;k d d{kd viuh Åtk rFkk byDVku vHk dk iuforj.k dj mruh gh l[;k e leku Åtk rFkk leku vkÑfr oky uohu d{kd cukr g] mUg ldfjr d{kd dgr g] rFkk bl ifj?kVuk dk ldj.k dgr gA

ldj.k d fy, ifjfLFkfr;k

(Conditions of Hybridisation)

1- ,d gh ijek.k ;k vk;u d yxHkx leku Åtk d d{kd ldj.k e Hkkx yr gA

2- ldfjr d{kdk dh l[;k ldj.k e Hkkx yu oky fofHkUu d{kdk dh l[;k d cjkcj gkrh gA

3- ldj.k e fjDr] v)i.k ;k i.k Hkj d{kd Hkkx yr gA

4- ldfjr d{kd çcy vkc/k cukr g] D;kfd bue vf/kd fn'kkRed x.k gkr gA

5- ,d rÙo fofHkUu çdkj d ldj.k n'kk ldrk gA

6- ldfjr d{kd LFkk;h 0;oLFkk iku d fy, f=foe e fof'k"V fn'kkvk e funf'kr gkr gA blfy, ldj.k dk çdkj v.k dh T;kfefr fu/kkfjr djrk gA

ldj.k d çdkj (Types of Hybridisation)

s, p o d d{kd vkil e lfEefyr gkdj sp, sp^2, sp^3, dsp^2, sp^3d, sp^3d^2 rFkk sp^3d^3 ldfjr d{kd cukr gA

bl v/;k; e ge s o p d{kdk d vkil e lfEefyr gku l cu rhu çdkj d ldj.k dk v/; ;u djxA

(i) sp ldj.k (ii) sp^2 ldj.k (iii) sp^3 ldj.k

j[kh; ;k sp ldj.k (Linear or sp hybridisation)

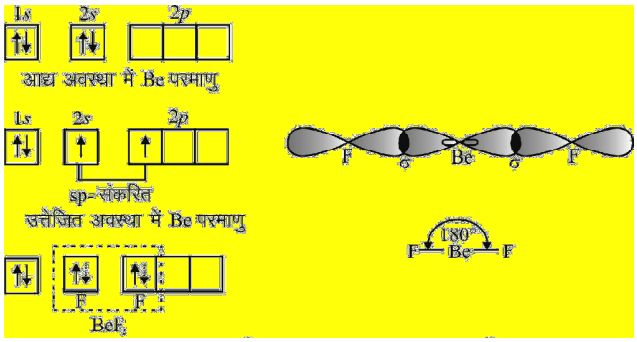
bl çdkj d ldj.k e ,d s rFkk ,d p d{kd ldfjr gkdj nk u; sp ldfjr d{kd cukr gA bld v.k dh vkÑfr j[kh; gkrh gA bl ldj.k dk fod.k ;k j[kh; ldj.k Hkh dgr gA mnkgj.k % $BeCl_2$, CO_2, $HgCl_2$, BeF_2, C_2H_2 vkfnA

cfjfy;e ¶ykjkbM v.k dk fuek.k

(Formation of Beryllium fluoride (BeF_2) Molecule)

Be dk ijek.k Øekd 4 vkj vk| voLFkk e bldk byDVkfud foU;kl $1s^2 2s^2$ gkrk gA pfd bld nkuk d{kd Hkj gkr g] vr% vkc/k fuek.k e bld Hkkx yu dh lEHkkouk ugh gkrh gA v.k dk l= n'kkrk g fd ;g f}l;kth (Bivalent) gA blfy, ij Hkj g, 2s d{kd l ,d byDVku 2p d ,d fjDr d{kd e çkUur dj fn;k tkrk g] tl k fd uhp nf'kr g %

2s ,o 2p nkuk d{kd] ftue fd ,d&,d byDVku gkrk g] sp-ldj.k e lfEefyr gkr gA nk sp-ldj d{kd nk ¶yvkjhu ijek.kvk ($1s^2 2s^2 2p_x^2 2p_y^2 p_z^1$) d v)ifjr 2p-d{kdk l v{kh; vfr0;kiu dj vkc/k cukr gA BeF_2 dk d{kd fp= fuEuor gkrk g ¼fp= 12-10½A



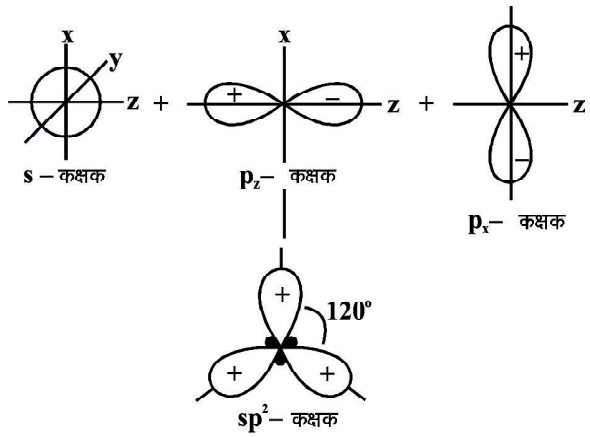
fp= 12-10 % BeF_2 v.k dk d{kd fp=

f=dk.kh; ;k sp^2 ldj.k

(Trigonal or sp^2 hybridisation)

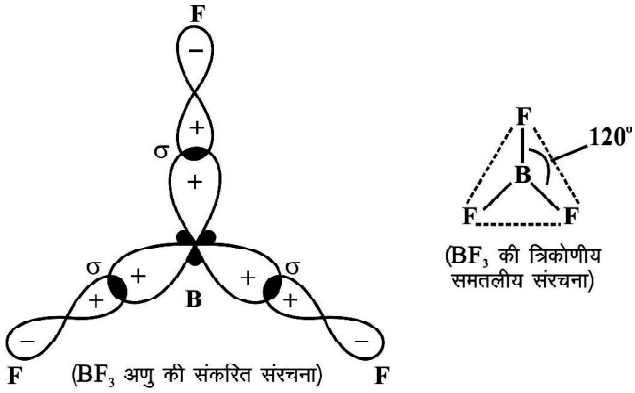
bl çdkj d ldj.k d vUrxr ,d s o nk p d{kd ldfjr gkdj rhu u, sp^2 ldfjr d{kdk dk fuek.k djr gA çR;d sp^2 ldfjr d{kd e 33.3% s- y{k.k rFkk 66.7% p-y{k.k gkr g ¼fp= 12-11½A

v.k dh vkÑfr f=dk.kh; leryh; gkrh g rFkk v.k e vkc/k dk.k 120° dk gkrk gA v.k dh vkÑfr f=dk.kh; gku d dkj.k bl f=dk.kh; ldj.k Hkh dgr gA



fp= 12-11 % sp^2 ldj.k

mnkgj.k & BF_3, $AlCl_3$, C_2H_4, NO_2^-, SO_2, $SnCl_2$ vkfn ¼fp= 12-12½A



fp= 12-12 % BF_3 v.k dk d{kd fp=

tl & BF_3 v.k dk cuuk (Formation of BF_3 Molecule)

pr"Qydh; ;k sp^3 ldj.k

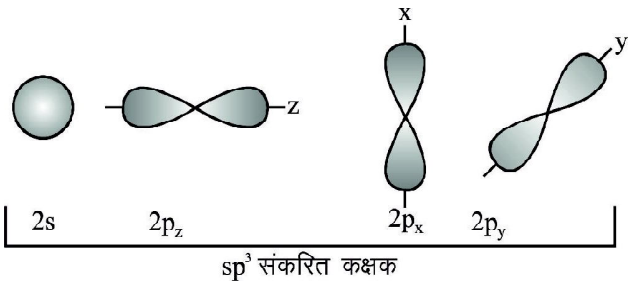
(Tetrahedral or sp^3 hybridisation)

bl ldj.k d vrxr ,d s o rhu p d{kd ldfjr gkdj pkj u, sp^3 ldfjr d{kdk dk fuek.k djr gA çR;d sp^3 ldfjr d{kd e 25% s-y{k.k o 75% p-y{k.k gkr gA

v.k dh vkÑfr lepr"Qydh; gkrh g rFkk v.k e vkc/k dk.k 109.28° gkrk gA v.k dh vkÑfr pr"Qydh; gku d dkj.k bl pr"Qydh; ldj.k Hkh dgr g ¼fp= 12-13½A

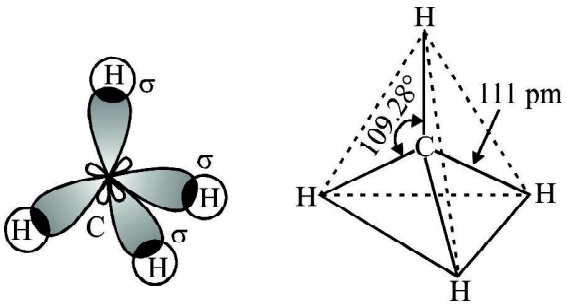
(i) eFku dk fuek.k &

eFku (CH_4) v.k e dkcu d pkjk sp^3 ldj.k d{kd gkbMkt u d v)ifjr 1s d{kd d lkFk v{kh; vfr0;kiu djr gA bl çdkj lHkh pkjk C – H vkcèk



चित्र 12.13 चतुष्फलकीय या sp^3 संकरण

σ vkc/k gkr g vkj 109.28° d vkc/k dk.k d lkFk ,d fu;fer pr"Qyd d pkjk fdukjk ij fLFkr gkr gA ¼fp= 12-14½

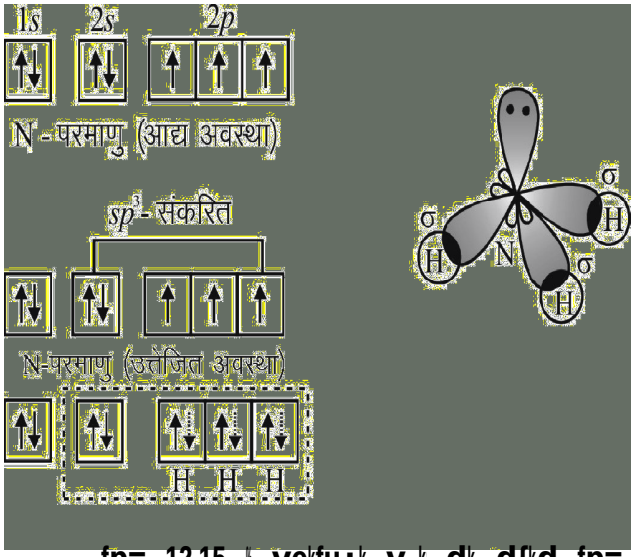


fp= 12-14 % eFku v.k dk d{kd fp=

(ii) **vekfu;k dk fuek.k %** vekfu;k e ukbVkt u dk ijek.k Øekd 7 vkj byDVkfud foU;kl $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ gkrk gA ukbVkt u ijek.k sp^3 ldfjr gkrk g vkj rhuk p-d{kd gkbMkt u d{kdk d lkFk vfr0;kiu e lfEefyr gkr gA

bl çdkj lHkh N – H vkc/k ( ) çÑfr oky gkr gA byDVku d ,dkdh ;Xe dh mifLFkfr fijkfeMh T;kfefr dk rFkk vkc/k dk.k 107.5° dk fu:fir djrk g ¼fp= 12-15½A

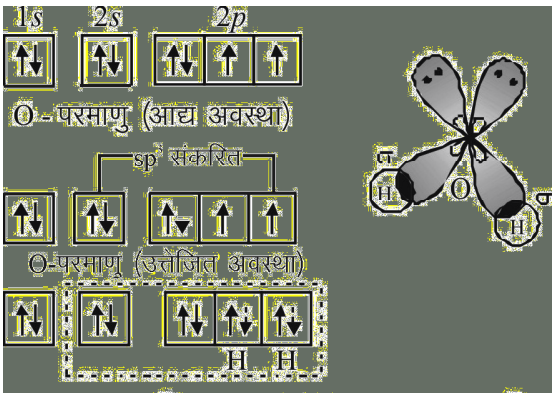
(iii) **ty dk fuek.k %** H_2O e vkDlhtu dk ijek.k Øekd 8 rFkk byDVkfud foU;kl $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$ gkrk gA vkDlhtu ijek.k Hkh sp^3 ldfjr gkrk g tcfd bl fLFkfr e ,d&,d bydVku oky nk d{kd



fp= 12-15 % vekfu;k v.k dk d{kd fp=

gkbMkt u d{kdk d lkFk vfr0;kiu e 'kkfey gkr gA vr% nkuk O – H vkc/k flXek (σ) vkc/k gkr gA nk ,dkdh byDVku ;Xe dh mifLFkfr eMh gb ;k dk.kh; T;kfefr dk rFkk vkc/k dk.k 104.5° fu:fir djrh g ¼fp= 12-16½A

egRoi.k fcUn



fp= 12-16 % H_2O v.k dk d{kd fp=

1- v.k e ijek.kvk d e/; mifLFkr vkd"k.k cy dk jklk;fud vkc/k dgr gA bld cuu l v.k e LFkkf;Ro vk tkrk gA

2- vkc/k dk fuek.k v"Vd fu;e d vulkj gkrk g] vFkkr çR;d ijek.k viu ckáre dk'k e vkB byDVku çkIr

djuk pkgrk gA

3- v"Vd fu;e d viokn&

(i) byDVku U;u ;kfxd & $BeCl_2$, BF_3, $AlCl_3$ vkfnA

(ii) v"Vd dk çkj & PCl_5, SF_6, IF_7 vkfnA

(iii) fo"ke byDVku ;Dr ;kfxd & NO, NO_2 vkfnA

4- jklk;fud vkc/k çe[krk rhu çdkj d gkr g & vk;fud] lgl;ktd rFkk milgl;ktd vkc/k

5- vk;fud vkc/k vf/kdrj s-Cykd d rRo rFkk p-Cykd d gyktuk l cur gA

6- lgl;kth vkc/k v)ifjr d{kdk d vfr0;kiu ;k byDVku lk>nkjh d ifj.kkeLo:i cur gA

7- milgl;ktd vkc/k e nk ijek.k lk> d byDVku ;Xe }kjk c/k jgr g] ijUr lk> dk byDVku ;Xe doy ,d gh ijek.k }kjk fn;k tkrk gA byDVku ;Xe nu oky ijek.k dk nkrk vkj xg.k dju oky ijek.k dk xkgh dgr gA

8- flXek (σ) vkc/k vkc/kh d{kdk d vrukfHkdh; v{k ij fljokj ;k lev{kh; vfr0;kiu l cur gA

9- ikb (π) vkc/k d{kdk d vrukfHkdh; v{k ij yEcor] rFkk lkf'od lekukrj vfr0;kiu l cur gA

10- ldj.k e yxHkx leku Åtk d d{kd vkil e lerY; Åtk ,o vkÑfr d uohu d{kd cukr gA

11- sp ldj.k dk j[kh; ldj.k Hkh dgr gA

12- sp^2 ldj.k dk f=dk.kh; ldj.k Hkh dgr gA

13- sp^3 ldj.k dk pr"Qydh; ldj.k Hkh dgr gA

vH;klkFk ç'u

oLrfu"B ç'u

1- fuEufyf[kr e l fdl v.k e v"Vd dk fue; ykx ugh gkrk &

¼v½ CO_2

¼c½ H_2O

¼l½ O_2

¼n½ CO

2- fuEufyf[kr e l vk;fud vkc/k ;Dr ;kfxd g &

¼v½ $CHCl_3$

¼c½ Cl_2

¼l½ $BaCl_2$

¼n½ CH_4

3- og ;kfxd ftle vk;fud rFkk lgl;ktd vkc/k nkuk mifLFkr g &

¼v½ CH_4

¼c½ H_2

¼l½ KCN

¼n½ KCl

4- ,d s rFkk ,d p d{kdk d ldj.k l cur g &

¼v½ nk ijLij yEcor d{kd

¼c½ 180º ij fLFkr nk d{kd

¼l½ ,d lery ij rhu d{kd

¼n½ pr"Qydh; ljpuk

5- og ;kfxd ftle sp^3 ldfjr d{kd ik;k tkrk g &

¼v½ CO_2

¼c½ CH_4

¼l½ BF_3

¼n½ $BeCl_2$

vfryÄÙkjkRed ç'u

1- jklk;fud vkc/k dk ifjHkkf"kr dhft,A

2- fdlh ,d ;kfxd dk l= fyf[k; ftle v"Vd dk çkj gkrk gA

3- σ rFkk π vkc/k d fuek.k dk fp= l çnf'kr dhft;A

4- fdlh ,d lgl;ktd ;kfxd dk uke fyf[k, tks o|r dk lpkyd gA

5- ty d v.k e vkDlhtu dh ldfjr voLFkk crkb,\

yÄÙkjkRed i'u

1- xQkbV lgl;ktd gkr g; Hkh o|r dk lpkyd g] D;k\

2- BF_3 dh ljpuk leryh; f=dk.kh; g] tcfd NH_3 dh fijkfeMh gA D;k\

3- $BF_3 \leftarrow NH_3$ v.k e fdl çdkj dk jklk;fud vkcèk ik;k tkrk g\ bl v.k dh byDVkfud ljpuk nhft,A

4- vk;fud ;kfxd ty e foy; gkr g] tcfd lgl;ktd ;kfxd ty e vfoy;A D;k\

5- vk;fud ;kfxd Hkxj gkr g] le>kb,\

fucU/kkRed ç'u

1- vk;fud vkc/k fdl dgr g\ vk;fud vkc/k dh vko';d 'kr crkb,A vk;fud ;kfxdk d vfHkyk{kf.kd x.k/kek dh foopuk dhft,A

2- v"Vd fu;e D;k g bldh 0;k[;k djr g, bld viokn fyf[k,A

3- lgl;ktd vkc/k fdl dgr g\ lgl;ktd vkc/k fdru çdkj dk gkrk g\ lgl;ktd ;kfxdk dh e[; fo'k"krk, nhft ,A

4- milgl;ktd vkc/k fdl dgr g\ bl vkc/k dh e[; fo'k"krkvk dh 0;k[;k dhft ,A

5- ldj.k fdl dgr g\ fofHkUu çdkj d ldj.k dh mnkgj.k lfgr 0;k[;k dhft ,A

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mÙkjekyk % 1 ¼n½ 2 ¼l½ 3 ¼l½ 4 ¼c½ 5 ¼c½

bdkb & VII

v/;k; & 13

jklk;fud rFkk vk;fud lkE;

(Chemical and Ionic Equilibrium)

Hkfedk

,lh jklk;fud vfHkfØ;k, ftue fØ;kdkjd Lih'kht fdUgh fo'k"k ifjfLFkfr;k e ijLij vfHkfØ;k djd mRiknk e ifjofrr gkr g yfdu mUgh ifjfLFkfr;k e mRiknk l fØ;kdkjd çkIr ugh fd; tk ldr g] mUg vuRØe.kh; vfHkfØ;k, dgr gA bUg fØ;kdkjd l mRiknk dh vkj rhj dk fpà cukdj çnf'kr djr gA tl&

$$AgNO_3(aq) \quad NaCl(aq) \qquad AgCl(s) \quad NaNO_3(aq)$$

,lh jklk;fud vfHkfØ;k, ftue fØ;kdkjd fdUgh fo'k"k ifjfLFkfr;k e vkil e vfHkfØ;k dj mRiknk e ifjofrr gkr g vkj mUgh ifjfLFkfr;k e gh mRikn iu% fØ;kdkjdk e ifjofrr gkr g vFkkr vfHkfØ;k nkuk fn'kkvk e ¼vx rFkk çrhi½ lEiUu gkrh gk] mUg mRØe.kh; vfHkfØ;k, dgr gA

bu vfHkfØ;kvk e ck;h l nk;h vkj pyu okyh vfHkfØ;k ;k ftl vfHkfØ;k e fØ;kdkjd mRikn e cnyr g ml vx vfHkfØ;k dgr g tcfd nk;h l ck;h vkj pyu okyh vfHkfØ;k ;k ftl vfHkfØ;k e mRikn iu% fØ;kdkjd e cnyr g ml çrhi vfHkfØ;k dgr gA tl&

$$N_2(g)+3H_2(g) \underset{\text{çrhi vfHkfØ;k}}{\overset{\text{vx vfHkfØ;k}}{\rightleftharpoons}} 2NH_3(g)$$

jklk;fud lkE; (Chemical Equilibrium)

mRØe.kh; vfHkfØ;k dh og voLFkk ftld vUrxr vx vkj çrhi nkuk vfHkfØ;kvk dh nj cjkcj gk tkrh g rFkk fØ;kdkjdk vkj mRiknk dh lkUærk, fLFkj gk tkrh g] jklk;fud lkE; ;k lkE;koLFkk dgykrh gA tl&

$$CaCO_3(s) \rightleftharpoons CaO(s)+CO_2(g)$$

$$H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$$

$$N_2(g) \quad O_2(g) \rightleftharpoons 2NO(g)$$

lkE; dk fuEufyf[kr nk Hkkxk e oxhZÑr fd;k x;k g&

1- **Hkkfrd lkE;** (Physical Equilibrium) : fofHkUu Hkkfrd çØek e LFkkfir gku oky lkE; dk Hkkfrd lkE; dgr gA tl& cQ dk fi?kyuk] ty dk okf"ir gkuk vkfnA

2- **jklk;fud lkE;** (Chemical Equilibrium) : fofHkUu jklk;fud çØek e LFkkfir gku oky lkE; dk jklk;fud lkE; dgr gA tl& H_2 o I_2 d e/; vfHkfØ;k] $CaCO_3$ dk vi?kVu vkfnA

jklk;fud lkE; dh çÑfr

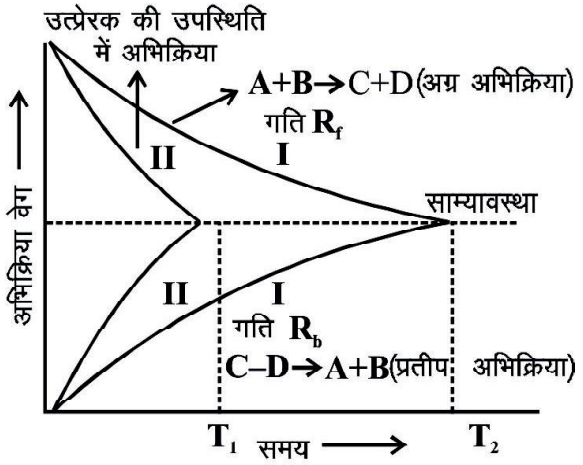
jklk;fud lkE; dk le>u d fy, ge ,d mRØe.kh; vfHkfØ;k ij fopkj djr g&

$$A+B \rightleftharpoons C+D \qquad ...(1)$$

çkjEHk e ge A o B dh dN ek=k, ,d cUn ik= e yr gA tl gh vfHkfØ;k çkjEHk gkrh g C rFkk D dk cuuk çkjEHk gk tkrk g vkj lkFk gh C vkj D vfHkfØ;k djd A vkj B cukuk çkjEHk dj nr g vFkkr vx vkj çrhi vfHkfØ;k; yxHkx ,d gh le; çkjEHk gk tkrh gA çkjEHk e vx vfHkfØ;k dk ox çrhi vfHkfØ;k d ox l cgr vf/kd gkrk g ijUr tl&tl C vkj D dh ek=k c<xh çrhi vfHkfØ;k dk ox Hkh c<xkA bl çdkj le; d lkFk&lkFk vx vfHkfØ;k dk ox ?kVxk tcfd çrhi vfHkfØ;k dk ox c<xkA dN le; ckn ,lh fLFkfr vkrh g fd vx vfHkfØ;k vkj çrhi

vfHkfØ;k dk ox leku gk tkrk g vkj vfHkfØ;k lkE;koLFkk e vk tkrh g vFkkr og fLFkfr tc nk foijhr vfHkfØ;k, leku ox l gkrh gk vkj vfHkdkjdk vkj mRiknk dh lkUærk le; d lkFk ifjofrr u gk] lkE;koLFkk dgykrh gA

lkE;koLFkk ij fØ;kdkjdk vkj mRiknk dh lkUærk e dkb ifjoru ugh gkrk g ijUr vx vkj çrhi vfHkfØ;k, lEiUu gkrh jgrh g blfy; jklk;fud lkE; ,d xfrt lkE; (Dynamic Equilibrium) ¼fp= 13-1½ gA



fp= 13-1 % ,d vfHkfØ;k e xfrd lkE;

Hkkfrd çØek e lkE;

Hkkfrd iØe dk vFk inkFk dh fofHkUu voLFkk Bkl] æo vkj xl l lEcfU/kr gA Hkkfrd çØe d v/;;u l lkE;koLFkk e fdlh fudk; d vfHky{k.kk dk vkl kuh l le>k tk ldrk gA Hkkfrd voLFkkvk e vUr%ifjoru bld J"B mnkgj.k g&

Bkl ⟺ æo

æo ⟺ xl

Bkl ⟺ xl

1- **Bkl&æo lkE;koLFkk** (Solid-liquid Equilibrium) : ,d Å"ekjk/kh Fkel ¶ykLd e j[kh cQ ,o ty] tc ¶ykLd inkFk vkj ifjo'k e Å"ek dk fofue; ugh gkrk g vFkkr uk rk Å"ek ckgj fudyrh g vkj uk gh Å"ek ckgj l vnj vkrh g] tc rkieku rFkk nkc fLFkj jgr g rk lkE;koLFkk e cQ rFkk ty d æ0;ekuk e dkb ifjoru ugh gkrkA mi;ä lkE;koLFkk LFkkfrd ugh gkrh g ijUr xfrd gkrh gA cQ rFkk ty d e/; vfHkfØ;k lrr pyrh jgrh gA

cQ ⟺ ty

$H_2O(s)$ ⟺ $H_2O(\ell)$

xyu dh nj ⟺ fgeÑr gku dh nj

2- **æo&xl lkE;koLFkk** (Liquid-Gas Equilibrium) : ty dk ,d [ky ik= e j[kr g rk ty dk ok"iu gkrk g rFkk dN le; i'pkr ijk ty okf"ir gk tkrk gA fuf'pr rkiØe ij ;fn ty dk ,d cUn ik= e j[k rk ty okf"ir gkxk ,o ty d v.k æo voLFkk l ok"i voLFkk e tk;x vkj ok"i nkc c<xkA ,d fLFkfr ,lh vkrh g tc ok"iu dh nj l?kuu dh nj d leku gk tkrh gA vFkkr fuf'pr rkiØe ij vc ty] tyok"i dh ek=k ugh c<xhA ;g lkE;koLFkk dk çnf'kr djrh gA

$H_2O(\ell)$ ⟺ $H_2O(g)$

ok"iu dh nj ⟺ l?kuu dh nj

3- **Bkl dk æo e o xl dk æo e lkE; %**

¼v½ **Bkl dk æo e lkE; %** ;fn fuf'pr rkiØe o nkc ij ty d fuf'pr vk;ru e 'kôj dk ?kkyrk 'kôj dk foy;u ikIr gkrk g bl foy;u e 'kôj dh ,d fuf'pr ek=k gh ?kyrh gA yfdu ,d fLFkfr ,lh vk,xh tc 'kôj dh vf/kd ek=k ?kkyu ij og ugh ?kyxh vFkkr 'kôj dk lrIr foy;u çkIr gkrk gA lrIr foy;u e 'kDdj d ?ky g, v.kvk ,o fcuk ?ky v.kvk d e/; xfrd lkE;koLFkk LFkkfir gk tkrh gA

'kôj ¼foy;u½ ⟺ 'kôj ¼Bkl½
?ky fcuk ?ky g,

lkE;koLFkk ij 'kôj d ?kyu dh nj 'kôj d iu% fØLVyu dh nj d cjkcj gkrh gA

'kôj d ?kyu dh nj ⟺ 'kôj d iu% fØLVyu dh nj

¼c½ **xl dk æo e lkE; %** tc xl dk æo e ?kkyk tkrk g rk fLFkj rki ,o nkc ij xl d vfoy; v.kvk ,o æo e ?ky g, v.kvk d e/; lkE;koLFkk LFkkfir gk tkrh gA

tl& $CO_2(g)$ ⟺ CO_2 ¼æo e ?kfyr½

jklk;fud çØek e lkE;
(Equilibria in Chemical Systems)

¼v½ **$CaCO_3$ dk fo;ktu %** tc Bkl dk ,d cUn ik= e ydj fuf'pr rkiØe ij xje djr g rk ;g Bkl CaO rFkk CO_2 xl e fo;kftr gkrk gA tc rd nkc c<xk rc rd fo;ktu gkrk jgxk yfdu FkkMh nj ckn nkc fLFkj gk tkrk gA bldk vFk ;g gvk fd CO_2dk cuuk fLFkj gk x;k tcfd $CaCO_3$ vHkh Hkh mifLFkr gA bl vfHkfØ;k e nkc dh fLFkjrk bl ckr dk inf'kr djrh g fd vfHkfØ;k e lkE; LFkkfir gk x;k gA ftl fuEufyf[kr çdkj l çnf'kr djr g&

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

¼c½ **gkbMktu o vk;kMhu dk l;kx %** tc gkbMktu o vk;kMhu dk cUn ik= e ydj fuf'pr rkiØe ij xje fd;k tkrk g rk gkbMktu vk;kMkbM curh gA çkjEHk e ik= e feJ.k xgj cxuh jx dk gkxk yfdu tc vfHkfØ;k gkxh rk gkbMktu] vk;kMhu l vfHkfØ;k djxh o vk;kMhu dh ek=k de gku yxxh o ik= e cxuh jx gYdk gkrk tk,xk vFkr jx dh rhork de gkrh tk,xhA ,d fLFkfr ,lh vk,xh fd vfHkfØ;k feJ.k d jx dh rhork fLFkj gk tk,xh tcfd mle vHkh Hkh vfHkdkjd mifLFkr gA ;g jx dh fLFkjrk bl ckr dk çnf'kr djrh g fd vfHkdkjd o mRikn dh lkUærk fLFkj gk xb g o lkE;koLFkk çkIr gk xb gA

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

æ0; vuikrh fØ;k fu;e ,o lkE;
fLFkjkd (Law of Mass Action and Equilibrium Constant)

jklk;fud vfHkfØ;k d ox ij lkUærk d çHkko dk le>ku d fy, lu 1867 e uko d jlk;uK lh-,e- xycx (C.M. Gulberg) o ih- okx (P. Wage) u ,d fu;e fn;k ftl xycx&okx dk fu;e] æ0; vuikrh fØ;k dk fu;e ;k lfØ; æ0;eku dk fu;e dgr gA

bl fu;e d vulkj çR;d jklk;fud vfHkfØ;k dk ox vfHkfØ;k e Hkkx yu oky fØ;kdkjd inkFkk d lfØ; æ0;ekuk d x.kuQy d lekuikrh gkrk gA bl fu;e e ç;ä 'kCnk dh 0;k[;k v|kfyf[kr g&

vfHkfØ;k dk ox % fØ;kdkjd inkFkk dh xke ekyk e og l[;k tk bdkb le; e mRiknk e ifjofrr gk tk;] vfHkfØ;k dk ox dgykrk gA

$$\text{vfHkfØ;k dk ox} = \frac{\text{lkUærk e ifjoru}}{\text{le;}}$$

vfHkfØ;k ox dh bdkb eky yhVj$^{&1}$ ld.M$^{&1}$ gkrh gA

lfØ; æ0;eku (Active mass) : fØ;kdkjd inkFkk dh xke ekyk e og l[;k tk bdkb vk;ru e mifLFkr gk lfØ; æ0;eku dgykrh gA lfØ; æ0;eku dk xke eky çfr yhVj e çdV fd;k tkrk gA bl xke v.kdrk ;k ekyjrk Hkh dgr gA

$$\text{lfØ; æ0;eku} = \frac{\text{inkFk dh ek=k ¼xke e½ @ inkFk dk v.kHkkj}}{\text{ik=dk vk;ru ¼yhVj e½}}$$

fdlh jklk;fud vfHkfØ;k % $A + B \rightleftharpoons C + D$ (i) e A, B, C, D d lfØ; æ0;eku Øe'k% [A], [B], [C], [D] gk] vx vfHkfØ;k dh xfr r_f o çrhi vfHkfØ;k dh xfr r_b gk] rc æ0; vuikrh fØ;k fu;ekulkj&

vx vfHkfØ;k dh xfr $r_f \propto [A][B]$

çrhi vfHkfØ;k dh xfr $r_b \propto [C][D]$

$r_f = K_f [A] [B]$ ...(2)

$r_b = K_b [C] [D]$ ...(3)

K_f o K_b vx o çrhi vfHkfØ;k d ox fu;rkd gA lkE;koLFkk ij&

$r_f = r_b$

$K_f [A] [B] = K_b [C] [D]$ ...(4)

$$\frac{K_f}{K_b} \quad \frac{C \quad D}{A \quad B} \qquad ...(5)$$

$$K = \frac{K_f}{K_b}$$

rkiØe d fLFkj jgu ij] vfHkfØ;kvk d ox fu;rkd Hkh fLFkj jgr gA

K_f ;k $K_b \propto$ rkiØe

K dk lkE; fLFkjkd dgr gA

K nk çdkj dk gkrk gA K_p o K_c

K_p dk vFk lkE; fLFkjkd nkc d :i e gA

K_c dk vFk lkE; fLFkjkd lkærk d :i e gA

tl& $K_c = \frac{\text{fØ;kQyk dh lknrk dk x.kuQy}}{\text{fØ;kdkjdk dh lknrk dk x.kuQy}}$

tl& $K_C = \frac{[C][D]}{[A][B]}$ ...(6)

;fn jklk;fud vfHkfØ;k xlh; voLFkk e gkrh g vFkkr fØ;kdkjd ,o mRikn lHkh xlh; çÑfr d gk rk ge fØ;kdkjdk ,o mRiknk e ekyj lkUærkvk d LFkku ij mud vkf'kd nkck (partial pressure) dk ç;kx e yr gA bu ifjfLFkfr;k e lkE; fLFkjkd dk K_p e inf'kr fd;k tkrk gA vfHkfØ;k

$aA + bB \rightleftharpoons cC + dD$ ¼xlh; voLFkk e½

jklk;fud lkE; d vuqkj

$K_p \quad \frac{P_C^{\,c}\ P_D^{\,d}}{P_A^{\,a}\ P_B^{\,b}}$ ...(7)

bl çdkj tc Lih'kht dh ekyj lkUærk, yh tkrh g rc lkE; fLFkjkd K_c gkrk gA tc Li'kht dk vkf'kd nkc fy;k tkrk g rc lkE; fLFkjkd K_p gkrk gA

lkE;koLFkk dk çHkkfor dju oky dkjd
(Factors Affecting the State of Equilibrium)

tc fudk; lkE;koLFkk e gkrk g rc vx rFkk çrhi vfHkfØ;k, ,d leku ox l lEiUu gkrh gA vFkkr lkE; xfrd voLFkk e gkrk gA rki] nkc vkj lkUærk dk lkE; ij çHkko ek=kRed :i l rk æ0; vuikrh fØ;k d fu;e d vuqkj fn;k tk ldrk g] yfdu x.kkRed :i l bud lkE; ij çHkko dk v/;;u 1884 e Ýkalhlh oKkfud yk&'kkrfy; u fd;k rFkk ,d fu;e çLrr fd;k ftl yk 'kkrfy; dk fu;e dgr gA

bl fu;e d vuqkj ;fn fdlh vfHkfØ;k dh lkE;koLFkk ij rki] nkc ,o lkUærk vkfn e ifjoru fd;k tkrk g rk lkE; ml fn'kk e foLFkkfir gk tkrk g ftl vkj fd, x, ifjoru dk çHkko u"V gk ldA

¼1½ **lkUærk ifjoru dk çHkko** (Effect of Change of Concentration) : ,d vfHkfØ;k dh lkE;koLFkk ij fdlh fØ;kdkjd ,o mRikn dh lkUærk e of) dh tkrh g rk lkE; ml vkj foLFkkfir gkrk g] tgk inkFk dh lkUærk e deh gkA

mnkgj.k d fy, N_2 o H_2 }kjk vekfu;k dk l'y"k.k gkrk g

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

;fn lkE;koLFkk ij N_2 vFkok H_2 dh lkUærk c<kb tkrh g rk lkE; vx fn'kk e foLFkkfir gkrk g rkfd N_2 o H_2 dh lkUærk e deh gkA blh çdkj ;fn lkE;koLFkk ij NH_3 dh lkUærk c<kb tkrh g rk lkE; çrhi fn'kk e foLFkkfir gkrk gA vFkkr tc fdlh Hkh fØ;kdkjd dh lkUærk e of) gkrh g rk lkE; vx fn'kk e foLFkkfir gk tkrk g tc fdlh mRikn dh lkUærk e of) gkrh g rk lkE; çrhi fn'kk e foLFkkfir gk tkrk gA

¼2½ **rki ifjoru dk çHkko** (Effect of Change of Temprature) : rki e of) gku ij lkE; Å"ek'kk"kh vfHkfØ;k dh fn'kk e foLFkkfir gk tkrk g rFkk rki e deh gku ij lkE; Å"ek{kh vfHkfØ;k dh fn'kk e foLFkkfir gk tkrk gA

mnkgj.k d fy, ukbfVd vkDlkbM d fuek.k dh vfHkfØ;k Å"ek'kk"kh gA

$N_2(g) + O_2(g) \underset{\text{Å"ek{kh}}}{\overset{\text{Å"ek'kk"kh}}{\rightleftharpoons}} 2NO(g)\ \Delta H = +180.0\ kJ$

rki e of) dju ij lkE; nk;h vkj foLFkkfir gk tkrk g tcfd rki e deh dju ij lkE; ck;h vkj foLFkkfir gk tkrk gA

¼3½ **nkc ifjoru dk çHkko** (Effect of Change of Pressre) : nkc dk çHkko vfHkfØ;k e Hkkx yu oky fØ;kdkjdk ,o mRiknk d ekyk dh l[;k ij fuHkj djrk gA

(i) ;fn mRiknk d ekyk dh l[;k vfHkdkjd d ekyk dh l[;k l vf/kd gk

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

¼1 eky½ ¼2 eky½

Δn = mRikn d ekyk dh l[;k&vfHkdkjdk d ekyk dh l[;k

o vfHkfØ;k, ftue $\Delta n > 0$ vFkkr Δn /kukRed gk rk nkc c<ku ij lkE; çrhi fn'kk e vkj nkc e deh dju ij lkE; vx fn'kk e foLFkkfir gkxkA

(ii) o vfHkfØ;k, ftue $\Delta n < 0$ vFkkr Δn _.kkRed gk rk nkc c<ku ij lkE; vx fn'kk e vkj nkc de dju ij lkE; çrhi fn'kk e foLFkkfir gkrk gA

$N_2(g) \quad 3H_2(g) \rightleftharpoons 2NH_3(g)$

¼1 eky½ ¼3 eky½ ¼2 eky½

dy 4 eky

(iii)o vfHkfØ;k, ftue $\Delta n = 0$ rk lkE;koLFkk ij nkc ifjoru dk dkb iHkko ugh iMrkA

$$N_2(g) \quad O_2(g) \rightleftharpoons 2NO(g)$$

¼1 eky½ ¼1 eky½ ¼2 eky½

dy 2 eky

¼4½ **lkE;koLFkk ij mRçjd dk çHkko** (Effect of Catalyst on Equilibrium) : dkb mRçjd mRØe.kh; vfHkfØ;k dh vx rFkk çrhi nkuk vfHkfØ;k d ox dk ,d leku ek=k e c<krk gA mRçjd lkE;koLFkk e fØ;kdkjdk ,o mRiknk dh lkUærkvk dk çHkkfor ugh djrk vFkkr mRçjd lkE;koLFkk dk çHkkfor ugh djrkA mRçjd dh mifLFkfr e doy lkE;koLFkk 'kh?k çkIr gkrh gA

¼5½ **lkE;koLFkk ij fuf"Ø; xlk dk çHkko** (Effect of Inert gases on Equilibrium) : ;fn fLFkj vk;ru ij fuf"Ø; xlk dk feyk;k tkrk g rk lkE; d foLFkkiu dh fn'kk vfHkfØ;k dh çÑfr ij fuHkj djrh gA

levk;u iHkko vkj bldk egÙo

(Common ion Effect and its Importance)

fdlh ncy o|r vi?kV; d tyh; foy;u e le&vk;u mRiUu dju oky çcy o|r vi?kV; dk feyk fn;k tk; rk ncy o|r vi?kV; dh fo;kstu dh ek=k vkj de gk tkrh gA bl çdkj ncy o|r vi?kV; d fo;kstu dh ek=k de gku dk çHkko le&vk;u çHkko (Common ion Effect) dgykrk gA

levk;u çHkko vuç;kx

x.kkRed fo'y"k.k e vuç;kx

¼1½ **leg II e ru HCl dk mi;kx %** f}rh; leg e HCl dh mifLFkfr e H_2S çokfgr djr g rk le&vk;u çHkko d dkj.k lYQkbM vk;uk dk lkUæ.k de gk tkrk g tk de foy;rk x.kuQy oky f}rh; leg d lnL;k d vo{ki.k d fy, i;kIr gA

$$HCl \rightleftharpoons H^+ + Cl^-$$

$$H_2S \rightleftharpoons 2H \quad S^{2-}$$

¼levk;u½

bl çdkj le vk;u çHkko d dkj.k H^+ vk;u d lkUæ.k e of) gkrh g] ftlls H_2S dk vk;uu de gk tkrk g ftle S^{2-} FkkMh ek=k e çkIr gkr g tk fd f}rh; leg d lYQkbMk d vo{ki.k d fy, i;kIr g D;kfd /kuk;u o S^{2-} vk;uk dk vk;uh x.kuQy mud foy;rk x.kuQy l vf/kd gk tkrk g fdUr S^{2-} dk ;g de lkUæ.k IV leg d /kuk;uk d lYQkbMk d vo{ki.k d fy, vi;kIr g] vr% bl ifjfLFkfr e o vo{kfir ugh gkr gA

(iii) **rrh; leg e NH_4Cl dk mi;kx %** NH_4Cl dk mi;kx x.kkRed fo'y"k.k d III vkj V leg d èkuk;uk d vo{ki.k e fd;k tkrk g(

rrh; ox dk leg vfHkded vekfu;e Dykjkb M NH_4Cl dh mifLFkfr e NH_4OH gA NH_4OH ,d ncy o|r vi?kV; g ftldk vYi ek=k e fo;kstu fuEukulkj gkrk g&

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

NH_4Cl ,d çcy o|r vi?kV; g ftldk fo;kstu fuEukulkj g&

$$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$$

vr% çcy NH_4Cl dh mifLFkfr e ncy NH_4OH dk vk;uu de gk tkrk g ftll de OH^- vk;u çkIr gkr g tk fd doy rrh; leg Fe^{3+}, Al^{3+} rFkk Cr^{3+} vk;u gh gkbMkDlkbM d :i e vo{kfir gk ikr gA ipe leg d Ba^{2+}, Sr^{2+}, Ca^{2+} vk;u vo{kfir ugh gk ikr D;kfd rrh; ox d eydk d gkbMkDlkbMk dk foy;rk x.kuQy ipe ox d eydk d gkbMkDlkbM d foy;rk x.kuQy l de gkrk gA

foy;rk x.kuQy vkj bldk egÙo

(Solublity Product and its importance)

fuf'pr rki ij lrlr foy;u e mifLFkr vk;uk dh lkUærk d x.kuQy dk o|r vi?kV; dk foy;rk x.kuQy dgr gA

$$AgCl_{(s)} \rightleftharpoons AgCl_{¼foy;½} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$$

æ0; vuikrh fØ;k d fu;ekulkj

$$K = \frac{[Ag^+_{(aq)}][Cl^-_{(aq)}]}{[AgCl_{(s)}]}$$

$$K[AgCl] = [Ag^+_{(aq)}][Cl^-_{(aq)}]$$

pfd fLFkj rki ij fdlh lrlr foy;u e [AgCl] Bkl dh ek=k vFkok yo.k dh lkUærk fLFkj jgrh gA vr% K(AgCl) Hkh fLFkj gh jgxkA bl u; fLFkjkd K_{sp} }kjk 0;ä fd;k tkrk gA

$$K_{sp} = [Ag^+_{(aq)}][Cl^-_{(aq)}]$$

mi;ä 0; td d vk/kkj ij fuEufyf[kr fu"d"k fudky ldr gA ;fn vk;uh lkUærk dk x.kuQy foy;rk x.kuQy d cjkcj gkrk g rk foy;u lrlr gkxkA

$[A^+][B^-] = K_{sp}$ foy;rk x.kuQy

(ii) ;fn vk;uh lkUnrk dk x.kuQy foy;rk x.kuQy l de gkrk g rk foy;u vlrlr gkxk rFkk yo.k dh vkj ek=k ?kkyh tk ldrh gA

$[A^+][B^-] < K_{sp}$

(iii) ;fn vk;uh lkUærk dk x.kuQy foy;rk x.kuQy l vf/kd gkrk g rk foy;u vfrlrlr gkxkA bl fLFkfr e yo.k dk vo{ki.k gkrk gA

$[A^+][B^-] > K_{sp}$

foy;rk x.kuQy dk egÙo

¼1½ **ekyj foy;rk dh x.kuk %** foy;rk x.kuQy dh lgk;rk l vYi foy; o|r vi?kV; dh foy;rk eky çfr yhVj e Kkr dj ldr gA

¼2½ **ued dk 'kf)dj.k %** ued dk 'kf)dj.k foy;rk x.kuQy ij vk/kkfjr gA v'k) NaCl e vf/kdk'kr% KCl dh v'kf) gkrh gA KCl dk foy;rk x.kuQy NaCl dh ryuk e vf/kd gkrk gA v'k) NaCl d lkUæ foy;u e HCl xl çokfgr djr g ,lk dju ij Cl^- vk;u dh lkUærk c< tkrh g ;g lkUærk doy NaCl dk vo{kfir dju d fy, i;kIr gkrh g] KCl foy;u e gh jg tkrk gA

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$HCl \rightleftharpoons H^+ + Cl^-$$

¼3½ **lkcu dk fuyo.ku** (Salting out of soaps) **:** mPp olh; vEyk d lkfM;e ;k ikVf'k;e yo.k lkcu gkrk gA ry e lkfM;e ;k ikVf'k;e gkbMkDlkbM dk fuek.k gkrk gA bUg RCOONa ;k RCOOK l= l 0;ä djr gA bl foy;u e NaCl feyk;k tko rk foy;u e Na^+ vk;u dh lkUærk e of) gkrh gA ftll Na^+ LV,jV vk;uk dh lkUærk dk x.kuQy K_{sp} l vf/kd gk tkrk g ftld dkj.k lkcu dk vo{ki.k gkrk gA

tgk ij&

$$RCOONa_{(s)} \rightleftharpoons RCOO^-_{(aq)} + Na^+_{(aq)}$$

$(R=C_{17}H_{33},\ C_{17}H_{35},\ C_{15}H_{31})$

$K_{sp} = [RCOO^-][Na^+]$

NaCl feyku ij

$$RCOONa + NaCl \rightleftharpoons RCOO^- + 2Na^+ + Cl^-$$

$K_{sp} < [RCOO^-][Na^+]^2$

okLro e lkE; ck;h vkj foLFkkfir gkrk gA blfy, fXyljky dk ryh; :i e foy;u e NkMdj lkcu vo{kfir gkrk gA bl iØe dk fuyo.ku dgr gA

¼4½ **lkfM;e ckbdkckuV d fuek.k e %** lkYo fof/k e $NaHCO_3$ d fuek.k d fy, vekfu;kÑr ckbu¼vekfu;k e NaCl dk tyh; foy;u½ e CO_2 xl çokfgr dh tkrh g ftll $NaHCO_3$ dk vo{ki.k gk tkrk g] bldk dkj.k g fd $NaHCO_3$ dk vk;uh x.kuQy K_{sp} l vf/kd gk tkrk g ftll og vU; inkFkk l igy vo{kfir gk tkrk gA

¼5½ **x.kkRed fo'y"k.k e %** foy;rk x.kuQy dk x.kkRed fo'y"k.k e vR;f/kd mi;kx gA leku foy;rk x.kuQy d vk/kkj ij gh HkkfLed eydk dk fo'y"k.k legokj fd;k tkrk gA tl& Cu^{2+}, Pb^{2+}, Cd^{2+}, Sn^{4+}, As^{3+}, Sb^{3+} d lYQkbMk dk foy;rk x.kuQy yxHkx leku gkrk gA blfy, bUg ,d lkFk f}rh; leg e j[kk x;k gA blh çdkj rrh; leg Fe^{3+}, Cr^{3+}, Al^{3+} d gkbMkDlkbMk rFkk ipe leg d Ba^{2+}, Sr^{2+}, Ca^{2+} dkckuV dk foy;rk x.kuQy leku gkrk gA vr% bUg ,d gh leg e j[kk x;k gA HkLeh; eydk d leg dk Øe Hkh foy;rk x.kuQy d vk/kkj ij r; fd;k x;k g] tl Zn^{2+}, Co^{2+}, Mn^{2+}, Ni^{2+} d lYQkbMk dk foy;rk x.kuQy f}rh; leg d lYQkbMk l vf/kd gkrk gA vr% bUg prFk leg e j[kk x;k gA f}rh; leg e HCl dh mi;kfxrk HkkfLed eydk d çFke leg e ru HCl feykdj H_2S çokfgr dju ij doy f}rh; leg d lYQkbM gh vo{kfir gkr g] HCl dh mifLFkfr e levk;u çHkko d dkj.k H_2S d fo;ktu dh ek=k de gk tkrh g ftll S^{2-} vk;u dh lkUærk de gk tkrh g tk fd /kkr vk;u o S^{2-} vk;uk dh lkUærk dk x.kuQy f}rh; leg d /kkr lYQkbMk d foy;rk x.kuQy l vf/kd gkrk g ftll f}rh; leg d /kkr lYQkbM gh vo{kfir gkr g prFk leg d ughA

rrh; leg e lkUæ ukbfVd vEy feykuk

rrh; leg d $Al(OH)_3$, $Fe(OH)_3$ rFkk $Cr(OH)_3$ dk foy;rk x.kuQy yxHkx leku gkrk g] yfdu $Fe(OH)_2$ d K_{sp} dk eku $Fe(OH)_3$ d k_{sp} d eku l vf/kd gkrk gA

;fn foy;u e Fe^{2+} vk;u mifLFkr gk rk o $Fe(OH)_2$ d :i e rrh; leg e vo{kfir ugh gk ldr gA bl vo{kfir dju d fy, HNO_3 dk mi;kx djr g ftll Fe^{2+} dk Fe^{3+} e vkDlhdj.k gk tkrk g vkj NH_4OH feyku ij $Fe(OH)_3$ d :i e vo{kfir gk tkrk gA

prFk leg e NH_4OH dh mi;kfxrk% prFk leg d èkkr lYQkbMk dk foy;rk x.kuQy vf/kd gkrk gANH_4OH dh mifLFkr e H_2S çokfgr dju ij vekfu;e lYQkbM cu tkrk g tk yxHkx i.k fo;kftr gkdj S^{2-} eä djrk g ftll S^{2-} dh lkUærk c< tk;xhA

$$2NH_4OH + H_2S \rightarrow (NH_4)_2S + 2H_2O$$

$$(NH_4)_2S \rightleftharpoons 2NH_4^+ + S^{2-}$$

ipe leg d lnL;k dk ijh{k.k

ipe leg d /kuk;uk (Ba^{2+}, Sr^{2+}, Ca^{2+}) dk ijh{k.k blh Øe e fd;k tkrk gA

ipe leg d /kuk;u Ba^{2+} ØkeV d :i] Sr^{2+} vk;u lYQV d :i e rFkk Ca^{2+} vk;u vkDlyV d :i e vo{kfir gkr gA

$BaCrO_4$ d K_{sp} dk eku $SrCrO_4$ rFkk $CaCrO_4$ l de gkrk gA blhfy, loçFke $BaCrO_4$ dk ihyk vo{ki çkIr gkrk gA

$[Sr^{2+}][CrO_4^{2-}]$;k $[Ca^{2+}][CrO_4^{2-}] < K_{sp}$ gku d dkj.k $SrCrO_4$, $CaCrO_4$ foy;u e gh jgr gA

Ba^{2+} dk gVk; fcuk Sr^{2+} d ijh{k.k gr foy;u e $(NH_4)_2SO_4$ Mkyu ij $BaSO_4$ o $SrSO_4$ nkuk dk 'or vo{ki çkIr gkrk g fdUr $CaSO_4$ dk ugh $[Ba^{2+}][SO_4^{2-}] > K_{sp}$, $[Sr^{2+}][SO_4^{2-}] > K_{sp}$ $[Ca^{2+}][SO_4^{2-}] < K_{sp}$

blfy, Sr^{2+} d ijh{k.k l io Ba^{2+} vk;u dk gVk;k tkuk vko';d gA Ba^{2+}, Sr^{2+} rFkk Ca^{2+} rhuk d vkDlyV d K_{sp} de gku d dkj.k $(NH_4)_2C_2O_4$ Mkyu ij rhuk gh vkDlyV d :i e vo{kfir gk tkr gA blhfy, Ca^{2+} d ijh{k.k l io Ba^{2+} rFkk Sr^{2+} dh vuifLFkfr fuf'pr djuk vfrvko';d gA

egRoi.k fcUn

1- o vfHkfØ;k, ftue fØ;kdkjd mRiknk e ifjofrr gk ijUr mRikn iu% fØ;kdkjd e ugh ifjofrr gk mUg vuRØe.kh; vfHkfØ;k dgr gA

2- o vfHkfØ;k, ftue fØ;kdkjd vfHkfØ;k djd mRiknk e ifjofrr gk vkj mRikn iu% fØ;kdkjd e ifjofrr gk mUg mRØe.kh; vfHkfØ;k dgr gA

3- jklk;fud vfHkfØ;k e vx vfHkfØ;k dk ox çrhi vfHkfØ;k d ox d cjkcj gk ;g voLFkk jklk;fud lkE; dgykrh gA

4- lkE; pkg jklk;fud gk ;k Hkkfrd] xfrd çÑfr dk gkrk gA

5- lkekU; vfHkfØ;k d fy, lkE;koLFkk fLFkjkd

$$aA \quad bB \rightleftharpoons cC \quad dD$$

$$Kc = \frac{[C]^c[D]^d}{[A]^a[B]^b} \quad \text{vkj} \quad K_p = \frac{P_C^{\,c} \cdot P_D^{\,d}}{P_A^{\,a} \cdot P_B^{\,b}}$$

6- fdlh jklk;fud lkE; e vfHkfØ;k dk ox vfHkfØ;k e Hkkx yu oky fØ;kdkjd inkFkk d lfØ; æ0;eku d x.kuQy d lekuikrh gkrk gA

7- lkE;koLFkk dk çHkkfor dju oky dkjd rki] nkc] lkUærk] mRçjd rFkk fuf"Ø; xlk dk çHkko gA

8- ;fn fdlh vfHkfØ;k dh lkE;koLFkk ij rki] nkc vkj lkUærk vkfn e ifjoru fd;k tko rk lkE; ml fn'kk e foLFkkfir gkxk tk fd; x; ifjoru d çHkko dk u"V dj ldA bl yk&'kkrfy; dk fu;e dgr gA

9- fdlh ncy o|r vi?kV; d tyh; foy;u e le&vk;u mRiUu dju okyk çcy o|r vi?kV; feyk fn;k tko rk ncy vi?kV; d fo;ktu dh ek=k de gk tkrh gA bl çdkj fo;ktu dh ek=k de gku dk çHkko levk;u çHkko dgykrk gA

10- fuf'pr rki ij lrlr foy;u e mifLFkr vk;uk dh lkUærk d x.kuQy dk vYi foy; o|r vi?kV; dk foy;rk x.kuQy dgr gA

vH;klkFk ç'u

1- $A + 2B \rightleftharpoons C + D$ vfHkfØ;k d fy, lkE; fLFkjkd dk 0;td g &

¼v½ $\frac{[A][B]^2}{[C]}$ ¼c½ $\frac{[A][B]}{[C]}$

¼l½ $\frac{[C][D]}{[A][B]^2}$ ¼n½ $\frac{[C]}{2[B][A]}$

2- vfHkfØ;k $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)+X$ fdyk ty e vf/kd vekfu;k cuu d fy, vko';d 'kr g&

¼v½ mPp rki vkj mPp nkc

¼c½ de rki vkj mPp nkc

¼l½ mPp rki vkj de nkc

¼n½ mPp rki vkj de nkc

3- lfØ; æ0;eku g&

¼v½ xke eky çfr bdkb vk;ru

¼c½ xke ijek.k çfr bdkb {k=Qy

¼l½ xke ijek.k l[;k çfr bdkb vk;ru

¼n½ xke rY;kd çfr bdkb {k=Qy

4- vfHkfØ;k dh nj rFkk lkUærk e ek=kRed lEcU/k LFkkfir fd;k x;k Fkk&

¼v½ xYMcx&okx ¼c½ yk&'kkrfy;

¼l½ vkLVokYM ¼n½ vkjfu;l

5- fuEufyf[kr e l dkulk ;Xe levk;u çHkko n'kkrk g&

¼v½ $BaCl_2$ + $Ba(NO_3)_2$

¼c½ KCl + HCl

¼l½ CH_3 COOH + CH_3COONa

¼n½ AgCN+NaCN

vfry?kÙkjkRed ç'u

1- mRØe.kh; vfHkfØ;k dk ,d mnkgj.k lfgr le>kb,A

2- vuRØe.kh; vfHkfØ;k fdl dgr g\ ,d mnkgj.k nhft ,A

3- jklk;fud lkE; dk ifjHkkf"kr dhft ,A

4- æ0; vuikrh fØ;k d fu;e dh 0;k[;k dhft ,A

5- foy;rk x.kuQy fdl dgr g\

y?kÙkjkRed ç'u

1- vfHkfØ;k $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ d fy, K_p o K_c d 0;tdfyf[k;A

2- lfØ; æ0;eku dk ifjHkkf"kr dhft ,A

3- ç;kx }kjk dl fl) djkx fd jklk;fud lkE; ,d xfrd lkE; g\

4- x.kkRed fo'y"k.k e rrh; leg d fo'y"k.k l io HNO_3 D;k feykr g\

5- fdlh inkFk d vo{ki.k dk ey fl)kUr le>kb,A

fucU/kkRed i'u

1- yk&'kkrfy; d fu;e dh mnkgj.k lfgr 0;k[;k dhft ,A

2- foy;rk x.kuQy dk x.kkRed fo'y"k.k e vuç;kx nhft ,A

3- le&vk;u çHkko fdl dgr g] bldh dkb rhu mi;kfxrk crkb,A

4- xycx&okx d æ0; vuikrh fØ;k d fu;e l vkiD;k le>r g\

5- Hkkfrd ,o jklk;fud çØek e lkE; dk mnkgj.k lfgr le>kb,A

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mÙkjekyk % 1 ¼l½ 2 ¼c½ 3 ¼v½ 4 ¼v½ 5 ¼l½

bdkb & VIII

v/;k; & 14

/kkr vkj /kkrdeZ

(Metals and Metallurgy)

/kkfRod vkc/k dh iÑfr

(Nature of Metallic Bond)

/kkr fØLVyk e fo|eku /kkr ijek.kvk d e/; og fof'k"V vkc/k tk u rk i.kr;k vk;fud vkj u gh i.kr;k lgl;kt d çÑfr dk gkrk g] /kkfRod vkc/k dgykrk gA ;g nkuk çdkjk d vkc/kk dk feJ.k gA

/kkfRod Bkl e /kkfRod vkc/k dh çdfr dk le>ku d fy, loçFke lu 1900 e MM u fl)kUr fn;k ckn e lu 1916 e ykjUt }kjk ,d fl)kUr fodflr fd;k x;k ml eDr byDVku fl)kUr ;k MM&ykjUt fl)kUr Hkh dgk tkrk gA bl fl)kUr d vulkj /kkfRod Bkl /kuk;uk dk og >.Mg tk xfr'khy byDVku d æo vFkok leæ e 0;ofLFkr <x l Mck gvk gA og cy tk bu /kuk;uk dk byDVku d lkxj e ck/k g, j[krk g] /kkfRod vkc/k dgykrk gA

eDr byDVku fl)kUr d vk/kkj ij /krvk d dN çe[k x.kk tl & /kkfRod ped] o|r pkydrk] Å"eh; pkydrk] vk?kkro/;rk o rU;rk dh 0;k[;k dh tk ldrh gA

çÑfr e /krvk dh mifLFkfr

Hk&iiVh /krvk dk çe[k lkr gA leæh ty e Hkh èkkrvk d dN foy; yo.k tl lkfM;e Dykjkb M] eXuhf'k;e Dykjkb M] bR;kfn gkr gA

çÑfr e /kkr, e[; :i l nk voLFkkvk e feyrh g&

(i) eDr voLFkk e

(ii) l;Dr voLFkk e

(i) **eDr voLFkk e %** o /kkr, tk cgr gh de fØ;k'khy gkrh g eDr voLFkk e ikb tkrh gA tl & lkuk] pknh] lyfVue vkfnA

(ii) **l;Dr voLFkk e %** o /kkr, tk ueh] vkDlhtu vFkok dkcu MkbvkDlkb M l vfHkfØ;k dj yrh gA l;Dr voLFkk e ;kfxdk d :i e ikb tkrh gA

- /kkr d ;kfxd iFoh e ftl :i e ik; tkr g] mUg [kfut dgr gA
- o [kfut ftul /kkr, lfo/kkiod ,o de ykxr ij çklr dh tkrh g] mUg v;Ld dgr gA lHkh [kfut v;Ld ugh gkr yfdu lHkh v;Ld [kfut gkr gA
- çÑfr e çkflr d rjhd d vk/kkj ij /krvk d çe[k v;Ld fuEukulkj g&

1- **vkDlkbM v;Ld %** ykgk] ,yfefu;e] exuhf t] tLrk vkj rkck vkfn /krvk e vkDlhtu d çfr fo'k"k Lug gku d dkj.k ; /kkr, vkDlkbM v;Ldk d :i e ikb tkrh gA

fuEufyf[kr vkDlkbM v;Ld g&

(1) geVkbV Fe_2O_3 (2) ckDlkbV $Al_2O_3.2H_2O$

(3) ik;jkylkbV MnO_2

(4) ftdkbV ZnO (5) eXuVkbV Fe_3O_4

(6) D;çkbV Cu_2O

2- **lYQkbM v;Ld %** dN /kkr, Fe, Cu, Hg, Pb, Zn vkfn iFoh e lYQkbM v;Ldk d :i e ikb tkrh gA

fuEufyf[kr lYQkbM v;Ld g&

(1) dkij ikbjkbV $CuFeS_2$

(2) vk;ju ikbjkbV FeS_2

(3) xyuk PbS

(4) ftd Cy.M ZnS

(5) fluckj HgS

(6) dkij Xykl ;k Cu_2S

3- **dkckuV v;Ld %** çÑfr e mifLFkr /kkrvk d vkDlkbM vkj gkbMkDlkbM ok; dh CO_2 l vfHkfØ;k djd dkckuV v;Ld cukr gA

dkckuV v;Ld d :i e ikb tku okyh /kkr, Mg, Ca, Fe, Cu , Zn gA

fuEufyf[kr dkckuV v;Ld g&

¼1½ Mkykekbt $MgCO_3.CaCO_3$

¼2½ flMjkbV $FeCO_3$

¼3½ eykdkbt $CuCO_3.Cu(OH)_2$

¼4½ dykekbu $ZnCO_3$

4- **lYQV v;Ld %** çÑfr e mifLFkr /kkrvk d lYQkbM] ok;e.Myh; vkDlhtu l vfHkfØ;k djd lYQV cukrh gA

dN /kkr, Mg, Ca, Sr, Pb vkfn lYQV v;Ld d :i e ikb tkrh gA tl &

¼1½ blle yo.k $MgSO_4.7H_2O$

¼2½ ftlle $CaSO_4.2H_2O$

¼3½ ,Xylkbt $PbSO_4$

5- **gykbM v;Ld %** dN /kkr, & Na, K, Mg, Ca o Ag gykbM d :i e ikb tkrh gA tl &

¼1½ gku flYoj AgCl

¼2½ ¶ykjkLikj CaF_2

¼3½ [kfut yo.k NaCl

¼4½ dkuykbt $KCl.MgCl_2.6H_2O$

¼5½ Øk;kykbt Na_3AlF_6

/kkr fu"d"k.k d fofHkUu in
(Various Steps of Metallurgy)

fdlh Hkh v;Ld l Hkkfrd ,o jklk;fud çØek d }kjk 'k) /kkr çkIr dju dh lEi.k çfØ;k dk /kkrdeh dgr gA /kkrdfedh lfØ;k, fuEufyf[kr ink e i.k gkrh gA

1- v;Ld dk dVuk ,o ihluk (Crushing and Grinding of the Ore)

2- v;Ld dk lkUæ.k (Concentration of the Ore)

3- /kkr dk iFkDdj.k (Isolation of Metal)

4- /kkr dk 'kks/ku (Purification or Refining of the Metal)

v;Ld dk dVuk ,o ihluk
(Crushing and Grinding of the Ore)

[kuu l çkIr v;Ld LFky voLFkk e gkr g budk Ø'kj ;k pDdh dh lgk;rk l NkV&NkV d.kk e rkMr g] iuh bUg pDdh dh lgk;rk l ckjhd p.k e cnyr gA

bl çfØ;k dk p.khdj.k (Pulverisation) dgr gA

v;Ld dk lkUæ.k (Concentration of the Ore)

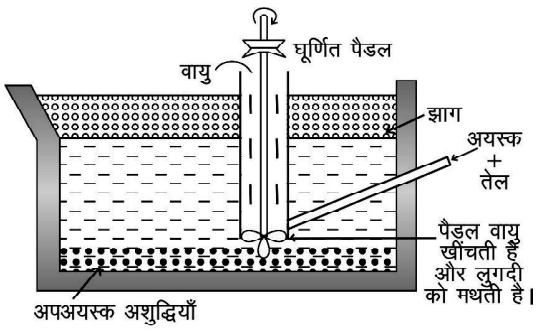
iFoh l fudyu oky v;Ld e db çdkj dh v'kf);k tl ddM] iRFkj] feVVh vkfn ikb tkrh gA bu v'kf);k dk vk/kkfjr] xx ;k efVDl dgr gA v;Ld l v'kf);k dk iFkd djuk lkUæ.k dgykrk gA

v;Ld dh çÑfr d vk/kkj ij v;Ld dk lkUæ.k fuEufyf[kr fof/k;k }kjk fd;k tk ldrk gA

¼v½ **gkFk l idMdj** (Hand picking) : dN fLFkfr;k e v;Ld ,o v'kf) d d.kk dh vkÑfr ,o vkdkj e vUrj gkrk g bUg ;kfn=d :i l gkFk l fudkydj nj fd;k tk ldrk gA

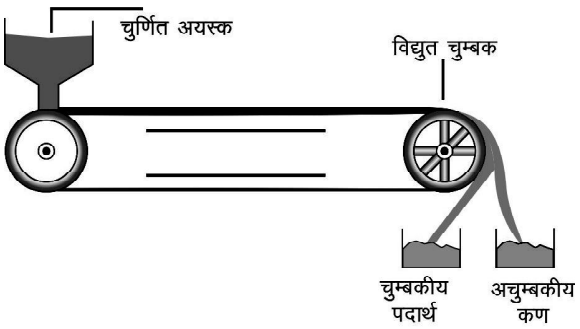
¼c½ **ty }kjk lkUæ.k ;k x:Roh; iFkDdj.k** (Hydraulic Washing or Gravity Separation) : lkUæ.k dh ;g çfØ;k mu v;Ldk d fy, ç;Dr gkrh g ftue v'kf);k v;Ld l gYdh gkrh gA bld fy, fo'k"k :i l foyQy Vcy dk ç;kx fd;k tkrk g] v;Ld d p.k dk Vcy ij Qyk fn;k tkrk gA bUg çokgeku ty èkkjk l lkQ dj fy;k tkrk gA v;Ld d d.k uhp cB tkr gA ;g fof/k SnO_2 ¼fVu LVku½ rFkk Fe_3O_4 d lkUæ.k e ç;Dr dh tkrh gA

¼l½ **>kx lyou fof/k** (Froth floatation method) : ;g fof/k dkij ikbjkbV] ftd Cy.M vkj xyuk vkfn lYQkbM v;Ldk d fy, mi;Dr gA ble ty d Vd e FkkMk lk phM dk ry feyk fn;k tkrk gA ,d fNæ;ä uyh e l ckgjh ok; dk nkc d lkFk Vd e çokfgr fd;k tkrk g ftl ry d dkj.k mRiUu >kx d lkFk v;Ld d d.k Åij mB tkr g vkj in dh vkj vk/kkfjh ¼v'kf);k½ cB tkrh g ¼fp= 14-1½A



fp= 14-1 % >kx lyou fof/k

¼n½ **pEcdh; iFkDdj.k** (Magnetic Separation) : bl fof/k dk ç;kx rc djr g tc v;Ld ;k v'kf) e l dkb ,d pEcdh; çÑfr dk gkA bl fof/k e v;Ld d p.k dk peM d cYV ij Mkyr g] tk fd jkyjk ij ?kerk gA v;Ld dk pEcdh; ?kVd pEcd }kjk vkdf"kr gkdj ,d <j e bdëk gk tkrk g tcfd nljk vpEcdh; ?kVd nljk <j cukrk g ¼fp= 14-2½A



fp= 14-2 % v;Ld dk pEcdh; iFkDdj.k

mnkgj.k& fVu LVku vpEcdh; çÑfr dk gkrk g tcfd Økfe;e rFkk vk;ju dh v'kf) pEcdh; çÑfr dh gkrh g bl fof/k }kjk SnO_2 l v'kf) dk iFkd dj ldr gA

¼;½ **fu{kkyu ;k jklk;fud iFkDdj.k** (Leaching or Chemical Separation) : ;g fof/k jklk;fud ifjoru ij vk/kkfjr gA bl fof/k e eghu fil g, v;Ld dh vfHkfØ;k mfpr vfHkded l djkr g ftl l og foy;u e vk trk g rFkk v/kk=h Bkl voLFkk e jg tkrh g foy;u l v;Ld iu% vo{ki.k vFkok fØLVyhdj.k }kjk lkUæ voLFkk e çkIr dj yr g] tl& ckDlkbV dk lkUæ.k {kkjh; NaOH d }kjk fd;k tkrk gA

lkfUær v;Ld dk vkDlkbM e ifjoru

(Conversion of the Concentrated ore to its Oxide form)

lkfUær v;Ld dk vkDlkbM e ifjoru nk ink e i.k gkrk gA (i) fuLrkiu (Calcination) rFkk (ii) Hktu (Roasting)A

(i) **fuLrkiu** % ok; dh vuifLFkfr ;k vYi mifLFkfr e xyukd d uhp v;Ld dk xje dju dh çfØ;k dk fuLrkiu dgr gA ;g fof/k dkckuV v;Ld d fy, ç;Dr dh tkrh gA ftu v;Ldk e ueh] ty;kftr gkbMkDlkbM] dkckuV vkj vU; ok"i'khy inkFk gkr g mudk fuLrkiu djd ty vkj ok"i'khy inkFk dk fu"dklu dj fn;k tkrk g lkFk gh dkckuVk dk fo?kVu gks jkrk gA

$$2M(OH)_3 \rightarrow M_2O_3 + 3H_2O$$

$$MCO_3 \rightarrow MO + CO_2$$

(ii) **Hktu** % ok; dh vf/kdrk e v;Ld dk xyukd d uhp xje dju dh çfØ;k dk Hktu dgr gA Hktu d QyLo:i ;fn dkb dkcfud inkFk mifLFkr gk rk u"V gk tkrk gA S, P, rFkk As tl v'kf) ;k vkDlkbM e ifjofrr gk tkrh gA /kkr lYQkbM vkDlkbM e cny tkr gA vf/kdk'k lYQkbM v;Ldk dk Hktu fd;k tkrk g ftl l lYQkbM] vkDlkbM e ifjofrr gk tkr g vkj lYQj MkbvkDlkbM xl fudy tkrh gA

$$2MS + 3O_2 \rightarrow 2MO + 2SO_2$$

/kkr vkDlkbM dk /kkr e vip;u

(Reduction of Metal Oxide to Metal)

¼v½ **jklk;fud vip;u ¼çxyu½ % dkcu }kjk vip;u&** fuLrkfir vFkok Hkftr v;Ld dk dkcu ¼dkd½ l vipf;r fd;k tkrk g /kkr fi?kyh voLFkk e ikIr dh tkrh gA çkÑfrd vkDlkbM tk fuLrkiu rFkk Hktu l çkIr gkr g ;k lYQkbM v;Ld dk dkd d lkFk feykdj okR;kHkVVh e xje fd;k tkrk gA

$$PbO + C \rightarrow Pb + CO$$

$$Fe_2O_3 \quad 3C \quad 2Fe \quad 3CO$$

¼c½ **Lovip;u }kjk çxyu** % dN /kkrvk d /kuk;uk dk vU; vipk;dk d feyk; fcuk gh vip;u gkrk gA dkij d fu"d"k.k e D;il lYQkbM vkj D;il vkDlkbM dh ikjLifjd vfHkfØ;k l /kkfRod dkij çkIr gkrk gA fluckj dk ok; e xje dju l ikjk çkIr gkrk gA

$$Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$$

¼l½ **FkekbV fof/k** % dN /kkfRod vkDlkbM tl Økfe;e o exuht d vkDlkbM dk vip;u dkcu l ugh fd;k tk ldrk Al, Mg vkfn lfØ; /kkrvk d mi;kx l Cr_2O_3 o MnO_2 dk vip;u fd;k tkrk gA

$$Cr_2O_3 \quad 2Al \quad Al_2O_3 \quad 2Cr$$

¼n½ **o|rvi?kVuh vip;u** (Electrolytic Reduction) : vf/kd /kufo|rh rÙo (Ca, Na, vkfn½ d mi;Dr yo.k tl vkDlkbM] DykjkbM dk lxfyr voLFkk e o|r vip;u fd;k tkrk g rk /kkr dFkkM ij ,df=r gkrh gA

¼;½ **/kkr foLFkkiu** % pknh vkj Lo.k tl /kkr dk mudyo.kk d foy;u l]ftd tlh vf/kd o|r /kuh; /kkr }kjk vo{ki.k fd;k tk ldrk gA pknh dk mld v;Ld l ru lkfM;e lk;ukbM foy;u }kjk foy;'khy ldj ;kfxd cukdj iFkd dj fy;k tkrk gA

$$Ag_2S + 4NaCN \rightarrow 2Na[Ag(CN_2)] + Na_2S$$

$$AgCl + 2NaCN \rightarrow Na[Ag(CN)_2] + NaCl$$

lkfM;e vjtUVklk;ukbM d foy;u eftd dh Nhyu Mkyu l pknh dk vo{ki.k gk tkrk gA

$$2Na[Ag(CN)_2] \quad Zn \qquad 2Ag \quad Na_2Zn(CN)_4$$

¼lkfM;e vjtUVklk;ukbM½ ¼lkfM;e ftdklk;ukbM½

'kk/ku

fdlh Hkh fof/k l çkIr /kkr çk;% v'k) gkrh gA mPpx.koÙkk d lkFk 'k) /kkr çkIr dju dh çfØ;k dk 'kk/ku dgr gA

fdlh Hkh /kkr d 'kk/ku dh fof/k mldh çÑfr rFkk mle mifLFkr v'kf);k dh çÑfr ij fuHkj djrh gA /kkr 'kk/ku dh dN fuEufyf[kr çe[k fof/k;k gA

¼v½ **vklou fof/k** (Distillation Method) : bl fof/k d }kjk ok"i'khy ¼de DoFkukd okyh½ /kkrvk ¼edjh] tLrk rFkk dMfe;e½ dk 'kk/ku fd;k tkrk gA fdlh fjVkV e v'k) /kkr dk vklou dju ij /kkr ok"i d :i e çkIr gkrh g] ftl B.Mk djd ,df=r dj yr gA vok"i'khy v'kf);k fjVkV e cph jg tkrh gA

¼c½ **æo.k fof/k** (Liquation Method) : ;g fof/k fofHkUu èkkrvk d xyukdk d vUrj ij fuHkj djrh gA bl fofèk e mu /kkrvk dk 'kk/ku djr g]ftudk xyukd de gkrk g vkj mue mifLFkr v'kf);k dk xyukd vf/kd gkrk g v'k) /kkr dk ,d <yvk pYg (inclined hearth) ij j[kdj xje djr gA /kkr fi?kydj uhp vk tkrh g] tcfd v'kf);k cph jg tkrh gA

Zn, Pb, Sn, Bi vkfn /kkrvk dk 'kk/ku bl fof/k l djr gA

¼l½ **o|r vi?kVuh ifj"dj.k** (Electrolytic Refining) : /kkrvk d 'kk/ku dh ;g çe[k fof/k g] bl fof/k e v'k) /kkr dh ,ukM cukr g vkj 'k) /kkr dh dFkkM cukr gA /kkr d yo.k dk tyh; foy;u o|r vi?kV; (Electrolyte) dk dk; djrk gA

,ukM % v'k) /kkr

dFkkM % 'k) /kkr

fo|r vi?kV; % /kkr d yo.k dk tyh; foy;u

o|r vi?kVu dju ij dFkkM ij 'k) /kkr tek(deposit) gku yxrh g vkj ,ukM ?kydj foy;u e vk tkrh gA v'kf);k foy;u e pyh tkrh g ;k ,ukM eM (anode mud) d :i e ,ukM d uhp ,df=r gk tkrh gA

,ukM ij fØ;k % $M \longrightarrow M^{n+} + ne^-$

dFkkM ij fØ;k % $M^{n+} + ne^- \longrightarrow M$

dkij d 'kk/ku e ftle v'k) dkij /kkr dh ,ukM rFkk 'k) dkij dh dFkkM cukr gA vEyh; $CuSO_4$ foy;u o|r vi?kV; ij dk; djrk gA vi?kVu dju ij dFkkM ij 'k) dkij tek (deposit) gku yxrk g vkj ,ukM okyk dkij foy;u e vk tkrk gA v'kf);k tl Sb, Se, Te, Ag, Au, Pt vkfn ,ukM eM d :i e çkIr gkr gA

,ukM ij fØ;k % $Cu \longrightarrow Cu^{2+} + 2e^-$

dFkkM ij fØ;k % $Cu^{2+} + 2e^- \longrightarrow Cu$

¼n½ **[k.M 'kk/ku ¼[k.M ifj"dj.k½** (Zone Refining) : [k.M ifj"dj.k bl fl)kUr ij vk/kkfjr gkrk g fd èkkr dh v'kf);k Bkl voLFkk dh vi{kk æo voLFkk e vf/kd foy; gkrh gA

bl fof/k e v'k) /kkr dh NM cukdj mld ,d flj dk xky rkid (circular heater) l fi?kyu rd xje djr g, /kh&/kh nlj flj dh vkj c<r tkr g] ftl vkx okyk Hkkx fi?kyrk tkrk g vkj viu lkFk v'kf) dk yr g, vkj Bkl gkrh gb 'k) /kkr dk ihN NkMr g, nlj flj dh vkj c<rk tkrk gA nlj flj ij bl çdkj vf/kd v'kf) igp tkrh g vkj cpk gvk Hkkx 'k) gk tkrk gA bl çfØ;k dk db ckj nkgjku l vfr'k) /kkr çkIr gkrh gA vUr e nlj flj dk ftle v'kf) gkrh g] dkVdj iFkd dj fn;k tkrk gA

¼;½ **ok"i çkoLFkk ifj"dj.k** (Vapour Phase Refining) : bl fof/k e v'k) /kkr dk mfpr fof/k l ok"i'khy ;kfxd e cnyr g ftl l v'kf);k ihN NV tk,A vLFkk;h gku d dkj.k mPprj rki ij ;ok"i'khy ;kfxd fo?kfVr gkdj 'k) /kkr nr gA

ok"i çkoLFkk ifj"dj.k dh fuEufyf[kr nk e[; 'kr g %

(i) /kkr ok"i'khy ;kfxd cuku e l{ke gkA

(ii) ok"i'khy ;kfxd vklkuh l fo?kfVr gkr gkA

¼j½ **o.k y[ku fof/k** (Chromotographic Method) : vfèk'kk"kd l feJ.k d fofHkUu ?kVdk d iFkDdj.k rFkk mfpr foyk;d dh lgk;rk l iu% çkfIr dh çfØ;k dk o.ky[ku fof/k dgr gA

ykg dk /kkrdeh (Metallurgy of Iron)

lYQkbM v;Ld l ykgk çkIr djuk dfBu vkj tfVy gA vr% e[; r% ykgk geVkbV Fe_2O_3, eXuVkbV Fe_3O_4 l gh çkIr fd;k tkrk gA

¼v½ lkUæ.k

(i) ykg dh [kkuk dh pVVkuk dk ck:n l rkMk tkrk gA bu pVVkuk d fQj NkV&NkV VdM fd; tkr gA bu VdMk dk xMjk ij j[kdj ty d rho çokg l /kk;k tkrk gA ftll feVVh cky] iRFkj vkfn vyx gk tkr g vkj xMjk ij v;Ld d VdM jg tkr gA

(ii) v;Ld d /ky g, VdMk dk ihldj p.k dj fn;k tkrk gA vc bldk o|r&pEcdh; iFkDdj.k fof/k }kjk lkUæ.k fd;k tkrk gA

¼c½ Hktu

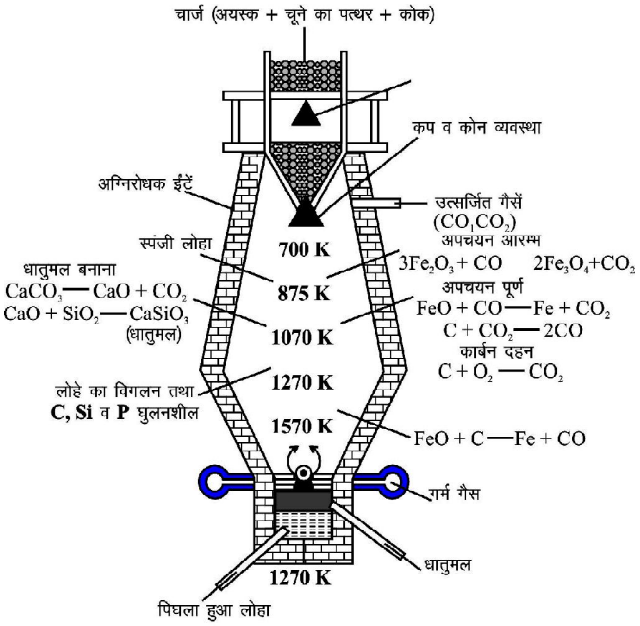
lkfUær v;Ld dk ijkoruh; HkVVh e Hktu fd;k tkrk gA HkVVh e ok; d >kd Hkh lkFk&lkFk çokfgr fd, tkr gA v;Ld e dkcu] QkLQkjl] lYQj] vklfud vkfn dh e[; v'kf);k jgrh gA Hktu l dkcu MkbvkDlkbM] QkLQkjl iVkvkDlkbM] lYQj MkbvkDlkbM vkj vklfud rFkk ,UVheuh d ok"i'khy vkDlkbM cur gA bl çdkj ; v'kf);k v;Ld l fudy tkrh g vkj vf/kd Hktu l Qjl vkDlkbM] Qfjd vkDlkbM e ifjofrr gk tkrk gA Qfjd vkDlkbM de xyuh; gA bldcu tku l Qjl flyhdV ¼dhV] tk Qjl vkDlkbM vkj flfydk d xyu l cu tkrk g½ ugh cu ikrkA bl rjg dN /kkr 0;Fk gh cckn gku l cp tkrh g vU;Fkk Qjl vkDlkbM flfydk l l;kx djd Qjl flyhdV cukrk jgrk g vkj dhV cu tku d dkj.k /kkr l vyx gkrk jgrk gA

¼l½ çxyu

Hkftr v;Ld dk okR;k Hkêh e çxyu djd dPpk vkj fQj <yok ykgk çkIr fd;k tkrk gA

okR;k Hkêh dk o.ku

;g yxHkx 80 QhV Åph vkj Hkhrj l 20 QhV 0;kl dh Hkêh gkrh gA ;g LVhy dh pknjk l cuh gkrk g ftld vUnj vfXu lg bVk dk vLrj yxk gkrk gA lEi.k Hkêh pkjk vkj l ty d tdV l f?kjh jgrh gA ;g Åij vkj in dh vkj l ldjh vkj chp e dN pkMh gkrh gA Åij dh vkj di ,o dku 0;oLFkk gkrh g ftle Hkftr v;Ld] pu d iRFkj



fp= 14-3 % okR;k Hkêh ¼i.k j[kkfdr o fØ;kvk lfgr½

vkj dkd d p.k dk feJ.k ¼/kku½ Mkyk tkrk gA Hkêh d in e ukfy;k }kjk ok; >kdk d :i e çokfgr dh tkrh gA Hkêh d in ij fi?kyk gvk dPpk ykgk ,df=r gk tkrk g tgk l mldk v'k fu"dklu fNæ }kjk le;≤ ij ckgj fudky fn;k tkrk gA HkVVh d ry e dN Åij ¼v'k fu"dklu fNæ l Åij½ ,d vkj fNæ gkrk g ftl dhV&fNæ dgr gA fi?kyh gb /kkr d Åij rjrk gvk dhV bl fNæ }kjk le;≤ ij ckgj cgk fn;k tkrk gA

Hkêh e dkd d tyu l dkcu MkbvkDlkbM curh gA dkcu MkbvkDlkbM xe dkd d lEid e vkrh g rk bldk vip;u gk tkrk g ftll ;g dkcu ekukvkDlkbM e ifjofrr gk tkrh gA

$$C + O_2 \rightarrow CO_2$$

$$CO_2 + C \rightarrow 2CO$$

;g dkcu ekuvkDlkbM v;Ld dk vip;u djd Lo; fQj dkcu MkbvkDlkbM e ifjofrr gk tkrh gA

$$Fe_2O_3 \quad 3CO \quad 2Fe \quad 3CO_2$$

Hkêh d Åij d Hkkx e dkcu ekukvkDlkbM] Qfjd vkDlkbM dk vip;u djrh g vkj Lit d leku ykgk èkkr çkIr gkrh gA Qfjd vkDlkbM dk vf/kdrj vip;u Hkêh d blh Hkkx e gkrk gA Hkêh d e/; Hkkx e v;Ld d lkFk mifLFkr ddj&iRFkj vkfn vk/kkjh pu l vfHkfØ;k djd ljyrk l xyu okyk dhV] dfYl;e flyhdV cukr gA

$$CaO + SiO_2 \rightarrow CaSiO_3$$

Hkêh d uhp d Hkkx e] tgk dk rki 1473 K rd jgrk g] ykgk dkd d lEid e vkr gh xy tkrk gA ¼fp= 14-3½ dkcu] flfydk] QkLQkjl] exuht vkfn v'kf);k dk dN Hkkx bl fi?ky g, ykg e foy; gk tkrk gA ;g ykgk dPpk ykgk dgykrk gA

<yok ykgk % dPp ykg dk fQj l xykdj lkpk e rhork l BMk dju ij <yok ykgk cu tkrk gA bldk fuek.k&dk; e mi;kx ugh fd;k tk ldrk g] D;kfd ;g dBkj yfdu Hkxj gkrk gA bll cuh oLr, ljyrk l VV ldrh gA <yok ykg l uy] jk'kuh d [kEHk] e'khuk d dN fgLl vkfn oLr, cukb tkrh gA <yok ykg dk vf/kdrj mi;kx fiVok ykg vkj LVhy cuku e gkrk gA ble dkcu dh 2.2-4.5% rd v'kf);k ikb tkrh gA

fiVok ykgk % <yok ykg l dkcu vkj vU; v'kf);k dk vyx dju l fiVok ykgk r;kj gkrk gA <yok ykgk ijkoruh; Hkêh e xyk;k tkrk gA Hkêh e gekVkbV dk vLrj yxk jgrk gA vLrj d Qfjd vkDlkbM }kjk dkcu] QkLQkjl] xU/kd vkfn v'kf);k d dN Hkkx dk vkDlhdj.k gk tkrk g vkj o dkcu MkbvkDlkbM vkj lYQj MkbvkDlkbM xlk d :i e vyx gk tkrh gA QkLQkjl] flfydk vkfn vkDlhÑr gkdj dhV d :i e ifjofrr gk tkr g vkj vyx dj fn; tkr gA v'kf);k d vyx gk tku l ykg dk xyukd c< tkrk g vkj HkVVh dk æo xk<k gkdj iLV dh rjg gk tkrk gA bl iLV dk xky cukdj Hkki gFkkMk d chp nck fn;k tkrk g] ftll lc dhV ¼/kkrey½ vyx gk tkr g ckn e jkyj l xtkj dj /kkr dk /kkrey l vyx fd;k tkrk gA

fiVok ykgk] ykg dk 'k)re :i gA ble dkcu dh cgr de (0.21 l 0.5%) ek=k gkrh gA

,yfefu;e dk fu"d"k.k
(Metallurgy of Aluminium)

0;kolkf;d Lrj ij ,yfefu;e dk fu"d"k.k ckDlkbV l fd;k tkrk g ;g ty ;Dr ,yfeuk g] ckDlkbV e Qfjd vkDlkbM vkj flfydk dh v'kf);k jgrh gA

ckDlkbV l ,yfefu;e dk fu"d"k.k rhu ink e fd;k tkrk g &

¼v½ **ckDlkbV dk 'kf)dj.k %** ckDlkbV dk 'kf)dj.k c;j çØe l fd;k tkrk gA

c;j çØe % ckDlkbV dk lkUæ dkfLVd lkMk d foy;u e 450 K ij dN ?k.Vk rd xje dju ij ckDlkbV lkfM;e eVk,yfeuV e ifjofrr gkdj foy; gk tkrk g vkj v'kf);k vfoy; gku d dkj.k vo{ki d :i e iFkd gk tkrh gA Nkuu d i'pkr fQYVfjr e ty feykdj foykfMr dju l lkfM;e eVk,yfeuV] ,yfefu;e gkbMkDlkbM e ifjofrr gk tkrk gA

$$Al_2O_3.2H_2O + 2NaOH \rightarrow 2NaAlO_2 + 3H_2O$$

¼lkfM;e eVk,yfeuV½

$$NaAlO_2 + 2H_2O \rightarrow Al(OH)_3 + NaOH$$

¼,yfefu;e gkbMkDlkbM½

,yfefu;e gkbMkDlkbM dk xje dju ij og 'k) ,yfeuk e ifjofrr gk tkrk gA

¼c½ **,yfeuk dk o|r vi?kVuh vip;u %** o|r vi?kVuh ly e 'k) ckDlkbV (Al_2O_3), Øk;kykbV (Na_3AlF_6)

$$Al(OH)_3 \xrightarrow{Å"ek} Al_2O_3 + 3H_2O$$

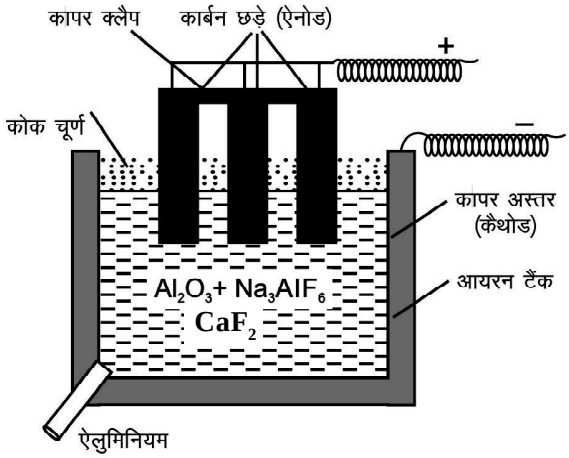
'k) ,yfeuk

rFkk QYlQkj (CaF_2) yr gA LVhy byDVkM dFkkM dk dk; djrk] tcfd xQkbV byDVkM ,ukM dk dk; djrk g] tk fd /kkr d vip;u e ç;Dr gkrk gA Na_3AlF_3 o CaF_2 dh mifLFkfr l Al_2O_3 dk xyukd de gk tkrk g rFkk o|r pkydrk c< tkrh gA

çfØ;k e ,ukM ij cuu okyh vkDlhtu (O_2) ,ukM d dkcu (C) l vfHkfØ;k dj CO/CO_2 cukrh gA çR;d fdykxke ,yfefu;e cuu dh çfØ;k e yxHkx vk/kk fdykxke ,ukM dk dkcu tydj CO/CO_2 xl e cny tkrk gA o|r vi?kVuh ly e fuEufyf[kr vfHkfØ;k, gkrh gA

$$2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$$

mijkä çfØ;k gky&gjkmYV (Hall-Heroult) fof/k dgykrh g ¼fp= 14-4½A bll yxHkx 99.5% 'k) /kkr çkIr gkrh gA



fp= 14-4 % gky&gjkYV çØe }kjk ,yfeuk l ,yfefu;e dk fu"d"k.k

¼l½ **,yfefu;e dk o|r&vi?kVuh 'kf)dj.k %** ,yfefu;e dk vkj vf/kd 'kf)dj.k gi fof/k l fd;k tkrk gA bl fof/k e ykg d ckDl dk mi;kx fd;k tkrk g ft l 'kf)dj.k ly dgr gA ble dkcu dk vLrj yxk gkrk gA ly e fi?ky g, æo] mud ?kuRo e vUrj d dkj.k] rhu Lrj e gkr gA lc l fupy Lrj e ,yfefu;e&dkij dk feJ.k gkrk gA ;g ,ukM dk dke djrk gA e/; d Lrj e Øk;kykbV vkj cfj;e ¶yvkjkbM gkrk gA Åij d Lrj e fi?kyk gvk 'k) ,yfefu;e gkrk g tk dFkkM dk dke djrk gA

o|r çokfgr dju ij e/; d Lrj l ,yfefu;e d vk;u dFkkM dh vkj tku yxr g vkj mud LFkku ij mru gh vk;u fupy Lrj l e/; Lrj e vk tkr g vkj dFkkM ij vipf;r gkdj ijek.kvk e ifjofrr gk tkr gA bl çdkj çklr ,yfefu;e 99-99 çfr'kr 'k) gkrk gA

dkij dk fu"d"k (Metallurgy of Copper)

dkij dk e[; v;Ld dkij ikbjkbV gA bl v;Ld l dkij dk fu"d"k.k fuEufyf[kr ink e fd;k tkrk g&

¼v½ **lkUæ.k %** dkij ikbjkbV dk igy NkV&NkV VdM djd ihl fy;k tkrk gA bl çdkj p.k fd; v;Ld dk >kx lyou fof/k }kjk lkUæ.k fd;k tkrk gA

¼c½ **Hktu %** lkfUær v;Ld dk ijkoruh HkVVh e xje fd;k tkrk g bll lYQj Mkbvkbl lkbM mRiUu gkrh g vkj dkij rFkk ykg d lYQkbM dk dN fgLlk mud vkDlkbM e ifjofrr gk tkrk gA dkij ikbjkbV d lkFk dN vklfud ,o ,UVheuh Hkh ik;k tkrk gA bud vkDlkbM ok"i'khy gkr g ftudk ijkoruh HkVVh e Hktu d nkjku ok"iu gk tkrk gA

$$2CuFeS_2 \quad O_2 \quad Cu_2S \quad 2FeS \quad SO_2$$

$$2Cu_2S \quad 3O_2 \quad 2Cu_2O \quad 2SO_2$$

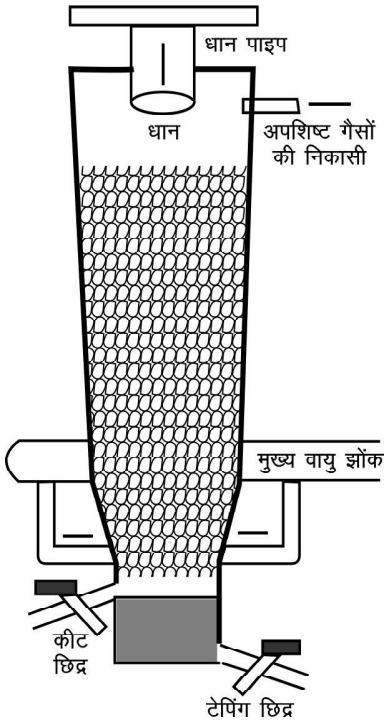
bl voLFkk e dN Qjl lYQkbM vkj D;il lYQkbM dk vkf'kd vkDlhdj.k gk tkrk gA

$$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$$

$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$

Hkftr feJ.k e e[;r% Cu_2S e FeS rFkk SiO_2 vkj FkkMh ek=k e FeO vkj Cu_2O gkr gA

¼l½ **çxyu %** Hkftr v;Ld e dN cky vkj dkd feykdj çxyu fd;k tkrk gA ;g çfØ;k çxyu Hkêh e dh tkrh gA ;g LVhy dh cuh gkrh g vkj bldk Hkhrjh



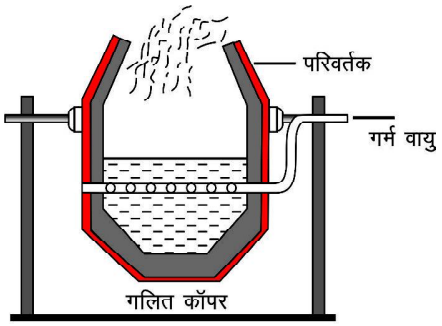
fp= 14-5 % çxyu Hkêh

vLrj vfXu lg bVk dk gkrk gA HkVVh d pkjk vkj ,d tdV gkrk g ft le xe ty çokfgr gkrk jgrk gA uhp dh vkj yxh 'kf.Mdkvk e l vkr g, xje ok; d >kdk l HkVVh d vUnj Hkj dkd dk ngu gkrk g ¼fp= 14-5½A çxyu e dkij vkDlkbM Qjl lYQkbM l vfHkfØ;k djrk g ft ld QyLo:i Qjl vkDlkbM vkj D;il lYQkbM cur gA

$$Cu_2O + FeS \rightarrow Cu_2S + FeO$$

bl çdkj çklr gvk Qjl vkDlkbM cky d lkFk l;kx djd Qjl flfydV cukrk gA ;g xyuh; gkrk g vkj dhV dgykrk gA gYdk gku d dkj.k dhV æo dh lrg ij rjrk jgrk g vkj Hkêh e ,d fNæ }kjk cgk fn;k tkrk gA Hkêh d vUnj dhV d uhp d æo e fi?kyk gvk dkij lYQkbM vkj Qjl lYQkbM dk feJ.k gkrk g] bl dkijeV dgr gA

¼n½ **clej çØe l QQkynkj rke çklr djuk %** çxyu d i'pkr æfor dkij eV dk clej ifjord e y tkr gA ;g LVhy l cuh uk'kikrh d vkdkj dh Hkêh gkrh gA ft le fdlh {kkjh; inkFk ¼t l eXuhf'k;e vkDlkbM½ dk vLrj gkrk gA ifjord e 'kf.Mdkvk l ok; d >kd Hkêh d vUnj çokfgr dh tkrh g ¼fp= 14-6½A



fp= 14-6 % clej ifjord

dkij eV e ik;k tku okyk Qjl lYQkbM vUnj vku okyh ok; dh vkDlhtu l vkDlhÑr gkdj] Qjl vkDlkbM e ifjofrr gk tkrk gA

$$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$$

bl çdkj çkIr Qjl vkDlkbM rFkk dkij ikbjkbV d Hktu d le; cuk gvk Qjl vkDlkbM cky d lkFk vfHkfØ;k djrk g ftl xyuh; dhV ¼Qjl flfydV½ cu tkrk gA

$$FeO + SiO_2 \rightarrow FeSiO_3$$

Qjl flfydV cuu d i'pkr ifjord e vku okyh ok; dh vkDlhtu eV d dN dkij lYQkbM dk vkDlhdj.k dj D;çl vkDlkbM e ifjofrr djrh gA

$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$

bl çdkj cuk gvk D;çl vkDlkbM eV d cp g, dkij lYQkbM l vfHkfØ;k djrk g ftl dkij /kkr çkIr gkrh gA

$$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$$

gYdk gku d dkj.k dhV fi?ky g, dkij dh lrg ij rjrk jgrk g vkj le;≤ ij vyx dj fn;k tkrk gA

clej ifjord e gku okyh çfØ;kvk dh lekflr ij fi?kyh gb dkij /kkr dk jr l cu lkpk e mMy fn;k tkrk gA bl fi?kyh gb /kkr e lYQj MkbvkDlkbM foy; jgrh g tk /kkr d B.M gku ij cycyk d :i e ckgj fudyrh jgrh gA bu cycyk d QVu d dkj.k Bkl /kkr dh lrg vleku fn[ku yxrh g vkj ,lk yxrk g fd /kkr ij QQky iMx; gkA bl dkij dk QQkynkj dkij (Blister Copper) dgr gA

¼;½ **o|r 'kq)/ku %** ble 'k) dkij dh iryh pknj l dFkkM cuk;k tkrk g rFkk vifj"Ñr dkij dh ekVh flYyh dk ,kM cuk;k tkrk gA dkij lYQV dk vEyh; foy;u bl ly dk o|r vi?kV; gkrk gA ly e o|r çokfgr dju ij ,kM dh ekVh flYyh èkhj&èkhj xyrh tkrh g vkj dFkkM dh 'k) dkij dh iryh pknj ekVh gkrh tkrh gA bl çdkj çkIr dkij 99-95 çfr'kr 'k) gkrk gA

jtr ¼flYoj½ dk fu"d"k.k

(Metallurgy of Silver)

jtr d v;Ld flYoj lYQkbM (Ag_2S) rFkk flYoj DykjkbM (AgCl) gA

¼v½ **lk;ukbM fof/k %** jtr d fu"d"k.k d fy, Ag_2S dk p.k djd >kx&lyou fof/k }kjk lkUæ.k fd;k tkrk gA lkfUær v;Ld d p.k dk lkfM;e lk;ukbM d vfr ru foy;u d lEid e j[kdj] foykMu fd;k tkrk g vkj lkFk gh ok; çokfgr dh tkrh gA bl fof/k l igy flYoj lk;ukbM curk g tk lkfM;e vjtUVk lk;ukbM e ifjofrr gk tkrk gA

$$Ag_2S + 2NaCN \rightarrow 2AgCN + Na_2S$$

$$AgCN + NaCN \rightarrow Na[Ag(CN)_2]$$

lkfM;e vjtUVk lk;ukbM

$$Na_2S + 2O_2 \rightarrow Na_2SO_4$$

lkfM;e vkjtUVk lk;ukbM d foy;u dk Nkudj vo{ki l vyx dj fy;k tkrk gA bl foy;u e ftd dh Nhyu Mkyu l lkfM;e ftdk lk;ukbM curk g vkj flYoj vo{kfir gk tkrh gA

$$2Na[Ag(CN)_2] + Zn \rightarrow 2Ag + Na_2[Zn(CN)_4]$$

lkfM;e ftdk lk;ukbM

bl flYoj dk Nku dj ,d xkyd ¼dyeh 'kkjk&ikVf'k;e ukbVV½ d lkFk fi?kyk;k tkrk gA bld i'pkr flYoj ¼jtr½ dk xykdj bV cuk yh tkrh gA

¼c½ **jtre; lhl dk fojtrhdj.k %** xyuk l çkIr lhl e Hkh bruh flYoj gkrh g ftldk fu"d"k.k ykHknk;d gkrk g flYoj vkj lhl d bl feJ.k dk jtre; lhlk dgr gA bl feJ.k l flYoj fudkyu dh fof/k jtre; lhl e jtr dh ek=k ij fuHkj djrh gA

(i) **ikDl fof/k %** bl fof/k dk vk/kkj ;g g fd fi?kyh gb flYoj fi?ky g, tLr e lhl dh vi{kk dgh vf/kd foy; g tc fi?ky g, jtre; lhl e 1-2% tLrk feyk;k tkrk g rk flYoj lhl l vyx gkdj tLrk e foy; gk tkrk g

B.Mk dju ij ¼tLr $ flYoj½ dk feJ/kkr Bkl çkIr gkrk gA bl feJ/kkr e dkcu feykdj fjVkV e rt xje dju ij tLrk okf"ir gk tkrk g vkj flYoj 'k"k jg tkrk g ckn e flYoj dk [kij.k fof/k }kjk 'kkf/kr fd;k tkrk gA

(ii) **ifVulu fof/k** % jtre; lhlk ¼vtUVkQjl yM½ dk xyk dj B.Mk dju ij igy 'k) lhl d fØLVy iFkd gk tkr g vkj lhl d fØLVyk dk vyx dj yr g] bl çØe dk db ckj nkgjkr g rk vof'k"V feJ/kkr e flYoj dh ek=k c< tkrh gA

(iii) **[kij.k** % [kij.k ikd rFkk ifVulu fof/k }kjk çkIr flYoj l lhl dk vyx dju dh fof/k g v'k) flYoj dk ijkoruh Hkêh d D;iy e fi?kyk;k tkrk g fi?ky g, flYoj d Åij ok; dh rt èkkjk çokfgr dh tkrh g ftl flYoj e mifLFkr lhlk PbO d :i e vkDlhÑr gkdj ok; dh èkkjk d lkFk cg tkrk gA dN PbO dk D;iy vo'kf"kr dj yrk g bl çdkj lhlk jfgr flYoj çkIr gkrk gA

¼l½ **flYoj dk 'kk/ku** % vifj"Ñr flYoj dk o|r vi?kVuh ifj"dj.k fof/k }kjk 'kk/ku fd;k tkrk gA ,d cM ly e flYoj ukbVV dk ru foy;u Hkj fn;k tkrk g vkj ble yxHkx 1% ukbfVd vEy feyk fn;k tkrk gA bl ly dh ,ukM vifj"Ñr flYoj dh ekVh flYyh gkrh gA ly e o/kr çokfgr dju ij 'k) flYoj dFkkM ij fu{kfir gku yxrk gA

egRoi.k fcUn

1- HkiiVh l v;Ldk d fu"d"k.k dh çfØ;k [kuu dgykrh gA

2- /kkr d ;kfxd iFoh e ftl :i e ik; tkr g mUg [kfut dgr gA

3- o [kfut ftul /kkr, lfo/kkiod ,o de ykxr ij çkIr dh tkrh g mUg v;Ld dgr gA

4- v;Ld çÑfr e vkDlkbM] lYQkbM] dkckuV] lYQV d :i e ik; tkr gA

5- v;Ld l v'kf);k dk iFkd djuk lkUæ.k dgykrk gA

6- >kx lyou fof/k lYQkbM v;Ld lkUæ.k d fy, ç;Dr dh tkrh gA

7- ok; dh vuifLFkfr ;k vYi mifLFkfr e xyukd d uhp v;Ld dk xje dju dh çfØ;k dk fuLrkiu dgr gA

8- ok; dh vf/kdrk e v;Ld dk xyukd d uhp xje dju dh çfØ;k dk Hktu dgr gA

9- ykg d çe[k v;Ld geVkbV Fe_2O_3 rFkk eXuVkbV Fe_3O_4 gA

10- <yok ykg e 2.2–4.5% rd dkcu dh v'kf);k ikb tkrh gA

11- fiVok ykgk ykg dk 'k)re :i gA

12- ,yfefu;e dk çe[k v;Ld ckDlkbV $Al_2O_3, 2H_2O$ gA

13- jtr dk çe[k v;Ld Ag_2S ¼flYoj lYQkbM½ rFkk AgCl ¼gku flYoj½ gA

14- rkc dk çe[k v;Ld dkij ikbjkbV $(CuFeS_2)$ gA

15- v'k) /kkrvk l mPp x.koÙkk okyh 'k) /kkr çkIr djuk 'kk/ku dgykrk gA

16- 'kk/ku dh çe[k fof/k;k vklou] æo.k] o|r vi?kVuh ifj"dj.k] [k.M 'kk/ku ok"i çkoLFkk ifj"dj.k rFkk o.ky[ku fof/k gA

vH;kl lkFk ç'u

oLrfu"B ç'u

1- dkij ikbjkbV dk l= g&

¼v½	CuFeS	¼c½	$CuFeS_2$
¼l½	Cu_2S	¼n½	Cu_2FeS_2

2- ykg dk v;Ld g&

¼v½	geVkbV	¼c½	xyuk
¼l½	dkij ikbjkbV	¼n½	ftd CyM

3- lno eDr voLFkk e feyu okyh /kkr g&

¼v½	xkYM	¼c½	flYoj
¼l½	dkij	¼n½	lkfM;e

4- ok; dh vuifLFkfr ;k vYi mifLFkfr e xyukd d uhp v;Ld dk xje dju dh ifØ;k dk dgr g&

¼v½	fuLrkiu	¼c½	Hktu
¼l½	çxyu	¼n½	'kk/ku

5- <yok ykg e dkcu dh ifr'krrk g&

¼v½	6-8%	¼c½	2.2-4.5%
¼l½	0.10-0.25%	¼n½	0.25-2.0%

vfry?kÙkjkRed i'u

1- ml v;Ld dk uke crkb, ft ll ,yfefu;e lkekU; r% fu"df"kr fd;k tkrk gA
2- fuLrkiu vkj Hktu e dkb ,d e[; vUrj crkb,A
3- >kx lyou fof/k l fdl çdkj d v;Ldk dk lkUæ.k fd;k tk ldrk g\
4- vklou fdl dgr g\
5- [k.M ifj"dj.k l vki D;k le>r g\

y?kÙkjkRed ç'u

1- fdl çdkj d v;Ldk dk lkUæ.k pEcdh; iFkDdj.k fof/k }kjk fd;k tkrk g\ nk mnkgj.k nhft ,A
2- ok"i çkoLFkk ifj"dj.k fdl dgr g\ le>kb,A
3- p.khdj.k fdl dgr g\
4- fu{kkyu ;k jklk;fud iFkDdj.k fof/k dk le>kb,A
5- /kkfRod vkc/k dh çÑfr dk le>kb,A

fucU/kkRed i'u

1- v;Ld d lkUæ.k e ç;Dr gku okyh fofHkUu fof/k;k dk le>kb,A
2- ykg d fu"d"k.k d nkjku okR;k HkVVh d fofHkUu {k=k e gku okyh vfHkfØ;kvk dk fyf[k,A
3- ,yfefu;e /kkr] ckDlkbV l dl fu"df"kr dj ldr g\ le>kb,A
4- dkijikbjkbV l dkij /kkr d fu"d"k.k dk le>kb,A
5- /kkrvk d 'kk/ku dh çe[k fof/k;k dk le>kb,A

---

mÙkjekyk % 1 ¼c½ 2 ¼v½ 3 ¼v½ 4 ¼v½ 5 ¼c½

bdkb & IX

v/;k; & 15

dkcfud jlk;u

(Organic Chemistry)

Hkfedk

nfud thou e vf/kdk'k mi;kxh oLr, tl& diM] dkxt] tr&pliy] eke] olyhu] Øhe] tr dh ikfy'k] vk"kf/k;k] mojd bR;kfn inkFk dkcfud ;kfxdk l cu gkr gA

dkcfud ;kfxdk d vfLrRo d fy, dkcu Lo; d rFkk vU; rÙok tl& gkbMktu] vkDlhtu] ukbVktu] lYQj] gyktu d lkFk lgl;ktd vkcU/k cuk ldrk gA dkcu Lo; d ijek.kvk d lkFk lgl;ktd vkcU/k }kjk tMdj ych Ük[kyk dk fuek.k djrk g ftl Ük[kyu (Catenation) dgr gA dkcu e pr%l;ktdrk ikb tkrh g vFkkr dkcu ijek.k pkj vU; dkcu ijek.kvk ;k pkj vU; rÙo d ijek.kvk d lkFk lgl;ktd vkc/k cukrk gA dkcu o gkbMktu d l;kx l gkbMkdkcu cur gA

jlk;u foKku dh og 'kk[kk ftld vUrxr dkcfud ;kfxdk ¼gkbMkdkcu vkj mud 0;RiUuk½ dk v/;;u djr g ml dkcfud jlk;u dgr gA

dkcfud ;kfxdk dk oxhdj.k ,o uked.k (Classification and Nomenclature of Organic Compounds)

dkcfud ;kfxdk dk oxhdj.k

dkcfud ;kfxdk dk e[; rÙo dkcu gA dkcfud ;kfxdk dk bue mifLFkr dkcu Ük[kyk dh ljpuk d vkèkkj ij çe[kr% nk Hkkxk e oxhÑr fd;k x;k g &

1- **foor Ük[kyk ;k vpØh; ;kfxd** (Closed Chain or Cyclic Compound)

foor Ük[kyk ;k vpØh; ;kfxd % bu ;kfxdk e dkcu ijek.k vkil e vkcf/kr gkdj ,d ych Ük[kyk dk fuek.k djr gA bud vfre flj Lor= jgr gA bu ;kfxdk dk vpØh; ;kfxd dgr gA bu ;kfxdk e dkcu ijek.kvk dh Ük[kyk lh/kh ;k 'kkf[kr gkrh gA mnkgj.k %

$CH_3 - CH_2 - CH_3$ — ikiu

$CH_3 - CH_2 - CH_2 - CH_3$ — C;Vu

¼lh/kh Ük[kyk½

$CH_3 - \underset{\displaystyle CH_3}{\overset{|}{C}}H - CH_3$ — 2&efFky ikiu

$CH_3 - \underset{\displaystyle CH_3}{\overset{|}{C}} = CH_2$ — 2&efFkyiki&1&bu

¼'kkf[kr Ük[kyk½

bUg ,fyQfVd ;kfxd Hkh dgr g] D;kfd çkjEHk e bl J.kh d dN lnL;k dk i'k olk l çklr fd;k tkrk FkkA [xhd e ,fy (alci) tr vkj QVkl (phatos) : olk]

vpØh; ;kfxdk dk iu% nk Hkkxk e foHkkftr fd;k tkrk gA

(i) lrlr ;kfxd (Saturated Compounds)

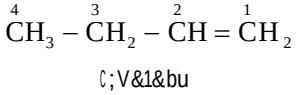
(ii) vlrlr ;kfxd (Unsaturated Compounds)

(i) **lrlr ;kfxd** (Saturated Compounds) : vpØh; ;kfxdk dh ljpuk e ;fn dkcu & dkcu ijek.k d eè; lHkh ,dy vkc/k gkr gk rk mUg lrlr ;kfxd dgr g] bUg ijkfQu Hkh dgr gA

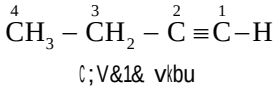
ijk (parum) = de] fQu (fin) = fØ;k'khy vr% ; de fØ;k'khy gkr gA

(ii) **vlrlr ;kfxd** (Unsaturated Compounds) : vpØh; ;kfxdk dh ljpuk e ;fn dkcu & dkcu ijek.k d

eè; cgvkc/k ¼f}vkc/k vFkok f=vkc/k½ gkr g] rk mUg vlrlr ;kfxd dgr gA



C;V&1&bu



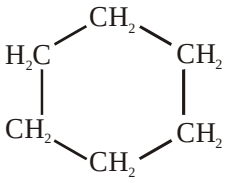
C;V&1& vkbu

loÙk Ük[kyk ;k pØh; ;kfxd % bu ;kfxdk e dkcu ijek.k vkil e ;k vU; rÙok d lkFk oy; ¼cU/k Ük[kyk½ d :i e 0;ofLFkr jgr g] mUg loÙk ;k pØh; ;kfxd dgr gA pØh; ;kfxd nk çdkj d gkr gA

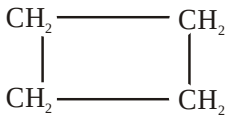
(i) le pØh; (Homocyclic Compounds)

(ii) fo"ke pØh; (Heterocyclic Compounds)

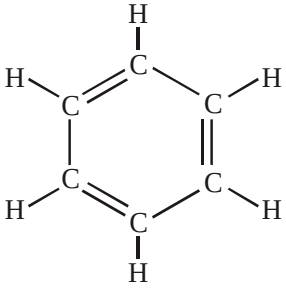
(i) **lepØh;** (Homocyclic Compounds) : bu pØh; ;kfxdk e oy; doy ,d gh ijek.k vFkkr dkcu ijek.k dh cuh gkrh g] vr% bUg lepØh; ;kfxd ;k dkcklkbfDyd ;kfxd Hkh dgr gA



;k  lkbDykgDlu



;k  lkbDykC;Vu

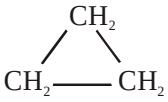


;k  cthu

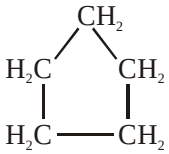
lepØh; ;kfxdk dk Hkh iu% 2 Hkkxk e oxhÑr fd;k x;k gA

¼v½ **,fylkbfDyd ;kfxd** (Alicyclic Compounds) % bu ;kfxdk e rhu ;k rhu l vf/kd dkcu ijek.kvk dh oy; gkrh g] vkj bud x.k ,fyQfVd ;kfxdk d leku gkr gA

mnkgj.k %

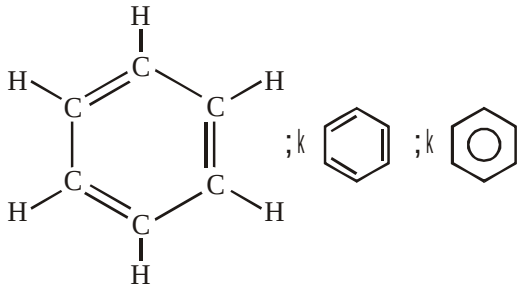


lkbDykikiu

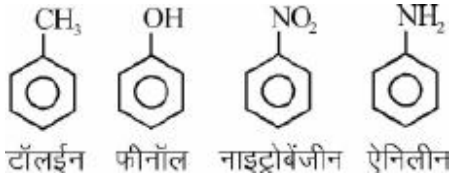


lkbDykiUVu

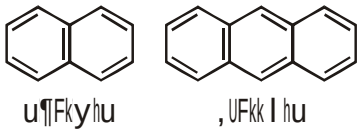
¼c½ **,jkefVd ;kfxd** (Aromatic Compounds) % bu ;kfxdk e ,d ;k vf/kd cthu oy; gkrh g] tk fd dkcu ijek.kvk dh "kVQydh; ljpuk gkrh gA bue ,dkUrj Øe e ,dy ,o f}vkc/k gkr gA ;fn ,d ;k vf/kd cthu oy; gk rk lkekU;r% lxfyr jgrh gA bu ;kfxdk e mifLFkr oy; d vk/kkj ij f}pØh;] f=pØh; bR;kfn dgr gA bu ;kfxdk e fof'k"V xU/k gkrh g vr% bUg ,jkefVd ;kfxd dgr gA



;k ;k



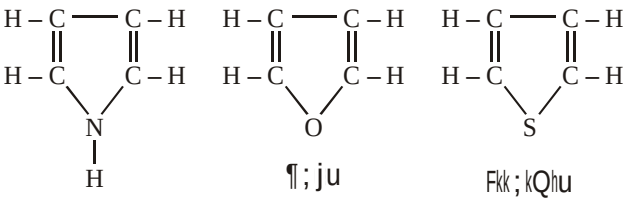
टॉलईन फीनॉल नाइट्रोबेंजीन ऐनिलीन



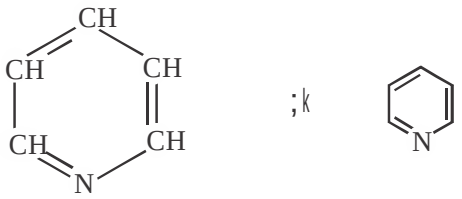
u¶Fkyhu ,UFkklhu

ukV % dN ,jkefVd ;kfxdk e cthu oy; ugh gkrhA

(ii) **fo"ke pØh; ;kfxd** (Heterocyclic Compounds) : bu ;kfxdk e oy; ,d l vf/kd çdkj d ijek.kvk dh cuh gkrh g] dkcu ijek.k d vfrfjDr N, O vkj S ijek.k Hkh oy; cuku e lgk;d gkr gA ,l ;kfxdk dk fo"ke pØh; ;kfxd dgr gA

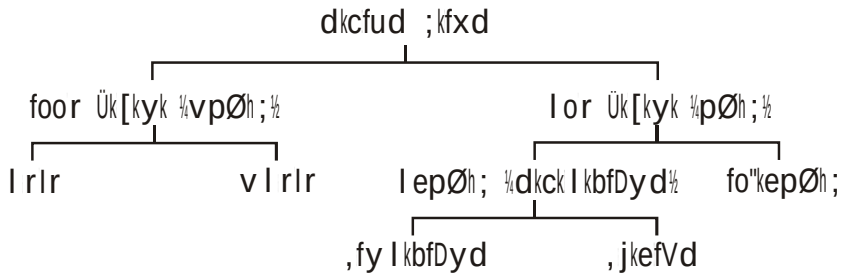


fijky ¶;ju Fkk;kQhu



;k fifjMhu

dkcfud ;kfxdk d oxhdj.k dk lf{kIr e fuEukuIkj fy[k Idr gA



dkcfud ;kfxdk dk ukedj.k (Nomenclature of Organic Compounds)

dkcfud jlk;u d vrxr yk[kk dkcfud ;kfxd gkr gA bud ukedj.k d fy, fuEufyf[kr i)fr;k dkmi;kx fd;k tkrk gA

1- **Ik/kkj.k ;k :< ç.kkyh** (Common or Trivial System) : ;g dkcfud ;kfxd d ukedj.k dh lcl ijkuh i)fr gA bl i)fr d vuIkj ;kfxd dk uke mld lkr vFkok fdlh x.k d vk/kkj ij fd;k tkrk gA

lkj.kh 15-1

l=	:< uke	lkr
1- CH_4	ek'k xl	nynyh ¼ek'kh½ LFkku l ikIr
2- CH_3OH	dk"B fLifjV	ydMh ¼dk"B½ d Hkrd vkIou l ikIr
3- HCOOH	Qkfed vEy	yky phfV;k ¼Qkfedk½ d vkIou l ikIr
4- COOH | COOH	vkDlfyd vEy	vkDlyl ik/k l ikIr
5- CH_3COOH	,lhfVd vEy	fljd l ikIr

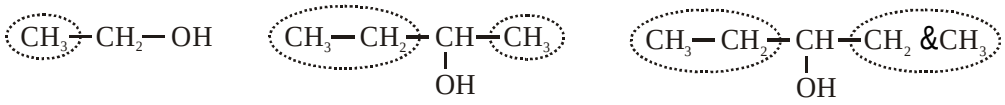
:< i)fr e lh/kh dkcu Ük[kyk ¼v'kkf[kr½ gkbMkdkcu d fy, ukey (n-) 'kCn dk mi;kx fd;k tkrk gA

mnkgj.k % $CH_3 - CH_2 - CH_3$ n- çkiu $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ n- iUVu

;fn fdlh 'kkf[kr ;kfxd dh ljpuk d ,d flj ij $CH_3 - \underset{\underset{CH_3}{|}}{CH} -$ leg gkrk g] rk mld fy, ioyXu vkblk (iso)

tcfd ;kfxd d ,d flj ij $CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} -$ leg gku ij rrh;d (tertiary) dk mi;kx fd;k tkrk gA

2. **0;RiUu ç.kkyh (Derived System) :** dkcfud ;kfxdk dk ukedj.k ml J.kh d ljyre lnL; d uke l 0;RiUu fd; tkr gA lkekU;r% tud ;kfxd ml ;kfxd dh l tkrh; J.kh dk çFke lnL; gkrk gA mnkgj.k & ,Ydkgky dk dkchuky (CH_3OH) dk 0;RiUu ekuk tkrk gA



efFky dkchuky ,fFky efFky dkchuky Mkb,fFky dkchuky

3- **vkb-;-ih-,-lh- ç.kkyh** (IUPAC System) : oreku e dkcfud ;kfxdk d ukedj.k gr l0;ofLFkr ç.kkyh dk mi;kx djr gA ftl vkb-;-ih-,-lh (IUPAC = International Union of Pure and Applied Chemistry) ç.kkyh dgr gA rRdkyhu IUPAC i)fr 1993 e cu l>kok ij vk/kkfjr gA

bl ç.kkyh }kjk dkcfud ;kfxd dk uke çkIr dju d fy, loçFke ey gkbMkdkcu Ük[kyk dk p;u djr gA bld i'pkr ey gkbMkdkcu d uke e mfpr ioyXu rFkk vuyXu yxkdj ;kfxd dk uke ikIr djr gA

(i) **ey gkbMkdkcu** (Hydrocarbon root): dkcfud ;kfxd dh e[; Ük[kyk dk ey gkbMkdkcu Ük[kyk dgr gA

Ük[kyk ycb	ey 'kCn	Ük[kyk ycb	ey 'kCn
C_1	eFk	C_6	gDl
C_2	,Fk	C_7	glV
C_3	iki	C_8	vkDV
C_4	C;V	C_9	uku
C_5	iUV	C_{10}	Md

(ii) **ioyXu** (Prefix) : ;g ey gkbMkdkcu d uke l igy vkrk g] rFkk ey gkbMkdkcu l tM çfrLFkkfi;k dk n'kkrk gA IUPAC ç.kkyh e dN çdk;kRed leg dk çfrLFkkih ekuk tkrk gA vr% bUg lno ioyXu d :i e fy[kr gA

lkj.kh 15-3

çdk;kRed leg	ioyXu
– F	¶yvkjk
– Br	ckek
– I	vk;kMk
– CI	Dykjk
$– NO_2$	ukbVk
$– OC_2H_5$	,FkkDlh

cgçdk;kRed leg oky dkcfud ;kfxd dh fLFkfr e db nlj çdk;kRed leg dk Hkh çfrLFkkih ekur gA

(iii) **vuyXu** (Suffix) : ;g ;kfxd e mifLFkr çdk;kRed leg d ckj e crkrk gA IUPAC ç.kkyh e ç;Dr vuyXu nk çdkj d gkr gA

(a) **çkFkfed vuyXu** (Primary Suffix) : ;g ;kfxd e dkcu ijek.kvk d e/; vkcU/ku d çdkj dk n'kkrk gA ;fn dkcu&dkcu d e/; ,dy vkcèk gk rk vuyXu ,u (ane) gkrk g] tcfd dkcu&dkcu d e/; f}vkcèk gku ij vuyXu bu (ene) rFkk dkcu&dkcu d e/; f=vkc/k gku ij vuyXu vkbu (yne) gkrk gA

mnkgj.k % $CH_3 - CH_3$

,Fk $,u ¾ ,Fku

$CH_3 - CH = CH_2$

çki $ bu ¾ çkihu

$CH_3 - CH_2 - C \equiv CH$

C;V $ vkbu ¾ C;Vkbu

(b) **f}rh;d vuyXu** (Secondary Suffix) : ;g dkcfud ;kfxd e mifLFkr çdk;kRed leg dk n'kkrk gA IUPAC ç.kkyh e bl çkFkfed vuyXu d lkFk tkMdj fy[kk tkrk gA

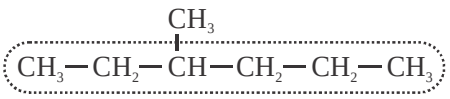
dkcfud ;kfxdk d ukedj.k d lkekU; fu;e (General Rules for Nomenclature of Organic Compounds)

(A) lrlr 'kkf[kr Ük[kyk ¼,Yduk½ d IUPAC ukedj.k d fu;e &

1- **nh?kre Ük[kyk dk fu;e** (Longest Chain Rule) :

(i) ,Ydu v.k e ukedj.k gr lokf/kd ych dkcu Ük[kyk dk p;u fd;k tkrk gA ftl tud Ük[kyk ;k e[; Ük[kyk (Parent Chain or Principal Chain) dgr gA

mnkgj.k %



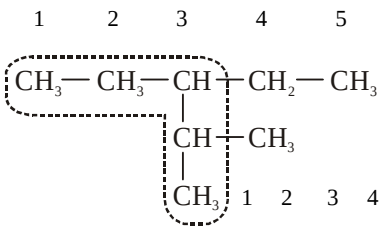
tud Ük[kyk e N% dkcu ijek.k gA

(ii) ;fn fdlh ,Ydu v.k e lcl yEch Ük[kyk e nk ;k nk l vf/kd lEHkkouk gk rk ml dkcu Ük[kyk dk ojh;rk nx ftle çfrLFkkih dh l[;k vf/kd gkA

lkj.kh 15-4

çdk;kRed leg	f}rh;d vuyXu ¼e[; çdk;kRed leg½	ioyXu d :i e uke ;k f}rh;d fØ;kRed leg
– COOH	vkbd vEy	dkckDlh
$-SO_3H$	lYQkfud vEy	lYQk
$-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-$	vkbd ,ugkbMkbM	&
– COOR	,fYdy ,Yduk,V	,YdkDlh dkckfuy
– COX	vk;y gykbM	gykQkfey
$-CONH_2$	,ekbM	dkcek;y
$-C \equiv N$	ukbVkby	lk;uk
– CHO	,y	Qkfey ;k ,YMk
$>C=O$	vku	vkDlk ;k dhVk
– SH	Fkk;ky	edlVk
– OH	vky	gkbMkDlh
$-NH_2$	,ehu	,ehuk

mnkgj.k %



ble lh/kh Ük[kyk e dkcu ijek.k dh l[;k 5 g ijUr ,d gh çfrLFkk;h vkbl kçkfiy tMk g tcfd Åij vfdr e[; Ük[kyk e Hkh dkcu dh l[;k 5 g fdUr mle nk çfrLFkk;h tM gA

2- **y?kÙke vdu dk fu;e** (Lowest Number Rule) : tud Ük[kyk e dkcu ijek.k dk vdu Ük[kyk d ml flj l çkjEHk djr g] tgk l çfrLFkkih dk U;ure vd çkIr gkA

mnkgj.k % $\overset{5}{CH_3}-\overset{4}{CH_2}-\overset{3}{CH_2}-\overset{2}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{1}{CH_3}$ tud Ük[kyk dk Øekdu lgh gA

$\overset{1}{CH_3}-\overset{2}{CH_2}-\overset{3}{CH_2}-\overset{4}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{5}{CH_3}$ tud Ük[kyk dk Øekdu xyr gA

og Øekd tk tud Ük[kyk e çfrLFkkih dh fLFkfr dk crkrk g] ml fLFkfr vd (Position Number) ;k ykdUV (Locant) dgr gA

3- **vdk d y?kÙke lePp; dk fu;e** (Lowest Set of Locants Rule) : ;fn tud Ük[kyk l nk ;k nk l vf/kd ifrLFkkih leg tM gk] rc tud Ük[kyk dk Øekdu ml flj l djr g] ftl vdk dk y?kÙke lePp; ikIr gkA

mnkgj.k % $\overset{5}{CH_3}-\overset{4}{CH_2}-\overset{3}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{2}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{1}{CH_3}$ vdk dk lePp; = 2, 3 ¼lgh½

2 + 3 = 5 ¼lgh½

$\overset{1}{CH_3}-\overset{2}{CH_2}-\overset{3}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{4}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{5}{CH_3}$ vdk dk lePp; = 3, 4 ¼xyr½

3 + 4 = 7 ¼xyr½

4- **ik'o Ük[kyk ¼;k ifrLFkkih½ d fy, vxth o.kekyk dk Øe** (Alphabatical Order for the Side Chains or Substituents) : ;fn tud Ük[kyk ij nk ;k nk l vf/kd ,fYdy leg mifLFkr gk rc tud Ük[kyk dk Øekdu ml flj l djr g] tgk l vxth o.kekyk Øe e igy vku oky ,fYdy leg dk U;ure vd feyA

mnkgj.k % $\overset{6}{CH_3}\ \overset{5}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}\ \overset{4}{CH_2}\ \overset{3}{\underset{\displaystyle C_2H_5}{\underset{|}{CH}}}\ \overset{2}{CH_2}\ \overset{1}{CH_3}$ 3&,fFky&5 efFky&gDlu ¼lgh½

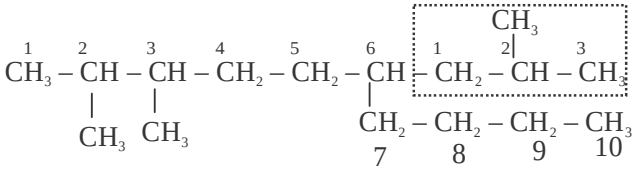
$\overset{1}{CH_3}-\overset{2}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}-\overset{3}{CH_2}-\overset{4}{\underset{\displaystyle C_2H_5}{\underset{|}{CH_2}}}-\overset{5}{CH_2}-\overset{6}{CH_3}$ 4&,fFky&2 efFky&gDlu ¼xyr½

5- **lerY; fLFkfr;k ij fofHkUu çfrLFkkfi;k dk ukedj.k** (Naming the different Substituents at equivalent positions) : ;fn tud Ük[kyk e nk fHkUu&fHkUu çfrLFkkih leg ,d nlj l lerY; fLFkfr ij gk] rc tud Ük[kyk dk Øekdu ml flj l djr g tgk l çfrLFkkih leg vxth o.kekyk d Øe d vulkj igy vkrk gkA

mnkgj.k % $\overset{6}{CH_3}\text{-}\overset{5}{CH_2}\text{-}\overset{4}{\underset{\displaystyle CH_3}{\underset{|}{CH}}}\text{-}\overset{3}{\underset{\displaystyle C_2H_5}{\underset{|}{CH}}}\text{-}\overset{2}{CH_2}\text{-}\overset{1}{CH_3}$ 3&,fFky&4&efFky&gDlu

6- **tfVy çfrLFkkfi;k ;k ,fYdy legk dk ukedj.k**
(Naming the substituents or alkyl groups) : ;fn ,fYdy leg e Hkh çfrLFkkih leg tM gk rk ml tfVy ,fYdy çfrLFkkih leg dgr gA ;fn tud Ük[kyk l tfVy çfrLFkkih tMk gk] rk tud Ük[kyk l tM bl leg d dkcu ijek.k dk 1 vd ndj çfrLFkkih ,fYdy leg d :i e uke nr g] rFkk bl tfVy çfrLFkkih d uke dk d"Bd e fy[kr gA

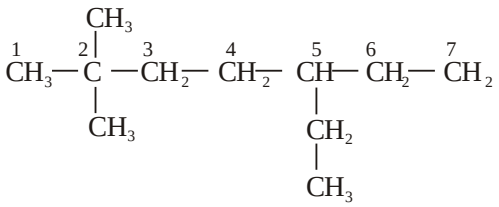
mnkgj.k %



2] 3&MkbefFky &6& ¼&2&efFky ikfiy½ Mdu

7- ;fn leku çfrLFkk;h ,d l vf/kd l[;k e mifLFkr g rk mud uke l igy Mkb] Vkb] VVk vkfn 'kCn fy[k tkr g] ijUr bUg vxth o.kØe e utjvnkt dj nr gA mnkgj.kkFk&

bue MkbefFky d Mkb 'kCn dk vxth o.kekyk e ugh fxur vr% igy ,fFky çfrLFkkih dk uke fy[kk tkrk gA

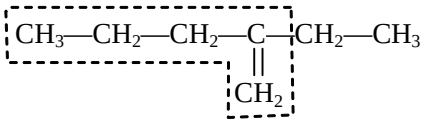


5&,fFky&2]2&MkbefFky gIVu

(B) **vlrlr gkbMkdkcuk ¼,Ydhuk vkj ,Ydkbuk½ d IUPAC ukedj.k d fu;e**
(Rules for IUPAC Nomenclature of Unsaturated Hydrocarbons Alkenes and Alkynes) :

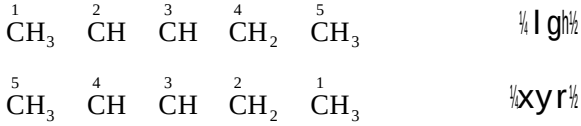
vlrlr gkbMkdkcuk d ukedj.k e lrlr gkbMkdkcu d ukedj.k d fu;e dk gh vulj.k gkrk g] vlrlr gkbMkdkcuk d IUPAC ukedj.k d fu;e fuEufyf[kr g %

1- loçFke ml yEch Ük[kyk dk p;u djr g ftll f}vkc/k vFkok f=vkc/k mifLFkr gkrk gA



2- tud Ük[kyk dk Øekdu ml flj l djr g] tgk l cgvkc/k ¼f}c/k vFkok f=c/k½ dh fLFkfr dk U;ure vd feyA

mnkgj.k %



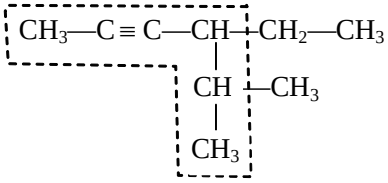
¼lgh½

¼xyr½

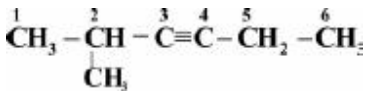
¼xyr½

¼lgh½

3- ;fn leku dkcu l[;k dh ,d l vf/kd Ük[kyk gkrk ml Ük[kyk dk ojh;rk nx ftle vf/kd l[;k e çfrLFkk;h tM gkA



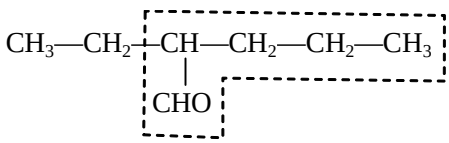
4- ;fn f}vkc/k ;k f=vkc/k nkuk flj e leku njh ij gk rk Øekdu ml flj l fd;k tkrk g tgk l çfrLFkk;h dk U;ure vd çkIr gkrk gA



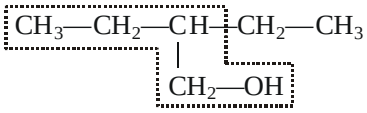
(C) **,d çdk;kRed leg oky ;kfxd dk IUPAC ukedj.k d fu;e**
(Rules for IUPAC Nomenclature of Monofunctional group Compund) :

çdk;kRed leg % og leg tk fdlh dkcfud ;kfxd d x.k fo'k"kdj jklk;fud x.kk dk fu/kkj.k djr gk mUg çdk;kRed leg dgr g] tl —OH, —NO_2, —COOH vkfnA ,d çdk;kRed leg oky ;kfxd dk IUPAC ukedj.k d fu;e fuEufyf[kr g&

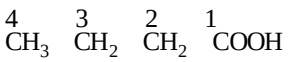
1- nh?kre dkcu Ük[kyk dk p;u djx ftle çdk;kRed leg mifLFkr gk pkg ;kfxd e mll yEch nljh Ük[kyk Hkh mifLFkr D;k u gkA



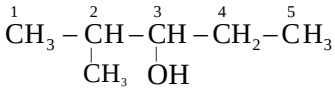
2- çdk;kRed leg e ;fn dkcu gk rk og p;fur yEch dkcu Ük[kyk e vkuk pkfg, ;fn çdk;kRed leg e dkcu mifLFkr u gk (—OH, —NO_2) vkfn½ rk og dkcu ftll og çdk;kRed leg tMk gk p;fur yEch dkcu Ük[kyk e vkuk pkfg,A



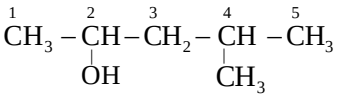
3- Ük[kyk dk Øekdu ml flj l fd;k tkrk g tgk l çdk;kRed leg dk U;ure vd çkIr gkA



4- ;fn çdk;kRed leg nkuk flj l leku njh ij gk rk Øekdu ml vkj l djx tgk çfrLFkk;h dh U;ure vd çkIr gkA

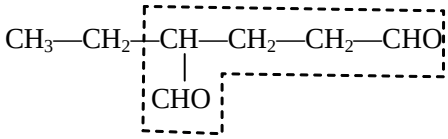


5- ;kfxd dk uke fy[kr le; çdk;kRed leg dk uke fLFkfr d lkFk mfpr vuyXu d :i e fy[kk tkrk g rFkk lHkh çfrLFkkih ioyXu d :i e mud uke d vxth o.kekyk e fy[kr gA mnkgj.k %



4–efFky&iUVu&2&vky

6- ;fn leku çdk;kRed leg ,d l vf/kd l[;k e mifLFkr g rk ml yEch Ük[kyk dk p;u djx ftle vf/kd l[;k e çdk;kRed leg mifLFkr gkA

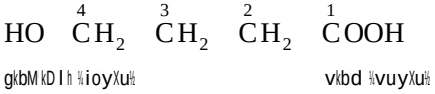


(D) **,d l vf/kd fofHkUu çdk;kRed leg oky ;kfxdk dk ukedj.k** (IUPAC Nomenclature for Compounds Containing more than one Functional Group) :

;fn fdlh dkcfud ;kfxd e nk ;k nk l vf/kd çdk;kRed leg mifLFkr gk rk bue l ,d dk p;u e[; çdk;kRed leg d :i e djr g rFkk 'k"k lHkh f}rh;d çdk;kRed leg dgykr gA e[; çdk;kRed leg dk p;u fuEufyf[kr çkFkfedrk Øe d vk/kkj ij djr gA"

dkckfDlfyd vEy > lYQkfud vEy > ,flM ,ugkbMkbM > ,LVj > ,flM gykbM > ,fly ,ekbM > ukbVkby > ,fYMgkbM > dhVku > ,Ydkgky > ,ehu A

' 'k"k cp g, çdk;kRed leg & NO_2, ¼ukbVk½ –X ¼gyk½] -OR ¼,YdkDlh½ vkfn dk çfrLFkk;h leg ;k ioyXu dh rjg ç;Dr fd;k tkrk gA e[; fØ;kRed leg dk f}rh;d vuyXu }kjk çnf'kr djr g rFkk blçkFkfed vuyXu d lkFk ey 'kCn e tkMr g 'k"k lHkh f}rh;d çdk;kRed leg dk mfpr ioyXu tk ey 'kCn e tkM tkr g] d }kjk çnf'kr djr gA



4&gkbMkDlh&C;Vukbd vEy

ltkrh; J.kh (Homologous Series)

dkcfud ;kfxdk dh l[;k cgr vf/kd gkrh g bu ;kfxdk d 0;ofLFkr v/;;u d fy, bUg db Jf.k;k e foHkkftr fd;k x;k gA bu Jf.k;k e çR;d lnL;k d çdk;kRed leg ,o jklk;fud x.k leku gkr gA

ljpukRed x.kk e lekurk j[ku oky ;kfxdk d leg d lnL;k dk c<r g, v.k Hkkj d Øe e fy[kk tkrk g] rk ml J.kh dk ltkrh; J.kh dgr gA

ltkrh; J.kh d vfHky{k.k

1- ltkrh; J.kh d lHkh lnL;k dk lkekU; l= }kjk çnf'kr fd;k tkrk gA tl %

,Ydu & C_nH_{2n+2}

,Ydhu & C_nH_{2n}

,Ydkbu & C_nH_{2n-2}

,Ydkgky & $C_nH_{2n+2}O$

2- ltkrh; J.kh d Øekxr lnL;k e v.kHkkj 14 dk vrj gkrk gA

3- ltkrh; J.kh d Øekxr lnL;k d v.kl= e $-CH_2$ leg dk vrj gkrk gA

4- ltkrh; J.kh d lnL;k d Hkkfrd x.kk e Øfed ifjoru gkrk gA

5- ltkrh; J.kh d çR;d lnL;k dk lkekU; fof/k;k }kjk cuk;k tk ldrk gA

lkj.kh 15-4

	,Ydu J.kh	,Ydhu J.kh	,Ydkbu J.kh	,Ydkgky J.kh
n = 1	C_nH_{2n+2} CH_4 ¼eFku½	C_2H_{2n} –	C_nH_{2n-2} –	$C_nH_{2n+2}O$ CH_3OH ¼eFkuky½
n = 2	C_2H_6 ¼,Fku½	C_2H_4 ¼,Fkhu½	C_2H_2 ¼,Fkkbu½	CH_3CH_2-OH ¼,Fkuky½
n = 3	C_3H_8 ¼çkiu½	C_3H_6 ¼çkihu½	C_3H_4 ¼çkikbu½	$CH_3–CH_2–CH_2–OH$ ¼ikiu&1&vky½
n = 4	C_4H_{10} ¼C;Vu½	C_4H_8 ¼C;Vhu½	C_4H_6 ¼C;Vkbu½	$CH_3–CH_2–CH_2–CH_2–OH$ ¼C;Vu&1&vky½
n = 5	C_5H_{12} ¼iUVu½	C_5H_{10} ¼iUVhu½	C_5H_8 ¼iUVkbu½	$CH_3–CH_2–CH_2–CH_2–CH_2–OH$ ¼iUVu&1&vky½

6- çR;d ltkrh; J.kh dk fo'k"k çdk;kRed leg gkrk gA ftld dkj.k lnL;k d jklk;fud x.k/ke leku gkr gA

leko;ork (Isomerism)

cftfy;l o Ogkyj u ik;k fd NH_2CONH_2 ¼;fj;k½ rFkk NH_4CNO ¼vekfu;e lk;uV½ nkuk dk vkf.od l= CH_4N_2O leku gA fdUr mud Hkkfrd ,o jklk;fud x.k fHkUu&fHkUu gA

nk ;k nk l vf/kd ,l ;kfxd ftudk vkf.od l= leku gk fdUr Hkkfrd ,o jklk;fud x.k fHkUu&fHkUu gk] leko;oh (Isomers) dgykr g rFkk bl ifj?kVuk dk leko;ork (Isomerism) dgr gA

leko;ork çe[kr% nk çdkj dh gkrh g %

1- **ljpukRed leko;ork** (Structural Isomerism)

2- **f=foe leko;ork** (Stereo Isomerism or space Isomerism)

1- **ljpukRed leko;ork** (Structural Isomerism) : bl çdkj dh leko;ork e leko;oh ;kfxdk dk vkf.od l= rk leku gkrk gA yfdu v.k e ijek.kvk dh fofHkUu O;oLFkk d dkj.k ljpukREd l= fHkUu&fHkUu gkrk g] **ljpukRed leko;oh** dgykr g] rFkk bl ifj?kVuk dk **ljpukRed leko;ork** dgykrh gA ljpukRed leko;ork ikp çdkj dh gkrh g &

(i) Ük[kyk leko;ork

(ii) fLFkfr leko;ork

(iii) çdk;kRed leg leko;ork

(iv) e/;ko;ork

(v) pyko;ork

(i) **Ük[kyk leko;ork** (Chain Isomerism) : ,l leko;oh ;kfxd ftudk vkf.od l= leku gk] fdUr dkcu ijek.k dh Ük[kyk fHkUu&fHkUu gk] mUg **Ük[kyk leko;oh** dgr g] rFkk bl ifj?kVuk dk **Ük[kyk leko;ork** dgr gA

tl C_4H_{10} vkf.od l= oky ,Ydu d nk Ük[kyk leko;o lHko gA

$CH_3-CH_2-CH_2-CH_3$ C;Vu

$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$ 2&efFky ikiu

C_5H_{12} vkf.od l= oky ,Ydu d rhu Ük[kyk leko;o lEHko gA

$CH_3-CH_2-CH_2-CH_2-CH_3$ n–iUVu

$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_3$ 2&efFky C;Vu

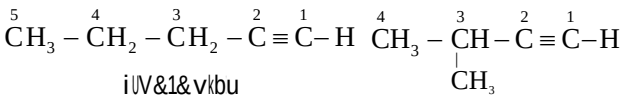
$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3$ 2] 2&MkbefFky ikiu

C_4H_8 vkf.od l= d nk Ük[kyk leko;o lEHko gA

$\overset{4}{C}H_3-\overset{3}{C}H_2-\overset{2}{C}H=\overset{1}{C}H_2$ C;V&1&bu

$\overset{3}{C}H_3-\overset{\displaystyle 2}{\underset{\displaystyle CH_3}{\underset{|}{C}}}=\overset{1}{C}H_2$ 2&efFky iki&1&bu

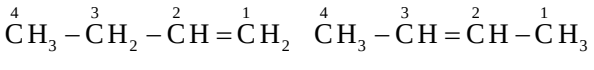
C_5H_8 vkf.od l= d nk Ük[kyk leko;o lEHko gA



iUV&1&vkbu 3&efFky C;V &1&vkbu

(ii) **fLFkfr leko;ork** (Position Isomerism) : ,l leko;oh ;kfxd ftudk vkf.od l= leku g] fdUr ;kfxd e f}vkc/k] f=vkc/k] çfrLFkkih] çdk;kRed leg dh fLFkfr fHkUu&fHkUu gkrh gA **fLFkfr leko;o** dgykr g rFkk ifj?kVuk dk **fLFkfr leko;ork** dgr gA

C_4H_8 vkf.od l= okyh ,Ydhu nk fLFkfr leko;o çnf'kr djrk gA



C;V&1&bu C;V&2&bu

C_4H_6 vkf.od l= okyk ,Ydkbu nk fLFkfr leko;o çnf'kr djrk gA

C;V&1&vkbu C;V&2&vkbu

C_3H_7Cl vkf.od l= oky ,fYdy gykbM nk fLFkfr leko;o çnf'kr djr gA

1&Dykjkikiu 2&Dykjkikiu

C_3H_7OH vkf.od l= oky ,Ydkgky nk fLFkfr leko;o inf'kr djr gA

1&ikiuky 2&ikiuky

(iii) **çdk;kRed leg leko;ork** (Functional Group Isomerism) :

,l leko;oh ;kfxd ftudk vkf.od l= leku g ijr mue mifLFkr çdk;kRed leg fHkUu&fHkUu gkr g **çdk;kRed leg leko;o** dgykr g rFkk bl ifj?kVuk dk **çdk;kRed leg leko;ork** dgr gA

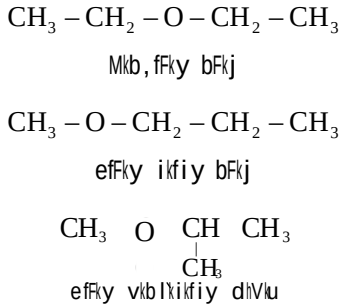
C_3H_6O vkf.od l= d fuEufyf[kr nk çdk;kRed leko;o g &

ikiuy ¼,fYMgkbM½ ikiuku ¼dhVku½

C_2H_6O vkf.od l= d fuEufyf[kr nk çdk;kRed leko;o gA

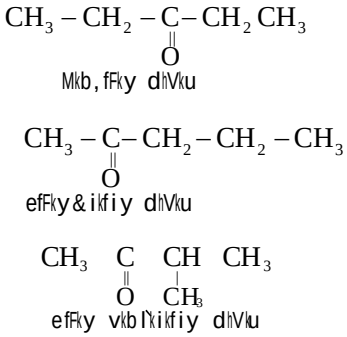
,Fkuky eFkkDlheFku

(iv) **e/;ko;ork** (Metamerism) : ,l leko;oh ;kfxd tk ltkrh; J.kh d gk mudk vkf.od l= leku gk ijr fdlh cgl;kth çdk;kRed leg ij yx ,fYdy leg fHkUu&fHkUu gk mUg **e/;ko;oh** dgr g rFkk bl ifj?kVuk dk **e/;ko;ork** dgr gA e/;ko;ork d rgr] cgl;kth çdk;kRed leg l lyXu ,d ,fYdy leg l nlj ,fYdy leg e CH_2 dk LFkkukrj.k gkrk gA $C_4H_{10}O$ vkf.od l= oky ;kfxd d rhu e/;ko;oh lHko gA



Mkb,fFky bFkj efFky ikfiy bFkj efFky vkblikfiy dhVku

$C_5H_{10}O$ vkf.od l= oky ;kfxd d rhu e/;ko;oh lHko gA



Mkb,fFky dhVku efFky&ikfiy dhVku efFky vkblikfiy dhVku

gkbMkdkcu (Hydrocarbon)

dkcu ,o gkbMkstu d l;kx l cu ;kfxdk dk

gkbMkdkcu dgr gA gkbMkdkcu dk ljpuk d vk/kkj ij nk Hkkxk e oxhÑr fd;k x;k g&

(i) foor Ük[kyk gkbMkdkcu

(ii) lor Ük[kyk vFkok pØh; gkbMkdkcu

(i) **foor Ük[kyk gkbMkdkcu** (Open chain Hydrocarbon) : o dkcfud ;kfxd ftue dkcu ijek.k vkil e vkcf/kr gkdj yEch Ük[kyk dk fuek.k dj vkj mud vfUre flj LorU= jgr gA bUg **foor Ük[kyk gkbMkdkcu** dgr gA bUg iu% nk Hkkxk e oxhÑr fd;k tkrk gA

¼v½ lrlr ¼c½ vlrlr

¼v½ **lrlr gkbMkdkcu** % o gkbMkdkcu ftue lHkh dkcu ijek.k doy ,dy lgl ;ktd vkc/k l cèk gkr g] bUg **lrlr gkbMkdkcu** dgr gA bUg ,Ydu Hkh dgr gA bu ij vf/kdk'k jklk;fud vfHkdedk dh dkb vfHkfØ;k ugh gkrh g vr% bUg ijkfQu Hkh dgr gA ,Ydu dk lkekU;r l= C_nH_{2n+2} gkrk gA bue dkcu sp^3 ldj.k voLFkk e gkrk g vFkkr T;kferh lepr"Qydh; gkrh g vkj vkc/k dk.k 109°28' gkrk gA ,Ydu e C—C vkc/k yEckb 1.54Å rFkk C – H vkc/k yEckb 1.12Å gkrh gA

,Ydu k d fojpu dh lkekU; fof/k;k

(Methods of Preparation of Alkanes)

1- vlrlr gkbMkdkcu ¼,Ydhu rFkk ,Ydkbu½ d gkbMk tuhdj.k l (By Hydrogenation of unsaturated Hydrocarbon (Alkens and Alkynes)

mRçjd iyfM;e] lyfVue] ju fudy vkfn dh mifLFkfr e ,Ydhu rFkk ,Ydkbu dh Mkbgkbmk tu d lkFk vfHkfØ;k l ,Ydu curh gA

$$HC \equiv CH + 2H_2 \xrightarrow[Pd/BaSO_4]{Pd/C} \underset{,Fku}{C_2H_6}$$

,Fkkbu

ju fudy dh mifLFkfr e ,Ydhu rFkk ,Ydkbu dk gkbMk tuhdj.k 473–573K rki ij gkrk gA bl **lkekR; l.MjUl vfHkfØ;k** (Sabatier Senderen's Reaction) dgr gA

$$\underset{ikihu}{CH_3 - CH = CH_2} + H_2 \xrightarrow{ju\ fudy} \underset{ikiu}{CH_3 - CH_2 - CH_3}$$

2- ,fYdy gykbM ¼gyk,Ydu½ l (By Haloalkanes)

(i) **gyk,Ydu d vip;u }kjk** (By Reduction of Haloalkane) : gyk,Ydu $LiAlH_4$, Na–Hg, lkfM;e&,Fkuky] (Zn–Cu) o gkbMkDykfjd vEy vkfn vipk;d inkFkk dh mifLFkfr e vipf;r

$$\underset{Dykjk,Fku}{CH_3 - CH_2 - Cl} + 2[H] \xrightarrow{vipk;d} \underset{,Fku}{CH_3 - CH_3} + HCl$$

gkdj ,Ydu cukrh gA

(ii) **oVt vfHkfØ;k** (Wurtz Reaction) : gyk,Ydu 'k"d bFkj dh mifLFkfr e lkfM;e /kkr d lkFk vfHkfØ;k djd ,Ydu cukr gA ;g vfHkfØ;k **oVt vfHkfØ;k** dgykrh gA

$$\underset{ckekeFku}{CH_3 - Br} + 2Na + Br - CH_3 \xrightarrow[bFkj]{'kq} 2NaBr + \underset{,Fku}{CH_3 - CH_3}$$

3- dkckfDlfyd vEyk l

(i) fodkckfDlyhdj.k ¼CO_2 dk fu"dkyu½ ekukdkckfDlfyd vEyk d lkfM;e yo.k dk lkMkykbe d lkFk xje dju ij ,Ydu çklr gkrh gA

$$\underset{lkfM;e,Fkuk,V}{CH_3COONa} + NaOH(CaO) \xrightarrow{\Delta} Na_2CO_3 + \underset{eFku}{CH_4}$$

bl vfHkfØ;k e ey dkcfud ;kfxd l ,d dkcu de gk tkrk g vr% bl vfHkfØ;k dk mi;kx l tkrh; J.kh d vojkg.k e fd;k tkrk gA

(ii) **dkYc o/kr vi?kVuh fof/k** (Kolbe's Electrolytic Process) % ekukdkckfDlfyd vEy d lkfM;e ;k ikVf'k;e yo.k d tyh; foy;u dk o|r vi?kVu dju l lel[;k okyh mPprj ,Ydu çklr gkr gA bl vfHkfØ;k dk **dkYc o|r vi?kVuh fof/k** dgr gA

$$\underset{ikVf'k;e,lhVV}{CH_3COOK + 2H_2O} \xrightarrow[vi?kVu]{o/kr} \underset{,Fku}{CH_3 - CH_3} + 2CO_2 + H_2 + 2KOH$$

4- xhU;kj vfHkdedk l (From Grignard Reagent)

,fYdy eXuhf'k;e gykbM R-MgX dk xhU;kj vfHkded dgr gA xhU;kj vfHkded dh vfHkfØ;k fØ;k'khy gkbMk tu ;Dr ;kfxdk ¼tl H_2O, ,Ydgky] ,ehu] Fkk;ky] ,lhfVyhu vkfn½ l djku ij lxr ,Ydu çklr gkrk gA

$$\underset{,fFky eXuhf'k;e ckekbM}{CH_3 - CH_2 - Mg - Br} + HOH \longrightarrow \underset{,Fku}{CH_3CH_3} + \underset{gkbMkDlh eXuhf'k;e ckekbM}{Mg\begin{matrix}Br\\OH\end{matrix}}$$

5- **Dyhelu vip;u** (Clemmenson Reduction)

Zn–Hg o lkUæ gkbMk tu Dykjkb M dh mifLFkfr e ,fYMgkbM o dhVku d vip;u l ,Ydu curh gA bl vfHkfØ;k dk **Dyhelu vip;u** dgr gA

$$CH_3\overset{\overset{O}{\|}}{C}CH_3 \quad 4(H) \xrightarrow[HCl]{Zn\ Hg} CH_3CH_2CH_3 + H_2O$$

$$CH_3-CHO+4(H)\xrightarrow[HCl]{Zn-Hg}CH_3-CH_3+H_2O$$

6- **,Ydkgky] ,fYMgkbM] dhVku ,o dkckfDlfyd vEy l** (From Alcohols, Aldehydes, Ketones and Carboxylic Acids)

,Ydkgky] ,fYMgkbM] dhVku ,o dkckfDlfyd vEy dk yky QkLQkjl rFkk HI }kjk vip;u l ,Ydu çkIr gkrk gA

$$\underset{eRuky}{CH_3OH} + 2HI \xrightarrow{yky\ p} \underset{eRu}{CH_4} + I_2 + H_2O$$

$$\underset{,Fkuy}{CH_3CHO} + 4HI \xrightarrow{yky\ p} \underset{,Fku}{CH_3CH_3} + 2I_2 + H_2O$$

$$\underset{ikiuku}{CH_3COCH_3} + 4HI \xrightarrow{yky\ p} \underset{ikiu}{CH_3CH_2CH_3} + 2I_2 + H_2O$$

$$\underset{,Rukbd\ vEy}{CH_3COOH} + 6HI \xrightarrow{yky\ p} \underset{,Ru}{CH_3CH_3} + 3I_2 + 2H_2O$$

,Yduk d mi;kx (Uses of alkanes)

1- jcj] lykfLVd] tl inkFkk d fy, v/koh; foyk;d d :i e ç;Dr gkr gA
2- ,Fku B.Md ink dju e ç;Dr gkr gA
3- C;Vu o vkbl kC;Vu L.P.G. dh ?kVd xl gA
4- ,Fku dk mi;kx Ñf=e dij (C_2Cl_6) d fuek.k e gkrk gA
5- gyktu 0;RiUu tl & DykjkQke ($CHCl_3$), dkcu VVkDYkjkbM (CCl_4) vkfn ç;kx'kkyk rFkk m|kx e mi;kxh gkr gA
6- iVkfy;e l çkIr mPp ,Ydu tl & iVky] fdjkl hu] Lugd ry] ijkfQu eke vkfn cgr mi;kxh gkr gA
7- eFku] lEihfMr çkÑfrd xl (C.N.G.) dh e[; ?kVd xl gA
8- eFku dk mi;kx dkcu Cyd d fuek.k e gkrk gA
9- ,Ydu d mRçjdh; vkDlhdj.k l ,Ydkgky] ,fYgkbM] vkj vEy tl mi;kxh ;kfxd cur gA

,Ydhu (Alkene)

vlrlr ,fyQfVd gkbMkdkcu ftue dkcu&dkcu f}vkc/k ik;k tkrk g ,Ydhu dgykr gA ,Ydhuk dk lkekU; l= C = C vkc/k e lfEefyr dkcu ijek.k sp^2 ldfjr gkr g] dkcu ijek.k dh T;kferh f=dk.kh; gkrh g vkj vkc/k dk.k dk eku 120°, C–C vkc/k yEckb 1.34°A rFkk C–H vkc/k yEckb 1.10°A gA f}vkc/k ,d ikb (π) rFkk fl Xek (σ) vkc/k l cuk jgrk gA ryh; ;kfxd cuku dh {kerk d dkj.k bUg vkfyfQu Hkh dgr gA bl ox d çFke nk lnL; ,Fkhu (C_2H_4) rFkk çkihu (C_3H_6) gA

,Ydhuk d fojpu dh lkekU; fof/k;k

(General Methods of Preparation of Alkenes)-

1- **gyk,Ydu ¼,fYdy gykbM½ d fogkbMkgyktuhdj.k** (–HX) l (By Dehydrohalogenation of Haloalkanes) : ,fYdy gykbM dk ,Ydkgkyh KOH d lkFk xje dju ij ,Ydhu çkIr gkrh gA bl vfHkfØ;k e HX foykfir gkrk gA vr% bl fogkbMkgyktuhdj.k (Dehydrohalogenation) dgr gA

$$CH_3-CH_2-Cl\xrightarrow[KOH]{,Ydkgkyh}CH_2=CH_2+HCl$$

2- **MkbgykbM d fogyktuhdj.k l** (By Dehalogenation of Dihalides) : **fudVorh** (Vicinal) Mkbgyk,Ydu dk ;'knjt (Zinc-dust) rFkk eFkuky d lkFk xje dju ij ,Ydhu curh gA

$$\underset{\underset{Cl}{|}}{H_2C}-\underset{\underset{Cl}{|}}{CH_2}+Zn\xrightarrow[\Delta]{CH_3OH}ZnCl_2+CH_2=CH_2$$

1] 2 MkbDykjk, Fku , Fkhu

te MkbgykbM (Gem Dihalides) vxj nkuk gyktu ijek.k ,d gh dkcu l tM gk rk ,l Mkbgykb M dk te Mkbgykb M dgr gA

$$H_2C(Br)(Br)-CH + Zn + CH(Br)(Br)-CH_3 \longrightarrow ZnBr_2 + CH_3-CH=CH-CH_3$$

1]1&Mkbdklek, Fku 1]1&Mkbdklek, Fku C;V&2&bu

3- **,Ydkgky d futyhdj.k** ($-H_2O$) **l** (By Dehydration of Alcohol) % ,Ydkgky dk futyhdkjd (lkUæ H_2SO_4, lkUæ H_3PO_4, Al_2O_3, $ZnCl_2$) d lkFk xje dju ij ,Ydkgky ty dk ,d v.k foykfir dj ,Ydhu cukr gA

$$\underset{,Fkuky}{CH_3-CH_2-OH}\xrightarrow[H_2SO_4]{lkUn}H_2O+\underset{,Fkhu}{CH_2=CH_2}$$

4- **,Ydu d rki vi?kVu l** (By Pyrolysis of Alkane) : ,Yduk dk ok; dh vuifLFkfr e 800-1000 K rd xje dju ij ,Ydu] fuEurj ,Ydu] ,Ydhu] ,Ydkbu e fo?kfVr gk tkrh gA bl rki vi?kVu dgr gA

$$CH_2-CH_2-CH_3 \xrightarrow{\Delta} CH_3-CH=CH_2+CH_2=CH_2+CH_4+H_2$$

,Ydhuk d mi;kx (Uses of Alkenes)

1- l'yf"kr jcj o vU; cgyd PVC, V¶yku] vkjyku tl ¼mi;kxh ;kfxd d fuek.k eA
2- fuEurj lnL; çdk'k lkr o b/ku d :i e mi;kx vkr gA
3- ,Fkhu dk cgyd ikfyFkhu cgrk;r ifdx inkFk e ç;Dr gkrk gA
4- ,Fkhu d mi;kx l ,Fkuky o ,fFkyhu Xykbdky Hkh cuk;k tk ldrk gA
5- ,Fkhu dk mi;kx ofYMx e vkDlh&,fFkyhu Tokyk d #i e fd;k tkrk gA
6- ,fFkyhu dk mi;kx Qyk dk Ñf=e :i l idku e ç;Dr gkrk gA

,Ydkbu (Alkynes)

vlrlr ,fyQfVd gkbMkdkcu ftue dkcu&dkcu f=vkc/k ik;k tkrk g] ,Ydkbu dgykr gA ,Ydkbuk dk lkekU; l= C_nH_{2n-2} gkrk gA vkc/k e lfEefyr dkcu ijek.k sp ldfjr voLFkk e gkr gA T;kferh j[kh; gkrh g vkj vkc/k dk.k dk eku 180°, C-C vkc/k yEckb 1.20°A rFkk C-H vkc/k yEckb 1.06° A gA f=vkc/k e nk ikb (π) rFkk ,d fl Xek (σ) vkc/k gkrk gA bl ifjokj dk çFke lnL; ,lhfVyhu g vr% lEi.k ifjokj çk;% ,lhfVyhu ifjokj d uke l Hkh tkuk tkrk gA

,Ydkbu d fojpu dh lkekU; fof/k;k

(General Methods of Preparation of Alkynes)

1- **Mkbgyk,Yduk d fogkbMkgyktuhdj.k l** (By Dehydrohologenation of Dihaloalkane) : 1,1 ;k 1,2-Mkbgyk,Ydu dk ,Ydkgkyh KOH d lkFk vfHkfØ;k djku ij gyk,Ydhu curh g tk lkMk,ekbM d lkFk vfHkfØ;k dj ,Ydkbu cukrh gA

$$CH_2(Br)-CH_2(Br) \xrightarrow[-HBr]{KOH+C_2H_5OH} CH_2=CH(Br) \xrightarrow[-HBr]{NaNH_2} CH\equiv CH$$

1] 2&Mkbckek,Fku ckek,Fkhu ,Fkkbu

2- **VVkgyk,Yduk d fogyktuhdj.k l** (By Dehalogenation of Tetrahaloalkanes) : 1,1,2,2 VVk ckek,Fku dk ftd ,o ,Ydkgky d lkFk vfHkfØ;k djku ij ,Fkkbu çkIr gkrh gA

$$H-C(Br)(Br)-C(Br)(Br)-H + 2Zn \xrightarrow{C_2H_5OH} 2ZnBr_2 + CH\equiv CH$$

1]1]2]2&VVkckek ,Fku ,Fkkbu

3- **dfY'k;e dkckbM ij ty dh vfHkfØ;k l** (By the action of water on Calcium Carbide) : dfY'k;e dkckbM dh ty l vfHkfØ;k djku ij ,lhfVyhu çkIr gkrh gA

$$CaC_2+2H_2O \longrightarrow C_2H_2+Ca(OH)_2$$

4- **DykjkQke ;k vk;kMkQke d fogyktuhdj.k l** (By the Dehalogenation of Chloroform or Iodoform) : DykjkQke ;k vk;kMkQke flYoj p.k d lkFk vfHkfØ;k djd fogyktuhdj.k }kjk ,Fkkbu cukr gA

$$CHI_3 + 6Ag + I_3CH \longrightarrow 6AgI + CH\equiv CH$$

vk;kMkQke ,Fkkbu

5- **dkcu vkj gkbMktu l l'y"k.k** (Synthesis from Carbon and Hydrogen) : nk dkcu byDVkM d e/; o|r vkd e l gkbMktu xl çokfgr dh tko rk ,Fkkbu ;k ,lhfVyhu çkIr gkxhA

$$2C+H_2 \xrightarrow[\text{vkd}]{o|r} HC\equiv CH$$

,lhfVyhu

6- **1&,Ydkbu d ,fYdyhdj.k l** (By Alkylation of 1-Alkynes) : 1&,Ydkbu dh æo vekfu;k e lkfM;e l vfHkfØ;k }kjk lkfM;e ,fYdukbM cur gA tk ,fYdy gykbM l vfHkfØ;k djd mPprj ,Ydkbu cur gA

$$H-C\equiv C-H+NaNH_2 \xrightarrow[NH_3(l)]{196K} H-C\equiv C-Na+NH_3$$

,Fkkbu lkfM;e ,FkkbukbM

H C C Na Cl CH_3 — lkfM;e ,FkkbukbM

H C C CH_3 NaCl — ikikbu

,Ydkbuk d mi;kx (Uses of Alkynes)

,Ydkbuk e ,lhfVyhu cgr gh mi;kxh g] bld dN mi;kx fuEufyf[kr gA

1- vkDlh,lhfVyhu Tokyk xl ofYMx e ç;Dr gkrh gA

2- ,lhfVyhu xl Qyk dk Ñf=e :i l idku e ç;Dr gkrh gA
3- ,lhfVyhu l db mi;kxh ;kfxd tl&,lhVfYMgkbM] ,lhfVd vEy vkfn cuk; tkr gA
4- ,lhfVyhu ¼gkdj yEi½ dkckbM yEi e çnhid d :i e ç;Dr gkrh gA
5- oLVku rFkk oLVklky uked mi;kxh foyk;d cuku eA
6- ,lhfVyhu dk mi;kx l'yf"kr jcj d fuek.k e gkrk gA

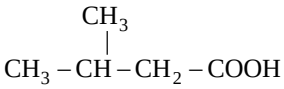
egRoi.k fcUn

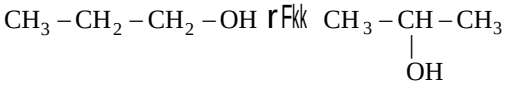
1- lHkh dkcfud ;kfxdk e dkcu vkj gkbMktu vko';d vo;o d :i e gkr gA
2- dkcu e Ük[kyu (Catenation) rFkk pr%l;ktdrk ikb tkrh gA
3- dkcfud ;kfxd lgl;ktd vkc/k }kjk vkcf/kr gkr gA
4- tc ljpukRed x.kk e lekurk j[ku oky ;kfxdk d leg d lnL;k dk c<r g, v.kHkkj d Øe e j[kk tkrk g rk ml J.kh dk ltkrh; J.kh dgr gA
5- nk vFkok nk l vf/kd ;kfxd ftud v.kl= leku gk ijUr ljpukRed rFkk f=foe foU;kl fHkUu&fHkUu gk] leko;o dgykr g vkj ifj?kVuk dk leko;ork dgr gA
6- ljpukRed leko;ork e leko;oh ;kfxd dk v.kl= leku gkrk g ijUr ljpukRed l= fHkUu&fHkUu gkrk gA
7- fLFkfr leko;ork e ;kfxd dk v.kl= leku gkrk g ijUr f}vkc/k] f=vkc/k] çfrLFkk;h leg rFkk çdk;kRed leg dh fLFkfr fHkUu&fHkUu gkrh gA
8- çdk;kRed leg leko;rk e ;kfxd dk v.kl= leku ijr çdk;kRed leg fHkUu&fHkUu gkrk gA
9- e/;ko;ork e ;kfxd dk v.kl= leku gkrk g ijUr cgl;kth çdk;kRed leg l tM ,fYdy legk dh ljpuk e vrj gkrk gA
10- dkcfud ;kfxdk d ukedj.k dh rhu ç.kkyh çpfyr g& :< ç.kkyh] 0;RiUu ç.kkyh rFkk IUPAC ç.kkyhA
11- ;kfxd dk IUPAC uke bl çdkj l curk g& f}rh;d ioyXu $ çkFkfed iodyXu $ ey 'kCn $ çkFkfed vuyXu $ f}rh;d vuyXuA
12- çdk;kRed leg dh ojh;rk dk Øe g& dkckfDlfyd vEy > lYQkfud vEy > ,flM ,ugkbMkbM > ,LVj > ,flM Dykjkb M > ,flM ,ekbM > ukbVkby > ,fYMgkbM > dhVku > ,Ydkgky > ,ehu

vH;klkFk ç'u

oLrfu"B ç'u

1- C_5H_{12} }kjk inf'kr ljpukRed leko;fo;k dh l[;k g&
¼v½ 4 ¼c½ 5
¼l½ 6 ¼n½ 3
2- ,d ltkrh; J.kh e&
¼v½ vkf.od l= leku gkr gA
¼c½ ljpukRed l= leku gkr gA
¼l½ Hkkfrd x.k leku gkr gA
¼n½ lkekU; l= leku gkr gA
3- fuEufyf[kr ;kfxd dk IUPAC uke g&



¼v½ 2&efFky&C;Vukbd vEy
¼c½ 3&efFky&C;Vukbd vEy
¼l½ vkblkikfiy C;Vukbd vEy
¼n½ rrh;d C;fVy C;Vukbd vEy
4- $CH_3-CH_2-CH_2-OH$ rFkk 
fuEufyf[kr leko;rk n'kkr g&
¼v½ fLFkfr leko;rk ¼c½ Ük[kyk leko;ork
¼l½ e/;ko;ork ¼n½ pyko;ork
5- RMgX l R-H cuku gr mi;Dr vfHkded gkxk&
¼v½ $R–NH_2$ ¼c½ ROH
¼l½ NH_3 ¼n½ mi;Dr lHkh
6- Fkk;kQhu e dkulk fo"ke ijek.k mifLFkr g&
¼v½ N ¼c½ O
¼l½ S ¼n½ N rFkk S

vfry?kÙkjkRed i'u

1- leko;ork fdl dgr g\
2- $C_4H_{10}O$ v.kl= d e/;ko;oh leko;fo;k dh ljpuk fyf[k,A

3- ltkrh; J.kh d nk y{k.k fyf[k,A

4- lepØh; ;kfxd fdl dgr g\ mnkgj.k nhft,A

5- $CH_3-CH_2-CH_2-CHO$ dh ey Ük[kyk e fdru dkcu ijek.k g\ ;kfxd dk IUPAC uke fyf[k,A

y?kUkjkRed ç'u

1- çdk;kRed leg leko;rk fdl dgr g\ ,d mnkgj.k nhft,A

2- fooÙk Ük[kyk ;kfxd fdl dgr g\ mnkgj.k lfgr le>kb,A

3- ,Yduk d fuek.k d fy, dkYc o|r vi?kVu dk le>kb,A

4- fuEufyf[kr ;kfxdk d IUPAC uke crkb,&

¼v½ $CH_3-CH_2-CH=CH_2$

¼c½ CH_3-CH_2-CHO

¼l½ $CH_3-\overset{\overset{O}{11}}{C}-CH_2-CH_3$

5- fLFkfr leko;drk dk ,d mnkgj.k ndj Li"V dhft,A

fucU/kkRed ç'u

1- gkbMkdkcu fdl dgr g\ gkbMkdkcu d oxhdj.k dk le>kb,A

2- leko;ork fdl dgr g\ fofHkUu çdkj dh ljpukRed leko;ok dk mnkgj.k ndj le>kb,A

3- fuEufyf[kr ij fVli.kh fyf[k,&

(i) oVt vfHkfØ;k

(ii) Dyheulu vip;u

4- fuEufyf[kr ;kfxdk d IUPAC uke crkb,&

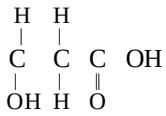
(i) $CH_3CH_2-\underset{\underset{CH_3}{|}}{CH}-CHO$

(ii) CH_3-CH_2-COOH

(iii) $CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3$

(iv) $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$

(v) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-C\equiv N$

(vi) 

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mÙkjekyk % 1 ¼n½ 2 ¼n½ 3 ¼c½ 4 ¼v½ 5 ¼n½ 6 ¼l½

bdkb & x

v/;k; & 16

cgyd

(Polymers)

Hkfedk

cgydk dh [kkst vkj mudk nfud thou e vuç;kx cgr egÙoi.k gk x;k gA nfud thou e mi;kx vku okyh oLr, tl f[kyku] lykfLVd dh ckfYV;k] ckry] Vh-oh- dchuV] oL= lkexh] Vk;jk] fo|rjk/kh inkFk] idt e i;Dr gku oky Fky vkfn cgydk l cuk; tkr gA e'khu d dyi tk] çR;kLFk cgyd] lykfLVd] j'kk vkj çyik ¼iVl½ d vk|kfxd fuek.k u nfud thou d lkFk & lkFk vk|kfxd txr e Økfr yk nh gA

cgyd ¼ikfyej½ 'kCn dh mRifÙk xhd Hkk"kk l gb g] tgk ikfy dk vFkZ çk; cg ¼vud½ rFkk el (meros) dk vFkZ çk; bdkb gA

mPp vkf.od æ0;eku ($10^3 - 10^7$u) oky o inkFk tk vud ljy v.kvk d jklk;fud vkc/k d l;Xeu l cuk; tkr gA bl çfØ;k e ljy v.kvk dk ,dyd dgr g] rFkk ,dyd d ;Xeu l cu mPp vkf.od æ0;eku ¼cgn.k½ oky inkFkk dk cgyd dgr gA bl çfØ;k dk cgyhdj.k ;k cgydu dgr gA

VVk¶ykjk,Fkhu dk V¶yku e :ikrj.k gDlkefFkyhuMkb,ehu rFkk ,fMfid vEy dh vfHkfØ;k l ukbyku& 6] 6 dk fojpu fofHkUu çdkj d cgydu d mnkgj.k gA

$$nF_2C=CF_2 \xrightarrow[\text{mPp nkc cgydu}]{\text{mRijd}} \left[CF_2-CF_2\right]_n$$

VVk¶ykjk,Fkhu → V¶yku

$$nNH_2(CH_2)_6NH_2 + nHOOC(CH_2)_4COOH \xrightarrow{\text{cgyd}} \left[-\overset{H}{\underset{|}{N}}-(CH_2)_6-\overset{H}{\underset{|}{N}}-\overset{O}{\underset{||}{C}}-(CH_2)_4-\overset{O}{\underset{||}{C}}-\right]_n$$

gDlkefFkyhuMkb,ehu + ,fMfid vEy → ukbyku& 6] 6

,sls n[kk x;k g fd ,d cgyd dh lHkh ,dyd bdkb;k leku gk Hkh ldrh g ;k ugh Hkh] tSl V¶yku] ,d gh çdkj dh ,dyd bdkb VVk¶ykjk,Fkhu dh iukofr l curk g] bl lecgyd (Homopolymer) dgr gA ukbyku& 6] 6 gDlkefFkyhuMkb,ehu rFkk ,fMfid vEy nk fofHkUu ,dyd bdkb;k dk cgyd g bl lg&cgyd (Copolymer) ;k fefJr cgyd (Mixed Polymer) dgr gA

cgydk dk oxhdj.k

(Classification of Polymers)

fof'k"V egÙok d vk/kkj ij cgydk dk db çdkj l oxhÑr fd;k tk ldrk gA cgydk d dN lkekU; oxhdj.k fuEukuqlkj g &

उत्पत्ति के स्रोत पर आधारित वर्गीकरण

(Classification Based upon Source of Origin)

mRifÙk d lkr d vk/kkj ij cgydk dk çkÑfrd] vèkl'yf"kr vkj l'yf"kr cgyd d :i e oxhÑr fd;k x;k gA

1- **çkÑfrd cgyd** (Natural Polymer) : o cgyd tk çkÑfrd lkrk tl iM&ik/kk rFkk trvk l çklr gkr g] mUg çkÑfrd cgyd dgr gA

mnkgj.k ¼ LVkp] çkVhu] çkÑfrd jcj] lyyktu] U;Dyhd vEy vkfnA

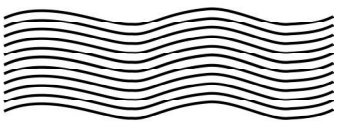
2- **अर्ध–संश्लेषित बहुलक** (Semi-Synthetic Polymer) : o cgyd tk çkÑfrd cgydk ij dN jklk;fud fofèk;k }kjk çkIr gkr g] mUg v/kl'yf"kr dgr gA mnkgj.k d fy, lyykl Mkb, lhVV ftl fo'k"k çdkj dh fQYe o Xykl cuku oky inkFk e ç;Dr djr g] tk fd lyykl d ,lhfVyhdj.k }kjk lY¶;fjd vEy dh mifLFkfr e ,lhfVd ,ugkbMkbM d lkFk vfHkfØ;k djkdj çkIr fd;k tkrk g] lyykl ukbVV ½xu dkVu½ rFkk xU/kd fefJr jcj v/k l'yf"kr cgyd d lkèkkj.k mnkgj.k gA

3- **l'yf"kr cgyd** (Synthetic Polymers) : o cgyd tk ç;kx'kkyk e jklk;fud fof/k;k }kjk cuk; tkr gk] mUg l'yf"kr cgyd dgr gA bUg ekuo fufer cgyd Hkh dgr gA dN lkekU; mnkgj.k g % ihohlh] V¶yku] cdykbV] Vfjyhu vkfnA

ljpuk ij vk/kkfjr oxhdj.k

,dyd bdkb;k e l;Xeu d vk/kkj ij cgydk dk rhu Hkkxk e oxhÑr fd;k x;k gA

1- **jf[kd cgyd** (Linear Polymer) : bl çdkj d cgydk e Ük[kyk, yEch o lh/kh gkrh gA ; jf[kd Ük[kyk, ,d&nlj d lkFk jk'kÑr gkdj 0;ofLFkr ljpuk cukrh g ¼fp= 16-1½] ifj.kkeLo:i bud ?kuRo] ruu lkeF; (Tensile Strength) rFkk xyukd mPp gkr gA tl mPp ?kuRo ikfyFkhu] ihohlh-ukbyku] ikfy,LVj vkfnA



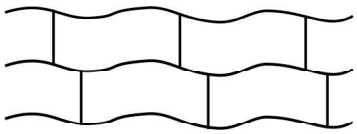
fp= 16-1 % jf[kd cgyd

2- **'kkf[kr Ük[kyk ;Dr cgyd** (Branched Chain Polymer) : bl çdkj d cgydk e ,dyd bdkb;k l;fXer gkdj yEch Ük[kyk cukrh g] bl Ük[kyk dk e[; Ük[kyk dgr gA bl e[; Ük[kyk l db vU; Ük[kyk, fudyrh g] ftUg ik'o Ük[kyk dgr gA ; vfu;fer gkrh g ¼fp= 16-2½ ftld ifj.kkeLo:i bud ?kuRo] ruu lkeF; rFkk xyukd fuEu gkr gA

fp= 16-2 % 'kkf[kr Ük[kyk cgyd

tl fuEu ?kuRo ikfyFkhu] Xykbdktu] ,ekbykifDVu vkfnA

3- **fr;d cf/kr vFkok tkyØe cgyd** (Cross Linked Polymer) : bl çdkj d cgyd f}çdk;kRed vkj f=çdk;kRed leg oky ,dydk l cur gA ble ,dyd bdkb;k l;fXer gkdj f=foe tkyd ljpuk बनाती है, ये बहुलक कठोर और भंगुर होते हैं (चित्र 16.3) l tl % cdykbV] fXylVy] ;fj;k QkeYMhgkbM jftu vkfnA



fp= 16-3 % fr;d cf/kr vFkok tkyØe cgyd

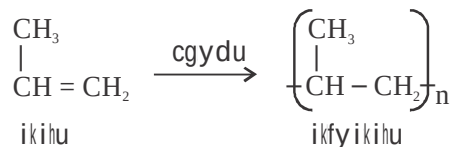
l'y"k.k ij vk/kkfjr oxhdj.k

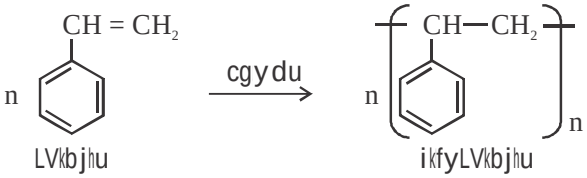
(Classification based on mode of synthesis)

cgydk dk cgydu dh fofèk d vk/kkj ij nk Hkkxk e oxhÑr fd;k x;kA

1- **;kxt cgyd** (Addition Polymers) : ;fn vud ,dyd bdkb;k fcuk fdlh v.k d foykiu }kjk yxkrkj ;kx dj yEch Ük[kyk, cukrh g] rk mul cuk mRikn ;kxt cgyd dgykrk g vkj çfØ;k dk ;kxt cgydu dgr gA ;fn ,dyd bdkb;k leku gkrh g] rk ml lecgyd dgr g ftudk vkf.od æ0;eku ,dyd bdkb d vkf.od æ0;eku dk l[;kRed x.kd gkrk gA

mnkgj.k d fy, &



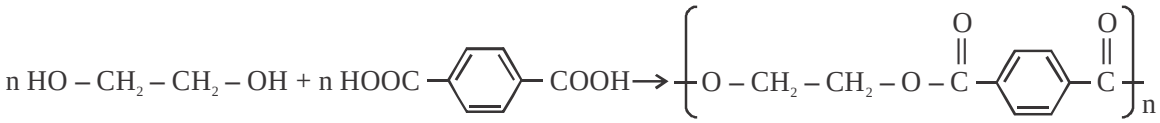


2- **l?kuu cgyd** (Condensation Polymer) : ;fn nk ;k nk l vf/kd f}çdk;kRed leg okyh ,dyd bdkb;k vkil e vfHkfØ;k djd ,d ljy v.k tl & ty] vekfu;k] HCl vkfn dk foykfir djrh g] bul cuu

okyk mRikn l?kuu cgyd dgykrk g vkj çfØ;k dk l?kuu cgydu dgr gA

mnkgj.k d fy, &

gA bUg lkpk e Mkydj] xje dju ij vR;f/kd fr;d c/k cu tkr g] vkj nxyuh; vkj vfoy; mRiknk e ifjofrr gk tkr gA tl & cdykbV] eyehuA



,fFkyhu Xykbdky ¼,Fku & 1] 2 Mkbvky½ Vj¶Fkfyd vEy ¼cthu 1] 4 Mkbdkckfdlfyd vEy½ Vfjyhu vFkok MØku

vkf.od cyk d vk/kkj ij oxhdj.k

(Classification based upon nature of molecular forces)

cgyd lkekU;r% vrjkvkf.od cy & okUMjokYl cy vkj gkbMkstu vkc/k l vkcf/kr jgr gA ; cgydk d dN ;kf=d x.k tl ruu lkeF;] iR;kLFkrk] n<iu vkfn dk iHkkfor djr gA cgydk e mifLFkr bu vkf.od cyk d ifjek.k d vk/kkj ij bUg fuEufyf[kr pkj mileg e oxhÑr fd;k x;k gA

1- **çR;kLFk cgyd** (Elastomers) : bu cgydk e vrjkvkf.od cy cgr de gkr g] ftld QyLo:i FkkMk lk gh cy yxku ij vklkuh l Qy tkr g tcfd cy gVku ij ioor vkdkj xg.k dj yr gA çR;kLFkrk cgydk e fr;d vkc/k Mkydj c<k;h tk ldrh gA tl çkÑfrd jcj e lYQj fefJr dju ij oYduhÑr jcj curk g] C;uk-S, C;uk-N vkj fuvkçhu bld vU; mnkgj.k gA

2- **j'k ;k rUr** (Fibres) : j'k ,d çdkj l /kkx cuku oky Bkl g] budh Ük[kyk e gkbMkstu vkc/k tl çcy vrjkvkf.od cy gkr g] ftld QyLo:i ijh Ük[kyk dk ck/kdj fØLVyh; çÑfr çnku djr gA bl ox l lEcfU/kr dN cgyd ukbyku& 6] 6] Vfjyhu] ikfy,fØykukbVkby gA

3- **rkil?kV; cgyd** (Thermoplastic Polymer) : ; j[kh; okbfuy cgyd g] budh Ük[kykvk e ncy okUMjokYl cy gkr gA tc bUg xje djr g rk o eny vkj B.Mk dju l dBkj gk tkr gA bl çdkj budk mi;Dr lkpk }kjk fofHkUu çdkj d vkdkjk e <ky ldr gA dN lkekU; mnkgj.k % ikfyFkhu] ikfyokbfuy Dykjkb M] ikfyLVkbjhu vkfn gA

4- **rkin< cgyd** (Thermosetting Polymer) : ; cgyd fr;dc) vFkok vR;kf/kd 'kkf[kr gkr g] bUg fuEu vkf.od æ0;eku oky v)æ0; inkFkk l cuk;k tkrk

of) cgydu d vk/kkj ij oxhdj.k

(Classificaion based on Growth Polymerisation)

;kxt vkj l?kuu cgydk dk mud fojpu e cgydu fØ;kfof/k d çdkj d vk/kkj ij Ük[kyk of) cgydu vkj in of) cgydu Hkh dgr gA

J[kyk of) cgyd (Chain Growth Polymers)

;kxt cgyd] ,dyd bdkb;k d ;kx l cur gA ;kxt çfØ;k e Ük[kyk fØ;kfof/k }kjk Ük[kyk cukrh g] vr% cuu oky cgyd J[kyk of) cgyd dgykr g rFkk ifj?kVuk dk Ük[kyk of) cgydu dgr gA tl & ikfyFkhu dk l'y"k.k] ikfyLVkbjhu dk l'y"k.kA

in of) cgyd (Step Growth Polymers)

bu cgydk e ,dyd bdkb;k ijLij l?kfur gkdj y?k v.k tl ty] gkbMkstu Dykjkb M] vekfu;k foykfir djr gA bu vfHkfØ;k e ,d d ckn ,d in Hkkx yr g vkj ink dh J.kh LFkkfir gk tkrh g vr% cuu oky cgyd in of) cgyd dgykr g rFkk ifj?kVuk dk in of) cgydu dgr gA

mijkDr cgydu dk fuEufyf[kr çdkj l Hkh le>k;k tk ldrk g &

$$\underset{,dyd}{A+B} \xrightarrow{l?kuu} A-B \qquad in\&I$$

$$A-B+A \xrightarrow{l?kuu} A-B-A \qquad in\&II$$

$$A-B-A+B \xrightarrow{l?kuu} A-B-A-B \qquad in\&III$$

fo'k"k in of) fØ;k &

$$A-B \xrightarrow{l?kuu} A-B \qquad in\&I$$

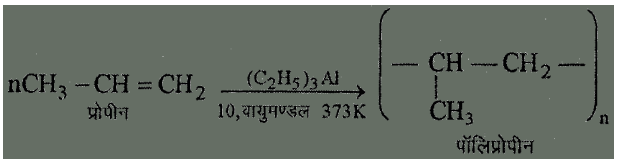
$$A-B \xrightarrow{l?kuu} \underset{cgyd}{A-B-A-B....(A-B)_n} \qquad in\&II$$

mnkgj.k& Vfjyhu ;k MØku dk cuukA

0;kikfjd :i l egÙoi.k dN l'yf"kr cgyd (Some Commercially important Synthetic Polymers)

ikfyçkihu (Polypropene)

373 K o 10 ok;e.Myh; nkc ij Vkb,fFky ,yefu;e dh FkkMh ek=k ;Dr n-gDlu e ?kuy'khy çkfiyhu d cgydu l ikfyçkihu cuk;h tkrh gA



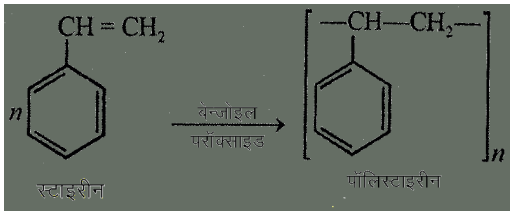
x.k ,o mi;kx % ikfyçkfiyhu ¼ikfyçkihu½ ikfy,Fkhu dh vi{kk vf/kd dBkj ,o n< gkrh gA bldk mi;kx

(i) vklu] [kky] dkyhu] j'k] jfLl;k] f[kyku] ikbi vkfn d cuku d fy, gkrk gA

(ii) fjdkMk d [kky o diM cuku d fy, gkrk gA

ikfyLVkbjhu (Polystyrene)

;g LVkbjhu ,dyd bdkb dk cgyd g] LVkbjhu dk cUtkby ijkDlkbM dh mifLFkfr e eDr eyd fØ;kfof/k }kjk xje djd cuk;k tkrk gA



x.k ,o mi;kx % ikfyLVkbjhu ,d ikjn'kd FkeklykfLVd inkFk gA bldk mi;kx %

(i) o|rjk/kh d :i e gkrk gA

(ii) f[kyku] jfM;k vkj Vfyfotu dfcuV cuku e gkrk gA

(iii) d?k] xe i; ihu oky di dk cuku d fy, gkrk gA

(iv) Nrk o tehu dk <du e ç;Dr gku oky VkbYl dk cuku d fy,A

ikfyokbfuy DykjkbM (Polyvinyl Chloride)

okbfuy DykjkbM dk tc MkbcUtkby ijkDlkbM dh mifLFkfr e xje djr g] rk og ikfyokbfuy DykjkbM e cgyhÑr gk tkrk gA

x.k ,o mi;kx % ;g ,d FkeklykfLVd cgyd gA lykLVhlkbtj dh lgk;rk l bldh l?kV;rk c<kb tk ldrh gA bldk mi;kx %

(i) cjlkrh dkV] et doj] Fky] in] vkfn cuku d fy, gkrk gA

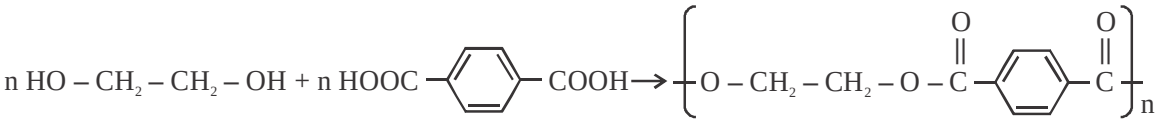
(ii) Ñf=e Hkry <du oky ¼okbfuy Q'k½ cuku d fy, gkrk gA

(iii) ihohlh ikbi d fuek.k d fy, gkrk gA

Vfjyhu (Terylene)

bl MØku Hkh dgr gA bl ,fFkyhu Xykbdky ¼,Fku&1] 2 Mkbvky½ o Vj¶Fkfyd vEy ¼cthu 1] 4&MkbdkckfDlfyd vEy½ 420 l 460 K rki ij ftd ,lhVV rFkk ,UVheuh VkbvkDlkbM mRijd dh mifLFkfr e l?kuu cgydu }kjk cuk;k tkrk gA

; ikfyLVj J.kh d cgyd gA



,fFkyhu Xykbdky ¼,Fku & 1] 2 Mkbvky½ Vj¶Fkfyd vEy ¼cthu 1] 4 Mkbdkckfdlfyd vEy½ Vfjyhu vFkok MØku

x.k ,o mi;kx % Vfjyhu jklk;fud rFkk tfod dkjdk l fØ;k ugh djrkA bld j'k etcr gkr gA

; Øhtjk/kh gkrh gA budk Åu ;k lr d lkFk feykdj ,fPNd l?kVu d oL= Vfjoy vFkok VfjdkV Hkh ikIr dj ldr gA

budk mi;kx %

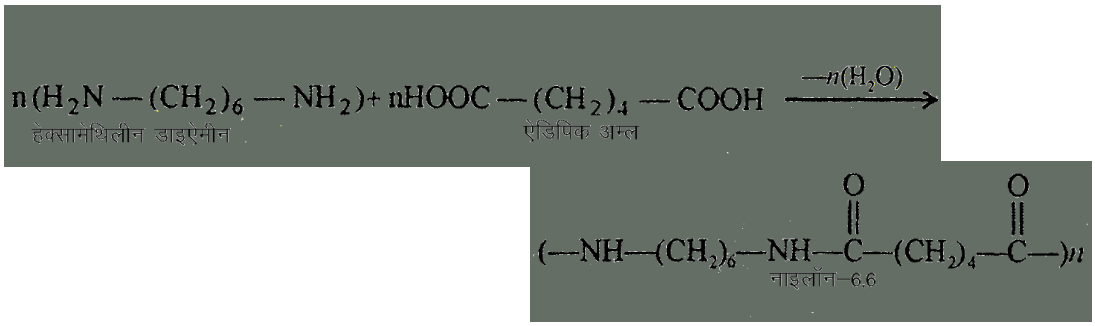
(i) fofHkUu çdkj d oL= tl & Vfjdk¡V] Vfjoy] VfjflYd vkfn d fuek.k e gkrk gA

(ii) pEcdh; fjdkfMx Vi] vk|kfxd etnjk d fy, ,çu vkfn cuku e gkrk gA

ukbykuk dk fojpu (Synthesis of Nylon's)

,ekbM vkc/k ;Dr cgyd l'yf"kr j'k d egÙoi.k mnkgj.k g] bUg uk;yku dgk tkrk gA

(i) uk;yku&6]6 (Nylon-6.6): bldk fojpu gDlkefFkyhuMkb,ehu ,o ,fMfid vEy d mPp nkc vkj mPp rki ij l?kuu }kjk fd;k tkrk gA uk;yku&6]6 dk vkf.od æ0;eku cgr mPp ijkl 12000 l 20000 d e/; gkrk gA pfd vEy ,o ,ehu nkuk e çR;d d ikl N% dkcu ijek.k gkr g] blfy, vuyXu 6] 6 nr g vkj bl ukbyku & 6]6 dgr gA



x.k ,o mi;kx % ukbyku & 6]6 d }kjk fufer j'kk dh ruu lkEFk; cgr mPp gkrh g] ;g dBkj o ?k"k.k d çfr vojk/kd gkrh gA uk;yku&6]6 lr dkru okyh e'khu d }kjk pknj ¼'khV½ ;k j'k e <kyk tk ldrk gA bldk mi;kx %

(i) nUr c'k d j'k cuku e gkrk gA

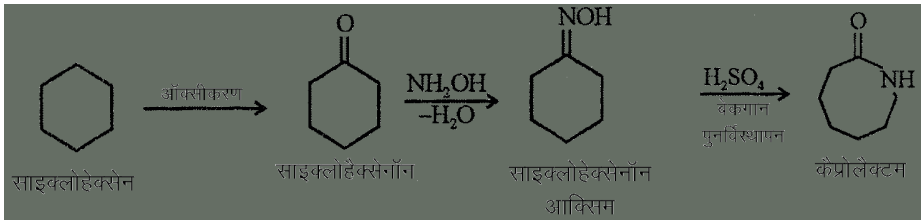
(ii) jLlh o pVkb okyh jLlh d fuek.k e gkrk gA

(iii) oL= m|kx e gkrk gA

ukbyku& 6 (Nylon - 6)

;g dçkyDVe d cgydu dk mRikn g tk lkbDykgDlu dh vkDlhdj.k vfHkfØ;k d ifj.kkeLo:i çkIr gkrk gA

dçkyDVe dk fuek.k



ueh dh mifLFkfr e dçkyDVe dk xje dju ij dçkyDVe dh oy; VV dj ε–,ehuk dkfjd vEy ;k 6-,ehuk gDlukbd vEy nr g] tk fd Ng dkcu ijek.k okyk ,ehuk ekukdkckDlfyd vEy g] bld cgydu l ukbyku& 6 çkIr gkrk gA

x.k ,o mi;kx % ;g Hkh ikfy,ekbM çÑfr d gkr gA pfd dçkyDVe ,dyd bdkb d ikl doy 6 dkcu ijek.k gkr g blfy, bl vuyXu 6 nr g vkj ukbyku& 6 dgr gA

bldk mi;kx %

(i) Vk;j dh Mkfj;k cuku e gkrk gA (ii) oL= m|kx e gkrk gA

(iii) jfLl;k d fuek.k e gkrk gA

egRoi.k fcUn

1- mPp vkf.od æ0;eku oky o inkFk tk vud ljy v.kvk d jklk;fud vkc/k d l;Xeu l cuk; tkr g] cgyd dgykr gA bl çfØ;k e i;Dr ljy v.kvk dk ,dyd dgr g] rFkk mPp vkf.od æ0;eku oky inkFkk dk cgyd dgr gA bl çØe dk cgydu dgr gA

2- ,l cgyd tk leku ,dyd bdkb;k l cur g] mUg lecgyd dgr gA

3- ,l cgyd tk fHkUu&fHkUu ,dyd bdkb;k l cur g] mUg lgcgyd dgr gA

4- mRifÙk d lkr d vk/kkj ij cgydk dk çkÑfrd] l'yf"kr vkj v/kl'yf"kr e oxhÑr fd;k x;k gA

5- ljpuk d vk/kkj ij cgydk dk jf[kd] 'kkf[kr vkj fr;d cf/kr cgyd e oxhÑr fd;k x;k gA

6- l'y"k.k d vk/kkj ij cgydk dk ;kxt ,o l?kuu cgyd e oxhÑr fd;k x;k gA

7- vkf.od cyk d vk/kkj ij cgydk dk çR;kLFk] j'k] rkil?kV; rFkk rkin< cgyd e oxhÑr fd;k x;k gA

8- fØ;kfof/k d vk/kkj ij cgydk dk Ük[kyk of) cgyd rFkk in of) cgyd e oxhÑr fd;k x;k gA

9- rki n< cgyd nckjk <ky ugh tk ldr g] tcfd rki l?kV; cgyd nckjk <ky tk ldr gA

10- Vfjyhu ikfy,LVj g] tcfd ukbyku&6]6 rFkk ukbyku&6 ikfy,ekbM gA

11- ;kxt cgydu çk;% Ük[kyk of) cgydu gA

12- l?kuu cgydu çk;% in of) cgydu gA

vH;kl lkFk i'u

oLrfu"B i'u

1- V¶yku dk ,dyd g &

¼v½ $CF_3 - CF_3$ ¼c½ $FCl\,C = CF_2$

¼l½ $CF_2 = CF_2$ ¼n½ $Cl_2 – CH – CH – Cl_2$

2- l'yf"kr cgyd Vfjyhu g &

¼v½ ikfy,LVj ¼c½ ikfybFkj

¼l½ ikfy,ekbM ¼n½ ikfyFkhu

3- dçkyDVe d cgydu l curk g &

¼v½ uk;yku & 6 ¼c½ uk;yku & 6] 6

¼l½ uk;yku 2] 6 ¼n½ ikfyFkhu

4- cdykbV g &

¼v½ ;kxt cgyd ¼c½ rkin< cgyd

¼l½ rkil?kV; ¼n½ çR;kLFk cgyd

5- gDlkefFkyhuMkb,ehu rFkk ,fMfid vEy d l?kuu cgydu l cuk gvk inkFk dgykrk g &

¼v½ Vfjyhu ¼c½ uk;yku & 6

¼l½ uk;yku & 6] 6 ¼n½ cdykbV

vfry?kÙkjkRed ç'u

1- cgyd vkj ,dyd ink dh 0;k[;k dhft,A

2- çkÑfrd vkj l'yf"kr cgyd e vUrj Li"V dhft,A

3- cgydu 'kCn dk ifjHkkf"kr dhft,A

4- fuEufyf[kr dk ;kxt ,o l?kuu cgydk e oxhÑr dhft, &

Vfjyhu] cdykbV] ikfyFkhu] ih-oh-lh-

5- ljpuk d vk/kkj ij cgydk dk fdru Hkkxk e ckVk x;k g\

y?kÙkjkRed ç'u

1- lecgyd rFkk lgcgyd e foHkn dhft, rFkk çR;d dk ,d&,d mnkgj.k nhft,A

2- fuEufyf[kr cgydk dk çkIr dju d fy, ç;Dr ,dydk dk fyf[k,A

(i) ikfyokbfuy Dykjkb M (ii) ikfyFkhu

(iii) ukbyku & 6] 6

3- ;kxt rFkk l?kuu cgydu e vUrj Li"V dhft,A

4- rkin< rFkk rkil?kV; cgyd e vUrj Li"V dhft,A

5- vkf.od cyk d vk/kkj ij cgydk dk fdru Hkkxk e oxhÑr fd;k x;k g\ çR;d dk ,d mnkgj.k nhft,A

fucU/kkRed i'u

1- fuEufyf[kr cgydk d l'y"k.k] x.k vkj mi;kx nhft, &

(i) Vfjyhu (ii) ikfyikihu

2- cgydu fdl dgr g\ cgydk d oxhdj.k dk le>kb,A

3- fuEufyf[kr cgydk d l'y"k.k] x.k vkj mi;kx nhft,A

(i) ukbyku & 6] 6 (ii) ikfy,Fkhu

4- cgydu fØ;kfof/k d vk/kkj ij cgydk dk fdru Hkkxk e oxhÑr fd;k x;k g\ le>kb,A

5- l?kuu cgydu fdl dgr g\ mnkgj.k lfgr le>kb,A

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mÙkjekyk % 1 ¼l½ 2 ¼v½ 3 ¼v½ 4 ¼c½ 5 ¼l½

bdkb & XI

v/;k; & 17

vkorcth iknik dk oxhdj.k

(Classification of Angiosperms)

ifjp; (Introduction)

iFoh ij yxHkx 4]00]000 ikni çtkfr;k Kkr g ftue l yxHkx 70 çfr'kr çtkfr;k i"ih; iknik dh gA çkphu dky e iknik dk oxhdj.k mudh mi;kfxrk d vk/kkj tl [kk|] vk"kf/k] j'k vkfn d vk/kkj ij fd;k x;k] yfdu ouLifr foKku dh çxfr d lkFk iknik dk oxhdj.k mud vkÑfrd y{k.kk (Morphological characters) tl 'kkd] {ki] o{k] chti=k dh l[;k] i"i dh ljpuk vkfn d vk/kkj ij fd;k tku yxkA

ofxdh (Taxonomy)

ouLifr foKku dh og 'kk[kk ftld vUrxr iknik d oxhdj.k dk v/;;u fd;k tkrk g ofxdh dgykrh gA ofxdh 'kCn dk loçFke ç;kx ouLifr'kkL=h ,-ih-Mh- dUMkyh (A.P. de Candole) u 1813 e fd;kA

cUFke ,o gdj dh oxhdj.k i)fr

(Bentham and Hooker's System of Classification)

1- ;g oxhdj.k i)fr Mh dUMkyh dh oxhdj.k i)fr ij vk/kkfjr gA

2- ;g ,d çkÑfrd oxhdj.k i)fr gA

3- bl i)fr e ,dchti=h iknik dk f}chti=h iknik d ckn e j[kk x;kA

4- ble f}chti=h iknik dk çFke leg ikyhiVyh (Polypetalae) rFkk çFke x.k (Order) juYl (Ranales) g] rFkk bl x.k dk dy (Family) juudylh (Rananculaceae) gA bl dy d ikni ;äk.Mih (Apocarpous) rFkk tk;kx/kjh (Hypogyenous) gA

5- bl oxhdj.k i)fr e iFkd ny;ä (Polypetalous) i"i oky dyk dk ikyhiVyh rFkk l;änyh (Gamopetalous) i"i oky dyk dk xekiVyh leg e j[kkA

6- bl oxhdj.k i)fr e ekukDyekbMh (Monoclamydeae) dk ,d iFkd leg e j[kkA

7- bl oxhdj.k e i"ih; iknik dk e[;r% ,d Ñf=e y{k.k d vk/kkj ij dN cM legk e ckVk x;k g ftld dkj.k fudV lEcU/kk oky dN dy ,d nlj l cgr nj py x;A

8- ble ftEukLie dk f}chti=h iknik d lkFk j[kk x;k gA

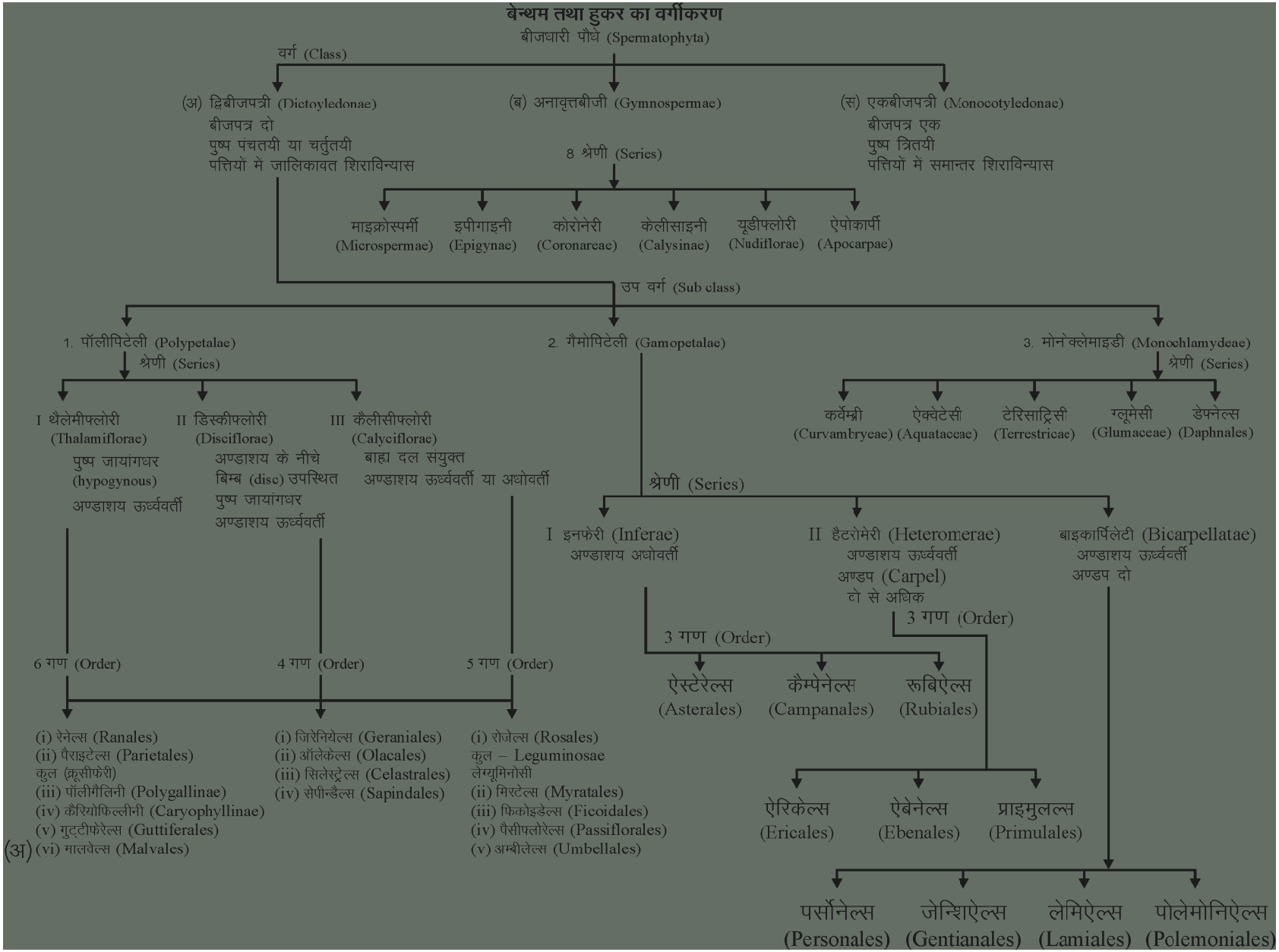
9- ,dchti=h ikni dyk dk lkr Jf.k;k (Series) e ckVk x;k yfdu bue l dkb Hkh leg vk/kfud ifj.kkek d vk/kkj ij lekx ugh gA

10- bl oxhdj.k e ,dchti=h iknik dk leg ekbØkLieh (Microspermae) J.kh l vkjEHk gkrk g rFkk bl J.kh dk lokf/kd fodflr dy vkfdMlh (Orchidaceae) gA

11- bl oxhdj.k i)fr e ,dchti=h iknik d leg dk vfUre dy xkfeuh (Graminae) ¼bl vc ik,lh (Poaceae dgr g½A bl dy dh ;g fLFkfr tkfroÙkh; y{k.kk d vk/kkj ij Bhd gA

12- bl oxhdj.k i)fr e leLr iknik dk 202 dyk e foHkkftr fd;k gA

cUFke rFkk gdj dh oxhdj.k i)fr dk lf{kIr e fuEufyf[kr çdkj l le>k tk ldrk g&



cUFke rFkk gdj dh oxhdj.k i)fr d x.k ,o nk"k

x.k (Merits)

;g oxhdj.k i)fr iknik d okLrfod y{k.kk ij vkèkkfjr g] vr% bld vk/kkj ij iknik dh igpku djuk vklku gA ;g gh dkj.k g fd fo'o e vkt Hkh vud gjcfj;ek e cUFke rFkk gdj dh oxhdj.k i)fr dk gh mi;kx fd;k tkrk gA

nk"k (Demerits)

;g oxhdj.k i)fr dyk d tkfroÙkh; lEcU/kk ij vkèkkfjr ugh g vr% ble iknik d fodklh; y{k.kk ij è;ku ugh fn;k x;k vr% ble vud ,l dy tk tkfroÙkh; vkèkkj ij vkil e lEcfU/kr ugh g mudh fLFkfr ,d nlj d fudV gA bld foijhr dN ,l dy Hkh g tk tkfroÙkh; vk/kkj ij ,d nlj l lEcfU/kr gkr g, Hkh bl i)fr e mudh fLFkfr ,d nlj l nj gA mnkgj.k d fy; cUFke o gdj d ;Qkjfc,lh dy dk ekukDyekbMh e j[kk tcfd tkfroÙkh; vk/kkj ij ;g dy ekYolh l lEcfU/kr gA

i"i dh ljpuk o dk;

(Structure and Function of Flower)

iknik dk :ikUrfjr çjkg (Modified shoot) tk fd iknik dh çe[k tuu ljpuk g] i"i dgykrk gA i"i d vkèkkjh; Hkkx ij ikb tku okyh iÙkh d leku ,d :ikUrfjr NkVh ljpuk lgi= (Bract) dgykrh gA rFkk i"iN= d vkèkkj ij mifLFkr lgi=k dk ifjpØd lgi= (Involucre bract) dgr gA i"ioUr l fodflr gku okyh dkf;d lgi= tlh ljpuk] lgif=dk (Bracteole) dgyrh gA og i"i ftld lkFk lgi= gk ml lgi=h (Bracteate) rFkk ftle lgi= vuifLFkr gk ml vlgi=h (Ebracteate) dgr gA blh çdkj ,lk i"i ftld lkFk lgif=dk gk ml lgif=dk;ä (Bracteolate) dgr gA

,d çk:fid i"i e pkj pØ Øe'k% ckányit (Calyx), nyit (Corolla), iex (Androecium) ,o tk;kx (Gynoecium) gkr gA ftl i"i e ; pkjk pØ mifLFkr gkr g ml i.k (Complete) rFkk ,lk i"i ftle pkjk pØk e l dkb ,d ;k ,d l vf/kd Hkkx ;k pØ v.k vuifLFkr gk ml vi.k (Incomplete) i"i dgr gA i"i d bu Hkkxk dk o.ku fuEu çdkj g&

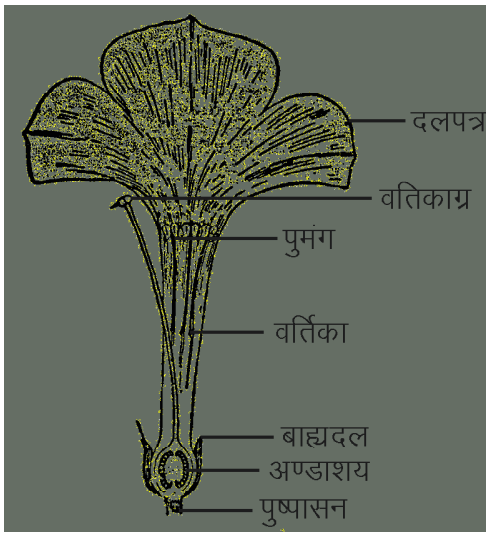
1- **ckány it** (Calyx) – ;g i"i dk lcl ckgjh pØ g rFkk vud ckányk (Sepals) l feydj cuk gkrk gA çR;d ckány i=h d leku gjh ljpuk, gkrh gA viokn Lo:i dN iknik e ; jxhu Hkh gkr g] mnkgj.k vkbfjl ,o V;fyiA budk dk; çdk'kl'y"k.k rFkk çkjfEHkd voLFkk e i"i d vkrfjd Hkkxk dh j{kk djuk gA

2- **nyit** (Corolla) – ;g i"i dk nljk pØ g tk fd ckányit d Hkhrj fLFkr gkrh gA ;g vud nyi=k (Petals) l feydj cuk gkrk gA nyi= cM o vkd"kd jxk d gkr gA vr% bul dhV irx vkdf"kr gkr g] tk ijkx.k e lgk;rk djr gA

ckányit o nyit lkefgd :i l ifjnyit dgykr g ; i"i d dkf;d Hkkx g vFkkr tuu e Hkkx ugh yr gA

3- **iex** (Androecium) – ;g i"i dk uj tuukx gA bldh çR;d bdkb idlj (Stamen) dgykrh gA çR;d idlj d nk Hkkx gkr g] irr (Filament) ,o ijkxdk"k (Anther)A çR;d ijkxdk"k] nk ijkxdk"Bk l feydj cuk gkrk g tk fd ;kth ÅÙkdk(Connective) }kjk vkil e tM gkr gA çR;d ijkxdk"k e ijkxd.kk (Pollen grains) dk fuek.k gkrk gA

4- **tk;kx** (Gynoecium) – ;g i"i dk L=h ;k eknk tuukx g tk fd ,d ;k vf/kd v.Mk (Carpels) l feydj curk gA v.Mi e ,d v.Mk'k; (Ovary), ofrdkx (Style), ,o ofrdk (Stigma) gkr gA v.Mi dk fupyk Hkkx Qyk gvk gkrk g ftle ch tk.M yx gkr gA lHkh v.Mi feydj ;fn l;ä :i l v.Mk'k; cuk, rk tk;kx ;äk.Mh (Syncarpous) dgykrk gA ;fn çR;d v.Mi ,d iFkd v.Mk'k; cuk, rk fo;äk.Mh (Apocarpous) dgykrk g ¼fp= 17-1½A i"i ikni d fy; ,d egRoi.k tuu vx g tk fd tuu dk dk; djrk g QyLo:i Qy o ch t cur gA



fp= 17-1 % ,d i"i dh vun/; dkV e ljpuk

ijkx.k (Pollination)

ijkxd.kk (Pollen grains) d ijkxdk"k (Anther) l eä gkdj tk;kx (Gynoecium) d ofrdkx (Stigma) rd igpu dh çfØ;k dk ijkx.k dgr gA

ijkxdk"k dh vUr%fHkfÙk (Endothecium) dh dkf'kdkvk e α–lyykt l cuh gb j'knkj ifê;k (Fibrous bands) ikb tkrh gA bu j'knkj ifê;k dh vkærkxkgh çÑfr d dkj.k ijkxdk"kk dk LQVu (Dehiscence) gkrk gA LQVu vun/; njkj (Longitudinal slit) }kjk ¼mnkgj.k xMgy ,o dikl½ dikV (Valves) }kjk ¼mnkgj.k cjcjhMlh dy d ikèkk½] fNæk (Pores) }kjk ¼mnkgj.k *lkyue½* vFkok vfu;fer (Irregular) :i l ¼mnkgj.k *ukt kl½* gkrk gA

ijkx.k d çdkj (Types of Pollination)

ijkx.k e[;r% nk çdkj l gkrk g&

1- Loijkx.k 2- ijijkx.k

1- **Lojkx.k** (Self pollination) – bl çfØ;k d vUrxr fdlh ,d i"i d ijkxd.kk dk LFkkukUrj.k mlh i"i d ofrdkx ij gkrk gA ;g nk çdkj l gk ldrk gA

(i) **Lo;Xeu** (Autogamy) – bl çdkj d Loijkx.k e ,d i"i d ijkxd.k mlh i"i d ofrdkx ij igpr g vFkkr i"i viu gh ijkxd.kk }kjk ijkfxr gkr gA

(ii) **ltkri"ih ijkx.k** (Geitonogamy) – tc ,d i"i d ijkxd.k mlh ik/k e mifLFkr fdlh nlj i"i d ofrdkx ij igpr gA ltkri"ih ijkx.k ,d gh ikèk e mifLFkr nk vyx&vyx i"ik d chp gkrk gA

Loijkx.k d fy, vudyu (Contrivances or adaptations for self pollination) – ,l ik/k ftue Loijkx.k gkrk g] dN fo'k"krk, çnf'kr djr g tk fd fuEu g&

(i) **mHk;fyxrk** (Bisexuality) – ,l ik/kk e mHk;fyxh (Bisexual) i"i ik, tkr gA

(ii) **ledkyiDork** (Homogamy) – ,l ik/kk d i"ik e iex ,o tk;kx ,d lkFk ifjiDo (Mature) gkr g vFkkr bue ledkyiDork (Homogamy) ikb tkrh gA ijkxd.k ,o ofrdkx ,d gh le; ifjiDo gku d dkj.k Loijkx.k gku dh ijh lHkkouk jgrh gA mnkgj.k *fejkfcfyl* (*Mirabilis*), *dFkjUFkl* (*Catharanthus*)A

(iii) **vUeehY;rk** (Cleistogamy) – dN ik/kk d i"i cn gh jgr g] vFkkr ; dHkh ugh [kyrA vr% bue vko';d :i l Loijkx.k gkrk gA mnkgj.k *dudkvk* (*Commelina*), *ok;kyk* (*Viola*), *vkXtfyl* (*Oxalis*), *tdl* (*Juncus*), *Mkljk* (*Drocera*) vkfnA

2- **ijijkx.k** (Cross pollination) – tc ,d ik/k d i"i d ijkx.k mlh tkfr d fdlh nlj ik/k d i"i d ofrdkx ij LFkkukUrfjr gkr g rk ml ijijkx.k dgr gA bl çdkj ijijkx.k e nk fHkUu ik/kk d uj ,o eknk ;Xedk e fu"kpu gkrk gA bl çfØ;k e thu iu;ktu (Gene recombination) rFkk fofHkUurk, (Variations) mRiUu gku dh lHkkouk, jgrh gA

ijijkx.k d fy, vudyu

(Contrivances or Adaptations for Cross Pollination)

1- **LocU/;rk** (Self sterility) – dN ik/kk d i"ik e Lo; d }kjk fodflr ijkxd.kk dk mlh i"i dh ofrdkx ij vdj.k ugh gk ikrk g] bl LocU/;rk dgr gA mnkgj.k jk[khcy (*Passiflora*), vxj (*Vitis*) ,o lc (*Malus*)A

2- **,dfyxrk** (Unisexuality) – dN ik/kk d i"i ,dfyxh gkr gA bue uj vFkok eknk nkuk e l dkb ,d çdkj d tuu vx ik, tkr gA mnkgj.k iihrk (*Carica*)A

3- **fHkUudkyiDork** (Dichogamy) – dN ik/kk d i"ik e ijkxdk"k ,o ofrdkx d ifjiDo gku dk vyx&vyx gkrk gA *lkfYo;k* (*Salvia*) e ijkxdk"k ofrdkx l igy ifjiDo gkr gA ;g fLFkfr iiork (Protandrous) dgykrh gA clhdlh (Brassicaceae) ,o jktlh (Rosaceae) dy d cgr l ik/k rFkk *,fjLVkykfd;k* (*Aristolochia*) e ofrdkx ijkxdk"k l igy ifjiDo gkr gA ;g fLFkfr L=hiork (Protogyny) dgykrh gA

4- **gjdkxeh** (Herkogamy) – ofrdkx ,o ijkxdk"k d chp çkÑfrd ljpukRed vojk/k (Structural barrier) ik;k tkrk gA mnkgj.k dfj;kfQyh (Caryophyllaceae) dy d ik/kk e ofrdk dh yEckb idlj l dkQh vf/kd gku d dkj.k bud chp ijkx.k lHko ugh gk ikrkA *Xykfj;kl* (*Gloriosa*) e ijkxdk"k LQVu bl çdkj gkrk g fd ijkxd.k nj tkdj fxjr gA vkd (*Calotropis*) e ijkx.k ijkxfi.Mk (Pollinia) e 0;ofLFkr jgr gA

5- **fo"keofrdkRo** (Heterostyly) – *fçeyk* (*Primula*) e nk çdkj d i"i ik, tkr g&, d ftue ofrdk yEch rFkk idlj NkV gkr g] nlj ftue ofrdk NkVh rFkk idlj yEc gkr gA ,l i"i f}:ih (Dimorphic) dgykr gA bu i"ik e Lojkx.k lHko ugh gk ikrkA

ijijkx.k dh fof/k;k

(Methods of Cross Pollination)

ijijkx.k e ijkxd.kk d LFkkukUrj.k d fy, cká lkèkuk (Agent) dh vko';drk gkrh gA ; lk/ku thoh;

vFkok vthoh; gk ldr gA bu lk/kuk d vk/kkj ij ijijkx.k fuEu çdkj dk gk ldrk g&

1- **ok; ijkx.k** (Anemophily) – tc ijkxd.kk dk LFkkukUrj.k ok; }kjk gkrk g rk bl ok; ijkx.k dgr gA ,l ijkx.k NkV] gYd] fpdu o 'k"d gkr gA bu ijkxd.kk dk mRiknu vf/kd l[;k e gkrk gA ok; ijkfxr i"ik e ofrdkx e vudyu ik, tkr gA ?kkl e i{ekHkh (Feathery) *VkbQk* (*Typha*) e c'k d tlk rFkk vkd o gty (Oak and Hazel) e i"i l ckgj fudyk gvk ofrdkx ik;k tkrk gA

2- **ty ijkx.k** (Hydrophily) – ;g nk çdkj l gkrk g&

(i) **v/kk ty ijkx.k** (Hypohydrophily) – tc ijkx.k ty d Hkhrj gkrk g ml v/kk ty ijkx.k dgr gA *ukt kl* (*Najas*), *fljVkfQye* (*Ceratophyllum*), *tkLVjk* (*Zostera*) vkfn ik/k fueXu (Submerged) gkr g rFkk bue v/kk ty ijkx.k ik;k tkrk gA

(ii) **vf/k ty ijkx.k** (Epihydrophily) – tc i"i ty dh lrg ij ijkfxr gkr g rk ml vf/k ty ijkx.k dgr gA mnkgj.k *ofylufj;k* (*Vallisneria*), *ikVekftVku* (*Potamogeton*), *fefj;kfQye* (*Myriophyllum*) bR;kfn ty h; ik/k gkr g ijUr bue ok; ijkx.k ik;k tkrk gA blh çdkj *fufEQ;k* (*Nymphaea*) e dhV ijkx.k ik;k tkrk gA

3- **dhV ijkx.k** (Entomophily) – e/kfD[k;k (Bees), efD[k;k (Flies), irxk (Moth), frryh (Butter fly), oLi (Wasp), chVy (Beetle) bR;kfn dhV ijkx.k e lgk;rk djr gA ,lk vueku g fd yxHkx 80% dhV ijkx.k eèkefD[k;k }kjk gkrk gA dhV ijkfxr ik/kk d i"i çk;% jxhu] pednkj] edjn ;ä ,o x/k;ä gkr gA

4- **i{kh ijkx.k** (Ornithophily) – vud m".k dfVcèkh; (Tropical) ik/k if{k;k }kjk ijkfxr gkr gA bue i"i ufydkdkj ¼mnkgj.k *fudkfVvkuk*½] l;kyuek ¼mnkgj.k *dyhLVeku*½ vFkok dHkkdkj ¼mnkgj.k ,jhdlh dy d ik/k½ gkr gA ; i"i pednkj] vkd"kd rFkk edjn;ä gkr gA edjn l vkdf"kr gkdj vk, if{k;k dh pkp ,o 'kjhj l ijkxd.k fpid tkr g rFkk bud lkFk gh nlj ik/kk rd igp tkr gA

5- **pexknM ijkx.k** (Cheiropteriphily) – dN ikèkk e i"i jkr e Hkh f[kyr g rFkk vf/kd ek=k e edjn L=kfor djr gA pexknM fu'kkpj (Nocturnal) gku d dkj.k bu ikèkk d ijkx.k e lgk;d gkrk gA mnkgj.k dnEc (*Anthocephalus*), dpukj (*Bauhinia*), ckye[khjk (*Kigelia*), xkj[k beyh (*Adansonia*) bR;kfnA

bld vfrfjä lio{k (*Arisaema*) vkj vkfdM (*Orchid*) e ?kk?k }kjk rFkk xyekgj vkj ley e fxygjh }kjk ijkx.k gkrk gA

vlxrrk (Incompatibility)

i.kr;k dk;{ke (Functional) ,o tuu{ke (Fertile) eknk ;Xedk ,o uj ;Xedk d e/; fu"kpu e foQyrk dk vlxrrk vFkok vfu"kP;rk dgr gA ;g nk çdkj dh gkrh g&

(i) **vUrjktkrh;** (Interspecific) – tc vfu"kP;rk fHkUu tkfr;k (Species) d lnL;k d e/; gkrh gA

(ii) **vkUrjktkrh;** (Intraspecific) – tc vfu"kP;rk ,d gh tkfr d lnL;k d e/; gkrh gA bl Lovfu"kP;rk vFkok LocU/;rk (Self incompatibility or self sterility) dgr gA

ijkx&L=hd lj ikjLifjd fØ;k (Pollen-pistil interaction) d ifj.kkeLo:i ik/kk e vlxrrk ikb tkrh gA bld fy, mÙkjnk;h dkjd dkf;dh; (Physiological) vFkok vkdkfjdh; (Morphological) gk ldr gA ;g vud ,yhy (Allele) ;ä thuk (Genes) }kjk fu;f=r gkrh gA lkekU;r% ;g ofrdkx d ifjiDo gku d le; rFkk ijkxd.kk dh fHkUkd fuek.k d le; fodflr gkrh gA Lovfu"kP;rk dk fu/kkj.k ,o fu;=.k ;fn uj ;Xedknfhkn vFkkr ijkx.k d thu ç:i (Genotype) }kjk gkrk g rk ml ;Xedknfhkn Lovfu"kP;rk (Gametophytic incompatibility) dgr gA bld foijhr chtk.knfhkn Ård ¼ftlld ijkxd.k mRiUu gkr g½ d thu ç:i }kjk fu/kkj.k gku ij ml chtk.knfhkn Lovfu"kP;rk (Sporphytic incompatibility) dgr gA

ik/kk e Lovfu"kP;rk d fuEu ifj.kke fn[kkb nr g&

1- ijkxd.kk e vdj.k dk vHkkoA

2- ijkxufydk dh of) u gk ikukA

3- ijkxufydk dk lgh LFkku ij u igp ikukA

4- ijkxufydk dk ofrdk e QV tkuk rFkk

5- dUædk e ly;u dk u gk ikukA

fu"kpu (Fertilization)

uj ,o eknk ;Xedk d l;ktu dk fu"kpu dgr gA bl fØ;k dk v/;;u lcl igy LVkl cxj (Strasburger, 1884) u *ekukVkik* e fd;kA

ijkxd.kk dk vdj.k ,o ijkxufydk dh of)
(Germination of pollen grains and growth of pollen tube) – ofrdkx dh lrg ij igpu d i'pkr ijkxd.kk e vdj.k çkjEHk gkrk gA ofrdkx dh lrg ij mifLFkr fofHkUu lko ftue fyfiM] 'kdjk] jftu] ckjku bR;kfn mifLFkr gkr g ijkxd.kk d vdj.k d fy, vPNk ek/;e çnku djr gA ofrdkx ij igpu d i'pkr ijkxd.k d vdj.k e yxu oky le; dk vdj.k dky (Germination period) dgr gA vdj.k d nkjku tuufNæ l tuu ufydk fudydj ofrdkx e ço'k djrh gA çk;% ,d ijkxd.k l ,d gh ijkxufydk fudyrh g] ,l ijkxd.kk dk ,d ufydh; (Monosiphonous) dgr gA ,d l vf/kd ijkxufydk, mRiUu dju oky ijkxd.k cgufydh; (Polysiphonous) dgykr g ¼mnkgj.k ddjfcVlh o ekYolh dy d lnL;½A bue l ,d gh ijkxufydk fØ;k'khy jgrh gA ijkxufydk dh yEckb ofrdk dh yEckb ij fuHkj djrh gA ftruh yEch ofrdk gkxh mruh gh yEch ijkxufydk gkxh eDdk (*Zea mays*) e bldh yEckb 450 feeh rd gkrh g ¼fp= 17-2½A

fp= 17-2 % ,d ifjiDo Hk.kdk"k dh ljpuk

ijkxufydk dk ekx

ijkxufydk dh of) e[;r% ofrdk dh vkUrfjd cukoV l çHkkfor gkrh gA *fyfy;e* (*Lilium*) ,o *jkbcht* (*Ribes*) e ofrdk [kk[kyh gkrh gA bldh xfgdk 'y"ed inkFk l Hkjh jgrh g rk ijkxufydk dh of) dk çfjr djrk gA vfèkdrj ik/kk e ofrdk cn (Closed) vFkok Bkl gkrh gA bu ik/kk e ofrdk d dUæh; Hkkx e mifLFkr Ård ifDVut (Pectinase) uked ,Utkbe dh fØ;k l u"V gk tkr gA vr% ofrdk d vUnj ,d ekx cu tkrk gA dN ik/kk tl *vkbukFkjk] fiVfu;k* vkfn e ijkxufydk ofrdk d dUæh; Hkkx dh dkf'kdkvk d e/; mifLFkr vUrjdkf'kdh; vodk'kk (Intercellular spaces) l xtjrh gb of) djrh g ¼fp= 17-3 v] c] l½A

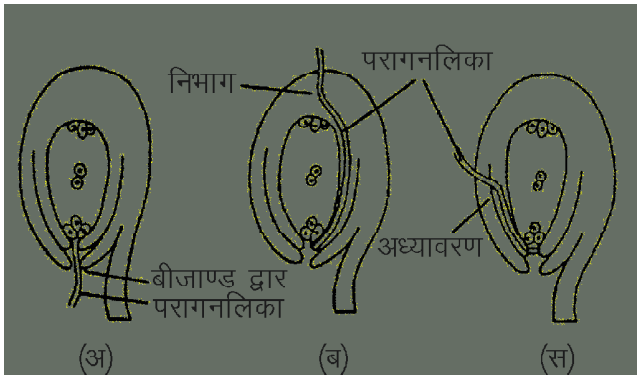
ijkxufydk dh of) lno v.Mk'k; dh vkj gkrh gA ofrdk v.Mk'k; rFkk chtk.M e mifLFkr ;kf=d (Mechanical), jlkluorh (Chemotropic) dkjd ijkxufydk dh of) dh fn'kk dk fu/kkfjr djr gA ;g lno of) djrh gb v.Mk'k; e mifLFkr chtk.M dh vkj vxlj gkrh gA

ijkxufydk dk chtk.M e ço'k (Entry of pollen tube in the ovule) – chtk.M e ijkxufydk dk ço'k rhu çdkj l gk ldrk g&

1- **chtk.M}kjh ço'k** (Porogamy) – ,d chtk.M e ijkxufydk dk ço'k chtk.M }kj (Micropyle) l gkrk gA mnkgj.k vf/kdk'k ik/kk e ¼fp= 17-3 v½A

2- **fuHkkxh ço'k** (Chalazogamy) – chtk.M e ijkxufydk dk ço'k fuHkkxh Nkj (Chalazal end) l gkrk gA mnkgj.k *dtjkbuk] fcVyk] txyUl* bR;kfn ¼fp= 17-3 c½A

2- **v/;koj.kh ço'k** (Mesogamy) – ble ijkx ufydk v/;koj.kk (Integuments) dk c/kh gb chtk.M e ço'k djrh gA mnkgj.k *ddjfcVk] ikiyl] ,Ypheyk* bR;kfn ¼fp= 17-3 l½A



fp= 17-3 % ijkxuyh dk chtk.M e ço'k ¼v½ v.M}kjh ço'k ¼c½ fuHkkxh ço'k ¼l½ v/;koj.kh ço'k

ijkxufydk dk Hk.kdk"k e ço'k (Entry of pollen tube in the embryo sac) – Hk.kdk"k e ijkxufydk lno chtk.M}kj oky Nkj l fuEu ekx }kjk ço'k djrh g&

(i) v.Mdkf'kdk rFkk ,d lgk;d dkf'kdk d chp l
(ii) Hk.kdk"k dh fHkfÙk rFkk ,d lgk;d dkf'kdk d chp l vFkok
(iii) ,d lgk;d dkf'kdk dk Hknr g,A

ijkxufydk dk Hk.kdk"k e çoZ'k fuEufyf[kr pj.kk e gkrk g&

(i) nk e l ,d lgk;d dkf'kdk] ijkxufydk d Hk.kdk"k e çoZ'k l io gh vigkflr gk tkrh gA

(ii) ijkxufydk nkuk lgk;d dkf'kdkvk d chp dN njh r; dju d ckn vigkflr lgk;d dkf'kdk d rUr : ih leP; (Filiform apparatus) }kjk mle çoZ'k djrh gA

(iii) lgk;d dkf'kdk d dkf'kdkæ0; e igpu d i'pkr ijkxufydk d 'kh"k Hkkx ¼mnkgj.k *fiVfuvk½* e vFkok 'kh"k l uhp ¼mnkgj.k dikl½ ,d fNæ fodflr gkrk gA bl fNæ e l nkuk uj ;Xed rFkk dkf'kdkæ0; dk dN Hkkx Hkh vigkflr lgk;d dkf'kdk e foeä gk tkr gA

(iv) nk e l ,d uj ;Xed v.M dkf'kdk rd lgtrk l igp tkrk g rFkk nljk uj ;Xed vehch; vFkok fuf"Ø; xfr }kjk f}rh;d dUæd rd igp tkrk gA

f}fu"kpu rFkk f=d ly;u (Double fertilization and triple fusion) – v.Mdkf'kdk rFkk ,d uj ;Xed d ly;u (Fusion) dk ;Xed ly;u (Gametic fusion or syngamy) vFkok lR; fu"kpu (True fertilization) dgr gA bld QyLo:i f}xf.kr ;Xeut (Diploid zygote) curk gA nljk uj ;Xed f}rh;d dUæd ¼tk /koh; dUædk d l;ktu l curk g½ l l;kftr gkdj f=xf.kr çkFkfed Hk.kik"k dUæd (Primary endosperm nucleus) cukrk gA bl çfØ;k dk f=d ly;u (Tripe fusion) dgr gA

vkorchft ;k e fu"kpu dh çfØ;k nk ckj gkrh gA ,d uj ;Xed v.M dkf'kdk l rFkk nljk /koh; dUæd l l;kftr gkrk gA vr% bl f}fu"kpu (Double fertilization) dgr gA f}fu"kpu dk v/;;u lcl igy ukokf'pu (Nawaschin, 1898) u *fÝfVyfj;k* ,o *fyfy;e* uked ikèkk e fd;kA

fofHkUu ik/kk e ijkx.k o fu"kpu d chp 2&25 ?k.V dk vrjky gkrk gA vkerkj ij f=d ly;u v.Mdkf'kdk o uj ;Xed d l;ktu l igy gkrk gA

f}fu"kpu dk egUo (Significance of double fertilization) – ,d uj ;Xed ,o v.M dkf'kdk d l;ktu l ;Xeut curk gA tk foHkktu }kjk Hk.k dk fuek.k djrk gA nljk uj ;Xed f}rh;d dUæd l l;kftr gkdj çkFkfed Hk.kik"k dUæd (primary endosperm nucleus) cukrk gA ftll Hk.kik"k dk ifjo/ku gkrk gA fodflr gk jg Hk.k d fy, ik"k.k dk çkjfEHkd lkr Hk.kik"k gh gkrk gA vr% ;g ,d furkr vko';d ljpuk gA Hk.kik"k e Hk.k d fy, vko';d ik"kd rUo miyC/k gkr gA vud ikni Hk.k oKkfudk dk ekuuk g fd Hk.kik"k e uj ,o eknk nkuk d x.kl= ik, tku d dkj.k ;g ldj vkt (Hybrid vigour) çnf'kr djrk gA chtk dh thou {kerk d fy, ;Xed ly;u ,o f=d l;ktu nkuk gh vko';d gA bll thoæ0; dk iufoU;kl ,o uohuhdj.k gkrk gA vr% ; nkuk gh çfØ;k, egUoi.k gA

Hk.kik"k (Endosperm)

f=d ly;u d }kjk f=xf.kr çkFkfed Hk.kik"k dUæd Primary endosperm nucleus) curk g tk fodkl djd Hk.kik"k cukrk gA vkorchth;k e Hk.kik"k f=xf.kr gkrk gA bld foijhr vukorchth;k e Hk.kik"k fu"kpu l io curk g rFkk vxf.kr gkrk gA Hk.kik"k] Hk.k d fodkl d fy, vko';d ik"k.k çnku djrk gA fodkl dh çfØ;k d vkèkkj ij Hk.kik"k rhu çdkj d gkr g&

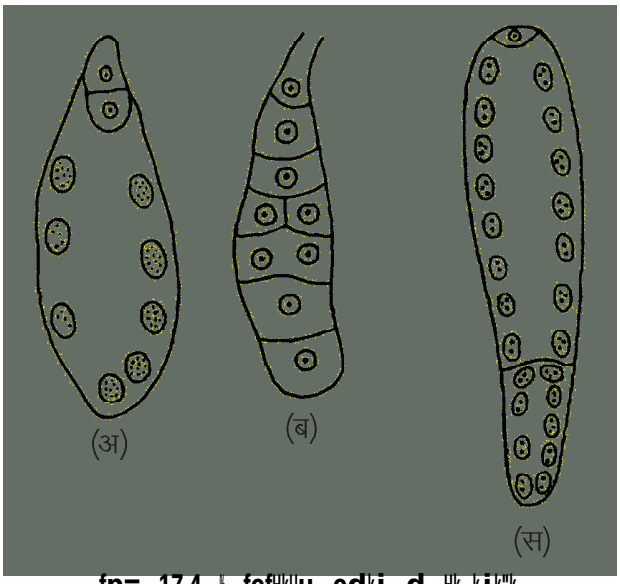
1- dUædh;

2- dkf'kdh; rFkk 3- ek/;e ;k ghykfc;y

1- **dUædh; Hk.kik"k** (Nuclear endosperm) – bl çdkj d Hk.kik"k ifjo/ku e çkFkfed Hk.kik"k dUæd e vkjEHk e lrr Lor= foHkktu gkr gA bl voLFkk e dkb fHkfÙk fuek.k ugh gkrkA bl çdkj cu dUæd ifjf/k ij foU;kflr gk tkr g rFkk e/; e ,d cMh fjädk cu tkrh gA lkekU;r% dN dUæd foHkktuk d i'pkr çR;d dUæd d pkjk vkj fHkfÙk fuek.k gk tkrk gA mnkgj.k *vkD/hLikjk* (*Oxyspora*), *ØkVyfj;k* (*Crotalaria*) bR;kfnA ukfj;y dk ikuh (Coconut milk) Hkh dUædh; Hk.kik"k dk mnkgj.k gA ble Hk.kik"k e ,d æ0; Hkjk gkrk g ftle cgr l dUæd rjr jgr g ¼fp= 17-4 v½A

2- **dkf'kdh; Hk.kik"k** (Cellular endosperm) – bl çdkj d Hk.kik"k ifjo/ku e çkFkfed Hk.kik"k dUæd e çFke rFkk mld ckn gku oky lHkh foHkktuk d lkFk&lkFk fHkfÙk fuek.k Hkh gkrk gA lkekU;r% bl çdkj d Hk.kik"k e p"kdkx fodflr gk tkr gA mnkgj.k ddjfcVlh dy d ik/k] *eXukfy;k* bR;kfnA ¼fp= 17-4 c½

3- **ghykfc;y Hk.kdk"k** (Helobial endosperm) – ble çkFkfed Hk.kik"k dUæd e çFke foHkktu d i'pkr fHkfÙk fuek.k gkrk gA ftll ,d cMh o ,d NkVh dkf'kdk curh gA fuHkkxh Nkj oky NkVh dkf'kdk d dUæd e eä foHkktu gkr gA ijUr dkf'kdk fHkfÙk dk fuek.k ugh gkrkA v.M kj oky cMh dkf'kdk e dUæd foHkktu o fHkfÙk fuek.k lkFk&lkFk



fp= 17-4 % fofHkUu çdkj d Hk.kik"k
¼v½ dUæh; ¼c½ dkf'kdh; ¼l½ gykfc;y

gkr gA bl çdkj ;g dUæh; o dkf'kdh; nkuk çdkj d Hk.kik"k dk feyktyk :i gkrk g ¼fp= 17-4 l½A

Hk.kik"k dk dk; (Function of endosperm) – Hk.kik"k dkf'kdkvk e dkckgkbMV] olk o çkVhu mifLFkr gkr gA ;g Hk.k ifjo/ku dh çkjfEHkd voLFkk e ml ik"k.k miyC/k djokrk gA dN iknik e dkf'kdh; Hk.kik"k e p"kdkx ik, tkr g tk Hk.kik"k vFkok mld ckgj mifLFkr dkf'kdkvk l Hkk tu dk p"k.k djr g Hk.kik"kh chtk e cht d vdj.k d le; Hk.kik"k uoknfHkn dk Hkk tu çnku djrk gA

cht dk fodkl (Development of Seed)

f}fu"kpu d i'pkr Hk.kdk"k e Hk.k ,o Hk.kik"k dk ifjoèku gkrk gA bld lkFk gh lEi.k chtk.M ,d cht d :i e fodflr gkrk gA bl le; chtk.M e vud ifjoru gkr gA chtk.M e mifLFkr nkuk v/;koj.k (Integuments) l chtkoj.k (Seed coat) cu tkrk gA ckÁ v/;koj.k l VLVk (Testa) rFkk vr% v/;koj.k l Vxeu (Tegmen) curk gA chtk.M oUr cht dk oUr (Stalk) cukrk g ukfHkdk (Hilum), chtk.M}kj (Micropyle), jkQ (Raphe) vkj fuHkkx (Chalaza) dkb fo'k"k ifjoru çnf'kr ugh djr gA bud Årdk e ifjiDork vk tkrh gA chtk.Mdk; dk e[; Hkkx Hk.kh; fodkl e dke vk tkrk gA dN ik/kk e ¼dkyhfep½ cpk gvk Hkkx ,d iryh f>Yyh (Papery membrane) d :i e fn[kkb nrk g] ftl ifjHk.kik"k (Perisperm) dgr gA dN ik/kk e chtk.M d pkjk vkj ,d vkoj.k feyrk g ftl ,fjy (Aril) dgr gA yhph e [kku ;kX; Hkkx ekly ,fjy gkrk gA ;Qkfc, lh dy d iknik e chtk.M}kj oky Nkj ij lQn jx dh ljpuk ikb tkrh gA ftl djUdy (Caruncle) dgr g ¼mnkgj.k vj.M½ vf/kdk'k ,dchti=h iknik e chtk.M}kj oky Nkj ij lyxuek ljpuk ikb tkrh gA ftl vkijdye (Operculum) dgr gA

chtk.M l cht cuu dh vof/k e gku oky çe[k ifjoru

Ø-l-	chtk.M d Hkkx	cht d Hkkx
1-	chtk.M oUr	oUr
2-	ukfHkdk	ukfHkdk
3-	chtk.Mdk;	vigkflr gk tkrk gA dHkh&dHkh ifjHk.kik"k cukrk gA
4-	v/;koj.k	chtkoj.k
5-	Hk.kik"k	
	& lgk;d ,o çfre[k dkf'dk,	vigkflr gk tkrh gA
	& v.M dkf'kdk	Hk.k
	& f}rh;d dUæd	Hk.kik"k

Qy dk fodkl (Development of Fruit)

fu"kpu d i'pkr v.Mk'k; Qy d :i e fodflr gkrk gA chtk.M ,o v.Mk'k; fHkfÙk e l'yf"kr of) gkeku d çHkko l v.Mk'k; Årdk e rth l dkf'kdk foHkktu gkr g rFkk v.Mk'k; fHkfÙk] Qy fHkfÙk e ifjofrr gk tkrh gA dHkh&dHkh fcuk fu"kpu d gh v.Mk'k; Qy e ifjofrr gk tkrk g bl vfu"kdQyu (Parthenocarpy) dgr g ¼mnkgj.k dyk] lrjk] vuUukl] iihrk] uk'kikrh vkfn½A bl çdkj d Qyk e cht vuifLFkr jgr gA db ckj ofrdkx ij gkeku ¼vkfDlu ,o ftcfyu½ fNMdu l Hkh vfu"kdQyu gk tkrk g bl çfjr vfu"kdQyu (Induced parthenocarpy) dgr gA

egRoi.k fcUn

1- çkphu dky e iknik dk oxhdj.k mudh mi;kfxrk d vk/kkj ij fd;k tkrk FkkA
2- ouLifr foKku dh og 'kk[kk ftld vUrxr iknik d oxhdj.k dk v/;;u fd;k tkrk g ofxdh dgykrh gA
3- cUFke ,o gdj dh oxhdj.k i)fr Mh d.Mkyh dh oxhdj.k i)fr ij vk/kkfjr gA
4- ;g ,d çkÑfrd oxhdj.k i)fr g vFkkr iknik dk oxhdj.k mud çkÑfrd yk{kf.kd y{k.kk ij vk/kkfjr gA
5- ble f}chti=h iknik dk çFke leg ikyhiVyh rFkk çFke x.k juYl g rFkk x.k dk dy juudyl h gA
6- bl oxhdj.k e ftEukLie dk f}chti=h iknik d lkFk j[kk x;k gA

7- bl oxhdj.k i)fr e ,dcht i=h iknik dk vfUre x.k ik,Yl rFkk bl x.k dk dy ik,lh ¼xfeuh½ gA

8- ;g oxhdj.k i)fr iknik d okLrfod y{k.kk ij vkèkkfjr g vr% bl vk/kkj ij iknik dh igpku djuk vklku gA

9- ;g oxhdj.k i)fr dyk d tkfroÙkh; lEcU/kk ij vkèkkfjr ugh gA

10- i"i ikni dk ,d tuu Hkkx g tk fd e[;r;k ckányit] nyit] iex o tk;kx l feydj cuk gkrk gA

11- iex i"i dk uj tuukx tcfd tk;kx eknk tuukx gA

12- ijkxd.kk d ijkxdk"k l ofrdkx rd igpu dh çfØ;k ijkx.k dgykrh gA

13- Loijkx.k ,o ijijkx.k d fy; i"ik e fo'k"k çdkj d fofHkUu vudyu ik; tkr gA

14- ijijkx.k e[;r% ok;] ty] dhV] i{kh ,o pexknMk }kjk gkrk gA

15- dk;{ke ,o tuu{ke gkr g, Hkh eknk ,o uj ;Xed e fu"kpu u gkuk vlxrrk dgykrk gA

16- v.Mk'k; e cht.M gkr gA cht.M e Hk.kdk"k fodfl r gkrk gA Hk.kdk"k e v.M lePp; rhu çfre[kh dkf'kdk, rFkk ,d f}rh;d dUæd gkrk gA

17- ,d uj ;Xed v.M lePp; e mifLFkr v.M dkf'kdk l rFkk nljk f}rh; dUæd l lyf;r gkrk gA bl f}fu"kpu dgr gA

18- f}rh;d dUæd nk /koh; dUædk l feydj cuk gkrk g bldk uj ;Xed l ly;u dk f=d ly;u dgykrk gA

19- fu"kpu d i'pkr ;Xeut l Hk.k rFkk çkFkfed Hk.kik"k dUæd l f=xf.kr Hk.kik"k dk fuek.k gkrk gA

20- fu"kpu d i'pkr lEi.k cht.M cht e rFkk v.Mk'k; Qy e ifjofrr gkrk gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- cUFke ,o gdj oxhdj.k i)fr e iFkd ny;ä i"i oky iknik dk fuEufyf[kr e l fdl leg e j[kk&

¼v½ ikyhiVyh

¼c½ xekiVyh

¼l½ ikyh o xekiVyh nkuk e

¼n½ nkuk e l fdlh e ugh

2- cUFke ,o gdj oxhdj.k i)fr e ,dcht i=h iknik d leg dk vfUre dy g&

¼v½ lkyu lh ¼c½ juudy lh

¼l½ xfeuh ¼ik,lh½ ¼n½ ekyolh

3- çkFkfed Hk.kik"k dUæd gkrk g&

¼v½ n ¼c½ 2n

¼l½ 3n ¼n½ 4n

4- f=ly;u d ifj.kkeLo:i fodfl r gkrk g&

¼v½ Hk.k ¼c½ Hk.kik"k

¼l½ Hk.kdk"k ¼n½ cht

5- cht koj.k dk fodkl gkrk g&

¼v½ v/;koj.k l ¼c½ cht.Mdk; l

¼l½ cht.MoUr l ¼n½ ukfHkdk l

vfry?kÙkjkRed i'u

1- cUFke ,o gdj dh oxhdj.k i)fr fdl oxhdj.k i)fr ij vk/kkfjr g\

2- fo"keofrdkRo D;k g\

3- vlxrrk fdru çdkj dh g\

4- ijkxufydk dk cht.M e ço'k dgk l gkrk g\

5- vkfdM e ijkx.k fdl çdkj gkrk g\

y?kÙkjkRed i'u

1- çkphu dky e iknik d oxhdj.k dk vk/kkj D;k Fkk\

2- cUFke ,o gdj oxhdj.k i)fr e ,dcht i=h iknik dh D;k fLFkfr g\

3- i"i d çe[k Hkkxk d uke ,o mud dk; fyf[k,A

4- Loijkx.k gr i"ik e ik; tku oky nk vudyu fyf[k,A

5- f}fu"kpu D;k g\

6- f=d ly;u l vki D;k le>r g\

7- Hk.kik"k dk egRo crkb;A

8- ijkxufydk dh of) dk dkul dkjd çHkkfor djr g\

9- ijkx.k D;k g\

10- vlxrrk D;k g\

fucU/kkRed i'u

1- cUFke ,o gdj dh ikni oxhdj.k i)fr dk lf{kIr e o.ku dhft ;A

2- i"i D;k g\ i"i dh ljpuk ,o bld fofHkUu Hkkxk d dk;k dh foLrr 0;k[;k dhft ;A

3- ijkx.k fdru çdkj dk gkrk g\ ijkx.k gr i"ik e ik; tku oky fofHkUu çdkj d vudyuk dk l{ki e o.ku dhft ;A

4- Hk.kik"k D;k g\ Hk.kik"k ifjo/ku dk lfp= le>kb;A bldk dk; crkb;A

5- fu"kpu D;k g\ fu"kpu d i'pkr Hk.kdk"k e gku oky ifjoruk dk o.ku dhft ;A

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mÙkjekyk% 1 ¼v½ 2 ¼l½ 3 ¼l½ 4 ¼c½ 5 ¼v½

v/;k; & 18

e[; ikni dyk dk okuLifrd o.ku

(Taxonomic Description of Main Plant Families)

dy & ekyolh

(Family – Malvaceae)

oxhÑr fLFkfr (Systematic Position)

çHkkx (Division) – Qujkxfe;k (Phanerogamia)

miçHkkx (Subdivision) – ,fUt;kLieh (Angiosperae)

ox (Class) – MkbdkVkbyhMuh (Dicotyledonae)

miox (Subclass) – ikyhiVyh (Polypetalae)

J.kh (Series) – Fkyeh¶ykjh (Thalamiflorae)

x.k (Order) – ekyoYl (Malvales)

dy (Family) – ekyolh (Malvaceae)

LoHkko (Habit) – ,do"kh; 'kkd & *lkbMk* (*Sida*), *ekYok* (*Malva*) o *,C;fVykU* (*Abutelon*) ;k {ki (Shrub) tl xMgy (*Hibiscus*) rFkk dHkh o{k LoHkkoA

tM (Root) – çk;% elyk tMA

ruk (Stem) – Bkl] cyukdkj] jkfey] igy 'kkdh; ckn e dk"Bh;] 'kkf[kjA

iÙkh (Leaf) – ,dkUrj] loUr] ljy o vui.khA

i"iØe (Inflorescence) – ,dy d{kLFk (Solitary axillary)A

i"i (Flower) – loUr] lgi=h] i.k] fu;fer] tk;kxèkj (Hypogynous) ,o ipr;h (Pentamerous)A

vuckány (Epicalyx) – 3-7, gj] Lor=A

ckányit (Calyx) – ckány 5] l;äny h] dkjLi'khA

nyit (Corolla) – ny 5] Lor=] 0;kofrr] 'y"eh] jxhu] vkd"kdA

iex (Androecium) – idlj vl[;] ,dl?kh (Monoadelphous), ,d dk"Bh;] ijkxdk"k oDdkdkj] irUr i"B yXuA idlj nyyXu] idlj d irr feydj idljh uky cukr gA

tk;kx (Gynoecium) – ip v.Mih ;k ;äk.Mih] ofrdkx Lor= vr% tk;kx vi.k ;äk.Mih (Incomplete syncarpous) gkrk gA v.Mk'k; e dk"Bk dh l[;k v.Mik d cjkcj gkrh gA vr% v.Mk'k; ipdk"Bh; ;k cgdk"Bh; gkrk gA ofrdk ,o v.Mk'k; idljh uky e cn jgr gA chtk.MU;kl LrEHkh; ;k v{kh;A

Qy (Fruit) – dk"B fonkjd dlly ¼dikl½ ;k fHknj ¼*ekYok* o *lkbMk*½ ;k xnnkj ljlA

i"i l= (Floral Formula) –

fgfcLdl jktk lkbufUl l

vkfFkd egRo (Economic Importance)

1- **Hkkstu d :i e** (As food) –

fHk.Mh (Okra) – *,cyekLdl ,LdyUVl*

2- **ry** (Oil) (i) dikl chtk l] (ii) *fgfcLdl ekLVVl* d chtk l eLd ry çkIr gkrk gA

3- **j'k** (Fibres) – (i) lrgh j'k & chtk dh lrg l çkIr gkr gA *fgfcLdl dukfcl* l iVlu çkIr gkrk g tk jLlh o ckj cuku d dke vkrk gA *ckEcDl lhck* dh QyfHkfÙk l dikd (Kapok) uked j'kk curk gA

4- **vk"kf/k;k** (Medicine) – ekYok oflyVk dh tM] dkyh [kkl h] *;jhuk ykcVk* dh tM o NkyA gkbMkQkfc;k jkx d mipkj e ykHknk;d gA blh çdkj *eyØk dfiVVk* dh tM xfB;k jkx o dej nn d mipkj e dke vkrh gA

5- **ltkoVh ikni** (Ornamental plants) – *pkbuk jkt* d nyi=k l yky cV ikfy'k r;kj dh dh tkrh gA gkyh gkd dh ifÙk;k l uhyk jx çkIr fd;k tkrk gA dkVu jkt (*Hibiscus mutabilis*) lcg lQn o fnu e xykch jx dk gk tkrk gA blh çdkj ikjl ihiy (*Thespesia populnea*), *ekYok flYoLVhl* (*Malva sylvestris*), *iokfu;k vkMkjVk* (*Pavonia odorata*) vkfn ltkoVh ikni g ¼fp= 18-1 v&j½A

dy & ddjfcVlh

(Family – Cucurbitaceae)

oxhÑr fLFkfr (Systematic Position)

çHkkx (Division) – Qujkxfe;k (Phanerogamia)

miçHkkx (Subdivision) – ,fUt;kLieh (Angiospermae)

ox (Class) – MkbdkVkbyhMuh (Dicotyledonae)

miox (Subclass) – ikyhiVyh (Polypetalae)

J.kh (Series) – dfyfl¶ykjh (Calyciflorae)

x.k (Order) – ifl¶ykjYl (Possiflorales)

dy (Family) – ddjfcVlh (Cucurbitaceae)

LoHkko (Habit) – ; ikni ,do"khZ; 'kkd (Herb), vkjkgh (Climber) ;k ryLi'kh (Trailing) gkr gA

tM (Root) – çk;% elyk eyA

ruk (Stem) – 'kkdh;] 'kkf[kr] ipdk.kh;] gjk rFkk çk;% [kk[kyk gkrk gA

iÙkh (Leaf) – loUr] LrfEHkd] 'kk[kh; (Ramal), ,dkUrj ljy] vuvui.kh] gLrkdkj ikfyr (Palmately lobed) o tkfydkor f'kjkfoU;kl ;ä gkrh gA

i"iØe (Inflorescence) – ,dy d{kLFk] dHkh&dHkh llhek{k xPN (Cymose cluster) Hkh ik;k tkrk gA

i"i (Flower) – vlgi=h] loUr] vi.k] ,dfyxh] f=T;kr lefer] ipr;h o tk;kxkifjd gkrk gA doy lkbtkiiku (Schizopepon) e mHk;fyxh i"i ik;k tkrk gA

uj i"i (Male Flower)

ckányit (Calyx) – ckány 5] l;ä o dkjLi'kh gkr gA

nyit (Androecium) – doy uj i"i e ik;k tkrk gA bld LFkku ij eknk i"i e c/; idlj (Staminodes) ik; tkr gA ikp idljk e l pkj idlj nk tkMk (Pairs) e rFkk ikpok idlj Lor= gkrk g vFkkr ikp idlj [(2)+(2)+1] Øe e gkr gA

bl dy d iknik d i"ik e fofHkUu çdkj d lltu ik; tkr g tl iFkd idljh ,o f}vk"Bh (Polyandrous, dithecous), *Qfofy;k* (*Fevillea*) e rFkk iFkd idljh ,d vk"Bh (Polyandrous, monothecous) mnkgj.k yQk (Luffa) rFkk *ekekjfMdk* (*Momordica*), *ddfel* (*Cucumis*) o *flVl* (*Citrus*) e liexh voLFkk gkrh gA

eknk i"i (Female Flower)

ckányit (Calyx) – ckány 5] l;ä o dkjLi'kh gkr gA

nyit (Corolla) – ny 5] nyit ?k.Vkdkj] l;ä] dkjLi'kh ;k dkjNknhA

tk;kx (Gynoecium) – ;g uj i"i e ugh ik;k tkrk gA tk;kx f=v.Mih (Tricarpellary), ;äk.Mih gkrk gA v.Mk'k; v/kkorh (Inerior), ,d dk"Bh; gkrk gA chtk.MkU;kl fHkfÙk; yfdu chtk.Mk lu d Qyu l ;g LrEHkh; çrhr gkrk gA ofrdk (Stigma) ,d yfdu ofrdkx rhu] 'kkf[krA ble idlj c/; gkr g ¼fp= 18-2 v&y½A

Qy (Fruit) – Qy çk;% ihik (Pepo), dHkh&dHkh cjh] mnkgj.k *Qfofy;k* o *bdcfy;e* (*Ecballium*) vkfnA

cht (Seed) – vHk.kik"kh gkrk gA

ijkx.k (Pollination) – i"i dhV ijkfxr gkr gA

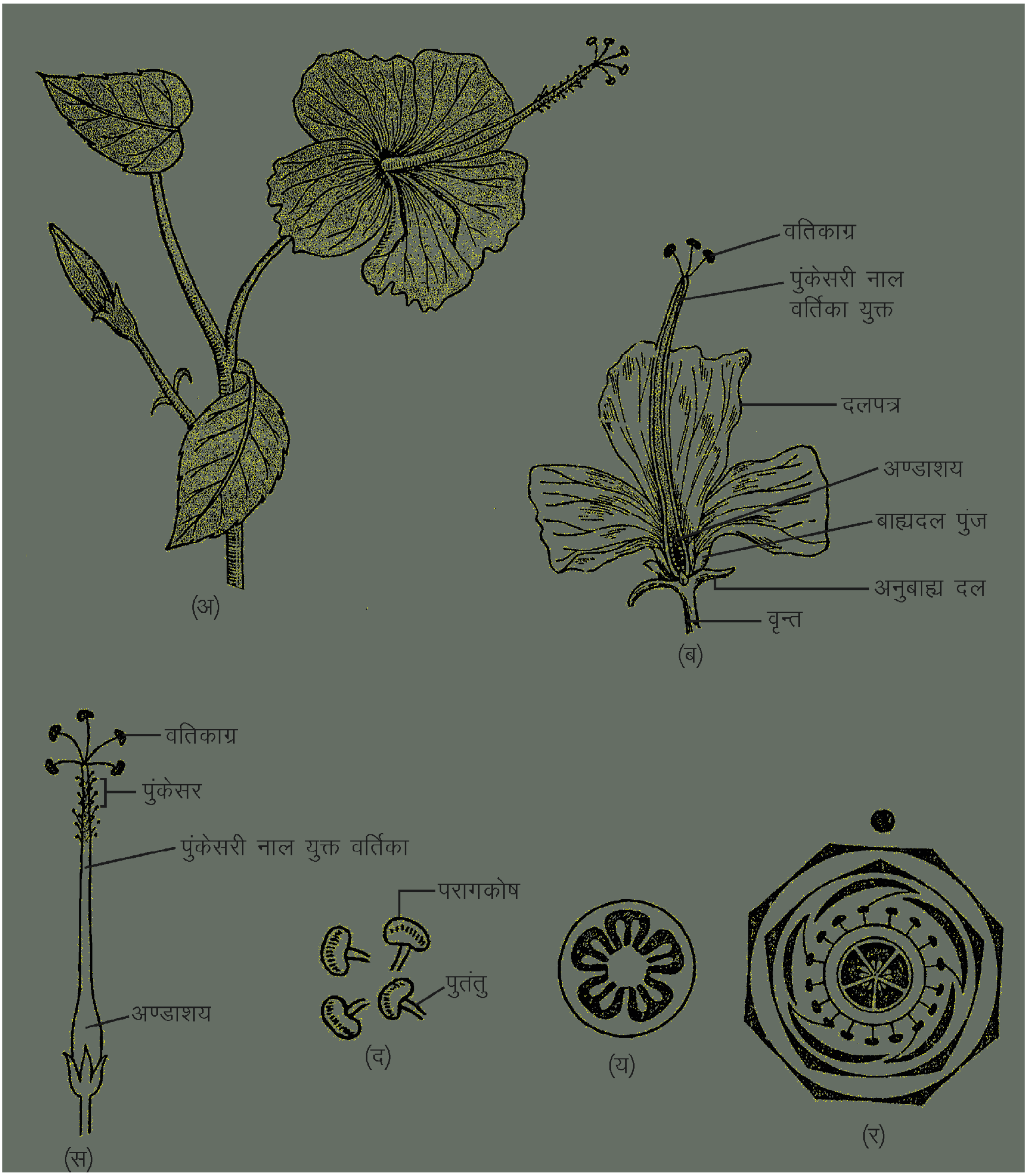
çdh.ku (Dispersal) – çdh.ku if{k;k o i'kvk }kjk gkrk gA

i"i l= (Floral Formula) –

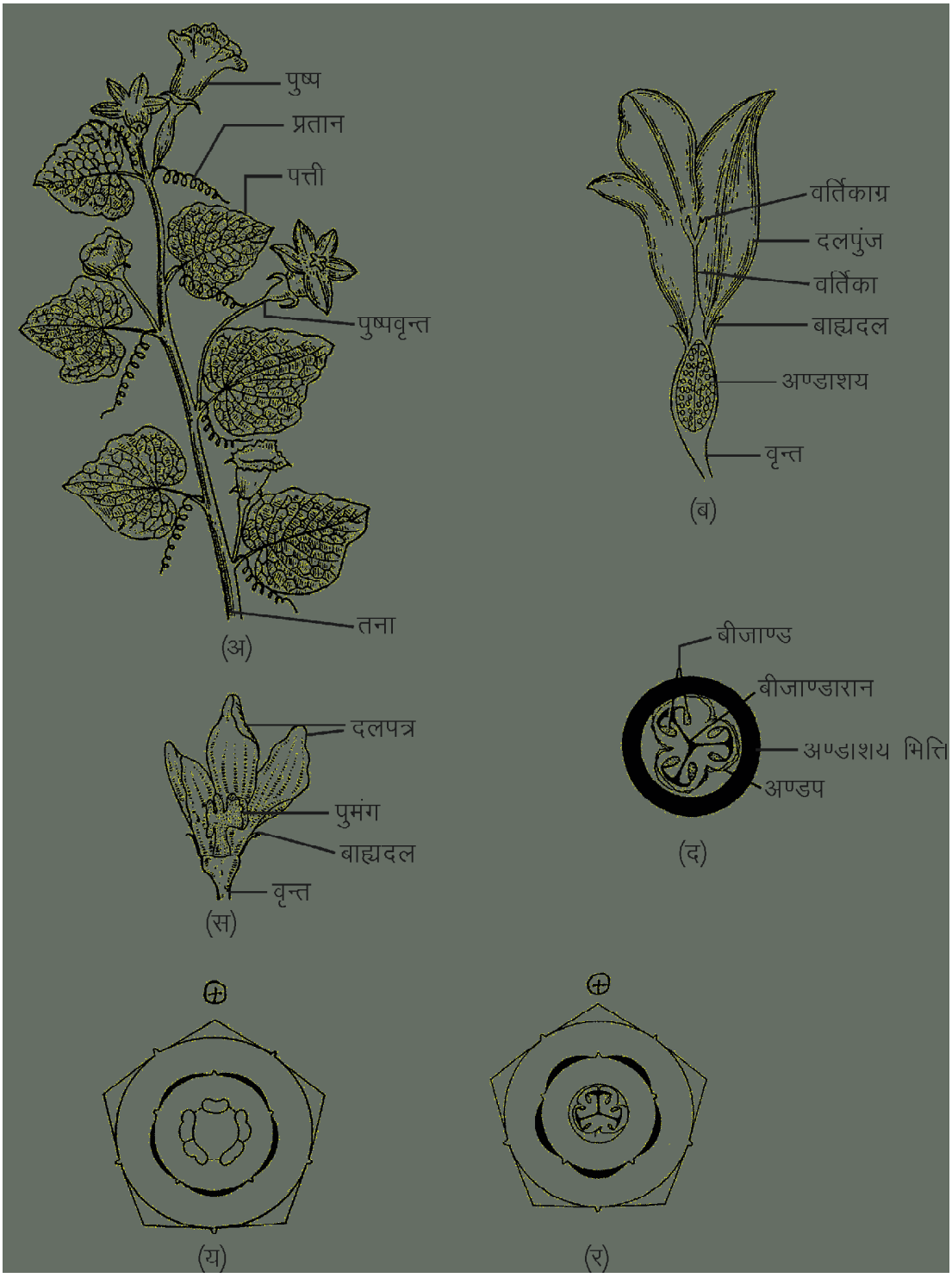
vkfFkd egRo (Economic Importance)

1- **Hkkstu d :i e** (As food) – bu iknik l lfCt;k o Qy çkIr gkr g tl f?k;k rkjb & *yQk flfyfUMdk* (*Luffa cylindrica*), ykdh & *y thufj;k flljfj;k* (*Lagenaria siceraria*), [khjk & *ddfel lVkbol* (*Cucumis sativus*), [kjctk & *ddfel eyk* (*Cucumis melo*), rjct & *flVyl oYxfjl* (*Citrullus valgaris*), djyk & *ekekjfMdk djfU'k;k* (*Momordica charantia*) vkfnA

2- **vk"kf/k d :i e** (As medicine) – bl dy d db iknik l vk"kf/k;k Hkh çkIr gkrh g tl bUæk;u & *flVyl dkykflfUFkl* (*Citrullus colocynthis*) l çkIr



fp= 18-1 ¼ ekyoLh ¼ *fgfcLdl jktk lkbufUll*
¼v½ i"ih; 'kk[kk ¼c½ i"i dk vun/; dkV ¼l½ i"i dk tuukx Hkkx
¼n½ idlj ¼;½ v.Mk'k; dk vuçLFk dkV ¼j½ i"i fp=



fp= 18-2 % ddjfcV lh % *dkfD/fu;k bfUMdk*

¼v½ i"ih; 'kk[kk ¼c½ eknk i"i dk vuçLFk dkV ¼l½ uj i"i dk vun/; dkV ¼n½ v.Mk'k; dk vuçLFk dkV ¼;½ uj i"i dk i"i fp= ¼j½ eknk i"i dk i"i fp=

dkykflfUFku e= o xfB;k jkxk d mipkj e rFkk *bdcfy;e byVfj;e* (*Ecballium elaterium*) l çkIr byVfj;e l çkIr byVfj;e eyfj;k o gkbMkQkfc;k e ykHkdkjh gA

3- **ltkoVh ikni** (Ornamental plants) – *bdcfy;e*] *lkbDyfUFkjk dkD lhfu;k* o *lhfd;e* dh dN çtkfr;k ltkoVh iknik dh rjg ?kjk o m|kuk e mxkb tkrh gA

dy & lkyulh

(Family – Solanaceae)

oxhÑr fLFkfr (Systematic Position)

çHkkx (Division) – Qujkxfe;k (Phanerogamia)

miçHkkx (Subdivision) – ,fUt;kLieh (Angiospermae)

ox (Class) – MkbdkVkbyhMuh (Dicotyledonae)

miox (Subclass) – xekiVyh (Gamopetalae)

J.kh (Series) – ckbdkjihyVh (Bicarpellatae)

x.k (Order) – ikyhekfu,Yl (Polymoniales)

dy (Family) – lkyulh (Solanaceae)

LoHkko (Habit) – bl dy d vf/kdk'k ikni ,do"kh;k cgo"kh; 'kkd gkr gA tl *lkyue ukbxe* (*Solanum nigrum*) o *fudkfVvkuk Vcde* (*Nicotiana tabacum*) dN {ki ¼*lkyue Vkjoe*½ rFkk NkV o{k ¼*lkyue oclhQkfy;e*½ vFkok vkjkgh ¼*lkyue MYdekjk*½A

tM (Root) – elyk ey gkrh gA

ruk (Stem) – m/o] dk"Bh; ;k 'kkdh;] jkfey ;k dVdh;] dN Hkkfexr ru : ikUrfjr gkdj [kk| lxg djr g tl vky & *lkyue V;cjkle* (*Solanum tuberosum*)A

iÙkh (Leaf) – ljy] vuvui.kh] lor] LrfEHkd ;k 'kk[kh;] ,dkUrj yfdu i"ih; {k= d ikl vfHke[k(Opposite) f'kjkfoU;kl&,df'kjh; tkfydkor] fiPNkdkj l;ä ifÙk;k VekVj e ikb tkrh gA

i"iØe (Inflorescence) – ,d'kk[kh llhek{kh (Monochasial cyme) çdkj dk gkrk gA

i"i (Flower) – lgi=h] i.k] f}fyxh] tk;kx/kj] ipr;h ,o f=T;kr lefer gkrk gA viokn Lo:i *lhtUFkl* (*Schizanthes*) o *lkYihXykfll* (*Salpiglosis*) e ,d 0;kl lefer gkrk gA

ckányit (Calyx) – ckány 5] l;ä] dkjLi'kh ,o fpjyYu (Persistant) gkr gA cxu e ckány Qy d lkFk&lkFk of) dj ekV o cM gk tkr g bUg ,Øhlu (Accrescent) dgr gA

nyit (Corolla) – nyi=5] l;ä] dkjLi'kh ¼*lkyue*½] dkjNknh ¼*lkrjk*½] dhikdkj ¼*fiVfu;k*½] ?k.Vkdkj ¼*Qkblfyl*½A

iex (Androecium) – idlj 5] iFkd idlji] nyyYu] vUre[kh rFkk ijkxdk"k f}vk"Bh; gkr gA

tk;kx (Gynoecium) – v.Mk'k; f}v.Mih] ;äk.Mih] f}dk"Bh;] chtk.MU;kl v{kh; gkrk gA tk;kx e f=;d iV (Oblique septum) o Qy g, chtk.Mklu dh mifLFkfr bl dy dk çe[k y{k.k gA

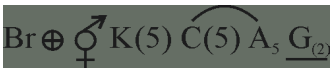
Qy (Fruit) – çk;% ljl Qy tcfd /krjk o fiVfu;k e dlly Qy gkrk gA

cht (Seed) – piV] mioDdkdkj] ekly] Hk.kik"k ;ä gkr gA

ijkx.k (Pollination) – i"i çk;% dhV ijkfxr gkr g] yfdu vky e Loijkfxr gkr gA

çdh.ku (Dispersal) – bl dy d iknik e chtk dk çdh.ku if{k;k ,o i'kvk }kjk gkrk gA */krjk*] ,*Vkik* vkfn dh dN tkfr;k e chtk dk çdh.ku ty }kjk gkrk g ¼fp= 18-3½A

i"i l= (Floral Formula)

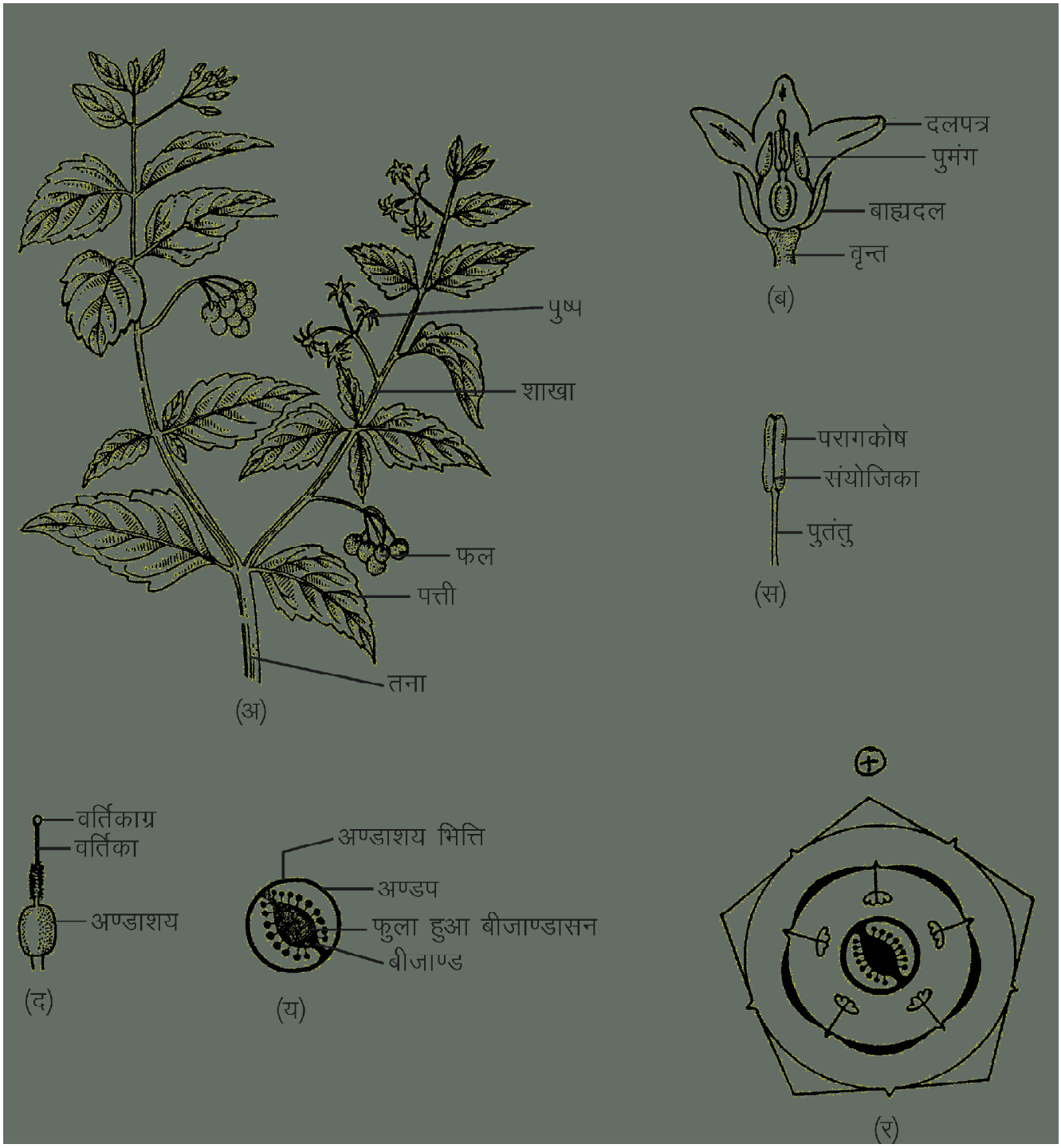


vkfFkd egRo (Economic Importance)

1- **Hkkstu d :i e** (As food) – bl dy d db ikni o ikni Hkkx Hkkstu d :i e dke efy; tkr g tl cxu (*Solanum melongena*), VekVj (*Lycopersicum esculentum*), fep (*Capsicum annum*), f'keyk fep (*Capsicum fruitescence*), vky (*Solanum tuberosum*) vkfnA

2- **vk"kf/k d :i e** (As medicine) – bl dy d iknik l db çdkj dh vk"kf/k;k çkIr gkrh g tk fd vud ekuo jkxk e ykHkdkjh g tl v'ox/kk (*Vithania somnifera*) efLr"d VkfudA */krjk* (*Datura alba*) d chtk l LVkekfu;e çkIr gkrk g ftle Ldkikykehu (Scopolamine) uked ,YdykbM gkrk g tk nn fuokjd o 'keudkjh gA rEckd (*Nicotiana tobacum*) e ,ukcflu (Anabasine) o fudkfVu (Nicotene) uked nk çe[k ,YdykbM gkr gA

3- **ltkoVh ikni** (Ornamental plants) – bl dy d dN ikni tl jkr dh jkuh ¼*lLVe ukDpjue* & *Cestrum nocturnum*½] fnu dk jktk ¼*lLVe Mkb;jue* & *Cestrum diurnum*½] cVj¶ykb i"i ¼*f'ktUFkl* & *Schizanthes*½]



fp= 18-3 ¼ lkyu lh ¼ *Hkyue ukbxe*
¼v½ i"ih; 'kk[kk ¼c½ i"i dk vun/; dkV ¼l½ iex
¼n½ tk;kx ¼;½ v.Mk'k; dk vuçLFk dkV ¼j½ i"i fp=

dy vkt dy ¼*cuQfYl;k gihuk & Brunfelsia hopeana*½ vkfn ltkoVh ikniksa d :i e cxhpk e mxk; tkr gA

4- **m|kxk e** (In industry) – rEckd (*Nicotiana tobacum*) dh ifÙk;k dk mi;ksx chMh] flxjV vkfn cuku e fd;k tkrk gA

dy & ik,lh

(Family – Poaceae)

oxhÑr fLFkfr (Systematic Position)

txr (Kingdom) – ikni (Plantae)

mitxr (Subkingdom) – i"ih (Phanerogams)

çHkkx (Division) – ,dchti=h (Monocotyledonae)

J.kh (Series) – Xyelh (Glumaceae)

dy (Family) – ik,lh ;k xehuh (Poaceae or Graminae)

LoHkko (Habit) – bl dy d ikni ,do"kh;] f}o"kh; vFkok cgo"kh; 'kkd (Herb) gA

tM (Root) – bue tM viLFkkfud ,oa j'knkj gksrh gA eDdk (*Zea mays*) ,oa et (*Saccharum*) e voLrEHk (Stilt) tM ik;h tkrh gA

ruk (Stem) – ruk ok;oh;] 'kkdh; ;k dBkj dk"Bh; gksrk gA

iÙkh (Leaf) – ifÙk;k ,dkUrj] çR;d iÙkh ,d Lrfjdk (Lamina) rFkk i.kvkPNkn e foHkfnr gksrh gA LrfEHkdk yEch] ldh.k] jf[kd vFkok Hkkykdkj vFkok vUrofyr gksrh gA ;g ç.k i.kvkPNkn l tMh gksrh gA i.kvkPNkn dYi dk pkjk vkj l ?kj jgrk gA i.kvkPNkn o Lrfjdk d tkM ij ,d NkVk f>Yyhe; vFkok jkfey fyX;y gksrk gA

i"iØe (Inflorescence) – bl dy d iknik e db çdkj d i"iØe ik; tkr g tl Likbfddk dk Likbd (Spike of spikelets), Likbfddk dk ifudy (Panicle of spikelets), eDdk dk uj i"iA Likbfddk dk LifMDl (Spadix of spikelets), bl i"iØe d pkjk vkj jxhu lgi=k dk vkoj.k gksrk gA

i"i (Flower) – i"i ç.k NkV] vukd"kd mHk;fyxh ¼eDdk e ,dfyxh½ lgi=h ,d0;kl lefer] f=Hkkxh rFkk tk;kx/kj gksrk gA mojk lgi=] mojk r"k (Fertile glume or lamina) dgykrk gA jkfey i"ioUr jfgr lgif=dk, mifLFkr gksrh g bUg ify;k (Palea) dgr gA

ifjnyyit (Perianth) – ifjny (Tepals) 2, Lor=] f>Yyhuek tk fd vx&ik'o e mifLFkr gksr g ftUg ykfMD;Yl (Lodicules) dgr gA

iex (Androecium) – idlj 3] ,d pØ e 0;ofLFkrA f}ikfyr o vUre[kh gksr gA *cEcl k* (*Bambusa*) o *vkjkbtk* (*Oryza*) e 6 idlj nk pØk e 0;ofLFkr gksr g] ¼3$3½A

tk;kx (Gynoecium) – v.Mk'k; f=v.Mih] ;äk.Mih] v.Mk'k; mèoorh] ,d dk"Bh;] chtk.MU;kl&fHkfÙk;] ofrdk 2] ijUr *cEcl k* e 3 ofrdk ikb tkrh g yfdu eDdk e nk ofrdk, l;ä gkdj ,d ofrdk cukrh gA ofrdkx ç.k fiPNdh; gksrk gA

Qy (Fruit) – ik,lh dy e ,dchtkUkjh Qy dfj;kfll gksr gA bl Qy dh QyfHkfÙk] chtkoj.k (Seed coat) d lkFk tMh jgrh gA ;g bl dy dk çe[k y{k.k gA yfdu *cEcl k* e Qy uV (Nut) ;k cjh gksrk gA

chtk (Seed) – chtk Hk.kik"k ;ä gksrk gA

ijkx.k (Pollination) – bl dy d ikni Loijkfxr vFkok ok; ijkfxr gksr gA

çdh.ku (Dispersal) – bl dy d vf/kdk'k iknik d chtk NkV gksr g budk çdh.ku ok; }kjk gksrk gA yfdu ftu tkfr;k e r"k 'kye; gksr g] mudk çdh.ku tUrvk }kjk Hkh gksrk gA

i"i l= (Floral Formula)

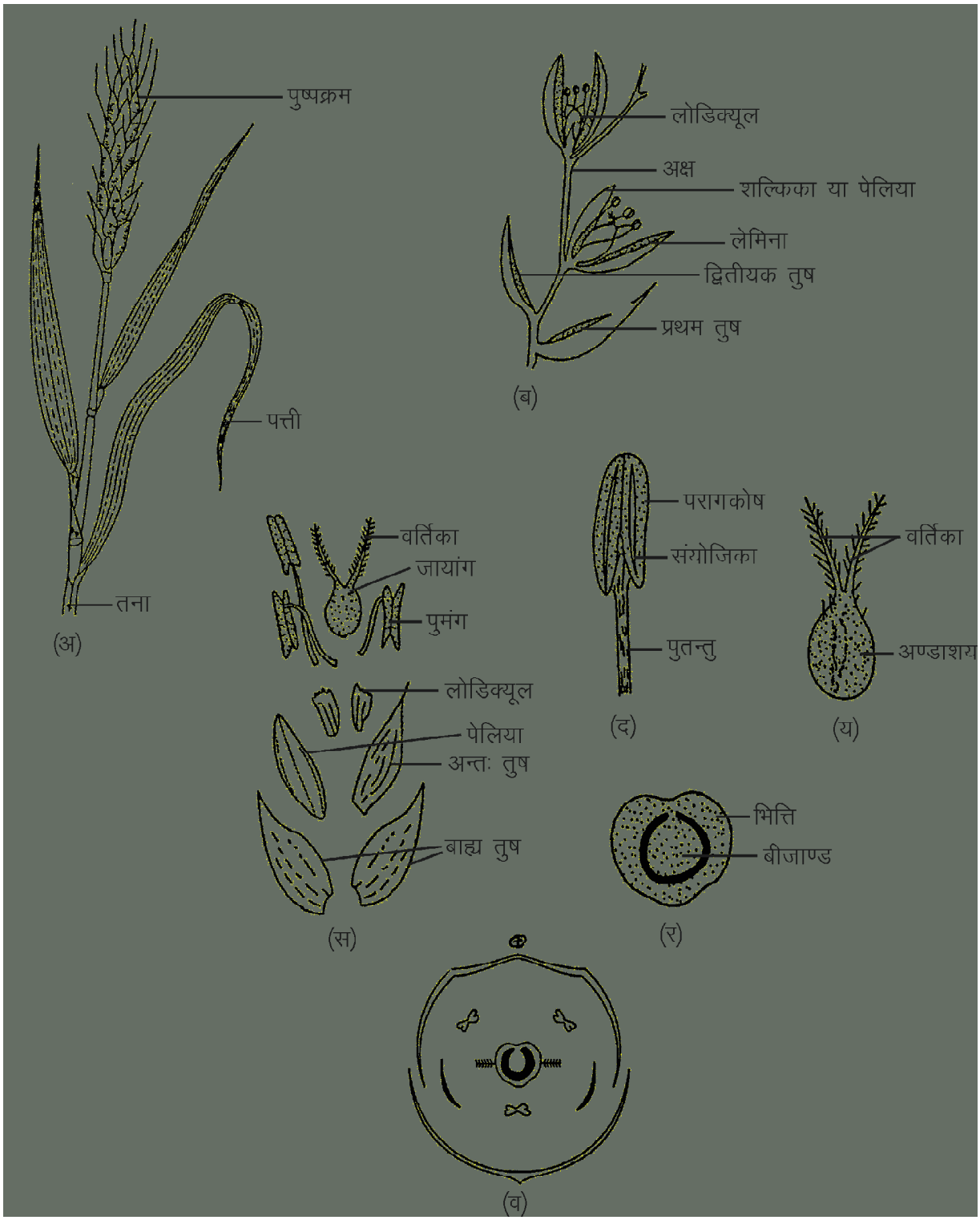
$$Br\ Brl\ \%\ \oplus\ \male\ P_2\ A_3\ \underline{G_{(3)}}$$

vkfFkd egRo (Economic Importance)

1- **vukt d :i e** (In form of cereals) – bl dy d vud iknikl turk dk vukt çkIr gksrk g tl xg & *fVfVde ,LVkboe* (*Triticum aestivum*), /kku & *vkjkbtk lVkbok* (*Oryza sativa*), eDdk & (*Zea mays*), tk & *gkfM;e oYxj* (Hordeum vulgare), Tokj & *lkjxe oYxj* (*Sorghum vulgare*), cktjk & *ifulhVe VkbQkbMhtk* (*Pennisetum typhoides*) vkfnA

2- **pkj d :i e** (In form of fodder) – bl dy d vud iknik dk mi;ksx i'kvk d pkj d fy; fd;k tkrk g tl *lkbukMku MDVkbyku* (*Cynodon dactylon*), *ikvk ,uvk* (*Poa annua*), *MDVkbfyl XykejVk* (*Dactylis glomerata*) vkfn ?kkl ikyr tkuojk d fy; çe[k pkjk gA

3- **ltkoVh ikni** (Ornamental plants) – fyfy & *fyfy;e cfYcQje* (*Lilium bulbiferum*), *Mfluk*



fp= 18-4 ¼ ik,lh ¼ *fVfVde ,LVkboe*
¼v½ i"ih; 'kk[kk ¼c½ i"iØe ¼l½ foPNfnr i"iØe
¼n½ iex ¼;½ tk;kx ¼j½ v.Mk"k; dk vuçLFk dkV ¼o½ i"i fp=

(*Dracaena*), lrkojh (*Asparagus*) o *V;fyi (Tulip)* vkfn ltkoVh iknik d :i e mxk; tkr gA

4- **vk"k/kh; ikni** (Medicinal plants) – pkc phuh (Smilax zeylanica) chtk dk mi;kx e= jkxk e fd;k tkrk gA blh çdkj ln'ku & *Økbue ,fl,fVde* (*Crinum asiaticum*) dh ifÙk;k dk jl dku nn o xfB;k jkxk e jkgr igpkrk gA yglu & ân; jkx] xfB;k o e/keg jkxk e ykHkdkjh gA dyhgkjh & *Xykfjvklk lijck* (*Gloriosa superba*) d"B jkx] cokLhj ,o lki o fcPN d dkVu ij mi;kxh fl) gkrk gA

4- **ry** (Oil) – bl dy d dN iknik l ok"i'kh ry çklr gkrk g ftudk mi;kx b= lkexh] ePNj çfrd"kd Øhe d :i e fd;k tkrk g tl yeu ?kkl & *flEckikxku flVVl* dh ifÙk;k l ry çklr gkrk gA

egRoi.k fcUn

1- dy ekyolh ox MkbdkVkbyhMuh rFkk miox ikyhiVyh d vUrxr vkrk gA

2- bl dy dk i"iØe ,dy d{kLFk gkrk gA

3- ekyolh dy dk i"i loUr] lgi=h] i.k] fu;fer] tk;kx/kj ,o ipr;h gkrk gA

4- bl dy d i"i e iex vl[; rFkk ,dl?kh gkr gA

5- bl dy dk Qy dk"B fonkjd dlly ;k fHknj ;k xnnkj ljl gkrk gA

6- bl dy d ikni Hkktu] j'k] vk"kf/k;k rFkk ltkoVh iknik d :i e dke e fy; tkr gA

7- dy ddjfcVlh d ikni ,do"kh; 'kkd ;k vkjkgh ;k ryLi'kh gkr gA

8- ddjfcVlh d iknik dk i"iØe ,dy d{kLFk ;k dHkh&dHkh llhek{k xPN gkrk gA

9- bl dy dk i"i vlgi=h] loUr] vi.k ,o ,dfyxh gkrk g vFkkr vf/kdk'k iknik e uj o eknk i"i vyx&vyx gkr gA

10- bl dy dk Qy çk;% ihik çdkj dk gkrk gA

11- lkyulh dy d iknik dk miox xekiVyh rFkk J.kh ckbdkjihyVh d vUrxr j[kk x;k gA

12- lkyulh iknik dk i"iØe ,dy'kk[kh llhek{k çdkj dk gkrk gA

13- bl dy dk i"i lgi=h] i.k] f}fyxh] tk;kx/kj] ipr;h ,o f=T;kr lefer gkrk gA

14- tk;kx e f=;d iV (Oblique septa) ,o Qyk gvk chtk.Mlu dy lkyjlh dk çe[k y{k.k gA

15- dy lkyulh e Qy çk;% ljl tcfd /krjk e dlly Qy gkrk gA

16- dy ik,lh ½xfeuh½ d ikni çk;% ,do"kh;] f}o"kh; vFkok cgo"kh; 'kkd gkr gA

17- ik,lh dy d iknik e db çdkj d i"iØe ik; tkr g tl Likbfddk dk Likbd] Likbfddk dk ifudy ,o Likbfddk dk LifMDl vkfnA

18- ik,lh dy d i"i miHk;fyxh] lgi=h] ,d 0;kl lefer] f=Hkkxh rFkk tk;kx/kj gkr gA bu i"ik e mojk lgi=] mojk r"k dgykr g tcfd jkfey i"ioUr jfgr lgif=dk, ify;k dgykrh gA

19- bl dy d i"i e ifjny it] 2 ifjnyk (Tepals) l feydj cuk gkrk gA ;g i"i dk f>Yyhuek Hkkx g ftUg ykfMD;Yl dgr gA

20- ik,lh dy e ,dcht/kkjh Qy dfj;kfllll ik;k tkrk gA

vH;klkFk ç'u

oLrfu"B ç'u

1- ,dl?kh iex fuEufyf[kr e l fdl ikni dy dk y{k.k g&

¼v½ lkyulh ¼c½ ekyolh

¼l½ ddjfcVlh ¼n½ ik,lh

2- ihik çdkj dk Qy ik;k tkrk g&

¼v½ ddjfcVlh e ¼c½ lkyulh e

¼l½ ik,lh e ¼n½ ekyolh e

3- f=;diV ;ä Qyk gvk chtk.Mlu y{k.k g&

¼v½ lkyulh dk ¼c½ ddjfcVlh dk

¼l½ ekyolh dk ¼n½ ik,lh dk

4- jkfey i"ioUr jfgr lgif=dk, dgykrh g&

¼v½ mojk r"k ¼c½ ify;k

¼l½ ykfMD;Yl ¼n½ Likbfddk

vfry?kÙkjkRed i'u

1- ekyolh dy e fdl çdkj dk i"iØe ik;k tkrk g\

2- ekyolh dy d dkb nk vk"k/kh; iknik d uke fyf[k;A

3- ddjfcVlh e fdl çdkj dk Qy ik;k tkrk g\

4- ddjfcVlh dy dk i"i fdl çdkj dk gkrk g\

5- lkyulh dy d tk;kx dk e[; y{k.k fyf[k;A
6- lkyulh dy e fdl çdkj dk i"iØe ik;k tkrk g\
7- ,dl?kh iex D;k gkr g\
8- ik,lh e fdl çdkj dk Qy ik;k tkrk g\
9- ik,lh dy d nk vkfFkd egRo d iknik d uke fy[kk tk Hkktu d :i e dke vkr gA
10- ykfMD;Yl D;k g\

y?kÙkjkRed i'u

1- ekyolh dy dk i"i dlk gkrk g\ bl dy dk i"i l= fyf[k;A
2- ekyolh dy d iknik dk vkfFkd egRo l{ki e crkb;A
3- dy ddjfcVlh dh oxhÑr fLFkfr crkb;A
4- dy ik,lh e i"iØe d ckj e crkb;A
5- dy ik,lh d i"i d fofHkUu Hkkxk dk ukekfdr fp= cukb;A

fucU/kkRed i'u

1- ekyolh dy d i"ih; Hkkxk dk lfp= o.ku dhft ;A
2- lkyulh dy d iex o tk;kx dk o.ku dhft ;A bl dy d i"i fp= ,o i"i l= fyf[k;A
3- ddjfcVlh dy dk vkfFkd egRo fyf[k;A
4- ik,lh dy i"i dk lfp= o.ku dhft ;A
5- ik,lh dy dk vkfFkd egRo crkb;A

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mÙkjekyk% 1 ¼c½ 2 ¼v½ 3 ¼v½ 4 ¼c½

bdkb & XII

v/;k; & 19

vkUrfjd ljpuk & tM] ruk] iÙkh] f}rh;d ,o vlxr of)

(Internal Structure – Root, Stem, Leaf, Secondary and Anomalous Growth)

ifjp; (Introduction)

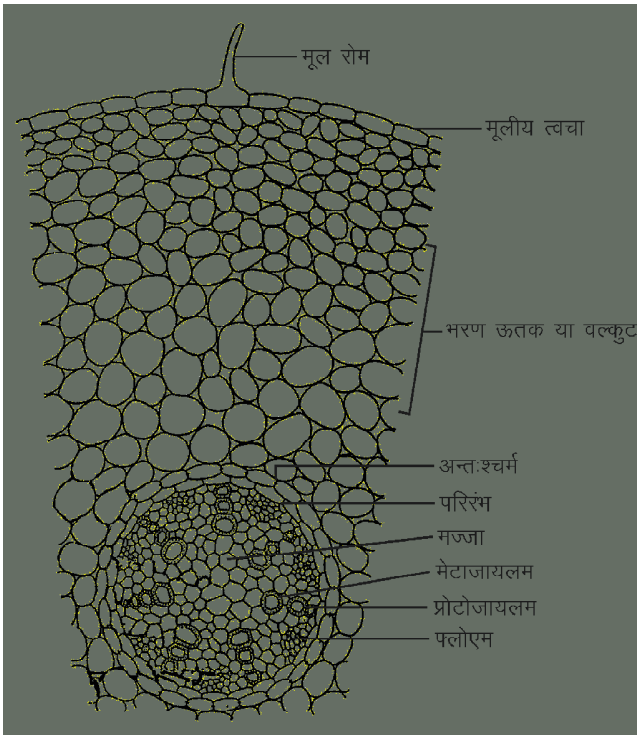
tM ikni dk og Hkkx g tk eykdj l fodflr gkrk g rFkk çdk'k d foijhr] iFoh d x#Rokd"k.k cy dh rjQ Hkfe d vUnj of) djrk gA tM i.k o iolf/k;k e foHkfnr ugh gkrh gA bl ij ,dd k'kh; ey jke ik; tkr g rFkk ey d 'kh"k Hkkx ij eyxki ikb tkrh g tk bl enk d ?k"k.k l cpkrk gA eyjke enk l ty ,o [kfut yo.kk dk vo'kk"k.k djr gA iknik d fofHkUu Hkkxk dh vkUrfjd ljpuk d v/;;u dk ikni 'kkjhfjdh (Plant anatomy) dgr gA

tM dh 'kkjhfjdh (Anatomy of Root)

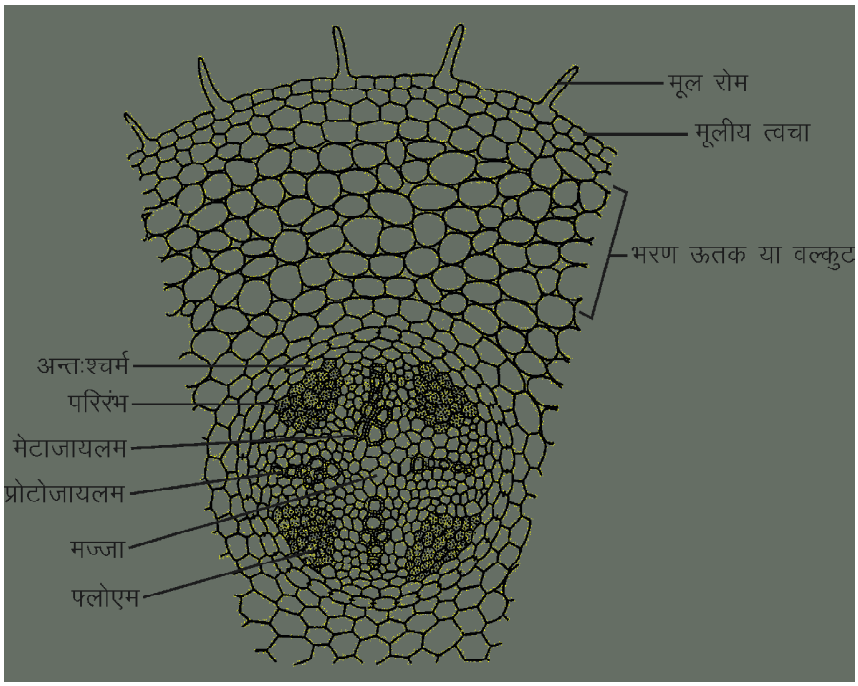
,dchti=h iknik e viLFkkfud ey (Adventitious root) gkrh g tk fd eykdj d vykok ikni d vU; fdlh Hkh Hkkx l mRiUu gkrh g tcfd f}chti=h iknik e elyk ey (Tap root) gkrh g tk eykdj l gh mRiUu gkrh gA

ey e lcl ckgj cká ijr ;k vf/kpe gkrh g tk fd feêh d d.kk l jxM [kkdj u"V gk tkrh g vr% oYdV (Cortex) dh lcl cká ijr eyh; Ropk (Epiblema) ;k jke/kj (Piliferous layer) ;k jkbtkMfel (Rhizodermis) e cny tkrh gA bl ij ,d ,dd'kh; eyjke ik; tkr gA bl ij miRopk (Cuticle) ,o jU/k ugh ik; tkr gA eyh; Ropk d uhp lfodflr oYdV ik;k tkrk gA ey dh vUr%'pe (Endodermis) Li"V gkrh gA budh dN dkf'kdkvk e dLifj;e iêhdk, ik;h tkrh gA ifjjHk (Pericycle) ,d Lrjh; rFkk enÙkdh; gkrh gA

ey e logu iy vjh; (Radial vascular bundle) gkr g vFkkr tk;ye rFkk ¶yk,e vyx&vyx f=T;kvk ij ,dUrj Øe e 0;ofLFkr gkr gA logu iy cká vkfnnk:d (Exarch) gkr g vFkkr çkVktk;ye ifjf/k dh vkj rFkk eVktk;ye dUæ dh vkj gkr gA ,dchti=h ey dh eTtk cMh ,o fodflr gkrh g tcfd f}chti=h iknik dh ey eTtk vYifodflr gkrh gA ,dchti=h o f}chti=h iknik dh ey e nljk cMk vUrj ;g gkrk g fd ,dchti=h ey e loguiyk dh l[;k 6 l vf/kd gkrh g tcfd f}chti=h iknik dh ey e loguiyk dh l[;k 2 l 6 rd gh gkrh g ¼fp= 19-1 v o c½A



fp= 19-1 ¼v½ ¼ ,dchti=h tM dk vuçLFk dkV



fp= 19-1 ¼c½ % f}ch ti=h tM dk vuçLFk dkV

ru dh vkUrfjd ljpuk
(Internal Structure of Stem)

ifjp; (Introduction)

ruk ikni dk og Hkkx g tk çkdj l fodflr gkrk g rFkk iFoh d x#Rokd"k.k cy dh vkj of) djrk gA ruk i.kr;k io o io lf/k;k e foHkfnr gkrk gA bldh vf/kpe ij cgdkf'kdh; LrEHk jke ik; tkr gA ,dch ti=h ,o f}ch ti=h ikni k d ru vyx&vyx vkUrfjd ljpuk n'kkr gA

I ,dch ti=h ru dh vkUrfjd ljpuk ;k 'kkjhfjdh
(Structure or Anatomy of Monocot Stem)

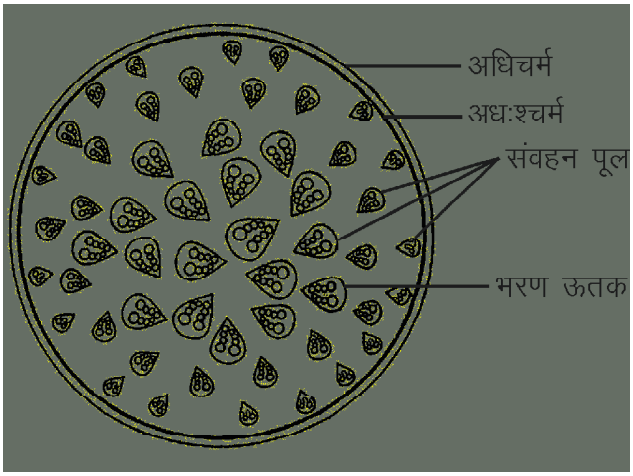
,dch ti=h ru d vuçLFk dkV e fuEufyf[kr Hkkx Li"V fn[kkb nr g&

1- **vf/kpe** (Epidermis) – ;g ,d Lrjh; ekVk ckÁ Hkkx gkrk gA ;g enÙkdh; dkf'kdkvk dk cuk gkrk gA bl ijr ij ,d ekVh miRopk (Cuticle) ik;h tkrh gA vfèkpe ij txg&txg j/k (Stomata) ik; tkr gA

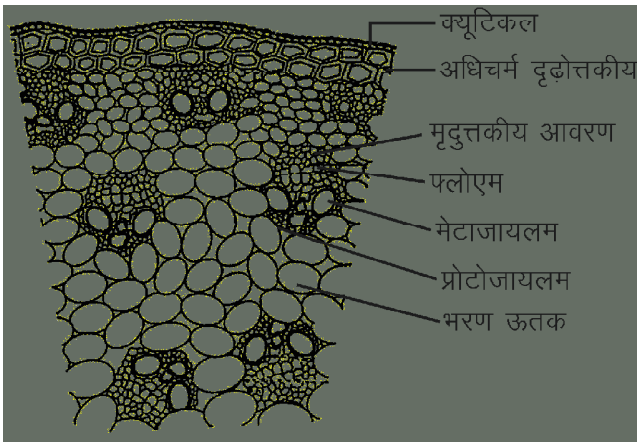
2- **v/k'pe** (Hypodermis) – vf/kpe d uhp ,d ekVk] n<kÙkdh;] cgLrjh; v/k'pe ik;k tkrk g] ;g ru dk n<rk çnku djrk gA dN iknik e v/k'pe Li"V ugh gkrh gA mnkgj.k ?kkl ,o lrkojhA

3- **Hkj.k Ård** (Ground tissue) – v/k'pe d uhp okyk leLr Hkkx Hkj.k Ård dgykrk gA ;g enÙkd l cuk gkrk gA ;g oYdV] vUr%Ropk (Endodermis), ifjfjHk ,o eTtk e foHkfnr ugh gkrk gA bldh dkf'kdk, cMh] xkykdkj ,o vUrjdkf'kdh; LFky ;ä gkrh gA bl Hkj.k Ård e loguiy fc[kj g, iM jgr gA viokn Lo:i xg d ru dk e/; Hkkx [kk[kyk gkrk gA bl [kk[ky Hkkx dk eTtk xgk dgr gA

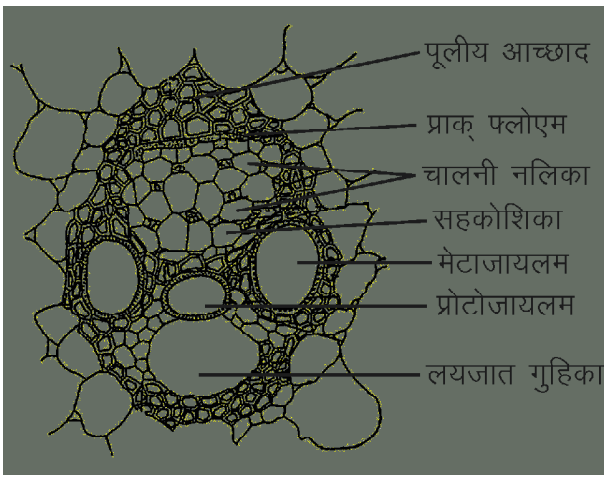
4- **loguiy** (Vascular bundle) – ,dch ti=h ru d loguiy l;ä (Conjoint), likf'kod (Collateral), vUr%vkfnnk:d (Endarch) rFkk cn (Closed) gkr gA ; loguiy dUæ dh rjQ cM rFkk ifjf/k dh vkj Øe'k% NkV gkr tkr gA budh l[;k dUæ dh vkj de rFkk ifjf/k dh vkj vf/kd gkrh gA çR;d loguiy d pkjk vkj n<kÙkd dkf'kdkvk l cuk ,d iyh; vkPNkn (Bundle sheath) gkrk gA bl loguiy dh tk;ye dkf'kdk, vxth d v{kj V ;k Y vkÑfr e 0;ofLFkr jgrh gA bu loguiyk e vud çkVk tk;ye ,o tk;ye enÙkd dkf'kdk, u"V gkdj y; tkr xfgdk, ;k ty xfgdk, (Lysogenous cavity or water cavity) cukrh gA ?kkl d ru e ; xfgdk, vuifLFkr gkrh g ¼fp= 19-2 ¼l½A



fp= 19-2 ¼v½ % ,dchti=h ru d vuçLFk dkV dk vkjf[kr fp=



fp= 19-2 ¼c½ % ,dchti=h ru d vuçLFk dkV dk dkf'kdh; fp=



fp= 19-2 ¼l½ % ,dchti=h ru dk logu iy

II f}cht i=h ru dh vkUrfjd ljpuk ;k 'kkjhfjdh
(Structure or Anatomy of Dicot Stem)

f}cht i=h ikni dh vkUrfjd ljpuk ;k 'kkjhfjdh dk le>u d fy; bl iLrd e ge ljte[kh (Sunflower = *Helianthus annus*) dk mnkgj.k yxA bl ikni d vuçLFk dkV e fuEufyf[kr Hkkx Li"V fn[kkb nr gA

1- **vf/kpe** (Epidermis) – ;g enÙkd dkf'kdkvk dh cuh cká ,d ijr gA bldh dkf'kdk, piVh o vkil e lVh gb gkrh gA bl vf/kpe ij D;fVu d teko d dkj.k miRopk curh gA vf/kpe ij db cgdk'kh; jke j/k ik; tkr gA

2- **v/k%'pe** (Hypodermis) – ;g vf/kpe d uhp okyk Hkkx gkrk g tk fd 4 l 7 ijrk l feydj cuk gkrk gA ;g LFkydk.k mÙkd l cuk gkrk gA budh dkf'kdkvk e gfjryod ik;k tkrk g rFkk bu dkf'kdkvk e vUrjkdkf'kdh; LFkyk dk vHkko gkrk gA

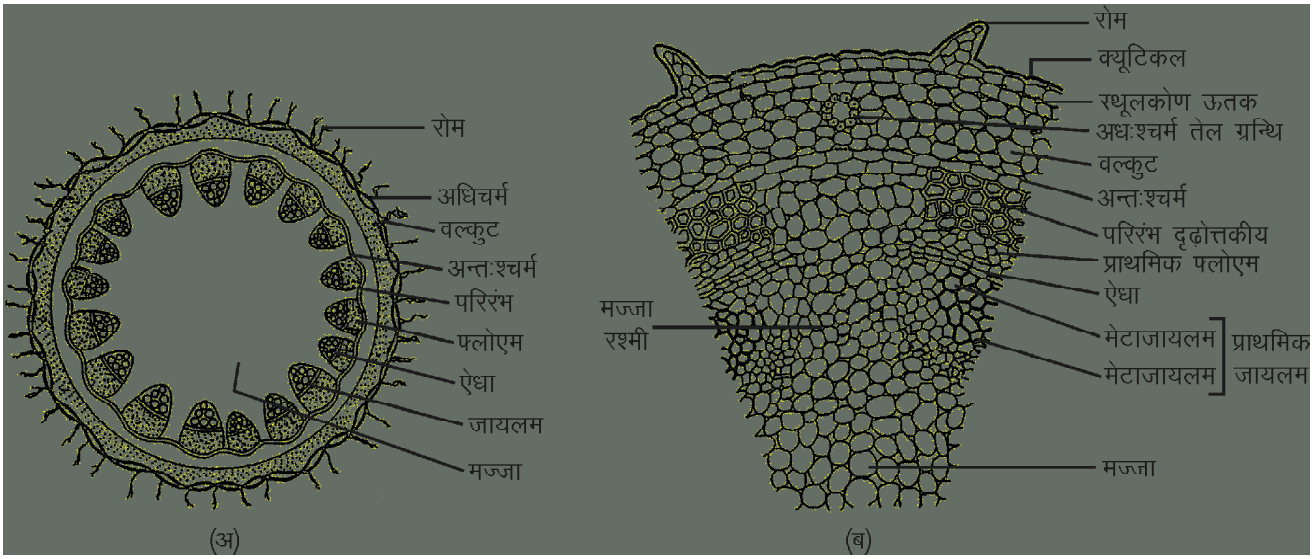
3- **oYdV** (Cortex) – ;g v/k%'pe d uhp cgLrjh; enÙkd dkf'kdkvk dk cuk Hkkx gA budh dkf'kdkvk d chp vUrjkdkf'kdh; LFky ik; tkr gA bl ikni d ru d oYdV e jky xfgdk, (Resin canal) o 'y"e xfgdk, (Mucilage canals) ik;h tkrh g tk fd xfgdk, xfFky dkf'kdkvk l <dh jgrh gA

4- **vUr%'pe** (Endodermis) – ;g oYdV d lcl vUnj dh ijr gA ;g <kydkdkj (Barrel shaped), lVh gb dkf'kdkvk l feydj curh gA bue d'ifj;u ifê;k ryukRed nf"V l de gkrh gA bu dkf'kdkvk e LVkp dh ek=k vf/kd gkrh g] vr% bl LVkp vkPNkn (Starch sheath) Hkh dgr gA

5- **ifjHk** (Pericycle) – ljte[kh ru e ifjHk nk çdkj dh dkf'kdkvk l feydj curh gA vr% ;g fo"kekxh (Heterogenous) gkrh gA logu iyk d Åij ;g cgLrjh;] v/koÙkkdkj n<kÙkd dh cuh gkrh g] ftl iy xki (Bundle cap) Hkh dgr gA

6- **loguiy** (Vascular bundle) – bl ru e çR;d loguiy l;ä] likf'kd] vUr%vkfnnk:d rFkk [kyk (Open) çdkj dk gkrk gA bue iyvkPNkn rFkk y;tkr xfgdk dk vHkko gkrk gA loguiyk dk vkdkj rFkk l[;k fuf'pr ugh gkrh g yfdu lHkh loguiy ,d oy; e fLFkr gkr gA

7- **eTtk** (Pith) – ;g {k= enÙkd dkf'kdkvk dk cuk gvk gkrk g rFkk ru d dUæ e Qyk gvk gkrk gA budh dkf'kdkvk d e/; vUrjkdkf'kdh; LFky ik; tkr gA



fp= 19-3 % f}ch ti=h ru dk vuçLFk dkV & ¼v½ vkjf[kr fp= ¼c½ dkf'kdh; fp=

loguiyk d e/; n<kÙkd dkf'kdkvk l cuh eTtk l ckgj fudyrh gb eTtk jLe (Medullary rays) Hkh ik;h tkrh g ¼fp= 19-3½A

,dch ti=h ,o f}ch ti=h ruk dh vkUrfjd ljpuk e vUrj

y{k.k	,dch ti=h ruk	f}ch ti=h ruk
1- vf/kpe	dkf'kdk, NkVh] jke jfgr	dkf'kdk, cMh] cgdkf'kdh; jke mifLFkr
2- v/k%'pe	n<kÙkd dh	LFkydk.k mÙkd dh
3- oYdV	vfoHkfnr gkrk gA	foHkfnr gkrk g] enÙkdh; gfjr mÙkdh;
4- vUr%'pe	vuifLFkr	mifLFkr
5- ifjjHk	vuifLFkr	mifLFkr
6- loguiy	(i) l;ä] likf'od] cn	l;ä] likf'od ;k lf}ikf'od rFkk [ky
	(ii) li.k Hkj.k Ård e fc[kj g,	,d ;k vf/kd ?kjk ;k oy;k e 0;ofLFkr
	(iii) loguiyk ij n<kÙkdh; iyh; vkPNkn gkrk gA	iyh; vkPNkn dk vHkko gkrk gA
	(iv) tk;ye okfgdk, "V" ;k "Y" vkÑfr e 0;ofLFkr	vjh; j[kkvk e 0;ofLFkr
	(v) ¶yk,e enÙkd dk vHkko	¶yk,e enÙkd mifLFkr
	(vi) y;tkr xfgdk mifLFkr	y;tkr xfgdk vuifLFkr
7- eTtk	vfoHkfnr	foHkfnr
8- eTtk fdj.k	vuifLFkr	mifLFkr
9- f}rh;d of)	vuifLFkr	mifLFkr

iÙkh dh vkUrfjd ljpuk

(Internal Structure of Leaf)

ifjp; (Introduction)

iÙkh ikni dk og Hkkx g tk i.k vkid (Leaf primordia) }kjk ru d io lf/k l ik'o mikx (Leaf appandages) d :i e fodflr gkrh g rFkk bld d{k e d{kLFk dfydk gkrh gA ,d fodflr iÙkh i.kk/kkj] i.koUr o i.kQyd rhu Hkkxk e foHkfnr gkrh gA ifÙk;k dk vkUrfjd ljpuk d vkèkkj ij nk çdkjk e ckVk x;k g ¼1½ i"Bk/kkjh ;k f}i"Bh (Dorsiventral or bifacial leaves) rFkk ¼2½ lef}ikf'od ;k lei"Bh; i.k (Isobilateral or equifacial leaves)A

1- **i"Bk/kkjh i.k** & bl çdkj dh i.k e v/kj (Adaxial)

,o i"B (Abaxial) lrg vleku gkrh gA bl i.k dh vèkj lrg l; dh fdj.kk d lkeu jgrh g vr% vf/kd gjh gkrh g tcfd i"B lrg ¼fupyh½ lrg ij l; dh fdj.k de iMu d dkj.k de gjh gkrh gA bl iÙkh e j/k doy i"B lrg ij gh gkr gA mnkgj.k f}cht i=h ikniA

2- **lef}ikf'od i.k** & bl çdkj dh iÙkh dh nkuk lrg leku gkrh gA ;g i.k ru ij mnx : i l yxh jgrh gA vr% l; dk çdk'k nkuk lrgk ij leku : i l çkIr gkrk gA bl i.k dh nkuk lrgk ij j/k leku : i l ik; tkr gA bue lekukUrj çdkj dk f'kjkfoU;kl ik;k tkrk gA mnkgj.k ,dcht i=h ikniA

bu nkuk çdkj dh ifÙk;k dh vkUrfjd ljpuk e Li"V vUrj fn[kkb nrk gA

I i"Bk/kkjh ;k f}cht i=h i.k dh vkUrfjd ljpuk ;k 'kkjhfjdh

(Structure or Anatomy of Dorsiventral or Dicot Leaf)

,d i"Bk/kkjh ;k f}cht i=h i.k d vuçLFk dkV e fuEufyf[kr ljpuk, Li"V fn[kkb nrh g&

1- vf/kpe (Epidermis)

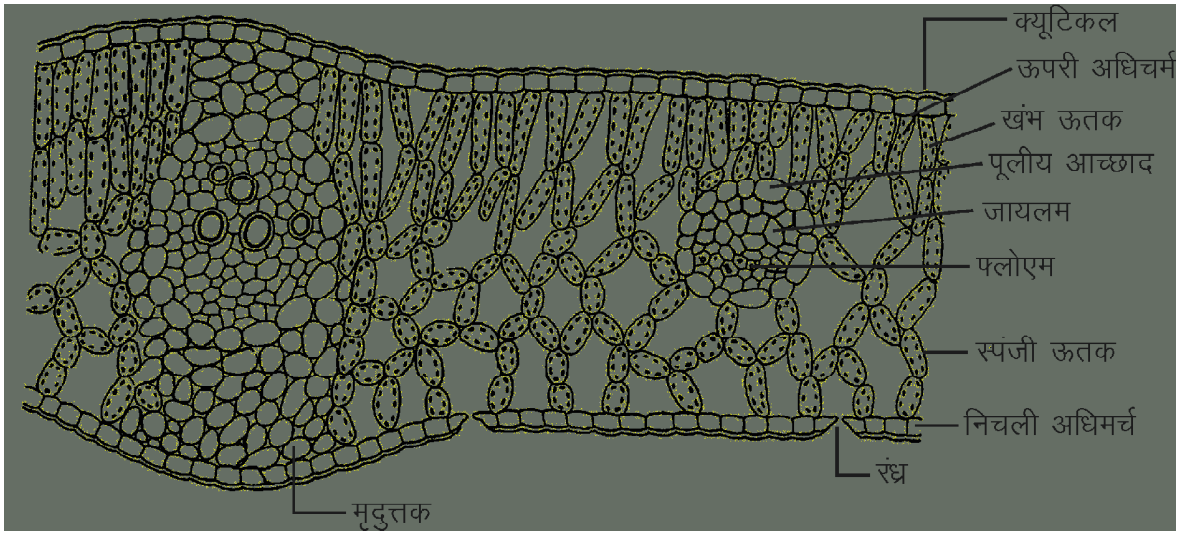
(i) **Åijh vf/kpe** (Upper epidermis) – ;g ,d Lrjh ckÁ ijr gkrh g tk fd enÙkd dkf'kdkvk l cuh gkrh g rFkk bl ij ekVh miRopk (Cuticle) gkrh gA ble j/kk (Stomata) dk vHkko gkrk gA dN e:nfHkn iknik tl *duj* (*Nerium*) o cjxn (*Ficus*) e ;g cgLrjh; gkrh gA

(ii) **fupyh vf/kpe** (Lower epidermis) – ;g Hkh ,d Lrjh; gkrh g rFkk enÙkd dkf'kdkvk dh cuh gkrh gA bldh miRopk (Cuticle) iryh gkrh gA bl ij j/k ik; tkr gA gfjryod doy j/kk dh j{kd ;k }kj dkf'kdkvk e gh ik; tkr gA çR;d j/k d vUnj dh vkj ,d xgk ikb tkrh g ftl lj/kh; xgk (Substomatal cavity) dgr gA blh xgk l ifÙk;k e xlk dk fofue; gkrk g rFkk i.k ok"ikRl tu gkrk gA

2- **i.keè;kÙkd** (Leaf mesophyll tissue) – i.k dh Åijh rFkk fupyh vf/kpe d e/; fLFkr leLr çdk'k l'y"kh dkf'kdk, i.ke/;kÙkd dgykrh gA i"Bk/kkjh i.k dk i.keè;kÙkd nk çdkj d Ård dk e foHkfnr gkrk g (i) [kEHk Ård rFkk (ii) Lith ÅrdA

(i) **[kEHk Ård** (Palisade tissue) – ;g Ård vf/kpe d uhp] [kEHkkdkj dkf'kdkvk dk cuk ,d ;k cgLrjh; Ård gA bl Ård dh dkf'kdk, vkil e lVh gb jgrh g rFkk bue gfjryod vf/kd ek=k e ik;k tkrk g rFkk bud e/; vUrjkdkf'kdh; LFky cgr de ;k vHkko gkrk gA duj (*Nerium*) rFkk cjxn e ;g cgLrjh; gh gkrk g rFkk duj e dfYl ;e vkDtyV d rkjuek fØLVy ik; tkr g ftUg LQjk jQkbMl (Sphaero raphides) dgr g tcfd cjxn dh iÙkh e dfY'k;e dkckuV d cu vxj d xPNuek fØLVy ik; tkr g] bUg flLVkfyFk (Cystolith) dgr gA

(ii) **Lith Ård** (Spongy tissue) – ;g Hkkx i.k e [kEHk Ård d uhp fLFkr gkrk g rFkk fupyh vf/kpe rd



fp= 19-4 % i"Bk/kkjh iÙkh dk vuçLFk dkV

Qyk gkrk gA ;g xkykdkj ;k v.Mkdkj ;k cgHkkth; Lituek Qyh gb dkf'kdkvk l cuk gkrk gA bu dkf'kdkvk d chp vUrjkdkf'kdh; LFky vf/kd rFkk gfjryod de ik;k tkrk gA bUgh vUrjkdkf'kdh; LFkyk l xlk dk folj.k gkrk gA

(iii) **loguiy** (Vascular bundle) – f}cht i=h i.k dk loguiy l;ä] likf'od rFkk c/k (Closed) çdkj d gkr gA lcl cMk loguiy e/;f'kjk e tcfd i.k eè;kÙkd e NkV ,o cM ,dkUrj Øe e 0;ofLFkr gkr gA /;ku j[ku ;kX; ckr g fd i.k e loguiy mYV 0;ofLFkr gkr g vFkkr tkye Åij dh rjQ rFkk ¶yk,e uhp dh vkj fLFkr gkrk gA çkVkt;ye ge'kk Åijh vf/kpe dh vkj gkrk gA çR;d loguiy enÙkd dkf'kdkvk l cu ,dLrjh; iyh; vkPNkn l f?kjk jgrk g ¼fp= 19-4½A

II lef}ikf'od ;k ,dcht i=h i.k dh vkUrfjd ljpuk (Internal Structure of Isobilateral Leaf or Monocot Leaf)

lef}ikf'od iÙkh dh vkUrfjd ljpuk d v/;;u d fy; bl iLrd e eDdk (*Zea mays*) dh iÙkh dk vuçLFk dkV dk mnkgj.k ydj Li"V dju dk ç;kl fd;kk x;k gA eDd dh iÙkh d vuçLFk dkV e fuEu ljpuk, Li"V fn[kkbnr g&

1- **vf/kpe** (Epidermis) – lef}ikf'od ;k ,dcht i=h iÙkh dh Åijh o fupyh nkuk vf/kpe leku gkrh g vFkkr nkuk vf/kpe ,dLrjh; enÙkdh; dkf'kdkvk dh cuh gkrh gA bu nkuk ij D;fVu teko d dkj.k miRopk curh g] lkFk gh nkuk vf/kpek ij j/k leku :i l forfjr gkr gA bl çdkj dh iÙkh dk mHk;j/kh iÙkh (Amphistomatic leaf) dgr gA

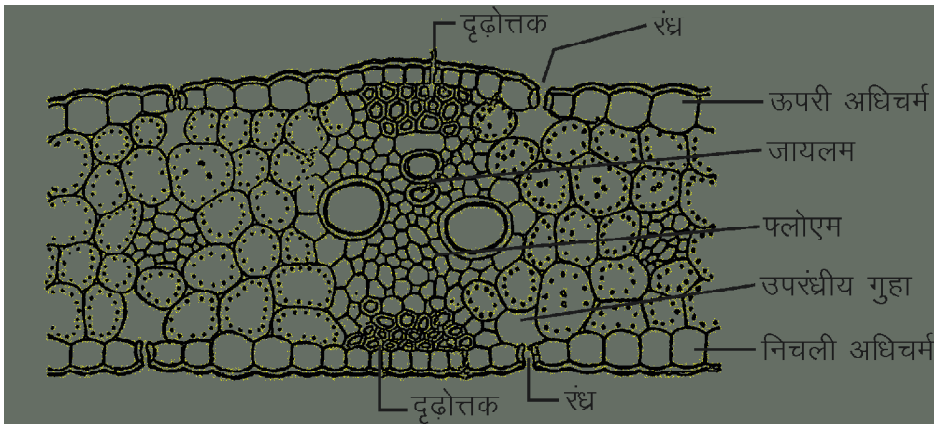
bl çdkj dh iÙkh dh Åijh vf/kpe e dN dkf'kdk, yEch o Qyh gb gkrh g bUg cyhQke dkf'kdk, (Bulliform cells) ;k ekVj dkf'kdk, (Motor cells) dgr gA ; dkf'kdk, vkærkxkgh gkrh gA ty dh deh ;k 'k"d okrkoj.k e ty dh deh d dkj.k ; dkf'kdk, fldMdj lfiykdkj Øe e eM tkrh g ftll ok"ikRltu dh nj fu;f=r gkrh gA ;g 'k"d okrkoj.k e bu ifÙk;k dk vudyu gA

2- **i.k e/;kÙkd** (Leaf mesophyll tissue) – lef}ikf'od ifÙk;k e doy Lith çdkj d Ård ik; tkr gA bue [kEHk Ård vuifLFkr gkr gA bu Lith Årdk dh dkf'kdk, leU;klh gkrh gA bu dkf'kdkvk d chp vUrjkdkf'kdh; LFky NkV rFkk de gkr gA bue gfjryod ik;k tkrk gA i.k e/;kÙkd d nkuk vkj vf/kpe d ikl dN Lith Ård gV tkr g ftll ,d cMh lj/kh xgk cu tkrh gA i.ke/;kÙkd dh dkf'kdkvk e i.kgfjr gku d dkj.k ; çdk'k l'y"k.k dk dk; djrh gA

3- **logu iy** (Vascular bundle) – bl çdkj dh ifÙk;k dk loguiy l;ä] leikf'od rFkk cn gkr gA tlkfd igy o.ku fd;k tk pdk g fd i.k e ; logu iy mYV 0;ofLFkr gkr gA bu ifÙk;k e Hkh f}cht i=h iknik dh ifÙk;k d leku e/;f'kjk e lcl cMk logu iy rFkk i.keè;kÙkd e cM o NkV logu iy ,dkUrj Øe e 0;ofLFkr jgr gA çR;d logu iy enÙkd dkf'kdkvk l cu ,dLrjh; iyh; vkPNkn l f?kj jgrk gA e/;f'kjk e fLFkr logu iy Åij o uhp nkuk rjQ n<kÙkd dkf'kdkvk d v/k'pe l <dk jgrk g ¼fp= 19-5½A

i"Bk/kkjh ,o lef}ikf'od ifÙk;k dh vkUrfjd ljpuk e vUrj

y{k.k	i"Bk/kkjh i.k	lef}ikf'od i.k
1- vf/kpe	Åijh o fupyh vf/kpe vleku	Åijh o fupyh nkuk vf/kpe leku
2- jU/k	iÙkh v/kkjU/kh (Hypostomatic) gkrh g vFkkr jU/k doy ,d gh vf/kpe ¼fupyh½ ij fLFkr gkr gA	iÙkh mHk;jU/kh (Amphistomatic) gkrh g vFkkr jU/k nkuk lrgk ij leku :i l forfjr gkr gA
3- cyhQke dkf'kdk,	vuifLFkr gkrh gA	Åijh vf/kpe e mifLFkr gkrh gA
4- i.k e/;kÙkd	[kEHk o Lith Årdk e foHkfnr gkrk gA	;g doy Lith Årdk l cuk gkrk gA
5- iyh; vkPNkn	;g enÙkdh; gkrk gA logu iy d nkuk vkj ¼Åij o uhp½ LFkydk.k Ård dk v/k'pe gkrk gA	;g Hkh enÙkdh; gkrk gA yfdu logu iy d nkuk vkj ¼Åij o uhp½ n<kÙkd dk v/k'pe gkrk gA



fp= 19-5 % lef}ikf'od iÙkh dk vuçLFk dkV

f}cht i=h tM e f}rh;d of)

(Secondary Growth in Dicot Root)

f}rh;d of) doy f}cht i=h tMk e gh gkrh g ,dcht i=h tMk e ;g of) ugh gkrh gA f}cht i=h iknik dh tM e ,/kk (Cambium) ,o dkx,/kk (Phellogen) f}rh;d foHkT;kÙkd çdkj dh gkrh gA vr% tM e f}rh;d of) çkjEHk gku ij loguh ,/kk curh g ,o bldh lfØ;rk dkx,/kk l io çkjEHk gkrh gA

1- **loguh ,/kk dh mRifÙk ,o lfØ;rk** (Origin and activity of vascular cambium) – tM e logu iy vjh; rFkk ckÁ vkfnnk:d gkr g ,o ,d f}cht i=h tM e budh l[;k 2 l 6 rd gkrh gA logu iy e tk;ye ,o ¶yk,e vyx&vyx f=T;k ij ,dkUrj Øe e 0;ofLFkr gkr gA ¶yk,e d l;kth enÙkdk dh lfØ;rk ,o fØ;k'khyrk d dkj.k ¶yk,e d vUnj dh vkj ,/kk dh piVh ifê;k cu tkrh g] lkFk gh ifjjHk dkf'kdkvk dh lfØ;rk ,o foHkktu d dkj.k ,/kk dh NkVh&NkVh ifê;k cuuk vkjHk gk tkrh gA QyLo:i ¶yk,e d vUnj dh vkj rFkk tk;ye d ckgj dh vkj ,/kk dh ifê;k cu tkrh gA bu ,/kk ifê;k e fujUrj viur foHkktu d dkj.k ,d ygjnkj (Wavy) loguh ,èkk curh gA

bl çdkj dh ,/kk lfØ;rk e fHkUurk n'kkrh gA çkjfEHkd voLFkk e ¶yk,e d uhp dh ,/kk vf/kd lfØ; gkrh g ftld QyLo:i ,/kk dk ,d xkykdkj ?kjk cu tkrk gA ,èkk dh lfØ;rk ,o fØ;k'khyrk d dkj.k ,/kk d vUnj dh vkj f}rh;d tk;ye rFkk ckgj dh vkj f}rh;d ¶yk,e cu tkrk g bUg f}rh;d Ård Hkh dgr gA bu f}rh;d Ård dk e fujUrj of) d dkj.k loguh {k= d ckgj d Ård k e fujUrj ncko iMrk g ftld dkj.k ckgj d Ård tl çkFkfed ¶yk,e] vUr%'pe oYdV vkfn VV tkr g rFkk ,d Nky (Bark) e cny tkr gA

,/kk dh jf'e çkjfEHkdk, enÙkd dkf'kdkvk d vjh; leg cukrh gA ; vjh; leg f}rh;d tk;ye ,o ¶yk,e e fdj.kk d :i e fLFkr gkrh g bUg f}rh;d jf'e fdj.k dgr gA

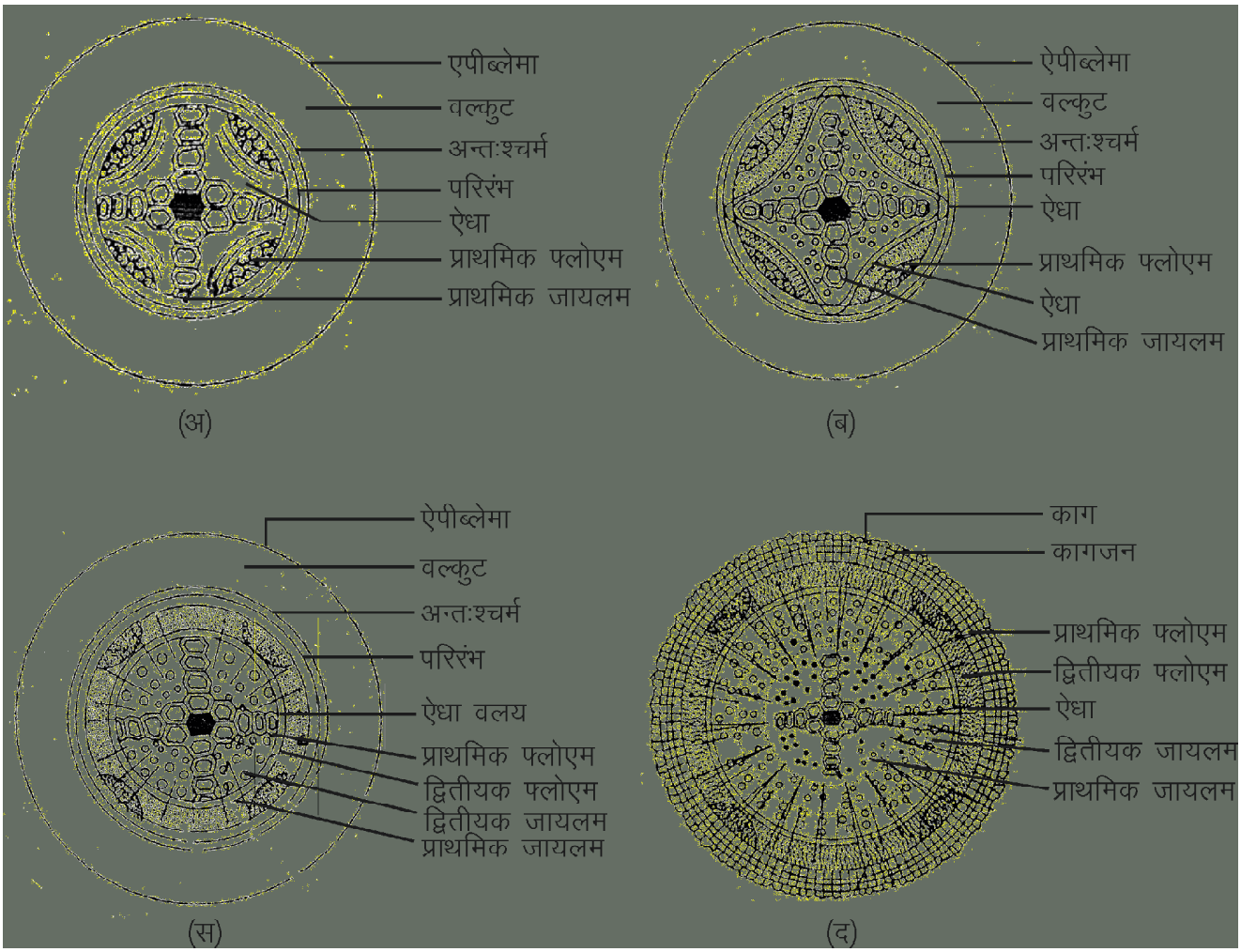
2- **dkxtu dh mRifÙk ,o lfØ;rk** (Origin and activity of Phellogen) – ifjjHk dkf'kdkvk dh lfØ;rk ,o foHkktu d dkj.k dkxtu dk fuek.k gkrk gA dkxtu dkf'kdk e ifjur foHkktu (Periclinal division) d dkj.k ckgj dh vkj dkx (Phellem) rFkk vUnj dh vkj dkxLrj (Phelloderm) curk gA vkx tkdj dkx e dkf'kdkvk e fujUrj viur o ifjur foHkktu d dkj.k dkd (Cork) dk fuek.k gkrk gA lkFk gh QykMe dh dkf'kdk, foHkkftr gkdj f}rh;d oYdV (Secondary cortex) cukrh gA dkx (Phellem) dkx,/kk (Phellogen) rFkk dkxLrj (Phelloderm), rhuk dk feydj ifjRop (Periderm) dgr g ¼fp= 19-6½A f}rh;d of) d dkj.k tM dh ekVkb e of) gkrh gA

f}cht i=h ru e f}rh;d of)

(Secondary Growth in Dicot Stem)

f}cht i=h dk"Bh; rFkk cgo"kh; iknik d ruk e f}rh;d of) ,d lkekU; y{k.k gA ;g of) ,/kk (Cambium) ,o dkx,/kk (Cork cambium) dh lfØ;rk d dkj.k gkrh gA bll ru dh ekVkb c<rh g bl f}rh;d of) dgr gA ;g f}rh;d of) çR;d _r e thoui;r gkrh jgrh gA

iknik e f}rh;d of) lkekU;r;k f}cht i=h iknik ,o ftEukLie e gh ikb tkrh g ijUr viokn Lo:i dN



fp= 19-6 ¼v½] ¼c½] ¼l½] ¼n½ % f}ch ti=h tM e f}rh;d of) dh fofHkUu çkoLFkk,

,dch ti=h ikni k tl *MhuK* (*Dracaena*), *;DdK* (*Yucca*), *,yK;* (*Aloe*) o *vxo* (*Agave*) e f}rh;d of) ikb tkrh gA

f}ch ti=h ru e f}rh;d of) bld fuEufyf[kr nk HkkxK e gkrh g&

1- **ru d jHk {k= e f}rh;d of)** (Secondary growth in stelar region of stem) – jHk {k= e f}rh;d of) ,/kk dh lfØ;rk d dkj.k gkrh gA ;g ,/kk nk çdkj dh gkrh g (i) logu iy e tk;ye ,o ¶yk,e d chp ikb tku okyh ,/kk vUr%iyh; ,/kk (Intra fascicular cambium) rFkk nk logu iyk d chp cuu okyh ,/kk vUrjiyh; ,/kk (Inter fascicular cambium) dgykrh gA ; nkuk ,/kk, vkil e tMdj ,d lEi.k ,/kk dk oy; cukrh gA loguh ,/kk rd:h çkjfEHkd ,o jf'e çkjfEHkd uked nk dkf'kdkvk l feydj cuh gkrh gA

logu iyk e çkFkfed tk;ye ,o çkFkfed ¶yk,e d ifjoDo gku d i'pkr f}rh;d loguh Årdk dk fuek.k gkrk gA f}rh;d of) d çkjEHk e ,/kk dh çR;d rd:ih çkjfEHkdk e ifjur foHkktu l ,d vUnj dh vkj tk;ye çkjfEHkdk rFkk ckgj dh vkj ¶yk,e çkjfEHkdk curh gA bul vkx Øe'k% f}rh;d tk;ye ,o f}rh;d ¶yk,e curk g ¼fp= 19-7½A lkFk gh ,/kk dh fdj.k çkjfEHkdk, vUnj o ckgj nkuk vkj enÙkd dkf'kdk, cukrh g bUg f}rh;d eTtk fdj.k dgr gA loguh ,/kk ifjur foHkktu d lkFk&lkFk vud viur o fr;d foHkktu (Oblique division) Hkh gkr g ftl ru dh ifjf/k; of) gkrh gA

ru dh f}rh;d of) d le; ,/kk dh lfØ;rk _rvk ij fuHkj djrh gA clUr _r e ,/kk dh lfØ;rk vf/kd tcfd xh"e _r ;k ir>M d le; lfØ;rk de gkrh gA

2- **ru d jHk d ckgjh {k= e of)** (Secondary growth in extra stelar region of stem) – ru d jHk d ckgjh {k= e f}rh;d of) dkx ,/kk (Cork cambium) ;k dkxtu (Phellogen) dh lfØ;rk }kjk gkrh gA bl ,/kk dk fuek.k vUr%'pe ;k oYdV ;k ifjHk dh dkf'kdkvk }kjk gkrk gA bu dkf'kdkvk dk f}rh;d foHkT;kÙkd Hkh dgr gA vfèkdk'k iknik e dkx ,/kk oYdV }kjk curk gA

dkx ,/kk e ifjur foHkktu l ckgj dh vkj dkx ;k Qye (Phellem) rFkk vUnj dh vkj dkx Lrj (Phelloderm) curk gA dkx dkf'kdkvk e fujUrj foHkktu l dkd (Cork) rFkk dkx Lrj dkf'kdkvk l f}rh;d oYdV curk gA dkx] dkx] dkxtu rFkk dkx Lrj rhuk feydj ifjRop (Periderm) cukr gA

3- **Nky** (Bark) – loguh ,/kk d ckgj fLFkr lHkh er Ård Nky dgykr gA ble çkFkfed ¶yk,e] f}rh;d ¶yk,e] oYdV ,o ifjRod lfEefyr gA

4- **okrj/k** (Lenticels) – dkx ,/kk }kjk ifjRod e xlk d fofue; d fy; mHkj g, l{e fNæ gkr g bUg okrjèk dgr gA okrj/k lkekU;r;k j/kk (Stomata) d uhp cur gA vf/kpe d u"V gku ij j/k Hkh u"V gk tkr g QyLo:i bud uhp okrj/k cu tkr gA bu okrj/kk d LFkku ij dkx ,èkk l tMh gb <hyh enÙkd dkf'kdk, gkrh g bUg ijd dkf'kdk, (Complementary cells) dgr gA bu ijd dkf'kdkvk d eè; vUrjdkf'kdh; LFky gkr g ftul xlk dk fofue; gkrk g ¼fp= 19-7½A

ru dh vlxr ljpuk,

(Anomalous Structures of Stems)

ru dh lkekU; çkFkfed ,o f}rh;d ljpuk dk vè;;u ge igy gh dj pd g rFkk geu ;g n[kk fd vf/kdk'k f}cht i=h ruk e logu iy ,d oy; d :i e 0;ofLFkr gkr g tcfd ,dcht i=h ruk e ; Hkj.k Ård e fc[kj iM jgr gA f}cht i=h ruk e vUrjiyh; rFkk vUrjkiyh; ,èkk feydj ,d lrr oy; cukr gA bl ,/kk d oy; l lkekU; f}rh;d of) d le; ckgj dh vkj f}rh;d ¶yk,e ,o vUnj dh vkj f}rh;d ¶yk,e curk gA ,/kk dh bl lfØ;rk d dkj.k f}rh;d ¶yk,e ,o f}rh;d tk;ye dk ,d i.k flfy.Mj curk g yfdu dN ,dcht i=h ,o f}cht i=h ruk e dN ,lh ljpuk, ikb tkrh g tk bu lkekU; ljpukvk l fHkUu gkrh gA bu fHkUu ljpukvk dk vlkekU; ;k vlxr ljpuk, (Abnormal or anomalous structures) dgr gA db iknik ; vlxr ljpuk, vkjEHk l gh mifLFkr gkrh g] tl eTtk e logu iy] oYdV e logu iy] tk;ye e okfgdkvk dh vuifLFkfr vkfnA bUg çkFkfed vlxr ljpuk, dgr gA bld foijhr dN iknik e vlxr ljpuk, ruk e vlkekU; f}rh;d of) d dkj.k mRiUu gkrh g tl vUrjk vfrfjDr (Intra and extra) tk;yeh ¶yk,e] vfrfjDr ,/kk ifê;k dk fuek.k vkfnA ; leLr ljpuk, f}rh;d vlxr ljpuk, (Secondary anomalous structures) dgykrh gA

Mlhuk ru e f}rh;d of)

(Secondary Growth in *Dracaena* Stem)

lkekU;r;k ,dcht i=h iknik d ruk e f}rh;d of) ugh gkrh gA bu ruk e logu iy cUn (Closed) gkr g vFkkr logu iyk e ,/kk vuifLFkr gkrh g yfdu viokn Lo:i *Mlhuk* (*Dracaena*) e vlxr f}rh;d of) gkrh gA bld vfrfjDr *;Ddk* (*Yucca*), *,yk;* (*Aloe*) ,o *vxo* (*Agave*) Hkh ,l mnkgj.k g tk ,dcht i=h gkr g, Hkh bue vlxr f}rh;d of) n'kkr gA bl iLrd e ge doy *Mlhuk* ru dh vlxr f}rh;d of) ;k ljpuk dk gh o.ku djxA

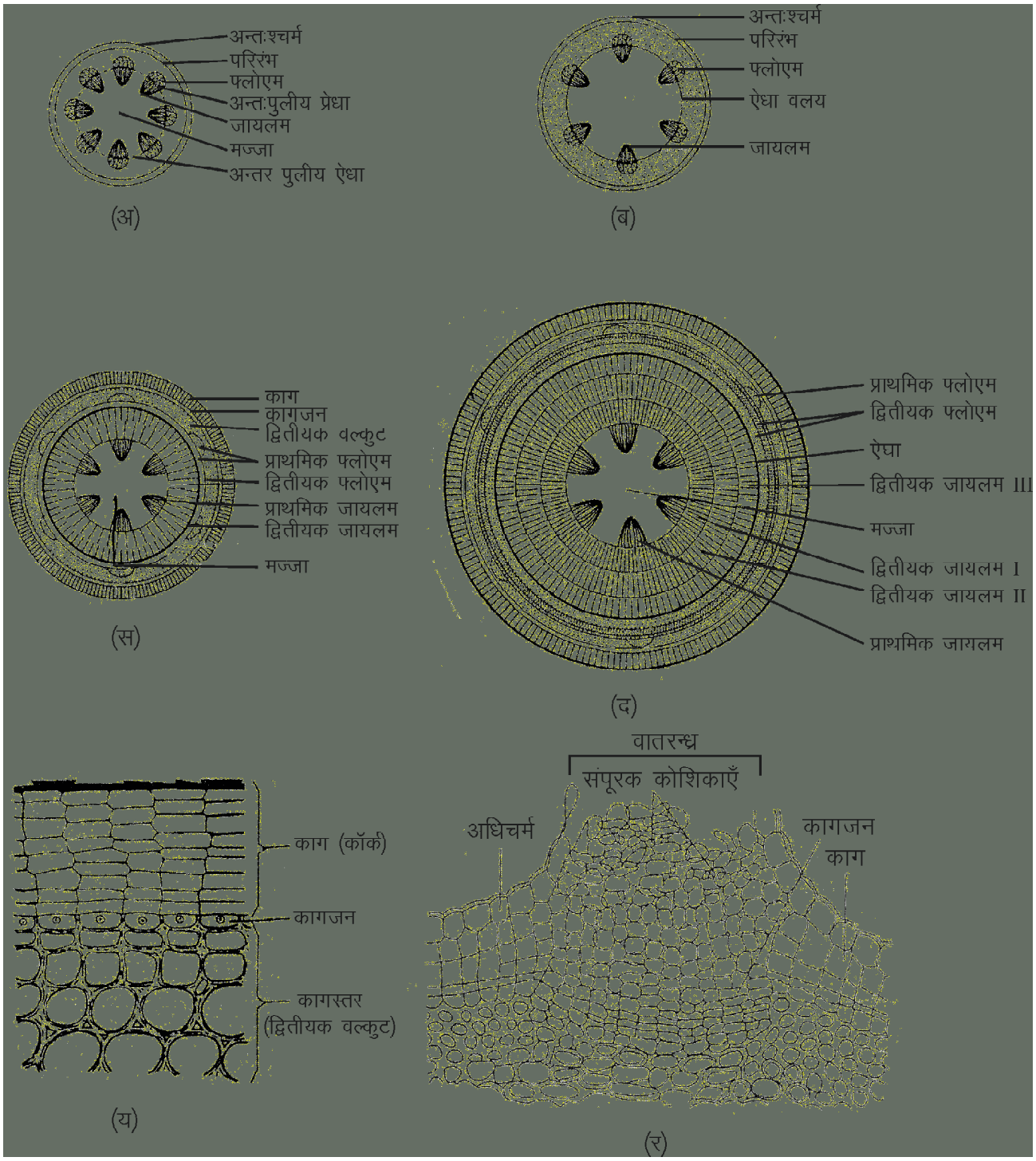
Mlhuk d ru d vuçLFk dkV e fuEufyf[kr ljpuk, fn[kkb nrh g&

ifjRod (Periderm) – ;g dkd] dkx,/kk (Phellogen or cork cambium) rFkk f}rh;d oYdV l fufer {k= gA dkd dh dkf'kdk, çk;% er] vk;rkdkj ,o lcjhu ;Dr gkrh gA bl {k= e dN okrj/k Hkh fLFkr gkr gA dkx ,èkk ,d ;k nk Lrjh; ekVh gkrh g rFkk bldh dkf'kdk, iryh fHkfÙk ;Dr ,o lfnf?kr gkrh gA

oYdV (Cortex) – ;g ru dk vfoHkfnr ,o enÙkdh; {k= gkrk g bldh dkf'kdk, LVkp ;Dr gkrh gA bu dkf'kdkvk d chp vUrjdkf'kdh; LFky mifLFkr gkr gA

foHkT;kÙkd {k= (Meristematic region) – ;g {k= oYdV d uhp fLFkr gkrk g rFkk bldh dkf'kdk, vk;rkdkj ,o lnhf?kr gkrh gA ; dkf'kdk, vud ifDr;k e fLFkr gkrh gA

logu r= (Vascular system) – foHkT;kÙkd {k= d uhp Hkj.k Ård gkrk gA bl {k= e vud logu iy vfu;fer rjhd l fc[kj iM jgr gA bue çkFkfed logu iy dUæh; Hkkx d ikl fLFkr gkr gA ; leikf'od (Collateral) ,o cUn (Closed) çdkj d gkr g tcfd f}rh;d logu iy ifjf/k ;k ckgj dh vkj gkr gA ; vkdkj e



fp= 19-7 % f}cht i=h ru e f}rh;d of) dh fofHkUu çkoLFkk, ¼v½ l ¼n½A
¼;½ jHk d ckgjh {k= e f}rh;d of) ¼j½ okrj/k dk dkf'kdh; fp=

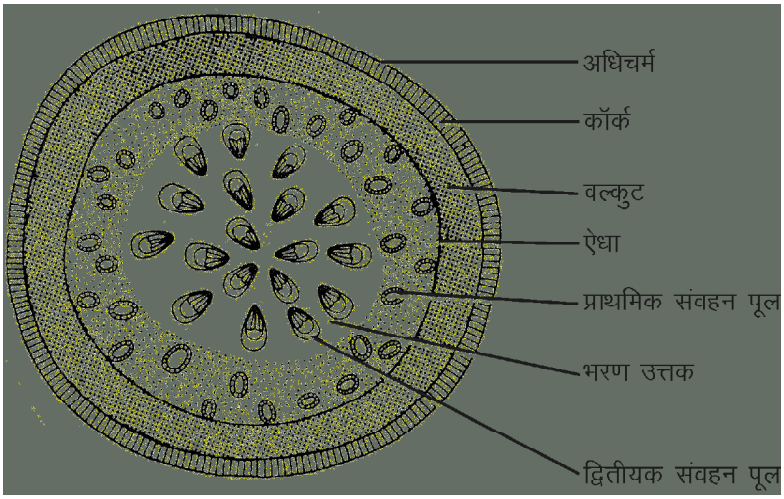
çkFkfed logu iyk l NkV gkr gA çR;d logu iy ldUæh (Concentric) ,o ¶yk,e dUædh (Amphivasal) gkr gA bue tk;ye Ård ¶yk,e dk ?kj jgrk gA f}rh;d tk;ye e okfgfudk, ,o tk;ye enÙkd tcfd f}rh;d ¶yk,e e pkyuh ufydk rRo ik; tkr gA

M/huk ru dh f}rh;d of) dh çe[k fo'k"krk ;g g fd ,/kk Hkhrj dh vkj tk;ye ,o ¶yk,e nkuk Årdk dk ,o ckgj dh vkj enÙkd dkf'kdkvk dk fuek.k djrk g tk fd f}ch ti=h ruk dh f}rh;d of) l fcYdy fHkUu g ¼fp= 19-8½A

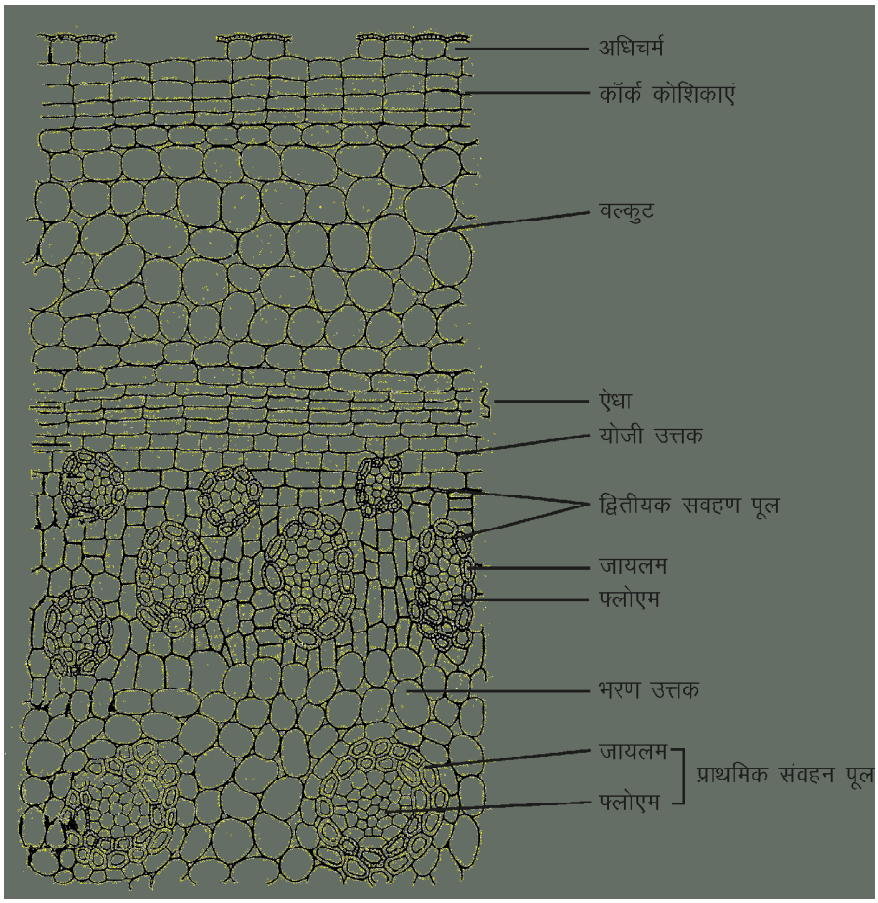
,dkbjUFk/ ru dh vlxr ljpuk,

(Anomalous Structures of *Achyranthes* Stem)

,dkbjUFk/ ru d vuçLFk dkV e fuEufyf[kr ljpuk, Li"V fn[kkb nrh g&



fp= 19-8 ¼v½ % *M/huk* ru d vuçLFk dkV dk vkjf[kr fp=



fp= 19-8 ¼c½ % *M/huk* ru d vuçLFk dkV dk dkf'kdh; fp=

vf/kpe (Epidermis) – ;g lcl ckgjh ijr gkrh gA bldh D;fVdy ;Dr rFkk bu ij cgdkf'kdh; jke gkr gA

oYdV (Cortex) – oYdV {k= LFkydk.k Ård] gfjr Ård ,o enÙkd e foHkfnr gkrk gA LFkydk.k Ård Ükxk (Ridges) d uhp pEik (Patches) d :i e xr {k= vf/kpe d uhp gfjr Ård (Collenchyma) ik;k tkrk gA

vUr%'pe (Endodermis) – ;g oYdV dh lcl vfUre ijr gkrh gA bldh dN dkf'kdkvk e dLifj;u ifêdk, ikb tkrh gA f}rh;d of) d ckn ;g ijr VV tkrh gA

ifjHk (Pericycle) – ;g ijr logu Ård d Bhd ckgj fLFkr gkrh gA bldh dkf'kdk, n<kÙkd legk d :i e ikb tkrh gA

logu Ård (Vascular tissue system) – ble çR;d logu iy] l;Dr] leikf'od] [kyk rFkk vUr%vkfnnk:d gkrk gA logu Ård r= e f}rh;d of) d dkj.k ,/kk d Åij dh vkj f}rh;d ¶yk,e rFkk ifjf/k dh vkj çkFkfed ¶yk,e tcfd ,/kk d Bhd uhp f}rh;d tk;ye rFkk dUæ dh vkj çkFkfed tk;ye fLFkr gkrk gA ,/kk ,d oy; d :i e ikb tkrh gA tk;ye dkf'kdkvk d e/; vrfo"V ¶yk,e (Included phloem) ;k vUrjtk;yeh ¶yk,e (Interxylary phloem) ik;k tkrk gA

eTtk (Pith) – ru d dUæh; Hkkx e Li"V] enÙkdh eTtk ikb tkrh gA eTtk d chpkchp nk eTtk logu iy ik; tkr gA bu eTtk iyk d çkFkfed tk;ye Ård ,d nlj d lkeu gkr gA

vlxr ljpuk d fo'k"k y{k.k

(Important Characters of Anomalous Structures)

,dkbjUFk/ ru e vlxr ljpuk d çe[k y{k.k fuEufyf[kr gkr g&

1- f}rh;d tk;ye dkf'kdkvk d chp iryh fHkfÙk;Dr ¶yk,e Ård] Li"V plik (Distinct patches) d :i e mifLFkr gkrk gA bl vrfo"V ¶yk,e (Included phloem) ;k vrjtk;yeh ¶yk,e (Interxylary phloem) dgr gA

2- *,dkbjUFk/* ru dh eTtk e nk logu iy ik; tkr g ftUg eTtk logu iy dgk tkrk gA ;g Hkh ru dh vlxr of) dk n'kkrk gA lkekU; f}rh;d of) e eTtk e logu iy ugh ik; tkr g ¼fp= 19-9½A

fudVUFk/ ru dh vlxr ljpuk,

(Anomalous Structures of *Nyctanthes* Stem)

fudVUFk/ ru d vuçLFk dkV e fuEufyf[kr ljpuk, Li"V :i l fn[kkb nrh g&

vf/kpe (Epidermis) – ;g lcl ckgjh ijr gkrh g tk fd <kydkdkj dkf'kdkvk dh cuh gkrh g rFkk ,d ifDr e 0;ofLFkr gkrh gA bl ij ekVh D;fVdy dk vkoj.k ,o cgdkf'kdh; jke gkr gA

oYdV (Cortex) – ;g {k= pkj&ikp ijrk e 0;ofLFkr gkrk g rFkk LFkydk.k ,o enÙkd e Li"Vr;k foHkfnr gkrk gA LFkydk.k ckgj dh vkj tcfd enÙkd vUnj dh vkj fLFkr gkrk gA oYdV {k= d pkjk mHkkjk oky {k=k e pkj çfrykekufir (Inversaly oriented) logu iy ik; tkr gA çR;d logu iy l;Dr] leikf'od] [kyk rFkk ckÁ vkfnnk:d gkrk g bUg oYdVh; logu iy (Cortical vascular bundle) dgk tkrk gA

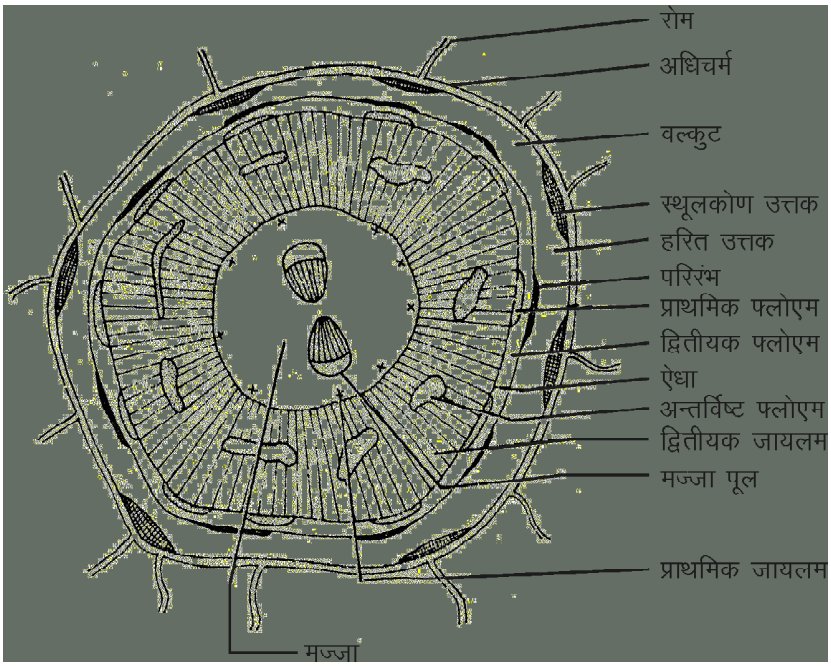
vUr%'pe (Endodermis) – oYdV {k= d Bhd uhp ;g ijr fLFkr gkrh gA ;g enÙkd dkf'kdkvk dh cuh ,d oy; d :i e gkrh g bldh dN dkf'kdkvk e dLifj;u ifêdk, ikb tkrh gA

logu Ård r= (Vascular tissue system) – ;g r= f}rh;d of) çnf'kr djrk gA ble ,/kk ,d oy; d :i e u gkdj pr"dk.kh; gkrh gA Li"V f}rh;d of) d dkj.k ,/kk d Åij f}rh;d ¶yk,e rFkk ifjf/k dh vkj çkFkfed ¶yk,e ik;k tkrk gA ,/kk d Bhd uhp f}rh;d tk;ye ,o dUæ Hkkx dh vkj çkFkfed tk;ye ik;k tkrk gA logu iy l;Dr] leikf'od] [kyk ,o vUr%vkfnnk:d çdkj dk gkrk gA

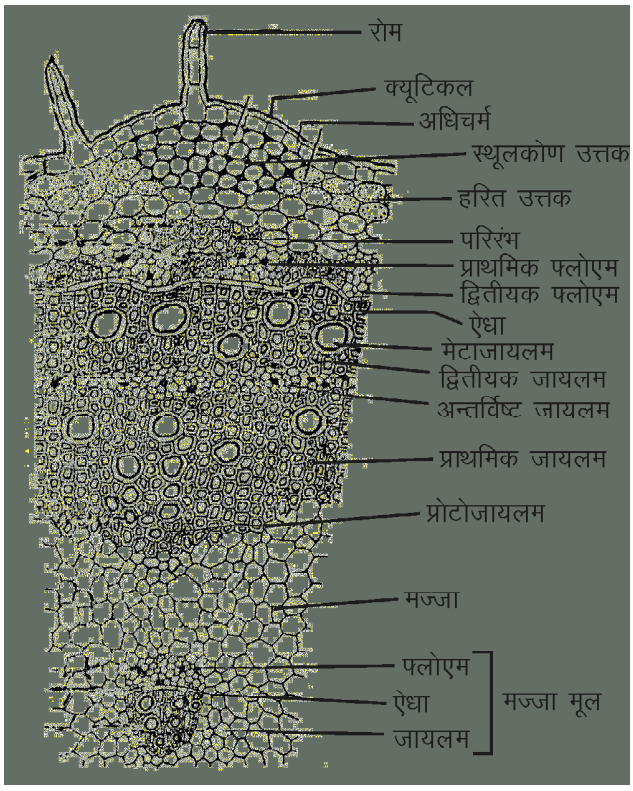
eTtk (Pith) – ru d dUæh; Hkkx e Li"V] enÙkdh; eTtk mifLFkr gkrh gA

fudVUFk/ ru dh vlxr ljpuk dk fo'k"k y{k.k (Important Character of Anomalous Structure of *Nyctanthes*)

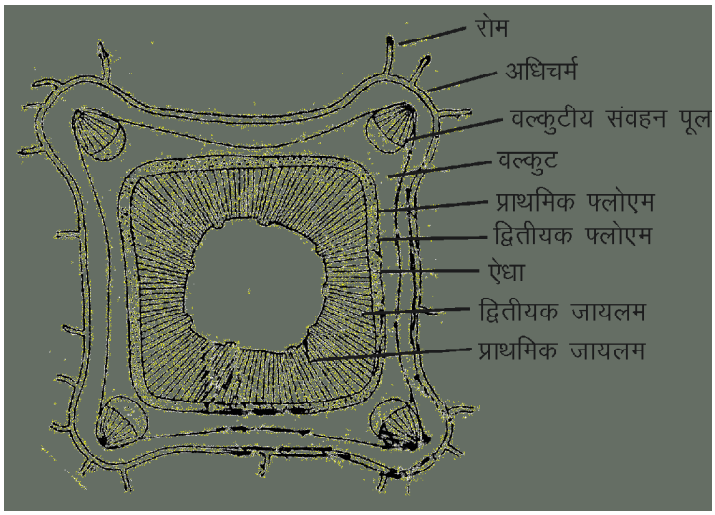
ru dh vkUrfjd ljpuk e pkjk mHkkjk d vUnj oYdV {k= e pkj çfrykekufir (Inversaly oriented) oYdVh; logu iy (Cortical vascular bundle) ik; tkr gA ;g ru dh lkekU; ljpuk ugh g vr% ,dkbjUFk vlr of) (Anomalous growth) n'kkrk ¼fp= 19-10½A



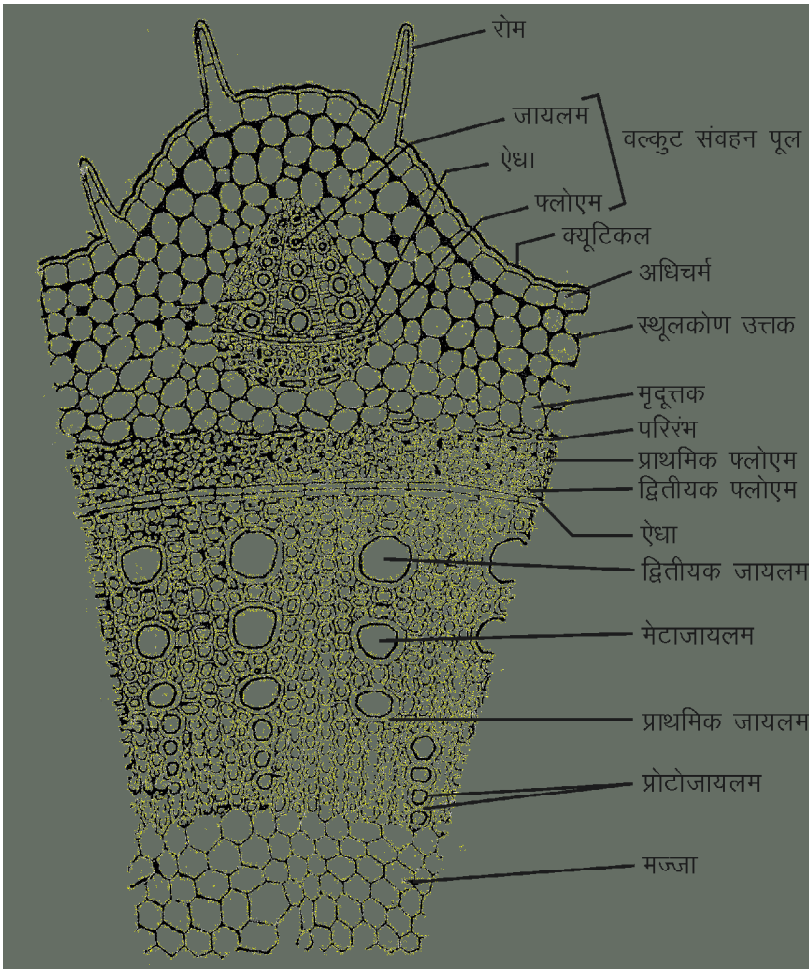
fp= 19-9 ¼v½ % ,dkbjksFkk ru d vuçLFk dkV dk vkjf[kr fp=



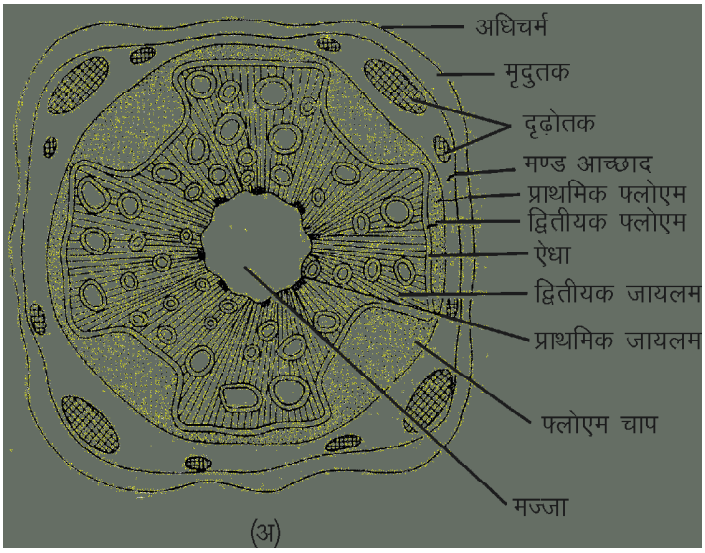
fp= 19-9 ¼c½ % ,dkbjksFkk ru d vuçLFk dkV dk dkf'kdh; fp=

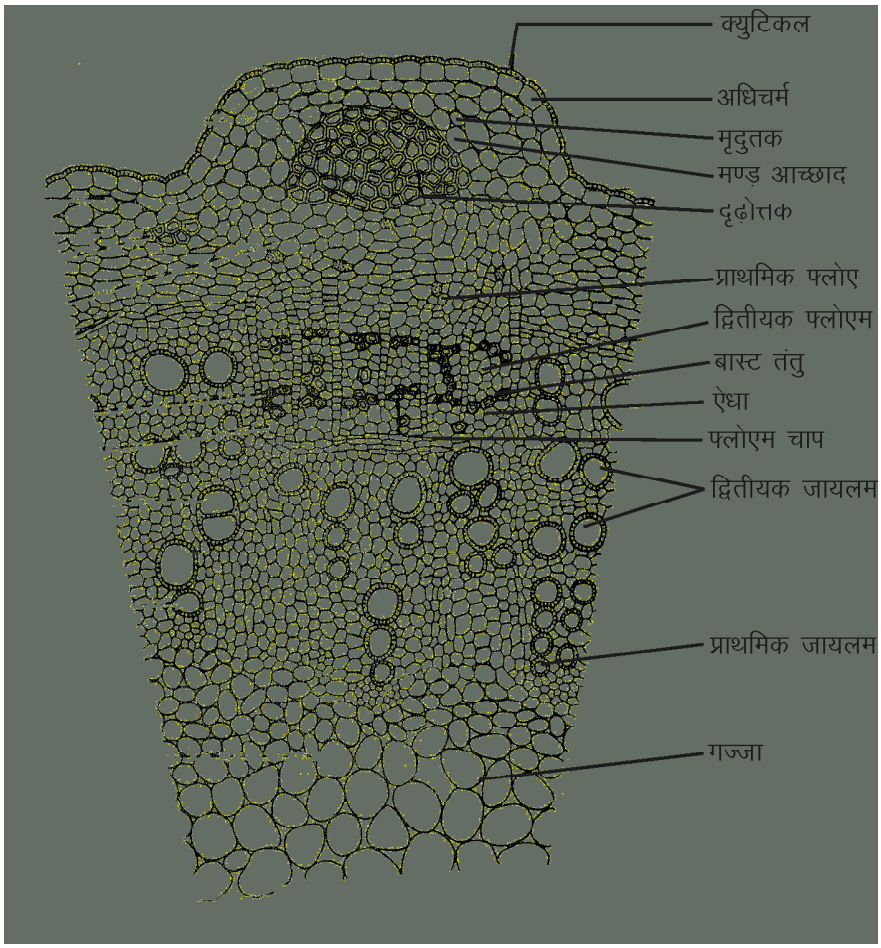


fp= 19-10 ¼v½ % *fudVUFk* / ru d vuçLFk dkV dk vkjf[kr fp=



fp= 19-10 ¼c½ % *fudVUFk* / ru d vuçLFk dkV dk dkf'kdh; fp=





fp= 19-11 % *fcxukfu;k* ru dk vuçLFk dkV
¼v½ vkjf[kr fp= ¼c½ dkf'kdh; fp=

fcxukfu;k ru dh vlxr ljpuk,

(Anomalous Structures of Bignonia Stem)

fcxukfu;k ru d vuçLFk dkV e fuEufyf[kr ljpuk, Li"V :i l fn[kkb nrh g&

vf/kpe (Epidermis) – ;g <kydkdkj dkf'kdkvk dh cuh lcl ckgjh ijr gkrh gA bl ij D;fVdy dk ,d ekVk vkoj.k ik;k tkrk gA

oYdV (Cortex) – ;g enÙkd dkf'kdkvk dk cuk nk ;k rhu ifDr;k dk {k= gA bu dkf'kdkvk d chp vUrjdkf'kdh; LFky ik; tkr gA

vUr%'pe (Endodermis) – ;g enÙkd dkf'kdkvk dh cuh ,d ijr g budh dkf'kdkvk e dLifj;u ifêdkvk d LFkku ij LVkp ik;k tkrk gA

ifjjHk (Pericycle) – ;g {k= n<kÙkd ;Dr] plik (Patches) d :i e ik;k tkrk gA ; n<kÙkd leg vyx&vyx vkeki (Size) d gkr g rFkk vrr oy; d :i e fLFkr gkr gA

logu Ård r= (Vascular tissue system) – ru dh f}rh;d of) d le; lkekU; ,/kk d vlkekU; 0;ogkj ,o fØ;k'khyrk d dkj.k ,/kk d pkj Li"V [kkpk (Wedges) fn[kkb nrh gA bu [kkpk ij dN txg ¶yk,e ckgj dh vkj ¶yk,e vf/kd curk g rFkk dN txgk ij deA tgk ij ¶yk,e vf/kd curk g ml LFkku ij ,/kk vUnj dh vkj /kl tkrh gA bl çdkj ,/kk dh pkj Li"V Hktk, (Arch) fn[kkb nrh gA ¶yk,e dVdk dh mifLFkfr d dkj.k pkj LFkkuk ij tk;ye dh xre; gk tkrk gA ,/kk d Bhd Åij f}rh;d ¶yk,e ,d oy; cukrk gA lkFk gh pkj f=;d {k=k (Four diagonal regions) ij ;g f}rh;d tk;ye ij ncko Mkyrk g ftl vxth d v{kj "U" vkÑfr dh ljpuk curh gA ;g vkÑfr ,d nlj d lkeu gkrh gA bu ¶yk,e [kkpk d dkj.k pkj LFkkuk ij f}rh;d tk;ye ckgj dh vkj çkFkfed tk;ye gkrk gA logu iy l;Dr] leikf'od] [kyk rFkk vUr%vkfnnk:d çdkj dk gkrk gA

eTtk (Pith) – ru d dUæh; Hkkx e lLi"V] enÙkdh eTtk ikb tkrh gA

fcxukfu;k ru dh vlxr ljpuk dk fo'k"k y{k.k (Important Character of Anomalous Structure of *Bignonia* Stem)

f}rh;d of) d le; ikni ruk e ,/kk lkekU; 0;ogkj ,o fØ;k'khyrk d dkj.k leku :i l f}rh;d ¶yk,e ,o f}rh;d tk;ye curk g] QyLo:i ,d leku loguh flfy.Mj curk g yfdu fcxukfu;k e lkekU; ,/kk d vlkekU; 0;ogkj ,o fØ;k'khyrk d dkj.k pkj [kkpk ;Dr loguh flfy.Mj curk g vFkkr pkj LFkkuk ij ,/kk d ckgj dh vkj vf/kd ek=k e ¶yk,e dk fuek.k gkrk g] bld foijhr Hkhrj dh vkj de ek=k e f}rh;d tk;ye dk fuek.k gkrk g bld ifj.kkeLo:i pkj f}rh;d ¶yk,e dh xgjh [kkp (Deep wedges) cu tkrh g tk fd f}rh;d tk;ye e xgjkb rd /kl gkrh gA ,/kk dh ,l vlkekU; fØ;k'khyrk ru dh lkekU; f}rh;d of) e ugh n[kh tkrh g vr% ;g vlxr f}rh;d of) dk mnkgj.k g ¼fp= 19-11½A

egRoi.k fcUn

1- tM ikni dk og Hkkx g tk eykdj l fodflr gkrk g rFkk l;d çdk'k d foijhr x#Rokd"k.k cy dh rjQ tehu e of) djrk gA
2- ey dh lcl ckÁ ijr feêh d d.kk l jxM [kkdj u"V gk tkrh g rFkk oYdV dh ckÁ ijr vf/kpe dh rjg dk; djrh g ftl eyh; Ropk (Epiblema) dgr gA
3- ey ij ,ddkf'kdh; ey jke ik; tkr gA
4- ey dk logu iy vjh; gkr g rFkk tk;ye ckÁ vkfnnk:d gkr gA
5- ,dchti=h ey e logu iyk dh l[;k 6 l vf/kd tcfd f}chti=h iknik e logu iyk dh l[;k 2 l 6 rd gh gkrh gA
6- ,dchti=h ru d logu iy Hkj.k Ård e fc[kj g, gkr gA
7- ,dchti=h ru d logu iy l;Dr] leikf'od] cUn rFkk vUr%vkfnnk:d gkr gA
8- ,dchti=h ru d çR;d logu iy d pkjk vkj n<kÙkd dkf'kdkvk l cuk ,d iyh; vkPNkn gkrk gA bl iy e tk;ye dkf'kdk, 'V' ;k 'Y' d vkÑfr e 0;ofLFkr gkrh gA
9- bu logu iyk e çkVktk;ye d uhp y;tkr ;k ty xfgdk, ikb tkrh gA
10- f}chti=h ru e logu iy ,d oy; d :i e dUæ e 0;ofLFkr jgr gA
11- f}chti=h ru dk logu iy l;Dr] leikf'od] [kyk o vUr%vkfnnk:d gkrk gA

12- iÙkh ikni dk og Hkkx g tk i.k vk|d (Leaf primordia) }kjk ru d io lf/k l ik'o mikx d : i e fodflr gkrh g ft ld d{k e d{kLFk dfydk mifLFkr gkrh gA

13- ,fUtvkLieh iknik e ifÙk;k nk çdkj dh gkrh g & ,dchti=h iknik e lef}ikf'od ,o f}chti=h iknik e i"Bk/kkjh i.kA

14- i"Bk/kkjh iÙkh e doy fupyh vf/kpe ij j/k (Stomata) ik; tkr g tcfd lef}ikf'od iÙkh dh Åijh o fupyh nkuk vf/kpek ij j/k leku : i l forfjr jgr gA

15- i"Bk/kkjh i.k dk i.ke/;kÙkd [kHk o Lith Årdk e foHkfnr jgrk g tcfd lef}ikf'od iÙkh e ;g doy Lith Ård dk cuk gkrk gA Lith Ård dk cuk gkrk gA

16- i.k e logu iy l;Dr] leikf'od rFkk c/k çdkj d gkr gA

17- i.k e logu iy mYV gkr g vFkkr tk;ye Åij dh vkj rFkk ¶yk,e uhp dh vkj fLFkr gkrk gA

18- tMk e f}rh;d of) doy f}chti=h iknik dh tMk e gh gkrh gA

19- f}chti=h iknik dh tM e ,/kk ,o dkx,/kk (Phellogen), f}rh;d foHkT;kÙkd çdkj dh gkrh gA vr% tM e f}rh;d of) çkjEHk gku ij loguh ,/kk curh gA

20- tMk e ,/kk dh lfØ;rk d dkj.k f}rh;d of) gkrh gA

21- tMk e dkx,/kk (Phellogen) dh lfØ;rk d dkj.k ifjRod (Periderm) curh gA

22- f}chti=h ru e f}rh;d of) bld jHk ,o jHk d ckgjh {k=k e gkrh gA

23- jHk {k= e f}rh;d of) ,/kk dh lfØ;rk d dkj.k gkrh g ft l f}rh;d ¶yk,e o tk;ye cur gA

24- ru d ckgjh {k= e f}rh;d of) dkx,/kk dh lfØ;rk d dkj.k gkrh gA

25- loguh ,/kk d ckgj dh vkj fLFkr lHkh er Ård Nky dgykr gA

26- dkx,/kk }kjk ifjRod (Periderm) e xlk d fofue; d fy; mHkj g, l{e fNæ gkr g bUg okrj/k dgr gA

27- *Mlhuk* ,dchti=h ruk gkr g, Hkh ble f}rh;d of) ikb tkrh gA ble nk çdkj d logu iy ik; tkr g (i) çkFkfed logu iy rFkk (ii) f}rh;d logu iyA

28- *,dkbjUFkl* ru d tk;ye e vUrfo"V ;k vUrjtk;yeh ¶yk,e ,o eTtk e nk eTtk iyk dk ik;k tkuk bldh vlxr of) dk n'kkrk gA

29- *fudVUFkl* d ru d oYdV e pkj çfrykekufir (Inversaly oriented) oYdV iy ik; tkr g tk bldh vlxr f}rh;d of) dk n'kkr gA

30- *fcxukfu;k* e lkekU; ,/kk dh vlkekU; fØ;k'khyrk d dkj.k vlxr ljpuk curh gA

vH;klkFk ç'u

oLrfu"B ç'u

1- ikni dk og Hkkx tk eykdj l fodflr gkrk g dgykrk g&

¼v½ ey ¼c½ ruk

¼l½ iÙkh ¼n½ mijkä lHkh

2- 2&6 rd logu iyk dh l[;k gkrh g&

¼v½ ,dchti=h tM e ¼c½ f}chti=h tM e

¼l½ ,dchti=h ru e ¼n½ f}chti=h ru e

3- Hkj.k Ård e fc[kj g, logu iy ik; tkr g&

¼v½ ,dchti=h ru e ¼c½ ,dchti=h ey e

¼l½ f}chti=h ey e ¼n½ f}chti=h ey e

4- eTtk e nk eTtk iyk dh mifLFkfr dk mnkgj.k g&

¼v½ *Mlhuk* ¼c½ *,dkbjUFkl*

¼l½ *fudVUFkl* ¼n½ *fcxukfu;k*

5- l;Dr] lef}ikf'od] [kyk o vUrkvkfnnk:d logu iy ik;k tkrk g&

¼v½ ,dchti=h ru e

¼c½ f}chti=h ru e

¼l½ lef}ikf'od iÙkh e

¼n½ f}chti=h ey e

vfry?kÙkjkRed i'u

1- ey e fdl çdkj d ey jke gkr g\

2- ey e logu iy fdl çdkj d gkr g\

3- ,dchti=h ey e logu iyk dh l[;k fdruh gkrh g\

4- ,dchti=h o f}chti=h ru e dkb nk e[; vUrj crkb;A

5- ,dchti=h ru d logu iy dh fo'k"krk fyf[k;A

y?kÙkjkRed i'u

1- ,dch ti=h o f}ch ti=h ru dh vkUrfjd ljpuk e vUrj crkb;A
2- i"Bk/kkjh o lef}ikf'od iÙkh dh vkUrfjd ljpuk e vUrj crkb;A
3- lef}ikf'od iÙkh dh vkUrfjd ljpuk dk ukekfdr fp= cukb;A
4- f}ch ti=h tM e f}rh;d of) dk ukekfdr fp= cukb;A
5- *M/huk* e vlxr ljpuk d y{k.k fyf[k;A
6- ,dch ti=h iÙkh d vuçLFk dkV dk ukekfdr fp= cukb;A
7- fcxukfu;k ru d vuçLFk dkV dk dkf'kdh; ukekfdr fp= cukb;A
8- tM d logu iy ij lf{kIr fVIi.kh fyf[k;A
9- f}ch ti=h ru e fdl çdkj dk logu iy ik;k tkrk gA bldk ukekfdr fp= cukb;A
10- ifjRod D;k g\ bld çe[k ?kVdk d dk; fyf[k;A

fucU/kkRed i'u

1- f}ch ti=h ru e f}rh;d of) fdl çdkj gkrh g\ foLrr 0;k[;k dhft ;A vko';d ukekfdr fp= cukb;A
2- i"Bk/kkjh i.k dh vkUrfjd ljpuk dk o.ku dhft ;A vko';d ukekfdr fp= cukb;A
3- *fudVUFk/* ru e vlxr of) dk lfp= o.ku dhft ;A
4- *,dkbjUFk/* ru e vlxr of) dk lfp= o.ku dhft ;A
5- fuEufyf[kr ij lf{kIr fVIi.kh fyf[k;&
¼v½ loguh ,/kk ¼c½ ifjRop

---

mÙkjekyk% 1 ¼v½ 2 ¼c½ 3 ¼v½ 4 ¼c½ 5 ¼c½

bdkb & XIII

v/;k; & 20

vk"kf/k; egRo d e[; iknik dk lkekU; fooj.k

(General Account of Main Medicinally Important Plants)

ekuo dh mRifÙk d lkFk gh ekuo }kjk iknik dk mi;kx fofHkUu çdkj dh chekfj;k d mipkj e fd;k tkrk jgk gA _Xon e iknik dk vk"kf/k d :i e mi;kx dk o.ku feyrk gA pjd&lfgrk rFkk lJr lfgrk ftUg fpfdRlk txr dk tud ekuk tkrk g] e yxHkx 700 vk"kf/k; iknik dk o.ku feyrk gA

vk"kf/k; iknik dk egRo mue ik; tku oky fofHkUu çdkj d jklk;fud inkFkk d dkj.k gkrk gA ; inkFk ,Ydykbyl (Alkaloids), Xykbdklkbyl (Glycosides), Vfuu (Tanin), jftu (Resins) ok"i'khy ry (Volatile oils), 'y"ek (Mucilage), xkn (Gums) vkfn gkr gA bUg ikni viu fofHkUu Hkkxk tl Qy] cht] Nky] tM] iÙkh vkfn e lxfgr djr gA vf/kdk'k vk"kf/k; ikni txyh ;k oU; (Wild) gkr gA dN iknik dk ?kjk] cxhpk ;k [krk e vk"kf/k; mi;kx d fy; mxk;k Hkh tkrk gA leLr ;ukuh ,o vk;ofnd vk"kfèk;k iknik l gh çkIr gkrh gA

bl v/;k; e ge dN egRoi.k vk"kf/k; iknik rFkk mul çkIr gku okyh vk"kf/k;k dk o.ku djxA

1. *jkmfYQ;k liUVkbuk* (*Rauwolfia serpentina*)

oxhÑr fLFkfr

mifoHkkx & vkorchth (Angiospermae)

ox & f}cht i=h (Dicotyledonae)

mi ox & xekiVyh (Gamopetalae)

J.kh & ckbdkiyVh (Bicarpellatae)

x.k & tfU'kfu,Yl (Gentianales)

dy & ,iklkbulh (Apocynaceae)

o'k & *jkmfYQ;k* (*Rauwolfia*)

tkfr & liUVkbuk (*Serpentina*)

lkekU; uke & lixU/kk

;g ikni Hkkjr e m".kdfVcU/kh; fgeky; {k=] nkftfyx] itkc] flfDde d rjkb {k=] vklke] if'peh ?kkVk d iBkjk rFkk v.Meku d B.M {k=k e cgrk;r l feyrk gA bld vfrjDr vktdy mÙkj çn'k] egkjk"V] tEe ,o d'ehj] fcgkj] djy] e/; çn'k ,o xtjkr e bldh [krh Hkh dh tk jgh gA

jkmfYQ;k dk ikni cgo"kh; >kMh (Perennial shrub) gkrk gA bldh yEckb 15 l 45 leh gkrh gA bl ikni dh dfUny tMk l vk"kf/k; çkIr dh tkrh gA ble yxHkx 80 çdkj d ,Ydykbyl ik; tkr g] ftle vtkefyu (Ajamaline), vtkefyfuu (Ajamalinine), liUVkbu (Serpentine), liUVkbfuu (Serpentinine), jljfifuu (Reserpinine), jljfiu (Reserpine), jkmfYQfuu (Rauwolfinine), fMljfifMu (Deserpidine) vkfn e[; gA

vk"kf/k; mi;kx (Medicinal Use)

jkmfYQ;k d e[; vk"kf/k; mi;kx fuEufyf[kr g &

(i) ekufld jkxk ,o mPp jäpki dk de dju d fy; vR;Ur mi;kxh gA

(ii) bl ikxyiu dh nok Hkh dgr g D;kfd bldk mi;kx rho ikxyiu dk de dju e fd;k tkrk gA

(iii) eyfj;k] lin'k] vfuæk] ehxh vkfn d mipkj e ;g mi;kxh gA

(iv) çlo dky d le; xHkk'k; ldpu d fy; Hkh bldk mi;kx fd;k tkrk gA

(v) nLr] ifp'k ,o vkrk d nn e bldh tMk dk dk<k jkxh dk fiyk;k tkrk g tk fd vR;Ur mi;kxh gA

(vi) ;g Ñfegj gkrh gA

2. djdek ykxk (*Curcuma longa*)

oxhÑr fLFkfr

mifoHkkx & vkorchth (Angiospermae)

ox & f}cheti=h (Dicotyledonae)

J.kh & bfixkbuh (Epigynae)

dy & ftUthcjlh (Zingiberaceae)

o'k & *djdek* (*Curcuma*)

tkfr & *ykxk* (*Longa*)

lkekU; uke & gYnh

gYnh mRiknu e Hkkjr fo'o dk lcl cMk n'k gA Hkkjr e bldh [krh egkjk"V] rfeyukM] dukVd] mMhlk] vkUèkçn'k o djy e dh tkrh gA

bldk ikni ,do"kh; 'kkd (Herb) g rFkk bldh Åpkb yxHkx ,d ehVj rd gkrh gA gYnh ik/k d Hkfexr çdUn (Rhizome) l çkIr dh tkrh gA ble e[; :i l djD;feu (Curcumine), ftfUtcfju (Zingiberine), Vjefjd ry (Termeric oil) rFkk ok"i'khy ry (Volatile oils) ik; tkr gA gYnh dk ihyk jx ble mifLFkr djD;feu d dkj.k gkrk gA

gYnh d vk"kf/k; x.k fuEufyf[kr g &

(i) gYnh jä 'kk/kd (Blood purifier), Ñfegj rFkk ok;uk'kd (Carminative) gkrh gA

(ii) lnh] tdke o [kklh e xuxu n/k d lkFk gYnh feykdj jkf= dk lkr le; ihu l vkjke feyrk gA

(iii) ihfy;k] nek] nLr] Toj ,o ;Ñr jkx d jkfx;k d fy; gYnh mi;kxh gA

(iv) cká ,o vkrfjd 'kkjhfjd pkVk e n/k d lkFk gYnh dk lou x.kdkjh gkrk gA

(v) Ropk lc/kh jkxk] pkV ,o ?kko ij gYnh dk yi x.kdkjh gkrk gA

3. iiksoj lkeuhQje (*Papaver somniferum*)

oxhÑr fLFkfr

mifoHkkx & vkorchth (Angiospermae)

ox & f}cheti=h (Dicotyledonae)

miox & ikyhiVyh (Polypetalae)

J.kh & Fkyeh¶jkjh (Thalamiflorae)

x.k & ijkbVYl (Parietales)

dy & iikojlh (Papaveraceae)

o'k & *iikoj* (*Papaver*)

tkfr & *lkeuhQje* (*somniferum*)

lkekU; uke & ikLr ;k vQhe

Hkkjr e vQhe (Opium) jch dh Qly d :i e mxk;k tkrk gA Hkkjr e bldh [krh mÙkj çn'k] e/; çn'k] fcgkj ,o jkt LFkku çkrk e dh tkrh gA bldh [krh gj 0;fä ugh dj ldrk gA bldh [krh d fy; ljdkj l vkKk yuh iMrh g rFkk bldh [krh ij ljdkjh fu;=.k gkrk gA

vQhe dk ikni ,do"kh; g rFkk ble ,dy vUrLFk (Solitary Terminal) i"i rFkk Qy dlly (Capsule) gkrk gA vQhe] ikni d dPp Qy dlly l çkIr dh tkrh gA dPp Qyk ij fo'k"k çdkj d /kkjnkj pkd }kjk phjk(incision) yxk;k tkrk gA phjk yxku ij gYd ihy jx dk n/k ;k yVDl fudyrk gA ;g n/k l[ku ij Hkj dky jx dk gk tkrk gA

vQhe e yxHkx 30 çdkj d ,Ydyk,Ml ik; tkr gA bue e[; ,Ydyk,Ml g &

ekfQu (Morphine), iikojhu (Papaverine), dkMhu (Codeine), ukjdkVhu (Narcotine), fFkcuhu (Thebenine), uklhu (Narceine) vkfnA

vQhe d vk"kf/k; mi;kx fuEufyf[kr g &

(i) vQhe 'kked (Sedative) ,o 'okid (Narcotic) x.k okyh gkrh g vr% bldk mi;kx nn fuokjd vk"kf/k d :i e fd;k tkrk gA

(ii) ;g vfrlkj (Diarrhoea) ,o nLr (Dysentry) e ykHknk;d gA

(iii) dkMhu dk mi;kx [kklh] tdke ,o uty d mipkj e fd;k tkrk gA

(iv) vQhe mÙktuk ,o cpuh l jkgr fnykdj uhn dk çfjr djrh gA

(v) vQhe d vf/kd mi;kx l Hk[k de yxuk] dCt] vfuæk] ydok] eNk (Coma) vkfn 0;kf/k;k Hkh mRiUu gk ldrh gA

4. Q:yk vkIkQkbfVMk (*Ferula asafoetida*)

oxhÑr fLFkfr

mifoHkkx & vkorchth (Angiospermae)

ox & f}cheti=h (Dicotyledonae)

miox & ikyhiVyh (Polypetalae)
J.kh & dYlh¶ykjh (Calyciflorae)
x.k & vEcyYl (Umbellales)
dy & vEcyhQjh (Umbelliferae) ;k ,fi,lh (Apiaceae)
o'k & *Q:yk* (*Ferula*)
tkfr & *vklkQkbfVMk* (*asafoetida*)
lkekU; uke & ghx

fgx if'peh vQxkfuLrku] bjku rFkk Hkkjr e ik;k tku okyk ikni gA Hkkjr e bl itkc rFkk d'ehj e mxk;k tkrk gA ghx dk ikni cgo"kh; 'kkd (Perenial herb) gA ghx bl ikni dh ekVh o ekly tM l çkIr gkrh gA ghx çkIr dju d fy; bldh ekVh o ekly tM ij dV yxkdj nf/k; jx dk rjy inkFk çkIr fd;k tkrk gA ;g nf/k;k rjy inkFk ok; d lEid e vku ij xgj Hkj jx d Bkl inkFk e cny tkrk gA blh xgj Hkj jx d Bkl inkFk dk ghx dgr gA

ghx vR;Ur dMok ,o rh[kh x/k okyk inkFk gkrk gA blee[; :il Q:fyd vEy] ok"i'khy ry] vEcyhQjkUl (Umbelliferons) rFkk dkcu Mkblh YQkbMe[; :il gkr gA

ghx d vk"kf/k; mi;kx fuEufyf[kr g &

(i) ghx vip] dQ o nek d mipkj e vR;Ur ykHknk;d gA
(ii) ghx dk mi;kx dCtgj (Laxative), ikpd (Digestive), ok;uk'kd (Carminative), Ñfegj (Antihelmintic), nLrkoj ,o mÙkstd d :i e fd;k tkrk gA
(iii) ghx cPpk e U;ekfu;k rFkk 'okluyh 'kkFk (Bronchitis) e vR;Ur x.kdkjh gA
(iv) fexh d mipkj e ghx dk mi;kx fd;k tkrk gA

5. *fludkuk vkfQfIufyl* (*Cincona officinalis*)

oxhÑr fLFkfr

mifoHkkx & vkorchth (Angiospermae)
ox & f}cht i=h (Dicotyledonae)
miox & ikyhiVyh (Polypetalae)
J.kh & buQjh (Inferae)
x.k & :fc,Yl (Rubiales)
dy & :fc,lh (Rubiaceae)
o'k & *fludkuk* (*Cincona*)
tkfr & *vkfQIhufyl* (*officinalis*)
lkekU; uke & duu (Quinan)

duu mRiknu d çe[k n'k Hkkjr o b.Mkuf'k;k gA Hkkjr e flfDde] uhyfxjh] if'peh cxky] e/; çn'k o nf{k.kh Hkkjr e duu ik;k tkrk gA duu nf{k.kh vefjdk dh bf.Mt igkfM;k dk ey fuoklh gA

duu ,d lnkcgkj o{k gkrk gA vk"kf/k ¼duu½ bldh Nky l çkIr dh tkrh gA *fl- dfyIk;;k] fl- yMftfjuk] fl- IDIh:ck] fl- jkxLVk* vkfn dh Nky dk l[kkdj mll ,Ydyk,Ml çkIr fd; tkr gA bue çe[k ,Ydyk,Ml duu (Quinan), fludkfuu (Cinconine), fludkfuMhu (Cinconidine) rFkk fDofuMhu (Quinidine) gA

duu d vk"kf/k; mi;kx fuEufyf[kr g &

(i) duu eyfj;k c[kkj d mipkj e vR;Ur çHkkodkjh gA
(ii) bldk mi;kx dkyh [kklh ,o frYyh d foo/ku (Enlargement of spleen) e fd;k tkrk gA
(iii) duu dk mi;kx jkxk.kjk/kh ,o dhV fod"kd(Repellant) d :i e fd;k tkrk gA
(iv) eUnkfXu] vfefcd ifp'k (Amoeboid dysentry), fuekfu;k vkfn e Hkh bldk mi;kx fd;k tkrk gA
(v) xfB;k ,o VkfUly 'kkFk (Tonsilitis) d mipkj e Hkh bldk mi;kx fd;k tkrk gA

egRoi.k fcUn

1- vkfndky l gh iknik dk mi;kx fofHkUu çdkj d ekuo jkxk d mipkj e fd;k tkrk gA
2- vk"kf/k; iknik e fofHkUu çdkj d ,YdykbMl ik; tkr gA vr% budk mi;kx vk"kf/k d :i e fd;k tkrk gA
3- leLr ;ukuh ,o vk;ofnd vk"kf/k; iknik l gh çkIr dh tkrh gA
4- *jkmfYQ;k* dk ikni ,d cgo"kh; >kMh gA bldh dfUny tMk l vk"kf/k çkIr dh tkrh gA
5- *jkmfYQ;k* ekufld jkxk] ikxyiu] eyfj;k] lin'k] fexh vkfn jkxk e vR;Ur ykHkdkjh gA
6- gYnh ik/k d Hkfexr çdUn l çkIr dh tkrh gA
7- gYnh dk ihyk jx ble mifLFkr djD;feu d dkj.k gA
8- vQhe ikni d dPp Qy dlly e phjk yxkdj çkIr dh tkrh gA çkjfEHkd voLFkk e ;g nf/k; jx dk yVDl gkrk gA ckn e ;g l[kdj xgj jx dk gk tkrk gA bl gh vQhe dgr gA

9- ghx Q:yk ikni dh ekVh o ekly tMk l çkIr dh tkrh gA
10- ghx ,d vR;Ur dMok ,o rh[kh x/k okyk inkFk g ble e[; :i l Q:fyd vEy ik;k tkrk gA
11- duu *fludkuk* uked ikni dh Nky l çkIr dh tkrh gA
12- duu nf{k.kh vefjdk dh bf.Mt igkfM;k dk ey fuokIh ikni gA

vH;klkFk ç'u

oLrfu"B ç'u

1- liUVkbu ,YdykbM çkIr fd;k tkrk g &
¼v½ lix/kk dh ey l
¼c½ v'ox/kk dh ey l
¼l½ *fludkuk* d ru l
¼n½ *iikoj* d dlly l
2- vQhe dk egRoi.k ,YdykbM g &
¼v½ duu ¼c½ liUVkbu
¼l½ ekfQu ¼n½ VkVk Dohu
3- ikxyiu dh nok çkIr dh tkrh g &
¼v½ v'ox/kk l ¼c½ lix/kk l
¼l½ vQhe l ¼n½ *fludkuk* l
4- gYnh dk ihy jx dk çe[k ,YdykbM g &
¼v½ djD;feu ¼c½ ftfUtcfju
¼l½ liUVkbu ¼n½ iikojhu
5- ghx çkIr dh tkrh g &
¼v½ ru l ¼c½ tM l
¼l½ dPp Qy l ¼n½ cht l

vfry?kÙkjkRed ç'u

1- lix/kk dk okuLifrd uke fyf[k;A
2- gYnh ikni d fdl Hkkx l çkIr dh tkrh g\
3- vQhe ikni d fdl Hkkx l çkIr dh tkrh g\
4- ghx D;k g\
5- duu ikni dk ey LFkku dkulk g\

y?kÙkjkRed ç'u

1- vk"kf/k çnku dju oky pkj iknik d okuLifrd uke fyf[k;A
2- ghx e mifLFkr ,YdykbMl d uke fyf[k;A
3- vQhe e ik; tku oky ,YdykbMl d uke fyf[k;A
4- vQhe dk vR;f/kd lou gkfudkjd D;k g\
5- iknik e vk"kf/k; x.k D;k gkr g\
6- lix/kk d vk"kf/k; x.k fyf[k;A
7- gYnh dk mRiknu dgk ij gkrk g\ ble ik; tku oky çe[k nk ,YdykbMl d uke fyf[k;A
8- vQhe d ikni dk okuLifrd uke fyf[k;A bll vQhe dl çkIr dh tkrh g\
9- ghx dl çkIr dh tkrh g\ ghx e ik; tku oky jklk;fud inkFkk d uke fyf[k;A
10- duu d vk"kf/k; mi;kx fyf[k;A

fucU/kkRed ç'u

1- fuEufyf[kr iknik d okuLifrd uke] dy rFkk mi;kxh ikni Hkkx dk uke fyf[k; &
v- lix/kk c- gYnh l- vQhe n- ghx ;- duu
2- duu dh oxhÑr fLFkfr crkb; rFkk bld vk"kf/k; mi;kx crkb;A
3- ghx dk forj.k rFkk vk"kf/k; mi;kx crkb;A

mÙkjekyk % 1 ¼l½ 2 ¼v½ 3 ¼c½ 4 ¼v½ 5 ¼c½

bdkb & XIV

v/;k; & 21

ikni 'kjhj fØ;k foKku & çFke

(Plant Physiology - I)

ikni ty lEcU/k (Plant Water Relationship)

ikni thou d fy, ty dk egRo

ty ,d vR;Ur egRoi.k fof'k"V ,o vlk/kkj.k ;kfxd g bld fof'k"V Hkkfrd ,o jklk;fud x.kk tl mPp fof'k"V m"ek] mPp ok"iu m"ek] mPp ll tu ,o vkl tu cy] rhuk voLFkkvk vFkkr Bkl] æo ,o xl e miyC/krk] lkof=d foyk;d] çÑfr e ckgY;rk vkfn d dkj.k ty dk fo'k"k egRo gA ik/k d Hkkj dk vf/kdre Hkkx ty gkrk g ,o ;g thoæ0; dk çe[k ?kVd gA ty fofHkUu tfod fØ;kvk l vfuok;; :i l lEc) g D;kfd lHkh tfod fØ;k, tyh; ek/;e e gh lEiUu gkrh gA bu lHkh fØ;kvk dk le>u d fy, mul lEcfU/kr fof/k;k dk le>uk vR;Ur vko';d gA ; fof/k;k fuEu gA

¼1½ folj.k ¼2½ ijklj.k ¼3½ thoæ0; dpu

¼4½ LQhfr ¼5½ vUr%'kk"k.k

ty d lkr ,o çdkj

enk e ty lno o"kk d dkj.k vkrk gA o"kk e vk;k ty /khj&/khj feêh e fjlrk g ijUr vf/kdk'k ty çkÑfrd <ykuk l cgdj unh] ukyk] rkykcke ,df=r gkrk tkrk gA ;g cgu okyk ty viokfgr ty (Run away water) dgykrk gA feêh e fjlu okyk ty pkj çdkj dk gkrk gA

1- **x:Roh; ty** (Gravitational water) % ;g ty x:Rokd"k.k d dkj.k dkQh xgjkb rd tkrk g ,o ikni dk vo'kk"k.k d fy, miyC/k ugh gkrk gA

2- **vkærk ty** (Hygroscopic water) % enk d.kk dh lrg ij ty dh ,d l{e ijr vf/k'kkf"kr gkrh g bl vkærk ty dgr gA ;g ty Hkh iknik dk miyC/k ugh gkrk gA

3- **:æ ty** (Bound water) % enk e mifLFkr fofHkUu jklk;fud ;kfxdk e Hkh ty dh dN ek=k ikb tkrh g tk iknik dk çklr ugh gkrh gA

4- **df'kdk ty** (Capillary water) % enk d.kk d e/; vodk'kk e ,df=r ty df'kdk ty dgykrk g ,o iknik }kjk tM d ek/;e l doy blh ty dk vo'kk"k.k fd;k tkrk gA

folj.k (Diffusion)

ty e 'kDdj Mkyu ij og ?ky tkrh gA blh çdkj cUn dej e b= dh 'kh'kh [kkyu ij bldh lx/k lkj dej e Qy tkrh gA ,lk D;k gkrk g\ leLr inkFkk d v.k pkg o Bkl] æo ;k xl voLFkk e gk xfrt Åtk d dkj.k fujUrj xfr djr jgr gA ,o ,d LFky l nlj LFky dh rjQ LFkkukUrfjr gku dh çÑfr n'kkr g] ftl folj.k dgk tkrk gA ifjHkk"kkulkj Bkl] æo vFkok xl d v.kvk dh mudh mPp lkUærk l fuEu lkUærk dh rjQ LFkkukUrfjr gku dh çofr folj.k dgykrh gA

folj.k fØ;k Bkl] æo ,o xl rhuk voLFkkvk e ikb tkrh gA xlk e bldh rhork lokf/kd gkrh g] æo e vi{kkÑr /kheh xfr l rFkk Bkl e ugh d cjkcj gkrh gA

ijklj.k (Osmosis)

ijklj.k folj.k dh ,d fof'k"V çfØ;k g ftle ty vFkok foyk;d d v.k viu mPp lkUæ.k {k= l fuEu lkUæ.k {k= dh rjQ v)ikjxE; f>Yyh l LFkkukUrfjr gkr gA ijklj.k dk fuEufyf[kr 'kCnk e ifjHkkf"kr fd;k tk ldrk g &^^tc ,d foy;u ,o ty v)ikjxE; f>Yyh }kjk ,d nlj l iFkd dj fn; tkr g rk ty d v.kvk dk bld mPp lkUæ.k {k= l fuEu lkUæ.k {k= dh rjQ v)ikjxE;

f>Yyh l gkr g, fol j.k gku yxrk g ft l ijkl j.k dgk tkrk gA ijkl j.k ,o fol j.k e dN vUrj fuEufyf[kr gA

ijkl j.k dk çn'ku vky ijkl j.kekih (Potato osmoscope) }kjk fd;k tk ldrk gA

rk ;g nkc ijkl j.k nkc dgykrk gA bl ok;e.Myh; nkc bdkb e çnf'kr fd;k tkrk gA

fol j.k	ijkl j.k
1- ble v.kvk dk fol j.k Lor= : i l fcuk fdlh jkd Vkd d gkrk gA	ble doy ty d v.kvk dk fol j.k v)ikjxE; f>Yyh e l gkrk gA
2- fol j.k fØ;k Bkl] æo ,o xl rhuk e gkrh gA	ijkl j.k doy ty@foyk;d d v.kvk e gkrk gA
3- folfjr gku oky v.k lh/k lEid e jgr gA	ijkl j.k dju oky v.k v)ikjxE; f>Yyh }kjk ,d nlj l iFkd jgr gA

vky ijkl j.kekih (Potato Osmoscope)

vky dk fNydk gVkdj mle pkd l ,d xfgdk cukr gA xfgdk e 'kdjk foy;u Hkjdj foy;u Lrj ij fiu yxk nr gA bl vc ty l Hkj chdj e j[kr g dN le; ckn ijh{k.k dju ij n[kr g fd xfgdk d ty Lrj e of) gk tkrh gA bldk dkj.k chdj l ty d v.kvk dk vky dh irk l gkdj xfgdk d foy;u e igpuk g] tk ijkl j.k fØ;k dk çnf'kr djrk g ¼fp= 21-1½A

ijkl j.k nkc (Osmotic Pressure)

nkc tk ty d v.kvk d v)ikjxE; f>Yyh l gkr g, tyh; foy;u e ço'k dju l bruh :dkoV mRiUu dj n ft l l fd foy;u d vk;ru e of) u gk ld ijkl j.k nkc dgykrk gA nlj 'kCnk e ;fn fdlh foy;u dk v)ikjxE; f>Yyh }kjk foyk;d l iFkd dj fn;k tk; vkj fdlh nkc }kjk foyk;d d v.kvk dk foy;u e ço'k gku l jkdk tk;

ijkl j.k d çdkj

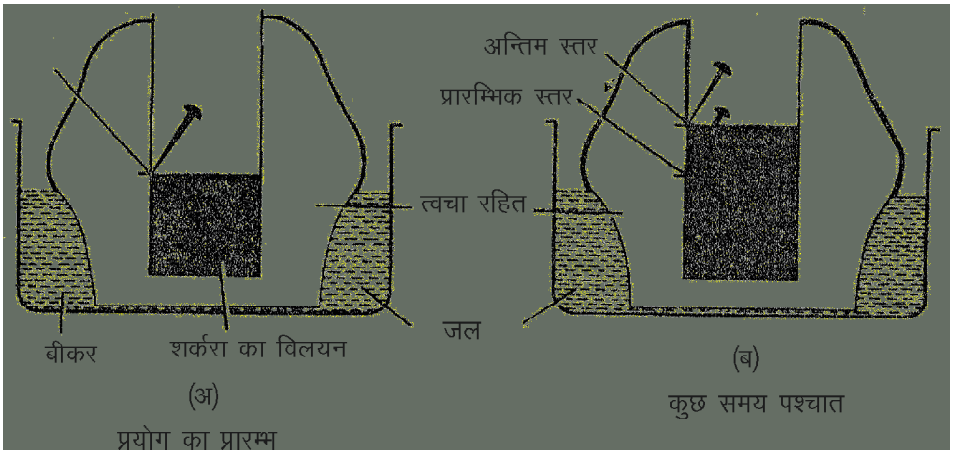
ijkl j.k nk çdkj dk gkrk gA

¼1½ vUr%ijkl j.k (Endosmosis)

¼2½ ckáijkl j.k (Exosmosis)

1- **vUr%ijkl j.k %** ty@foyk;d d v.kvk dk l tho dkf'kdk d Hkhrj fjfDrdk d dkf'kdk jl e ço'k vUr%ijkl j.k dgykrk gA l[kh fd'kfe'kk dk ty d vUnj j[ku ij budk ty vo'kk"k.k dj Qy tkuk vUr%ijkl j.k dk mnkgj.k gA

2- **ckáijkl j.k %** l tho dkf'kdkvk e ty d v.kvk dk ckgj fudyuk ckáijkl j.k dgykrk gA ;fn dN vxj ydj mUg 25-30% 'kdjk foy;u e j[k fn;k tk; rk dN le; ckn vxj fldM dj fipd tkr g D;kfd



fp= 21-1 vky dk ijkl j.kekih&ijkl j.k dh fØ;k dk çn'ku djr g, ¼v½ çkjfEHkd Lrj ¼c½ vfUre Lrj

vfrlkUæ 'kdjk d ?kkyd çHkko l vxj ty dk R;kx dju yxr gA ;g fØ;k ckáijklj.k dgykrh gA

LQhfr (Turgidity)

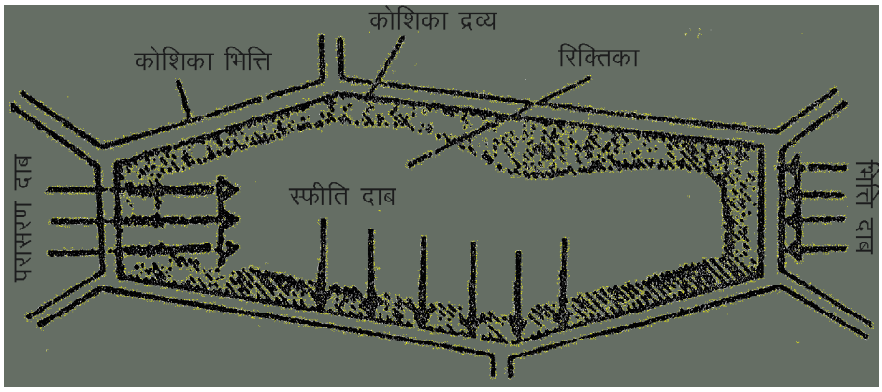
ijklj.k fØ;k }kjk vo'kkf"kr ty dkf'kdk dh fjfDrdk e ,df=r gkrk jgrk g ftld fjfDrdk d vk;ru e of) gkrh g ;g fjfDrdk dkf'kdk æ0; ij ncko Mkyrh g tk lykTek f>Yyh vkj vUr e dkf'kdk fHkfÙk rd igp tkrk gA bl nkc dk LQhr nkc dgr gA LQhr nkc (Turgor pressure) d dkj.k dkf'kdk d Qyu dk LQfrrk (Turgidity) rFkk dkf'kdk dk LQhr dkf'kdk dgr gA bl LQhr nkc d çfrfØ;k d dkj.k dkf'kdk fHkfÙk foifjr fn'kk e fjfDrdk dh f>Yyh ij nkc Mkyrh g ftl fHkfÙk nkc (Wall pressure) rFkk folj.k nkc U;urk e lEcU/k dk bl lehdj.k }kjk le>k;k tk ldrk gA

DPD = OP – TP

ijUr TP = WP

vr% DPD = OP–WP

ijklj.k fØ;k e ty dk çokg ge'kk de DPD {k= l vf/kd DPD {k= dh rjQ gkrk gA i.k LQhr dkf'kdk e dkf'kdk æ0; dk ijklj.k nkc ,o LQhr nkc cjkcj gkr g vr% folj.k nkc U;urk dk eku 'kU; gkrk g blfy, bl dkf'kdk }kjk ty dk vo'kk"k.k ugh gkrk g bld foifjr 'yFk dkf'kdk e LQhr nkc cgr de ,o ijklj.k nkc vfèkdre gkrk g vr% folj.k nkc U;urk dk eku vf/kd gku l ;g ty dk vo'kk"k.k djrh gA



fp= 21-2 % ikni dkf'kdk e fofHkUu nkc

dgr gA fHkfÙk nkc dk eku lno LQhr nkc d cjkcj fdUr fn'kk e foifjr gkrk g ¼fp= 21-2½A

folj.k nkc U;urk rFkk p"k.k nkc (Diffusion Pressure Deficit (DPD) and Suction Pressure)

'k) ty dh fdlh foy;u l ryuk dj rk foy;u e ikuh dh deh gkrh gA bl deh dh ifr gr ty ge'kk 'k) ty l foy;u dh rjQ tkrk gA ekuk fd foy;u dh lkUærk 5% g rk mle ty dk folj.k nkc 95 gkxkA pfd ty dk forj.k nkc 100 gkrk g vr% nkuk d folj.k nkc dk vUrj folj.k nkc U;urk dgykrh gA vFkkr DPD = 100–95=5 nlj 'kCnk e ok;e.Myh; nkc ij foyk;d ,o foy;u d e/; tk folj.k nkc fHkUurk gkrh g ml folj.k nkc U;urk dgr gA

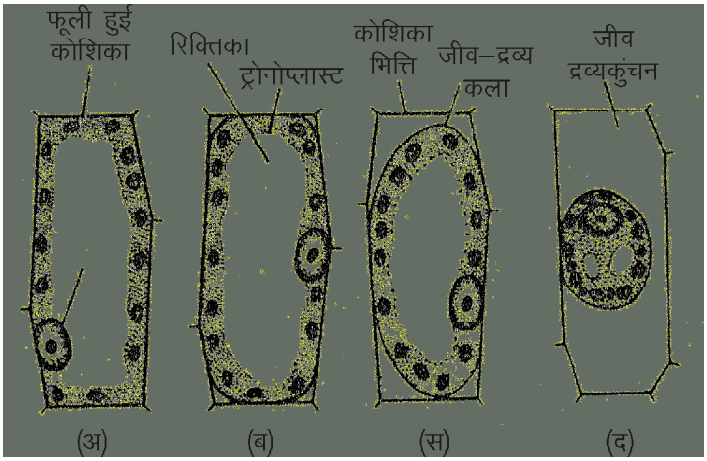
folj.k nkc U;urk dh deh ifr gr foy;u }kjk ty dk vo'kk"k.k gkrk g vr% bl p"k.k nkc Hkh dgk tkrk gA

ijklj.k nkc (OP), LQhr nkc (TP), fHkfÙk nkc (WP)

thoæ0; dpu (Plasmolysis)

;fn thfor dkf'kdk dk 'kdjk d vR;f/kd lkUæ foy;u e j[kk tko rk cfg%ijklj.k d }kjk fjfDrdk l ty dkf'kdk l ckgj tku yxrk gA bl çdkj l ty R;kxu d dkj.k thoæ0; ,o dkf'kdk fHkfÙk fldMuk çkjEHk dj nr gA dkf'kdk fHkfÙk ,d lhfer voLFkk rd gh vkdpu djrh g ijUr thoæ0; çR;kdf"kr gkdj dkf'kdk fHkfÙk l vyx gk tkrk g vkj vUr e dkf'kdk d e/; ,d xkykdkj fi.M d :i e jg tkrk gA thoæ0; d fdlh ckgjh vfrijklj.kh foy;u d çHkko d dkj.k vkdpu dh bl fØ;k dk thoæ0; dpu (Plasmolysis) dgr gA

;fn thoæ0; dfpr dkf'kdk dk 'k) ty ;k vèkkijklj.kh foy;u e j[kk tk; rk ckgj l ty dkf'kdk d Hkhrj çfo"V dju yxrk g ftll thoæ0; ,o dkf'kdk fHkfÙk iu% viuh okLrfod fLFkfr e vk tkr gA bl fØ;k dk fothon0; dpu (Deplasmolysis) dgr g ¼fp= 21-3½A



fp= 21-3 % tho æ0;dpu % ¼v½ LFkfyr dkf'kdk] ¼c½ vfrijkl.kh foy;u e j[ku d i'pkr dkf'kdk dk fldMuk

vUr%'kk"k.k (Imbibition)

vUr%'kk"k.k dh çfØ;k Hkh ijklj.k d leku ,d fo'k"k çdkj dh folj.k fØ;k g ftle 'k"d inkFk ty dk 'kk"k.k djd Qy tkr gA ifjHkk"kkulkj fdlh Bkl inkFk d d.kk }kjk fdlh æo dk fcuk foy;u cuk; vo'kk"k.k dju dk vUr%'kk"k.k dgr g ;k ty Lugh dkykbMk }kjk ty d vo'kk"k.k dk vUr%'kk"k.k dgr gA

cht Hkh vdj.k d le; vUr%'kk"k.k djr gA l[k chtk e folj.k nkc 'kU; gkrk gA tl gh ; ty d lEid e vkr g bue ty dk DPD LFkkfir gk tkrk g rFkk ty chtk e ço'k dju yxrk gA folj.k nkc d vfrfjDr vUr%'kk"k.k fØ;k gr ;g Hkh vko';d g fd cká ek/;e ¼ty½ rFkk vUr%'kk"kd inkFk d v.kvk d e/; ikjlkfjd vkd"k.k Hkh gkA ;fn nkuk d v.kvk d chp vkd"k.k dk vHkko gk rk vUr%'kk"k.k ugh gkxkA tl 'kh'kk o ty rFkk jcj o tyA

ik/kk }kjk ty vo'kk"k.k

(Absorption of Water by Plants)

ik/k tMk }kjk ty dk vo'kk"k.k djr gA ik/kk dh e[; tM ,o bldh 'kk[kk, Hkfe d vUnj ,d tky lk Qyk; j[krh gA çR;d r:.k ey d fuEu Hkkx gkr g&

1- **ey xki** (Root cap) % ey d 'kh"k ij ,d NkVh iryh Vkihuek ljpuk gkrh g ftldk ey xki dgr gA ;g 'kh"k ij fLFkr foHkT;krd dkf'kdkvk dk ?k"k.k u"V gku l cpkrh gA bl {k= dh ty vo'kk"k.k e dkb Hkfedk ugh gkrh gA

2- **dkf'kdk foHkktu {k=** (Region of cell division) % ey xki d Bhd ihN 'kh"kLFk foHkT;krd (apical meristem) gkrk g ftldh dkf'kdk, fujUrj foHkkftr gkdj ub dkf'kdkvk dk fuek.k djrh jgrh gA

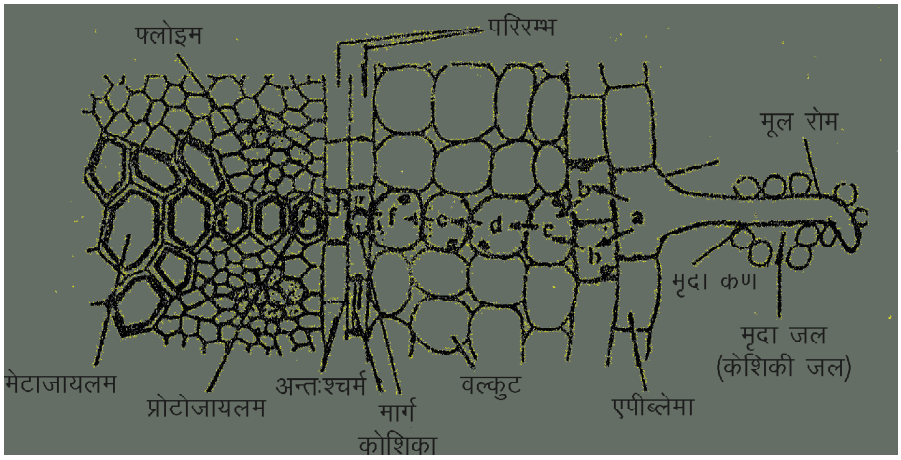
3- **dkf'kdk nh?kkdj.k {k=** (Region of cell elongation) : dkf'kdk foHkktu {k= dh Bhd ihN dkf'kdk nh?kkdj.k {k= gkrk g ftle uofufer dkf'kdk, vkdkj e of) djrh gA

4- **dkf'kdk nh?kkdj.k {k=** (Region of cell maturation) % dkf'kdk nh?kkdj.k {k= d Bhd ihN dkf'kdk ifjiDou {k= gkrk gA bl {k= e dkf'kdk, ljpukRed ,o fØ;kRed foHknu d dkj.k viuk vfUre Lo:i xg.k dj yrh gA bl {k= d cká dkf'kdh; Lrj l dkey] yEch vfrof);k d :i e ey jke fodflr gkr g ftud }kjk ty dk vo'kk"k.k gkrk gA ey jke dkey ,ddkf'kdh ,o 1-10 feeh- yEc gkr gA ey jke dh dkf'kdk fHkfÙk e[; :i l lY;ykt dh cuh gkrh gA ble dN ifDVu Hkh ik;k tkrk g ftld dkj.k ey jke enk d.kk l fpid jgr gA ey jke dk thoudky dN fnuk dk gkrk gA T;k&T;k tM fodflr ,o yEch gkrh jgrh g] ijku Hkkx d ey jke u"V gkr tkr g ,o 'kh"k Hkkx ij u; ey jke fufer gkr jgr gA

ty vo'kk"k.k dh fØ;k fof/k

(Mechanism of Water Absorption)

Øej (Kramer, 1949) ,o dN vU; oKkfudk d vulkj ty vo'kk"k.k dh çfØ;k nk çdkj l lEiUu gkrh g&



fp= 21-4 % ty vo'kk"k.k dk ekx

1- **lfØ; vo'kk"k.k** (Active absorption) : ;fn ty dk vo'kk"k.k ey e fodflr fo'k"k cy }kjk lEiUu gkrk g rk ml lfØ; vo'kk"k.k dgr gA

2- **fu"Ø; vo'kk"k.k** (Passive absorption) % og cy ;k dkjd tk vo'kk"k.k çfjr djrk g tM e fodflr u gkdj ikni d vU; Hkkxk t l ifÙk;k ,o 'kk[kkvk e fodflr gkrk g rk ml fu"Ø; vo'kk"k.k dgr gA

1- ty dk lfØ; vo'kk"k.k

lfØ; vo'kk"k.k nk fof/k;k }kjk lEiUu gkrk gA

(i) ijklj.k fof/k }kjk (Osmotic absorption)

(ii) vijkl.k fof/k }kjk (Non - osmotic absorption)

(i) **ijklj.k fof/k }kjk** % ijklj.k fof/k }kjk ty vo'kk"k.k dk fl)kUr ,VfdUl (Atkins) rFkk fçLVy (Pristley) }kjk çLrr fd;k x;k FkkA

bl fof/k e loçFke eyjke dh ckÁ ifDVu fHkfÙk enk foy;u e l ty dk vUr%'kk"k.k djrh g tk ty vo'kk"k.k dh çFke voLFkk gkrh gA bl fLFkfr e enk foy;u dh folj.k nkc U;urk (DPD) de rFkk ey jke dh folj.k nkc U;urk vf/kd gkrh g] ftl ty enk foy;u l eyjke e vk tkrk gA bl ey jke LQhr dh fudVLFk dkf'kdk dk DPD vf/kd gku l ty eyjke l fudVLFk dkf'kdk ,o bl rjg vkx dh rjQ folj.k nkc U;urk ço.krk ulkj çokfgr gkrk jgrk g vUr e oYdV dh Hkhrjh Lrj dh dkf'kdkvk rd igp tkrk gA oYdV l vUr'pe dh iFk dkf'kdkvk }kjk ifjjEHk e l gkrk gvk tk;ye e ijklj.k }kjk ço'k djrk g vr% ty ijklj.k fl)kUr d vulkj folj.k nkc U;urk dh ço.krk d vk/kkj ij eyjke l tk;ye rd igp tkrk gA lkjk'k e bl fof/k }kjk Hkfexr ty tMk e c<rh gb ijklj.k nkc ço.krk dh vkj çokfgr gkrk g vFkkr Hkfe e fLFkr ty eyjke o oYdV] vUr'pe o ifjjEHk l gkrk gvk tk;ye okfgdkvk rd igprk gA

(ii) **vijklj.kh fof/k l lfØ; vo'kk"k.k** % ;g fl)kUr Øej (Kramer, 1959) }kjk çfrikfnr fd;k x;k FkkA bl fl)kUr d vulkj tMk }kjk lkUærk ço.krk d foifjr fn'kk e ty dk lfØ; vo'kk"k.k gkrk g ijUr bl çdkj d ty vo'kk"k.k d fy, Åtk0;; djuh iMrh g] tk eyjke dkf'kdkvk d 'olu }kjk çkIr gkrh gA

2- ty dk fu"Ø; vo'kk"k.k

bl fl)kUr d vulkj ty vo'kk"k.k dk çfjr dju okyk cy ey e mRiUu u gkdj ifÙk;k ,o 'kk[kkvk e mRiUu gkrk gA ikni d ok;o Hkkxk e ok"ikRl tu d dkj.k tk cy ;k ruko mRiUu gkrk g og ey }kjk vo'kk"k.k dk çfjr djrk g ,o ey dh dkf'kdk, bl fØ;k e fu"Ø; jgrh gA

i.k dh dkf'kdk, l ty dk R;kx ok"ikRl tu }kjk ok"i d :i e gkrk g] ftl bu dkf'kdkvk dh folj.k nkc U;urk (DPD) c< tkrk g ftl fudV fLFkr dkf'kdkvk }kjk bu dkf'kdkvk e ty ijklj.k }kjk bu dkf'kdkvk dh ty dh deh dk ijk dju d fy, igp tkrk gA bl fudV dh dkf'kdkvk e folj.k nkc U;urk c< tkrh g ftldk lUrfyr dju d fy, ty i.k dh tk;ye okfgdkvk l bu dkf'kdkvk dk vkifr fd;k tkrk gA bl tk;ye LrEHk e ,d ruko mRiUu gkrk gA tk tMk d tk;ye LrEHk rd igp tkrk gA ;g ruko ogk ij p"k.k nkc mRiUu djrk g ftl ty eyjke] oYdV] ifjjEHk l gkrk gvk tk;ye e vk tkrk gA

bl çdkj fu"Ø; vo'kk"k.k 'kk[kkvk o i.kk d lfØ; ok"ikRlrq d dkj.k gkrk gA ik/kk }kjk vf/kdk'k ty fu"Ø; vo'kk"k.k }kjk vo'kkf"kr fd;k tkrk gA

ty vo'kk"k.k db dkjdk tl miyC/k Hkfe ty] enk rkieku] enk foy;u dh lkUærk] enk ok; }kjk fu;f=r ,o çHkkfor jgrk gA

ik/kk e jlkjkg.k (Ascent of Sap)

ik/kk dh tMk }kjk vo'kkf"kr ty iknik d fofHkUu Hkkxk tl ruk] 'kk[kk,] i.kk rd igprk gA i.kk e ty dk vf/kdk'k Hkkx ok"ikRlrq }kjk ok;e.My e igp tkrk g ijUr dN Hkkx çdk'k l'y"k.k ,o vU; tfod fØ;kvk e ç;Dr gk tkrk g bl çdkj enk l vo'kkf"kr ty x:Rokd"k.k d foifjr i;kIr Åpkb rd igp tkrk gA ;g fØ;k NkV iknik l ydj llkj d vf/kdre yEc o{kk e Hkh gkrh gA vr% x:Rokd"k.k d foifjr ty d ik/kk e vkjkg.k dh fØ;k jlkjkg.k dgykrh gA

jlkjkg.k dh fØ;k dk le>ku gr le;≤ ij oKkfudk }kjk fofHkUu fl)kUr çfrikfnr fd; x; g tk fuEukulkj gA

¼1½ to 'kfDr fl)kUr (Vital force theory)

¼2½ eynkc fl)kUr (Root pressure theory)

¼3½ Hkkfrd cy fl)kUr (Physical force theory)

1- **to 'kfDr fl)kUr %** bl fl)kUr d vulkj jlkjkg.k dh fØ;k ey:i l ltho dkf'kdkvk }kjk gkrh gA ijUr oKkfudk d erkulkj ;g fØ;k er tk;ye dkf'kdkvk }kjk lEiUu gkrh gA

2- **eynkc fl)kUr %** bl fl)kUr d vulkj tMk }kjk vo'kkf"kr ty dk lp;u ,d æo LFkfrd nkc mRiUu djrk g ftl eynkc dgr gA ;g eynkc ty dk Åij dh rjQ <dy dj vkjkg.k e enn djrk gA ijUr eynkc vf/kd Åpkb rd ty dk vkjkg.k dju e l{ke ugh gA

3- **Hkkfrd cy fl)kUr %** oKkfudk }kjk le;≤ ij vud Hkkfrd cy fl)kUr jlkjkg.k dh çfØ;k dk le>ku gr çLrr fd; ftue ok"ikRlrq ruko ,o ty llturk dk fl)kUr çe[k g ,o lokf/kd ekU;rk çkIr gA

ok"ikRlrq ruko ,o ty llturk dk fl)kUr (Transpiration Pull and Water Cohesion Tension Theory)

bl fl)kUr dk çfriknu fMDlu ,o tkyh (Dixon and Jolly) }kjk 1894 e fd;k x;k FkkA ;g fl)kUr fuEufyf[kr rF;k ij vk/kkfjr gA

1- **ok"ikRlrq ruko@f[kpko (Transpiration pull) %** ifÙk;k dh i.ke/;kÙkd dkf'kdkvk dh fHkkfÙk;k l ty dk fujUrj ok"iu gkrk jgrk g ftll bu dkf'kdkvk dh ijklj.k lkUærk ,o folj.k nkc U;urk c< tkrh gA bld dkj.k ty tk;ye okfgdkvk l [khpdj ijklj.k }kjk i.ke/;kÙkd dkf'kdkvk e ty dh deh dk i.k dju d fy, ço'k djrk gA bld ifj.kkeLo:i tk;ye d æo ij ,d ruko ;k f[kpko ok"ikRlrq d dkj.k mRiUu gkrk gA vr% bl ok"ikRlrq f[kpko@ruko (Transpiration pull) dgr gA

2- **ty dk lltd cy (Cohesive force of water) %** ty d v.k ijLij ,d nlj l ,d n< cy }kjk vkdf"kr jgr g] ftl lltd cy dgr gA bl lltd cy d dkj.k ty d v.k ,d ty LrEHk (Water column) dk fuek.k djr gA ty d v.k rFkk tk;ye okfgdk d e/; vkltd cy gkrk gA ; nkuk llltd ,o vkltd cy tk;ye e ty LrEHk dk vVV cuk; j[kr gA

i.kk e gk jg ok"ikRlrq d dkj.k ,d ruko ;k f[kpko okfgdkvk e mifLFkr ty LrEHk ij iMrk gA bld dkj.k ty LrEHk Åij dh rjQ f[kprk gA ty d v.k lltd cy rFkk vkltd cy d dkj.k ,d v[k.M LrEHk d :i e ik/kk d 'kk"k rd vkjkg.k djr gA bl 0;oLFkk e tk;ye vo;o ,d fu"Ø; uyh d :i e dk; djr g ¼fp= 21-4½A

ok"ikRlrq (Transpiration)

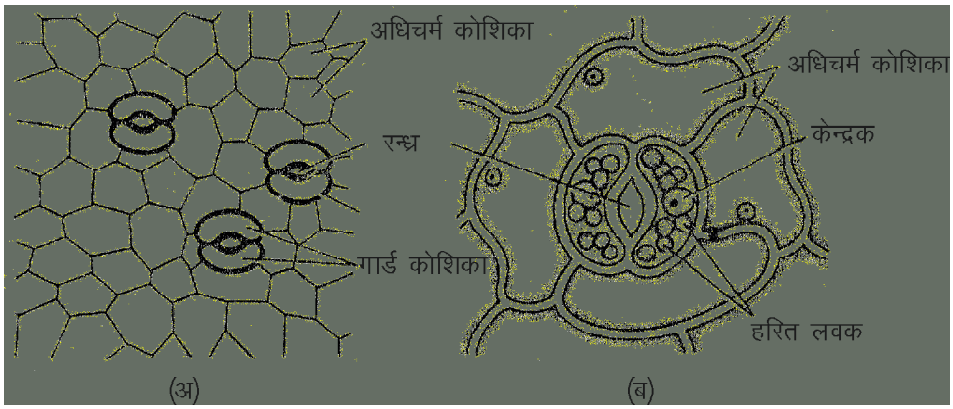
ik/k viu ey r= d }kjk enk l ty dk fujUrj vo'kk"k.k djr jgr gA ;g ty jlkjkg.k }kjk ikni d fofHkUu Hkkxk rd igprk gA bl ty dk vf/kdk'k Hkkx ¼yxHkx 95%½ ikni d ok;o Hkkxk }kjk ok"i d :i e ok;e.My e R;kx fn;k tkrk g ,o ty dk dN gh Hkkx ¼yxHkx 5%½ ik/k dh of) rFkk fodkl e dke vkrk gA

ltho ik/kk d ok;o Hkkxk }kjk ty dk ok"i d :i e R;kx ok"ikRlrq dgykrk gA ;g ,d 'kkjhfjd fØ;kRed çfØ;k g ftldk fu;=.k thoæ0; dh lfØ;rk }kjk gkrk gA

xhy diM] tyk'k;k vkfn e Hkh ty ok"i d :i e ok;e.My e fey tkrk g] ftl ok"ihdj.k dgr gA ok"ikRlrq ,o ok"ihdj.k fuEu çdkj l fHkUu&fHkUu çfØ;k, gA

ok"ikRlrq d çdkj (Types of Transpiration)

ikni d yxHkx lHkh ok;oh; Hkkxk l ok"ikRlrq gkrk g ijUr ifÙk;k bl dk; dh e[; vx gkrh gA ok"ikRlrq rhu çdkj dk gkrk g&



fp= 21-5 % jU/k o xkM dkf'kdkvk dk çnf'kr djrk i.k dh vf/kpe dk VdMk

ok"ikRlrtu (Transpiration)	**ok"ihdj.k** (Evaporation)
1- ;g ,d tfod çfØ;k g tk doy iknik e lEiUu gkrh gA	;g ,d Hkkfrd çfØ;k g tk fdlh Hkh ty lrg ;k vkæ oLr l gkrh gA
2- ty dk ok"i d :i e j/kk] miRopk ;k okrj/kk }kjk R;kxk tkrk gA	ty dh lrg ,o ue lrg l ty ok"i ckgj vkrh gA
3- bld }kjk dkf'kdk lrg 'k"d ugh gkrh g rFkk ikni lrg dk ue j[kdj l; d rki l ljk{kk dh tkrh gA	bld dkj.k lrg dh 'k"drk fujUrj c<rh jgrh gA
4- ;g vud dkjdk l çHkkfor gkrh gA	;g e[;r;k rki }kjk çHkkfor gkrh gA

1- **j/kh ok"ikRlrtu** (Stomatal transpiration) % ;g ifÙk;k ij fLFkr j/kk }kjk lEiUu gkrk gA bl ok"ikRlrtu l 80-90% rd ty gkfu gkrh gA

2- **miRoph; ok"ikRlrtu** (Cuticular transpiration) % 'kkdh; ruk ,o ifÙk;k e miRopk (Cuticle) ik;h tkrh gA ;g e[;r;k ok"ikRlrtu de djrh g] ijUr dN ek=k e ty bll gkdj ok"i d :i e okrkoj.k e pyk tkrk gA bl miRoph; ok"ikRlrtu dgr gA ;g yxHkx 3-9% rd gkrk gA

3- **okrj/kh ok"ikRlrtu** % dk"Bh; ruk rFkk dN Qyk e okrj/k ik; tkr gA dN ty bu okrj/kk l ok"i d :i e mM tkrk gA bldk okrj/kh ok"ikRlrtu dgr gA ;g ik/kk e yxHkx 1% rd gkrk gA

j/kh; ok"ikRlrtu dh fØ;k fof/k
(Mechanism of Stomatal Transpiration)

eyjke }kjk vo'kkf"kr ty oYdV l gkrk gvk ey d tk;ye e igp tkrk gA tgk l bldk jlkjkg.k gkrk g ftld QyLo:i ;g ifÙk;k d tk;ye rd igp tkrk gA ifÙk;k d tk;ye l ty i.ke/;kÙkd dkf'kdkvk e igp tkrk gA i.ke/;kÙkd dkf'kdkvk d e/; vUrjdkf'kdh; LFky gkr gA bue ok; Hkjh jgrh gA ty i.ke/;kÙkd dkf'kdkvk l ok"ihdj.k gku d ckn bu LFkyk e vk tkrk g rFkk j/kk l gkdj ok;e.My e igp tkrk gA

j/k dh ljpuk (Structure of Stomata)

çR;d j/k e ,d fNæ (Stoma) gkrk g tk 5-10 µ pkMk rFkk 10-40 µ yEck gkrk gA ;g fNæ nk oDdkdkj vf/kpe dkf'kdkvk }kjk f?kjk jgrk g ftUg }kj dkf'kdk(Guard cells) dgr gA ,dch ti=h ik/kk e }kj dkf'kdk, MEcy d vkdkj dh gkrh gA }kj dkf'kdkvk dh cká fHkfÙk iryh rFkk Hkhrjh D;Vhu d teko l ekVh gk tkrh gA }kj dkf'kdk, dUæd ,o i.kgfjr ;Dr gkrh gA }kj dkf'kdkvk d pkjk rjQ vf/kpe dkf'kdk, gkrh g ftUg lgk;d dkf'kdk dgr gA

j/k d [kyu ,o cUn gku dh fof/k

j/k dk [kyuk ,o cUn gkuk }kj dkf'kdh dh LQhfr ij fuHkj djrk gA }kj dkf'kdk d LQhr gku ij j/k [ky tkr

g tcfd bld 'yFk gku j/k cUn gk tkr g ;k NkV ,o vfr ldh.k gk tkr gA }kj dkf'kdk d ckgj dh vkj dh fHkfÙk;k vi{kkÑr iryh ,o yphyh gkrh g tcfd fNæ dh rjQ fLFkr fHkfÙk;k ekVh ,o n< gkrh gA ty vo'kk"k.k d ckn ; dkf'kdk, ckÁ fHkfÙk;k d iryh gku d dkj.k Qy tkrh g tcfd vUnj dh fHkfÙk ekVh ,o n< gku d dkj.k Hkhrj dh vkj f[kp tkrh g vkj j/k [ky tkr gA

vk/kfud fl)kUr d vulkj }kj dkf'kdkvk K+ e vk;u lkUærk c<u ij j/k [ky tkr g ,o bu vk;uk dh lkUærk de gku ij j/k cUn gk tkr gA

ok"ik dh fØ;k db çdkj d ckÁ ,o vkUrfjd dkjdk l çHkkfor gkrh gA ckÁ dkjdk e çdk'k] rkiØe] ok;] vkærk ,o miyC/k enk ty rFkk vkUrfjd dkjdk e i.k dk {k=Qy] miRopk] j/kk dk forj.k vkfn çe[k gA

egRoi.k fcUn

1- ty ik/kk dh lHkh tfod fØ;kvk d fy, vko';d gkrk gA
2- enk ty pkj çdkj dk gkrk g & x:Roh; ty] vkærk ty] :æ ty ,o df'kdk tyA df'kdk ty gh iknik dk vo'kk"k.k d fy, miyC/k jgrk gA
3- ty vo'kk"k.k dh rhu Hkkfrd fof/k;k g & folj.k] ijklj.k] vUr%'kk"k.kA
4- folj.k e v.k vf/kd lkUærk oky LFky l de lkUærk oky LFky dh rjQ xfr djr gA
5- ijklj.k fØ;k f>fYy;k dh ikjxE;rk rFkk foy;u d çdkj ij fuHkj djrh gA
6- tc nk foy;u ,d v)ikjxE; f>Yyh }kjk iFkd gkr g rk ru foy;u l lkUæ foy;u e ty d v.kvk dk v)ikjxE; f>Yyh l LFkkukUrj.k ijklj.k dgykrk gA
7- ijklj.k nkc foy;u dh lkUærk d vuØekuikrh gkrk gA
8- vUr%ijklj.k l dkf'kdk LQhr rFkk cfg%ijklj.k d dkj.k 'yFk gk tkrh gA
9- fdlh 'k) foyk;d e foy; dk ?kkyu ij folj.k e vkb deh dk folj.k nkc U;urk (DPD) dgr gA
10- fdlh dkf'kdk e folj.k nkc U;urk ml dkf'kdk d ijklj.k nkc (OP) rFkk LQhr nkc (TP) d vUrj d cjkcj gkrk gA
11- dkf'kdk dk vR;f/kd lkUæ foy;u e j[ku ij bld thoæ0; dk fldM tkuk thoæ0; dpu dgykrk g ;g x.k doy l tho dkf'kdkvk e ik;k tkrk gA
12- ty dk vo'kk"k.k ,ddkf'k; eyjke }kjk gkrk gA
13- ty dk vo'kk"k.k nk fof/k;k }kjk gkrk g & (i) lfØ; vo'kk"k.k (ii) fu"Ø; vo'kk"k.k
14- eyjke }kjk vo'kkf"kr ty dk iknik d fofHkUu Hkkxk rd LFkkukUrj.k jlkjkg.k dgykrk gA
15- iknik e jlkjkg.k ok"ikRl tu ruko ,o ty ll tu cy d dkj.k lEiUu gkrk gA
16- ik/kk d ok;oh; Hkkxk l ty dh ok"i d :i e gku okyh gkfu ok"ikRl tu dgykrk gA
17- vf/kdk'k ok"ikRl tu j/kk d }kjk lEiUu gkrk gA
18- }kj dkf'kdk d LQhr gku ij j/k [kyr g rFkk 'yFk gku ij cUn gk tkr gA

vH;klkFk ç'u

oLrfu"B ç'u

1- ijklj.k fØ;k d fy, vko';d g &
¼v½ v)ikjxE; f>Yyh
¼c½ vikjxE; f>Yyh
¼l½ lel;klj foy;u
¼n½ mi;Dr lHkh
2- vUr%ijklj.k l dkf'kdk dk vkdkj &
¼v½ c<rk g
¼c½ ?kVrk g
¼l½ vifjofrr jgrk g
¼n½ mijkDr e l dkb ugh
3- cjlkr e ydMh d njokt Qy tkr g bldk dkj.k g &
¼v½ folj.k ¼c½ ijklj.k
¼l½ vUr%'kk"k.k ¼n½ thoæ0; dpu
4- ijklj.k fØ;k e v)ikjxE; f>Yyh e l gkdj fdld v.k xeu djr g &
¼v½ foyk;d ¼ty½ ¼c½ foy;
¼l½ nkuk ¼n½ mijkDr e l dkb ugh
5- folj.k nkc U;urk çHkkfor gkrh g &
¼v½ ijklj.k nkc l ¼c½ LQhr nkc l
¼l½ fHkfÙk nkc l ¼n½ lHkh l
6- iknik e vf/kdre ok"ikRl tu gkrk g &
¼v½ j/kk }kjk ¼c½ miRopk }kjk
¼l½ okrj/kk }kjk ¼n½ mijkDr e l dkb ugh

7- ty d lfØ; vo'kk"k.k d fy, lR; g &
¼v½ df'kdkRo ¼c½ vUr%'kk"k.k
¼l½ ok"ikRl tu ¼n½ mikip;h Åtk dk 0;;

8- j/kk d [kyu ,o cUn gku dk dkulk /kkfRod vk;u fu;f=r djrk gA
¼v½ Fe^{++} ¼c½ K^{+}
¼l½ Na^{+} ¼n½ Mg^{++}

vfry?kÙkjkRed ç'u

1- ijklj.k dk ifjHkkf"kr dhft ;A
2- dkf'kdk fdl voLFkk e lokf/kd ty vo'kk"k.k djrh gA
3- ,d i.k LQhr dkf'kdk dh ty vo'kk"k.k {kerk fdruh gkxh\
4- ikni fdl çdkj d Hkfexr ty dk vo'kk"k.k dj ldr g\
5- thoæ0; dpu dc gkrk g\

y?kÙkjkRed ç'u

1- ijklj.k ,o folj.k e vUrj fyf[k;A
2- ok"ikRl tu ,o ok"ihdj.k e D;k vUrj g\
3- folj.k nkc U;urk (DPD) l vki D;k le>r g\
4- ok"ikRl tu fdru çdkj dk gkrk g\
5- folj.k nkc U;urk] LQhr nkc ,o fHkfÙk nkc e lc/k crkb;A

fuc/kkRed ç'u

1- ty vo'kk"k.k dh lfØ; ,o fu"Ø; fof/k;k dk le>kb;A
2- jlkjkg.k l vki D;k le>r g\ iknik e ;g fØ;k dl gkrh g\
3- j/k dh ljpuk dk lfp= o.ku dhft ; ,o ok"ikRl tu dh fØ;k le>kb;A

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mÙkjekyk % 1 ¼v½ 2 ¼v½ 3 ¼l½ 4 ¼v½ 5 ¼n½ 6 ¼v½ 7 ¼n½ 8 ¼c½

çdk'k l'y"k.k
(Photosynthesis)

vf/kdk'k gj ik/k Loik"kh gkr g D;kfd o viu Hkk tu dk fuek.k Lo; djr gA blfy, bu gj ik/kk dk mRiknd (Producers) dgk tkrk gA gj ik/kk e ;g vf}rh; x.k bue mifLFkr gj o.kd i.kgfjr (Chlorophyll) d dkj.k gkrk gA gj ik/k l; d çdk'k dk lh/k gh jklk;fud Åtk e :ikUrj.k dju e l{ke g] tcfd tUr çR;{k ;k vçR;{k :i e viuh tfod fØ;k, lEiUu dju d fy, vko';d Åtk gr iknik ij fuHkj jgr gA

ik/kk }kjk Hkk tu fuek.k dh mip;h (Anabolic) fØ;k dk çdk'k l'y"k.k dgr gA ;g lcl egRoi.k tfod fØ;k gkrh gA gj ik/k l; d çdk'k l Åtk çkIr djr g ,o bl Åtk dk mi;kx dj ty ,o CO_2 }kjk Hkk tu fuek.k djr gA Hkk tu fuek.k d lkFk&lkFk ;g fØ;k ok;e.My e CO_2 rFkk O_2 dk lUryu cuk; j[krh gA çdk'k l'y"k.k dk yxHkx 85% Hkkx egklkxjh; 'kokyk l rFkk 5% Hkkx unh] rkykck e mifLFkr 'kokyk l gkrk gA doy 10% Hkkx LFkyh; ik/kk }kjk gkrk gA

ifjHkk"kk

çdk'k l'y"k.k gj ik/kk dh og mip;h çfØ;k g ftle gj ik/kk }kjk l; d çdk'k dh mifLFkfr e ok;e.My l çkIr CO_2 o enk }kjk vo'kkf"kr ty dk dkckgkbMV :ih jklk;fud Åtk e ifjoru fd;k tkrk g rFkk vkDlhtu mi&mRikn (By product) d :i e fudyrh gA bl fuEu jklk;fud lehdj.k }kjk 0;Dr fd;k tk ldrk g&

$$6CO_2 + 12H_2O \xrightarrow[\text{i.kgfjr}]{\text{çdk'k}} C_6H_{12}O_6 + 6H_2O + 6O_2\uparrow$$

çdk'k l'y"k.k d fy, vko';d lkexh

pkj çdkj dh lkexh çdk'k l'y"k.k d fy, vko';d gkrh g&

1- o.kd (Pigment) 2- çdk'k (Light)
3- ty (Water) 4- dkcu MkbvkDlkbM (CO_2)

1- **o.kd** (Pigment) : iknik e mifLFkr fofHkUu jx ;Dr inkFkk dk o.kd dgr gA çdk'k l'y"k.k gr rhu çdkj d o.kd egRoi.k gkr g&

¼d½ **i.kgfjr** % i.kgfjr gj jx;Dr çe[k o.kd gkr g tk çdk'k l'y"k.k e e[; Hkfedk fuogu djr gA ; lkr çdkj d gkr ftue i.kgfjr a ,o i.kgfjr b çe[k gA

1- i.kgfjr a : lHkh gj iknik e mifLFkr gkrk gA
2- i.kgfjr b : mPp J.kh d iknik ,o gj 'kokyk e ik;k tkrk gA
3- i.kgfjr c : 'kokyk e feyrk g ¼Hkj 'koky e½
4- i.kgfjr d : dN 'kokyk e feyrk g ¼yky 'koky e½
5- i.kgfjr e : dN 'kokyk e feyrk g ¼ihy gj 'koky e½
6- cDVhfj;kfojhMhu ¼gjk jx½ % çdk'k l'y"kh thok.kvk e feyrk gA
7- cDVhfj;kDykjkfQy ¼cxuh jx½ çdk'k l'y"kh thok.kvk e feyrk gA

¼[k½ **djkfVukbMl** (Carotenoids) % ; lgk;d o.kd dgykr g D;kfd ; l; d çdk'k dk vo'kkf"kr dj i.kgfjr rd igpku dk dk; djr gA ; nk çdkj d gkr g &

1- djkVhu (Carotenes) : ; ukjxh jx d gkr gA bldk jk;k;fud l= $C_{40}H_{56}$ gkrk gA
2- tUFkkfQy (Xanthophils) : ; ihy jx d gkr g budk l= $C_{40}H_{56}O_2$ gA

¼x½ **Qkbdkfcfyul** (Phycobilins) % ; Hkh nk çdkj d gkr g &

1- Qkbdkbjhfrku (Phycoerythrin) : yky jx dk o.kd yky 'koky e mifLFkr gkrk gA
2- Qkbdklk;fuu (Phycocynin) : ;g uhy jx dk o.kd uhygfjr 'koky e ik;k tkrk gA

2- **çdk'k** (Light) : l; d çdk'k dk 1-4% Hkkx gh ifUk;k çdk'k l'y"k.k e dke e yrh gA çdk'k dk doy n'; çdk'k o.kØe gh çdk'k l'y"k.k d fy, egRoi.k gkrk gA yky ,o uhy o.kØe e çdk'k l'y"k.k lokf/kd gkrk gA gj o.kØe dk ifUk;k i.k :i e ijkofrr dj nrh g blfy, çdk'k l'y"k.k dh fØ;k ugh gkrh gA

3- **ty** (Water) : ty çdk'k l'y"k.k dk ,d egRoi.k vfHkdkjd gA ty dk çe[k lkr Hkfexr ty gkrk g ftl tMk }kjk vo'kkf"kr dj jlkjkg.k }kjk ifUk;k rd igpk;k tkrk gA

4- **dkcu MkbvkDlkbM** (CO_2) : dkcu MkbvkDlkbM dk çe[k lkr ok;e.Myh; CO_2 gA ;g doy vçdkf'kd vfHkfØ;k e ç;Dr gkrh gA LFkyh; ikni j/kk }kjk ok;e.My l CO_2 xg.k djr gA tyh; ikni ,o 'koky ty e foy; CO_2 dk mi;kx djr gA

çdk'k l'y"k.k dk LFky
(Site of Photosynthesis)

ikni dkf'kdk e gfjryod (Chloroplast) egRoi.k dkf'kdkx g ftle i.kgfjr ik;k tkrk gA blh dkf'kdkx e çdk'k l'y"k.k dh çfØ;k lEiUu dju d vko';d ,Utkbe ,o o.kd leg ik; tkr gA

gfjryod dh ljpuk
(Structure of Chloroplast)

gfjryod nk bdkb f>fYy;k l ifjc) ljpuk gkrh gA nkuk f>fYy;k d e/; vodk'k ik;k tkrk g] ftl ifjyodh; LFky dgr gA f>fYy;k d vUnj nk çe[k Hkkx gkr g &

¼d½ **xuk** (Grana) % ;g Fkkbydkbd iVfydkvk dh flDdk dh <jh tlh jpukvk }kjk fufer gkr gA ,d gfjryod e 40&60 xuk gk ldr gA bu xue dk tkMu okyh iVfydk, bUVjxue dgykrh gA xue çdk'k l'y"k.k dh çdkf'kd vfHkfØ;k dk LFky gA

¼[k½ **LVkek** (Stroma) % ;g gfjryod dk vk/kk=h g ftle jxghu çkVhu ;Dr inkFk ,o vU; inkFk ik; tkr gA ble çdk'k l'y"k.k dh vçdkf'kd vfHkfØ;k lEiUu gkrh g D;kfd CO_2 fLFkjhdj.k d lHkh ,Utkbe blh e ik; tkr g ¼fp= 21-6½A

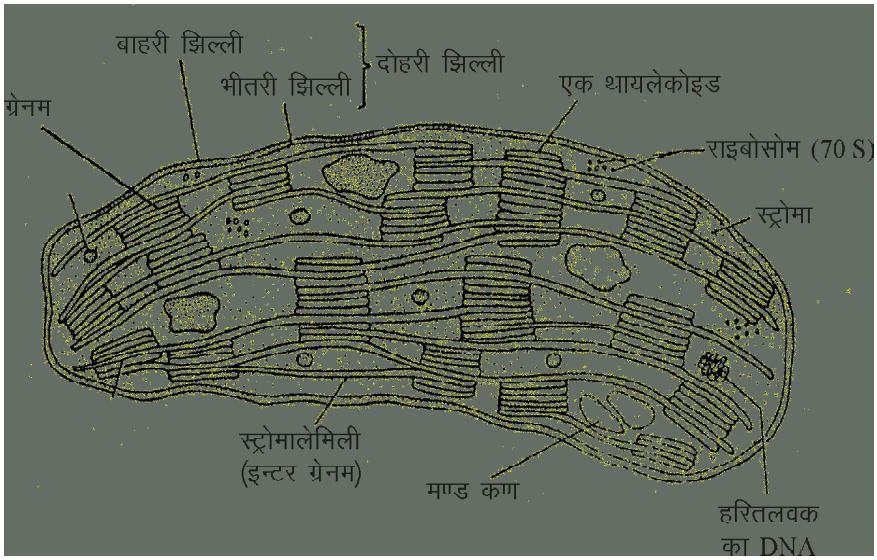
çdk'k l'y"k.k dh bdkbZ (Photosynthetic unit)

çR;d Fkkbydkbd e l{e df.kdke; jpuk, mifLFkr gkrh gA ikd ,o fcfxUl (Park and Biggins, 1964) u bUg Dok.Vkl ke (Quantasome) dgkA Dok.Vkl ke çdk'k l'y"k.k dh nf"V l fØ;k'khy bdkb gA çR;d Dok.Vkl ke yxHkx 230 i.kgfjr ,o dN djkfVukbM v.kvk }kjk fufer gkrk g ; i.kgfjr d v.k çdk'k Åtk dk vo'kkf"kr djd nlj v.kvk dk n nr gA vUr e ;g Åtk Dok.Vkl ke e fLFkr vfHkfØ;k dUæ (Reaction centre) dk LFkkukUrfjr dj nh tkrh g tk vkx dh çdk'k&jklk;fud vfHkfØ;k e Hkkx yrk gA vfHkfØ;k dUæ i.kgfjr-a dk fof'k"V v.k gkrk gA

bejlu çHkko vkj nk o.kd r=
(Emerson Effect and Two Pigment System)

bejlu ,o mld lg;kfx;k u çdk'k dh fofHkUu rjxn/;k dk çdk'k l'y"k.k dh nj ij gku oky çHkko dk v/;;u fd;kA mUgku n[kk fd tc ikni dk 680 nm l vfèkd rjxn/; dk çdk'k fn;k tkrk g] rc çdk'k l'y"k.k dh nj e rhork l deh vku yxrh gA ;g dHkh n'; LiDVe d yky {k= e gku d dkj.k bl yky iru (Red drop) dgk tkrk gA bejlu u crk;k fd bl deh dk ijk fd;k tk ldrk g] vxj 680 nm l vf/kd rjxn/; d lkFk 680 nm l y?k rjxn/; Hkh n nh tk;A bl çdkj nkuk rjxn/; lkFk&lkFk nu l çdk'k l'y"k.k dh nj tc nkuk rjxnè; vyx&vyx nh tkrh g] d lfEefyr ;kx l c< tkrh gA bl nj d c<u dh ?kVuk dk bejlu of)dj.k çHkko (Emerson enhancment effect) dgr gA

bejlu d ç;kxk l ;g fu"d"k fudyk fd çdkf'kr vfHkfØ;k nk Li"V çdk'k&jklk;fud çØek ;k nk o.kd r=k

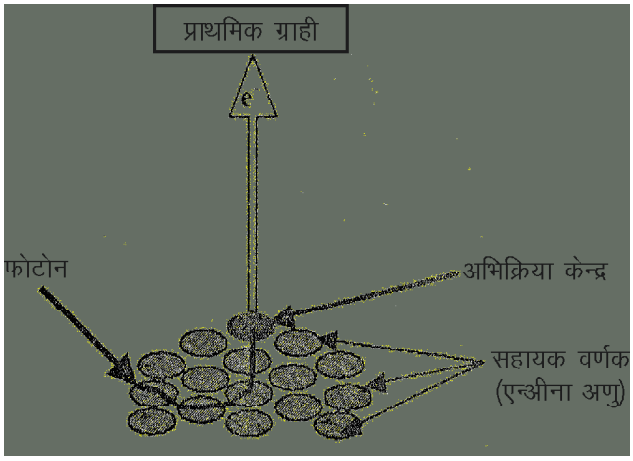


fp= 21-6 % gfjryod d vuçLFk dkV dk byDVku l{en'kh l n[kh ljpuk

(Pigment system) l feydj cuh gkrh gA ,d o.kd r= tk mPp ;k cMh rjxn/; d çdk'k dk vo'kkf"kr djrk g rFkk nljk og tk fuEu ;k y?k rjxn/; dk vo'kkf"kr djrk gA bu o.kd r=k dk Øe'k% çdk'k r=-I (Photosystem-I) o çdk'k r=-II (Photosystem-II) dgk tkrk gA çR;d çdk'k r= e 300-400 o.kd v.k ik; tkr gA çR;d çdk'k r= e ,d vfHkfØ;k dUæ gkrk g tk çdk'k Åtk dk jklk;fud Åtk e ifjofrr djrk gA vfHkfØ;k dUæ d pkjk rjQ lgk;d o.kd ik; tkr g tk çdkf'kd Åtk dk vo'kkf"kr djd vfHkfØ;k dUæ dk LFkkukUrfjr djr gA bu v.kvk dk ,UVhuk v.k (Antenna molecule) dgr gA

1- **çdk'k r=-I** (Photosystem-I) : bl r= dk vfHkfØ;k dUæ P_{700} (Chl a 700) gkrk g tk i.kgfjr a dk fof'k"V v.k g bl r= e ,UVhuk v.k d :i e i.kgfjr d fofHkUu v.k (Chl_{660}, Chl_{670}, Chl_{680}, Chl_{690}) o djkfVukbM gkr g tk fHkUu&fHkUu rjxn/; okyh rjxk dk vo'kkf"kr dj vfHkfØ;k dUæ igpkr gA ;g r= xuk ,o LVkek nkuk e ik;k tkrk g ,o bldk mi;kx pØh; ,o vpØh; nkuk çdkj d QkLQkfjyhdj.k e fd;k tkrk g ¼fp= 21-7½

2- **çdk'k r=-II** (Photosystem-II) : bl r= dk vfHkfØ;k dUæ P_{680} (Chl.680) gkrk g ,o ,UVhuk v.k d :i e Chl a 600, Chl_{670}, Chl b 650, tUFkkfQy] mifLFkr gkr gA bl çdk'k r= e çdk'k r= I dh ryuk e de rjxn/; okyh QkVku Åtk dk vo'kk"k.k gkrk gA bl çdk'k r= dk mi;kx doy vpØh; çdk'k QkLQkfjyhdj.k e gkrk gA



fp= 21-7 % çdk'k r= dh fØ;k&fof/k

çdk'k l'y"k.k dh fØ;k fof/k
(Mechanism of Photo Synthesis)

çdk'k l'y"k.k dh fØ;k vR;Ur tfVy gA ;g fØ;k nk pj.kk e lEiUu gkrh g&

(i) çdkf'kd vfHkfØ;k (Light Reaction)

(ii) vçdkf'kd vfHkfØ;k (Dark Reaction)

(i) **çdkf'kd vfHkfØ;k** (Light reaction) : ;g vfHkfØ;k doy çdk'k dh mifLFkfr e xue ij lEiUu gkrh g blA vfHkfØ;k e l; dh çdk'k Åtk dk jklk;fud Åtk e ifjofrr fd;k tkrk gA çdkf'kd vfHkfØ;k e fuEu ?kVuk, lEiUu gkrh g&

¼d½ i.kgfjr d byDVku dk çdk'k d QkVku }kjk mÙkstuk (Excitation of an electron of chlorophyll by a photon of light)

¼[k½ ty dk çdkf'kd vi?kVu (Photolysis of water)

¼x½ çdkf'kd QkLQkfjyhdj.k (Photophosphorylation)

¼?k½ $NADPH_2$ dk fuek.k (Formation of $NADPH_2$)

¼d½ **i.kgfjr d byDVku dk çdk'k d QkVku }kjk mÙkstuk %** çdk'k d fuf'pr QkVku dk vo'kk"k.k djd i.kgfjr v.k dN le; d fy, mÙkftr voLFkk e vk tkrk gA

i.kgfjr ¼lkekU;½ + hv ¼QkVku½ ¾ i.kgfjr ¼mÙkftr voLFkk½

xue d Fkkbydkbl e mifLFkr Dok.Vklke d dUæ e vfHkfØ;k dUæ ;k xkgh dUæ (Trapping centre) gkr gA çdk'k r= I e xkgh dUæ P_{700} rFkk çdk'k r= II e xkgh dUæ P_{680} d v.k mÙkftr voLFkk e gkr gA bud cká vkor dk mÙkftr byDVku mll ckgj fudy tkrk g] rFkk 10^{-9} ;k 10^{-8} ld.M rd ckgj jg ldrk gA bl le; og vU; ;kfxdk }kjk xg.k dj fy;k tkrk g vU;Fkk viuh Åtk dh gkfu dj iu% ey voLFkk e ykV vkrk gA xkgh dUæ dk byDVku QjhMkfDlu (Ferredoxin = Fd) }kjk rFkk P_{680} dk byDVku lykLVkfDouku (Plastoquinone = PQ) }kjk xg.k dj fy;k tkrk gA

$$\text{çdk'k} \rightarrow \text{çdk'k r= I} \rightarrow P_{700} \xrightarrow{2e^-} Fd^{--} + P_{700}^{++-}$$

$$\text{çdk'k} \rightarrow \text{çdk'k r= II} \rightarrow P_{680} \xrightarrow{2e^-} PQ^{--} + P_{680}^{++-}$$

¼[k½ **ty dk çdkf'k; vi?kVu %** çdkf'k; Åtk }kjk PS II d mÙktu l ;g çcy vkDlhdkjd dk dk; djrk gftll ty d v.k dk vi?kVu gk tkrk g bl fØ;k

e eXuht] dfY'k;e ,o DykjkbM vk;u egRoi.k Hkfedk fuoogu djr gA

$$2H_2O \xrightarrow{\text{çdk'k}} 4H^+ + 4e^- + O_2$$

oku uhy (Van Neil) u crk;k fd çdk'k l'y"k.k e O_2 ty vi?kVu l eDr gkrh gA bl dFku dk :cu] gkfln vkj dkeu (Ruben, Hassid and Kamen) u jfM;k ,fDVo vkDlhtu (O^{18}) dk ç;kx dj çekf.kr fd;kA

$$6CO_2 + 12H_2O^{18} \longrightarrow C_6H_{12}O_6 + 6H_2O + 6O_2^{18}$$

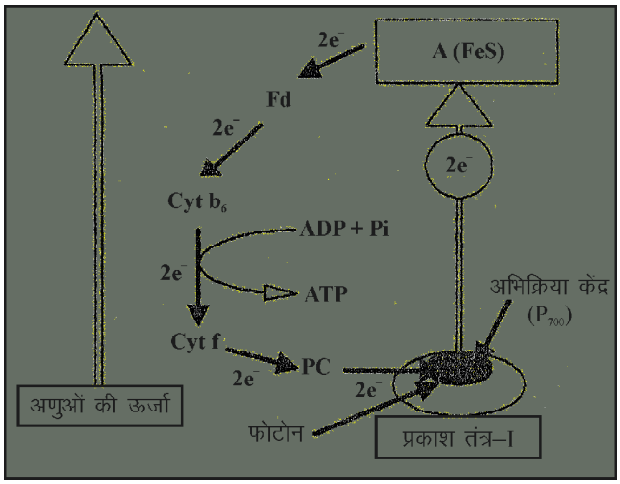
bl fl) gkrk g fd O_2 foekpu dk lkr ty gA

¼x½ **çdk'k QkLQkfjyhdj.k %** gfjryod e çdk'kh; Åtk }kjk ADP dk ATP e ifjoru ,o mud lg;kfx;k u [kktk FkkA çdk'k QkLQkfjyhdj.k fØ;k nk çdkj l gkrh g&

(i) pØh; çdk'k QkLQkfjyhdj.k (Cyclic photophosphorylation)

(ii) vpØh; çdk'k QkLQkfjyhdj.k (Non cyclic photophosphorylation)

(i) **pØh; çdk'k QkLQkfjyhdj.k %** çdk'k r= I l mRlftr byDVku A → Fd–cyt $b_{6/F}$ → lykLVklk;fuu l gkr g, ; P_{700} ij ykV vkr g bl çdkj okil ykVr byDVku Fd rFkk Cy + b_6 ,o Cy + b_6 rFkk Cy + F d e/; nk LFkyk ij ADP l ATP dk fuek.k djr gA bl vfHkfØ;k e byDVku P_{700} l mRlftr gkdj iu% P_{700} e pØh; fØ;k }kjk igp tkr g rFkk ATP dk fuek.k djr g blfy, bl pØh; QkLQkfjyhdj.k dgr g ¼fp= 21-8½A

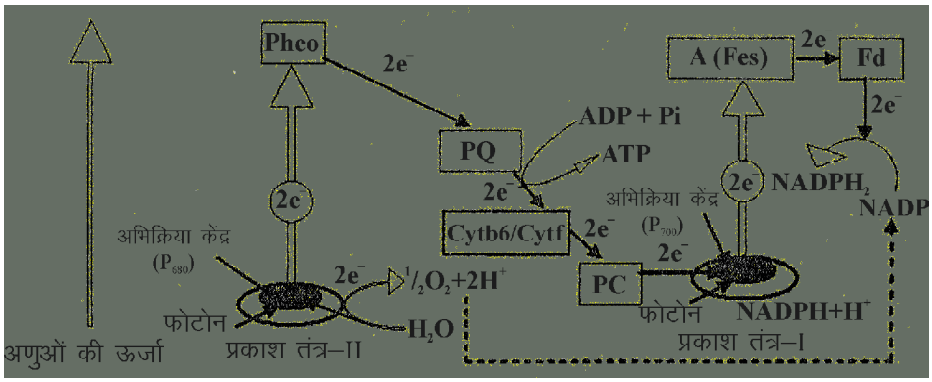


fp= 21-8 % çdkf'kd vfHkfØ;k e lEiUu gku okyk pØh; QkLQkfjyhdj.k

(ii) **vpØh; çdk'k QkLQkfjyhdj.k %** ;g QkLQkfjyhdj.k nkuk çdk'k r=k (PS I ,o PS II) d }kjk gkrk gA bl çdk'k l'y"k.k dh Z-Ldhe dgr g ftldh [kkt Hill ,o Bendall }kjk dh xb FkhA bl fØ;k e P_{680} }kjk mRlftr byDVku iu% P_{680} ij ugh vkdj ,d j[kh; iFk }kjk inkFk Pheo → lykLVkDohuku → lkbVkØke lkbVkØke b_6 → lkbVkØke $_F$ → lykLVklk;fuu l gkr g, P_{700} e igp tkr g rFkk Cy + b ,o Cy + F d e/; ATP dk fuek.k djr gA pfd bl fØ;k e P_{680} l mRlftr byDVku iu% P_{680} e ugh igpr g blfy, bl vpØh; QkLQkfjyhdj.k dgr g ¼fp= 21-9½A

¼?k½ **$NADPH_2$ dk fuek.k %** vpØh; QkLQkfjyhdj.k e PSI l mRlftr byDVku fofHkUu xkfg;k l gkr g, $NADP^+$ rd igp dj ml vipf;r dj nr gA ;g vipf;r $NADP^+$ ty vi?kVu l çklr çkVku xg.k dj $NADPH_2$ e ifjofrr gk tkrk gA

vr% çdkf'kd vfHkfØ;k e fufer ATP ,o $NADPH_2$ l'y"k.kRed 'kfDr (Assimilatory power) dk fuek.k djr g tk vçdkf'kd vfHkfØ;k e CO_2 dk vip;u dj Xydkt v.k d fuek.k e ç;Dr gkrh gA



fp= 21-9 % çdkf'kd vfHkfØ;k e lEiUu gku okyk vpØh; QkLQkfjyhdj.k

$$2NADP + 4H^{+} + 4e^{-} \longrightarrow 2NADPH_2$$

CO_2 d 6 v.kvk d vip;u gr 12 $NADPH_2$ dh vko';drk gkrh g tk ty d 12 v.kvk d vi?kVu d i'pkr çkIr gkr gA

pØh; ,o vpØh; QkLQkfjyhdj.k e vUrj

pØh; çdk'k QkLQkfjyhdj.k	vpØh; çdk'k QkLQkfjyhdj.k
1- ty dk çdkf'kd vi?kVu ugh gkrk gA	ty dk çdkf'kd vi?kVu gkrk gA
2- O_2 dk mRItu ugh gkrk gA	O_2 dk mRItu gkrk gA
3- doy çdk'k r= I dk mi;kx gkrk gA	nkuk çdk'k r=k dk mi;kx gkrk gA
4- $NADPH_2$ dk l'y"k.k ugh gkrk gA	$NADPH_2$ dk l'y"k.k gkrk gA

vçdkf'kd vfHkfØ;k (Dark Recation)

çdk'k l'y"k.k e lEiUu gku okyh ;g fØ;k gfjryod d LVkek e lEiUu gkrh g rFkk ble çdk'k dh vko';drk ugh gkrh gA bl çfØ;k e ok;e.My }kjk vo'kkf"kr CO_2 fofHkUu ,Utkbek }kjk vipf;r gkdj 'kdjk dk fuek.k djrh gA

dfYou pØ ;k C_3 pØ (Calvin Cycle or C_3 Cycle)

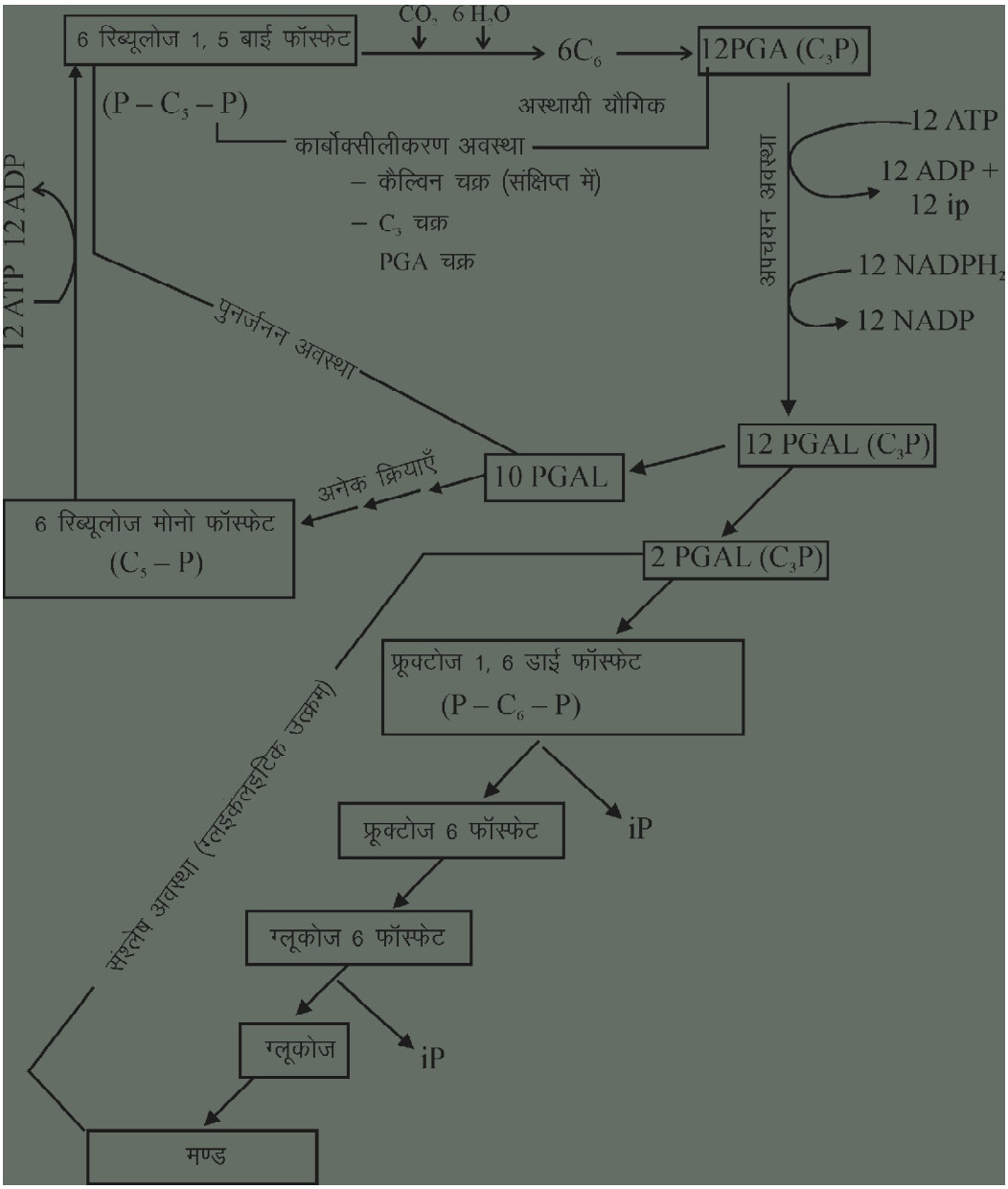
bl pØ dh [kkt dfYou] cUlu ,o mld lkfFk;k u 1946-1953 d e/; jfM;k&,fDVo Vlj ,o ØkeVkxkQh rduhd dk mi;kx djd dh Fkh bl dk; gr mUgku gj 'koky Dykjyk (*Chlorella*) ,o luMlel (*Scenedesmus*) dk mi;kx fd;k FkkA bl dk; d fy, 1961 e bUg ukcy ijLdkj }kjk lEekfur fd;k Fkk ¼fp= 21-10½A

dfYou pØ fuEufyf[kr pj.kk e lEiUu gkrk gA

1- dkckDlhyhdj.k voLFkk vFkkr CO_2 xg.k djuk (Carboxylative phase)
2- vip;u voLFkk vFkkr PQA dk vip;u (Reductive phase)
3- l'y"k.k voLFkk vFkkr 'kdjk dk fuek.k (Synthetic phase)
4- iutuu voLFkk vFkkr RuBP dh iuh çkfIr (Regenerative phase)

1- **dkckDlhyhdj.k voLFkk** (Carboxylative phase) : bl fØ;k e RuBP (Ribulose 1-5 bisphate) ,o CO_2 RuBP dkckDlhyt ;k :fcLdk (Rubisco) ,Utkbe dh mifLFkfr e feydj 6 dkcu ;Dr vLFkk;h ;kfxd dk fuek.k djr gA ;g ;kfxd 'kh?k VV dj 3 dkcu ;Dr ;kfxd QkLQkfXylfjd vEy (3-Phosphoglyceric acid or 3 PGA) d nk v.kvk e VV tkrk gA 3 PGA çdk'k l'y"k.k dk çFke LFkk;h mRikn gku l bl C_3 pØ Hkh dgr g D;kfd ;g 3 dkcu ;Dr ;kfxd gkrk gA

$$6RuBP + 6CO_2 + 6H_2O \xrightarrow{RUBISCO} \underset{\text{अस्थायी यौगिक}}{6C_6} \longrightarrow 12PGA$$
(Phosphoglyceric acid)



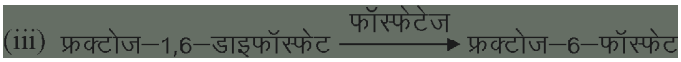
fp= 21-10 % dfYou pØ d çe[k pj.k

2- **vip;u voLFkk** (Reductive phase) : bl vfHkfØ;k e vipk;d 'kfDr tk çdkf'kd vfHkfØ;k e ATP ,o $NADPH_2$ d :i e fufer gb Fkh mldk mi;kx dj 3-QkLQkfXyljyfMgkbM (3 PGAL) e vipf;r gk tkrk gA ; fØ;k, Xykdkykbfll d foifjr gkrh g vr% bUg Xykbdkykbfvd mRØe.k (Glycolytic reversal) Hkh dgr gA ;g fØ;k nk ink e i.k gkrh gA

(i)

(ii) 

3- **l'y"k.k voLFkk** (Synthetic phase) : 3-QkLQkfX ljyfMgkb (3 PGAL) d nk v.kvk l Xydkt 'kdjk dk fuek.k gkrk g tk çdk'k l'y"k.k dk vfUre mRikn gA Xydkt l LVkp dk fuek.k gkrk gA l'y"k.k voLFkk e fuEu fØ;k, lEiUu gkrh gA



4- **iutuu voLFkk** (Regenerative phase) : 3 PGAL d 'k"k 10 v.k fofHkUu fØ;kvk }kjk vud e/;orh 'kdjkvk dk fuek.k djr gA ; lHkh e/;orh 'kdjk, vUr e fjC;ykt-5 QkLQV d 6 v.kvk dk fuek.k djrh gA tk ATP l fØ;k djd fjC;ykt 1-5 ckbQkLQV d 6 v.kvk e ifjofrr gk tkrh gA bl l fØ;k d vUr%RuBP dh iu% çkflr gk tkrh gA

vud e/;orh fØ;k,

$$10\ PGAL \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow 6\ RUMP$$

$$6\ RUMP + 6\ ATP \longrightarrow 6\ RUBP + 6\ ADP$$

çdk'k l'y"k.k dk çHkkfor dju oky dkjd (Factors Affecting Photosynthesis)

çdk'k l'y"k.k dh vfHkfØ;k db çdkj d cká ,o vkUrfjd dkjdk }kjk fu;f=r gkrh gA

1- **cká dkjd**

(i) **çdk'k %** ikni dh ifÙk;k }kjk vo'kkf"kr yxHkx 1-4% çdk'k gh çdk'k l'y"k.k e ç;Dr gkrk gA çdk'k nk çdkj l çdk'k l'y"k.k dk çHkkfor djrk gA

½d½ **çdk'k dh rhork %** çdk'k c<u d lkFk&lkFk çdk'k l'y"k.k dh nj c<rh g ijUr cgr vfèkd rhork gk tku ij nj ?kVrh gA

¼[k½ **çdk'k dh x.koÙkk %** çdk'k l'y"k.k çdk'k LiDVe d n'; Hkkx e gh lEiUu gkrh g çdk'k l'y"k.k dh vfèkdre nj n'; LiDVe d cká ,o uhy Hkkx e gkrh gA gj çdk'k e çdk'k l'y"k.k ugh gkrk gA

(ii) **dkcu MkbvkDlkbM** (CO_2) % ok;e.My e CO_2 dh ek=k doy 0.03% ;k 300 ppm gkrh gA ok;e.My e CO_2 dh ek=k 0.03 l c<dj 0.05% gku rd çdk'k l'y"k.k dh nj c<rh gA ijUr bl l vf/kd gku ij jèk cUn gku yxr g] ftl l çdk'k l'y"k.k dh nj de gk tkrh gA

(iii) **rkiØe** (Temperature) % çdk'k l'y"k.k dh nj 10°C l 35°C rkieku ij c<rh gA çR;d 10°C rkieku c<u ij fØ;k nj nxuh gk tkrh gA bl Q_{10} dk eku 2 dgk tkrk gA 10°C l de rkieku ij ,Utkbe fu"Ø; gk tkr g rFkk 35°C l vf/kd rkieku ij ,Utkbe dk foÑfrdj.k gk tkrk gA

(iv) **ty** (Water) % dy vo'kkf"kr ty dk doy 1% Hkkx gh çdk'k l'y"k.k e ç;Dr gkrk gA enk ty çR;{k :i l çdk'k l'y"k.k dh nj çHkkfor djrk gA enk ty vçR;{k :i l çdk'k l'y"k.k dh nj dk nk çdkj l çHkkfor djrk gA

¼d½ ty dh deh l ifÙk;k d j/k cUn gk tkr g ftl CO_2 dh lkUærk de gk tkrh gA

¼[k½ iÙkh dk ty foHko de gk tkrk gA

(v) **çn"kd** (Pollutant) % ok;e.My e SO_2, CO, vk tku rFkk vU; çn"kd xl çdk'k l'y"k.k dh nj dk de dj nrh gA

2- vkUrfjd dkjd

çdk'k l'y"k.k dh nj dk çHkkfor dju oky çe[k vkUrfjd dkjd fuEu gA

(i) **i.kgfjr** % i.kgfjr dh vuifLFkfr e çdk'k l'y"k.k dh fØ;k ugh gkrh gA çdk'k l'y"k.k dh nj i.k e i.kgfjr dh ek=k c<u d lkFk c<rh gA

(ii) **lfpr Hkk tu dh ek=k** % dkf'kdk e lfpr Hkk tu LVkp dh ek=k c<u d lkFk çdk'k l'y"k.k dh nj ?kVu yxrh g ijUr LVkp d njLFk Hkkx e LFkkukUrfjr gku ij ;g c<u yxrh gA

(iii) **i.k dh vkUrfjd ljpuk** % ;fn i.k ij j/kk dh l[;k vf/kd ,o i.ke/;kÙkd e gfjryodk dh l[;k vf/kd gkx rk çdk'k l'y"k.k dh nj vf/kd gkxhA

egRoi.k fcUn

1- çdk'k l'y"k.k ,d egRoi.k tfod fØ;k g ftle gj ik/k l; d çdk'k dh mifLFkfr e dkcu MkbvkDlkbM o ty }kjk tfVy dkcfud ;kfxdk dk fuek.k djr gA

2- çdk'k l'y"k.k dh fØ;k gfjryod e lEiUu gkrh g ftle ik; tku oky FkkbydkbM e gj o.kd i.kgfjr ,o lgk;d o.kd djkfVukbM ik; tkr gA

3- FkkbydkbM ,d nlj ij flDd dh <jh dh rjg 0;ofLFkr gkdj xuk dk fuek.k djr g tgk ij çdk'k l'y"k.k dh çdkf'kd vfHkfØ;k lEiUu gkrh gA

4- çdk'k l'y"k.k ,d to jklk;fud] vkDlhdj.k&vip;u fØ;k g ftle ikuh dk vkDlhdj.k rFkk CO_2 dk vip;u gkrk gA

5- çdk'k l'y"k.k e çdk'k Åtk dk vo'kk"k.k db i.kgfjr v.kvk ,o vU; lgk;d o.kdk }kjk gkrk g tk ckn e bl çdk'k Åtk dk vfHkfØ;k dUæ e LFkkukUrfjr dj nr gA ; lHkh o.kd feydj nk çdk'k r=k dk fuek.k djr g ftUg çdk'k r= I ,o çdk'k r= II dgk tkrk gA

6- çdk'k l'y"k.k dh vfHkfØ;k nk pj.kk e lEiUu gkrh gA

¼d½ çdkf'kd fØ;k xue Hkkx ij lEiUu gkrh g ,o ble O_2 eDr gkrh gA

¼[k½ vçdkf'kd vfHkfØ;k gfjryod d LVkek e lEiUu gkrh g] ftle CO_2 d fLFkjhdj.k l 'kdjk dk fuek.k gkrk gA

7- çdkf'kd vfHkfØ;k e ATP ,o $NADPH_2$ dk fuek.k gkrk g] ftl vipk;d 'kfDr ;k Lokxhdj.k 'kfDr dgk tkrk gA

8- vçdkf'kd vfHkfØ;k e vipk;d 'kfDr ATP ,o $NADPH_2$ dk mi;kx CO_2 d 'kdjk e vip;u gr fd;k tkrk gA

9- çdk'k l'y"k.k dh nj dk fu;eu db çdkj d ckÁ ,o vkUrfjd dkjdk }kjk gkrk gA bue CO_2 dh lkUærk] çdk'k dh rhork] ty dh miyC/krk o rkieku çe[k gA çdk'k l'y"k.k dh nj iÙkh dh vk; rFkk o.kdk dh ek=k ij Hkh fuHkj djrh gA

vH;klkFk ç'u

oLrfu"B ç'u

1- çdk'k l'y"k.k e çdk'k Åtk :ikUrfjr gkrh g &

¼v½ ;kf=d Åtk e ¼c½ xfrt Åtk e

¼l½ jklk;fud Åtk e ¼n½ fo|r Åtk e

2- çdk'k l'y"k.k fØ;k g &

¼v½ mip;h ¼c½ vkDlhdj.k&vip;u

¼l½ Åtk 'kk"kh ¼n½ mijkDr lHkh

3- çdk'k l'y"k.k e mRlftr vkDlhtu dk lkr g &

¼v½ ty ¼c½ dkcu MkbvkDlkbM

¼l½ mijkDr nkuk ¼n½ mijkDr e l dkb ugh

4- çdk'k l'y"k.k dh vçdkf'kd vfHkfØ;k lEiUu gkrh g &

¼v½ xuk e ¼c½ LVkek e

¼l½ ekbVkdkfUM;k e ¼n½ mijkDr lHkh

5- çdk'k l'y"k.k dk çFke pj.k g &

¼v½ i.kgfjr dk çdk'kh; Åtk }kjk mÙktu

¼c½ ty dk çdkf'kd vi?kVu

¼l½ QkLQkfjyhdj.k

¼n½ $NADPH_2$ dk fuek.k

6- C_3 iknik e vçdkf'kd dk çFke LFkk;h mRikn g &

¼v½ PEP ¼c½ PGA

¼l½ RUBP ¼n½ Xydkt

7- vipk;d 'kfDr g &
¼v½ ATP ¼c½ $NADPH_2$
¼l½ mijkDr nkuk ¼n½ dkb ugh

8- ty dk çdkf'kd vi?kVu dh vfHkfØ;k fdl l lc/k j[krh g &
¼v½ pØh; QkLQkfjyhdj.k
¼c½ vpØh; QkLQkfjyhdj.k
¼l½ çdk'k r=-I
¼n½ mijkDr lHkh

9- 40°C rkieku ij çdk'k l'y"k.k dh nj de gk tkrh g D;kfd &
¼v½ CO_2 dh ek=k e of)
¼c½ ty dh deh
¼l½ ,Utkbe dk foÑfrdj.k
¼n½ mijkDr e l dkb ugh

vfry?kÙkjkRed ç'u

1- çdk'k l'y"k.k dk ifjHkkf"kr dhft ;A
2- çdk'k l'y"k.k dk vfUre mRikn D;k g\
3- çdk'k l'y"k.k dh fØ;k e Hkkx yu oky lgk;d o.kd dku&dku l gkr g\
4- ty d çdk'kh; vi?kVu d fy, vko';d nk vk;uk d uke fyf[k;A
5- gfjryod e tk lokf/kd çkVhu feyrh g mldk uke fyf[k;A
6- jM Mki dh [kkt fdlu dh Fkh\ ;g ?kVuk n'; LiDVe d fdl Hkkx e gkrh g\
7- dfYou pØ dk C_3 pØ D;k dgr g\

y?kÙkjkRed ç'u

1- gfjryod dh ljpuk dk l{ki e o.ku dhft ;A
2- çdk'k l'y"k.k e ç;Dr gku oky o.kd dku&dku l g\
3- ty d çdk'kh; vi?kVu l vki D;k le>r g\
4- çdkf'kd QkLQkfjyhdj.k fdl dgr g\
5- pØh; ,o vpØh; QkLQkfjyhdj.k e vUrj Li"V dhft ;A
6- çdk'k r= II dh ljpuk le>kb;A
7- dfYou pØ dh vip;u voLFkk e dku&dku lh vfHkfØ;k, gkrh g\
8- çdk'k l'y"k.k ,d vkDlhdj.k&vip;u vfHkfØ;k g] le>kb;A

fucU/kkRed ç'u

1- çdk'k QkLQkfjyhdj.k l vki D;k le>r g\ pØh; ,o vpØh; çdk'k QkLQkfjyhdj.k dk foLrkj l le>kb;A
2- dfYou pØ }kjk CO_2 d fLFkjhdj.k dh çfØ;k dk o.ku dhft ;A
3- çdk'k l'y"k.k dk çHkkfor dju oky dkjdk dk o.ku dhft ;A

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mÙkjekyk % 1 ¼l½ 2 ¼n½ 3 ¼v½ 4 ¼c½
5 ¼c½ 6 ¼c½ 7 ¼l½ 8 ¼c½ 9 ¼l½

v/;k; & 22

ikni 'kjhj fØ;k foKku & f}rh;

(Plant Physiology - II)

'olu (Respiration)

leLr lthok dk viuh tfod fØ;k, dju d fy, Åtk dh vko';drk gkrh gA ltho mue mifLFkr dkcfud ik"kd inkFkk tl dkckgkbMV] çkVhu] olk vkfn l ; Åtk çklr djr gA bu tfVy dkcfud inkFkk e lfpr Åtk ,d fof'k"V to jklk;fud çfØ;k }kjk eDr gkrh g] ftldk ,d fof'k"V Åtk v.k ATP d :i e lfpr fd;k tkrk gA ATP }kjk fofHkUu to fØ;kvk d fy, ;g Åtk çnku dh tkrh gA

ifjHkk"kk dh nf"V e 'olu ,d vkDlhdj.k vfHkfØ;k g ftle lthok e mifLFkr fofHkUu tfVy dkcfud inkFkk dk fo?kVu gkrk g] ftld QyLo:i CO_2 ,o H_2O mRiUu gkrh g rFkk Åtk eDr gkrh gA vr% 'olu ,d vip;h] Åtk foekph rFkk vkDlhdkjh vfHkfØ;k gA ;g lthok e fujUrj pyu okyh vfHkfØ;k gA 'olu ik/kk ,o tUrvk d thfor jgu dk çe[k y{k.k gA

'olu ,o ngu (Respiration and Combustion)

lekurk, % 'olu ,o ngu e fuEu lekurk, mifLFkr gkrh g &

1- vkDlhtu dk mi;kx 2- dkcu MkbvkDlkbM dk fu"dklu 3- Åtk dk foeDr gkuk

'olu ,o ngu e db çdkj d vUrj ik; tkr g&

'olu d çdkj (Types of Respiration)

'olu fØ;k d vUrxr e[;r% dkcfud inkFkk d fo?kVu l jklk;fud vFkok dk;{ke Åtk foeDr gkrh gA 'olu vfHkfØ;k vkDlhtu d çR;{k mi;kx vFkok fcuk mi;kx d lEiUu gk ldrh gA vr% vkDlhtu d mi;kx@vui;kx d vk/kkj ij 'olu dk nk çdkj e foHkkftr fd;k tk ldrk g&

1- ok; vFkok vkDlh 'olu (Aerobic Respiration)

2- vok; vFkok vukDlh 'olu (Anaerobic Respiration)

1- vkDlh 'olu (Aerobic Respiration)

'olu dh ;g lkekU; çfØ;k g] tk vkDlhtu dh mifLFkfr e lEiUu gkrh gA vkDlhtu dh mifLFkfr e ,Utkbek dh lgk;rk l bl fØ;k d vUrxr dkcfud inkFkk d i.k vkDlhdkjh fo?kVu l ty rFkk CO_2 cur g rFkk Åtk eDr gkrh g vr% vkDlh 'olu ,d m"ek{kh vfHkfØ;k gkrh gA Xydkt vFkok ÝDVkt dk vfHkdkjd ekudj bl vfHkfØ;k dk lex lehdj.k fuEu çdkj l fn;k tk ldrk g&

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 686 K.cal / mol.$$

'olu (Respiration)	ngu (Combustion)
1- dkf'kdk }kjk fu;f=r vfHkfØ;k	dkf'kdk dk fu;=.k ugh gkrk gA
2- Åtk fu"dklu /khj&/khj gkrk gA	Åtk ,d lkFk vf/kd ek=k e mRiUu gkrh gA
3- ;g fØ;k lekU; rki ij gkrh gA	;g fØ;k mPp rki ij gkrh gA
4- ;g vfHkfØ;k ,Utkbe }kjk fu;f=r gkrh gA	bl fØ;k ij ,Utkbek dk fu;=.k ugh gkrk gA
5- Åtk dk m"ek d :i e gkl de gkrk gA	Åtk d m"ek d :i e gkl vR;f/kd gkrk gA
6- ATP dk fuek.k gkrk gA	ATP dk fuek.k ugh gkrk gA

2- vukDlh 'olu (Anaerobic Respiration)

ok; vFkok vkDlhtu dh vuifLFkr e gku okyh 'olu vfHkfØ;k vukDlh 'olu dgykrh gA bl vfHkfØ;k e dkcfud inkFkk vFkok 'oluk/kkjk dk vi.k vkDlhdj.k gkrk g] vr% vfUre mRikn ty ,o CO_2 ugh gkdj CO_2 ,o vU; dkcfud inkFk tl ,Ydkg.k] dkcfud vEy gkr gA vukDlh 'olu e 'oluk/kkjk d vkf'kd fo?kVu l mRikfnr Åtk dh ek=k Hkh de gkrh g bl vfHkfØ;k dk fuEu lehdj.k }kjk fu:fir fd;k tk ldrk g&

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2 + 28\,K.cal$$

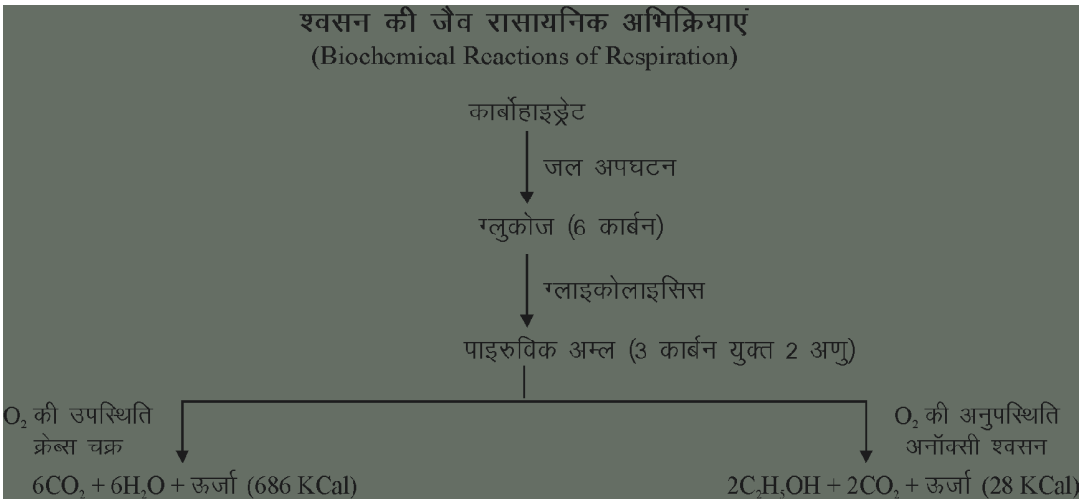
vok; 'olu vf/kdk'kr% thok.k ,o dodk e ik;k tkrk gA vud mPpoxh; ik/kk d mÙkdk] vdfjr gkr g, rFkk ,df=r chtk vkfn e Hkh dN le; d fy, vukDlh 'olu gkrk gA

vkDlh ,o vukDlh 'olu e vUrj

vkDlh 'olu	vukDlh 'olu
1- ;g fØ;k O_2 dh mifLFkfr e lEiUu gkrh gA	;g O_2 dh vuifLFkfr e gkrh gA
2- bl vfHkfØ;k e mPp ek=k e Åtk mRiUu gkrh gA	ble Åtk mRiknu vi{kkÑr dkQh de ek=k e gkrk gA
3- ble dkckgkbMV d i.k vkDlhdj.k l vfUre mRikn d :i e O_2 rFkk ty dk fuek.k gkrk gA	ble dkckgkbMV d vi.k vkDlhdj.k l CO_2 ,o ,Ydkgy mRikfnr gkr gA
4- ;g vfHkfØ;k dkf'kdk æ0; ,o ekbVkdkfUM;k e lEiUu gkrh gA	;g i.kr% dkf'kdkæ0; e lEiUu gkrh gA

'olu vfHkfØ;k d LFky

lkekU;r% ;dfj;kfVd dkf'kdkvk e 'olu vfHkfØ;k dkf'kdkæ0; ,o ekbVkdkfUM;k e lEiUu gkrh g bue vkDlhtu ij fuHkj leLr vfHkfØ;k, ekbVkdkfUM;k e lEiUu gkrh gA ekbVkdkfUM;k ATP d fuek.k e egRoi.k Hkfedk fuogu djrk g blfy, bl dkf'kdk dk 'kfDrxg (Power house of cell) dgr gA çkdfj;kfVd dkf'kdkvk e 'olu vfHkfØ;k, dkf'kdkæ0; ,o dkf'kdk f>Yyh ij lEiUu gkrh gA



vkDlh 'olu dh fØ;k fof/k

(Mechanism of Aerobic Respiration)

vkDlh 'olu dh lkekU; fØ;k fof/k rhu pj.kk e lEiUu gkrh g&

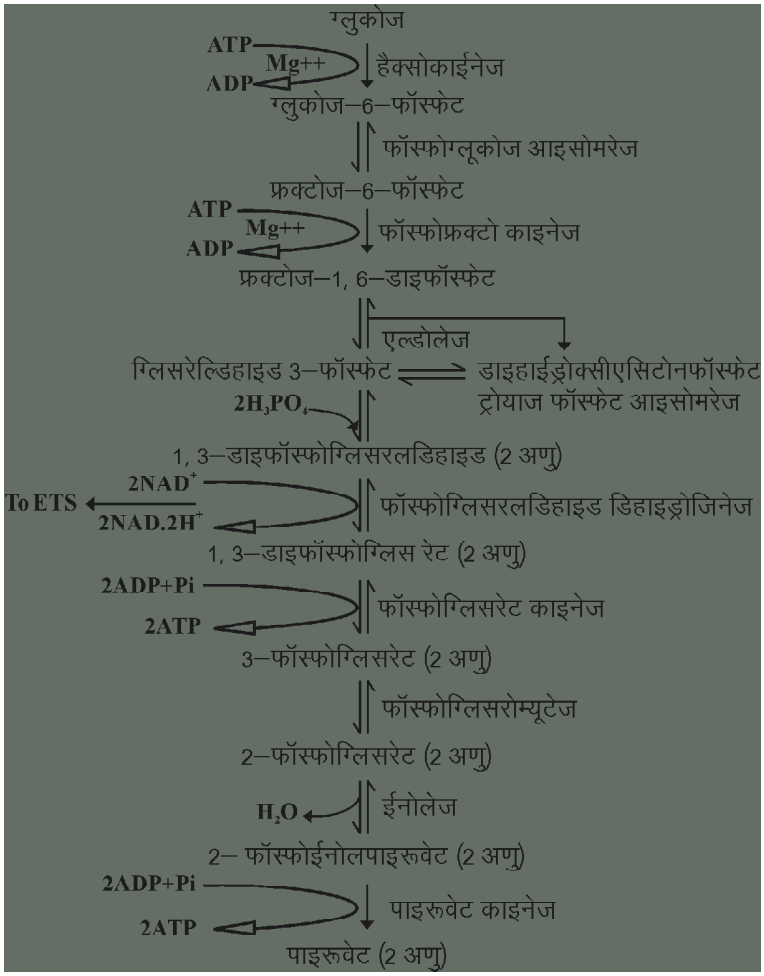
1- Xykbdkykbfll (Glycolysis)

2- ØCl pØ (Kreb's cycle)

3- byDVku ifjogu r= (Electron transport system)

1- **Xykbdkykbfll** (Glycolysis) : Xykbdkykbfll 'olu dh çFke vfHkfØ;k g ftle 6 dkcu ;Dr 'kdjk ¼çk;¼ Xydkt½ dk ifjoru 3 dkcu ;Dr ikb:fod vEy dh nk v.kvk e gkrk gA ;g vfHkfØ;k dkf'kdkæ0; e vkDlhtu dh mifLFkfr@vuifLFkfr e lEiUu gkrh gA bld fofHkUu pj.kk dh [kkt rhu teu oKkfudk ,EcMu] e;jgkQ ,o ikjukl (Embden, Mayer Hoff and Parnas) }kjk dh xb Fkh blfy, bl EMP ifjiFk Hkh dgr gA Xykbdkykbfll dh lex fØ;k dk fuEufyf[kr lehdj.k }kjk n'kk;k tk ldrk g ¼fp= 22-1½A

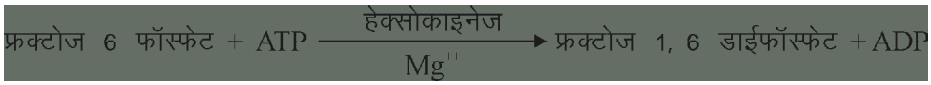
$$C_6H_{12}O_6 + 2ATP + 4ADP + 2pi + 2NAD \rightarrow 2C_3H_4O_3 + 2ADP + 4ATP + 2NADH_2$$



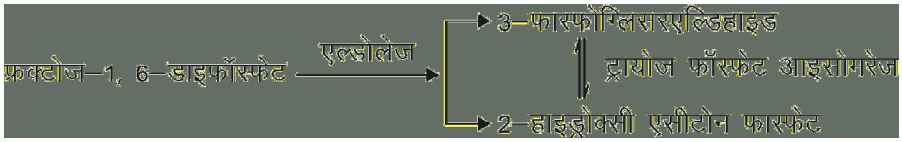
fp= 22-1 % Xykbdkykbfll dh fofHkUu tojklk;fud vfHkfØ;k,

Xykbdkykbfll dh vfHkfØ;k vukDlh ,o vkDlh 'olu e leku :i l lEiUu gkrh gA vok; 'olu dju oky thok e 'olu doy Xykbdkykbfll }kjk gh lHko gA bl vfHkfØ;k d vUrxr gku okyh leLr vfHkfØ;kvk dk fuEukulkj le>k;k tk ldrk g &

(i) **Xydkt dk lfØ;dj.k** (Activation of glucose) : Xydkt ,d LFkk;h 'kdjk g tk vklkuh l fo?kfVr ugh gkrh g vr% bl ATP }kjk Åtk çnku djd lfØ; fd;k tkrk g bl 'kdjk dk QkLQkfjyhdj.k Hkh dgr gA bld vUrxr fuEu fØ;k, gkrh gA

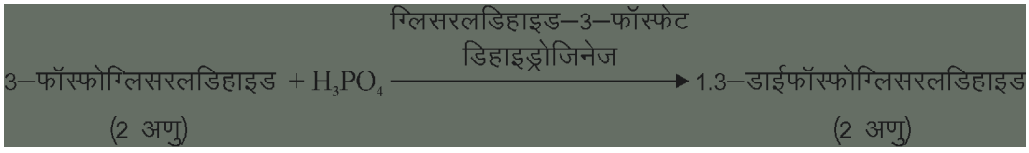


(ii) **ÝDVkt 1&6 MkbQkLQV dk QkLQkfXyljyfMgkbM e fo?kVu** (Splitting of fructose 1-6 diphosphate in phosphoglyaraldehyde) : ÝDVkt 1&6 MkbQkLQV ,d 6 dkcu ijek.k ;Dr v.kg tk ,YMkyt ,Utkbe dh mifLFkfr e fo[kf.Mr gkdj 3 QkLQkfXyljy ,fYMgkb o MkbgkbMkDlh ,lhVku&3 QkLQV dk fuek.k djrk gA ; nk ;kfxd Vk;kt QkLQV dgykr gA



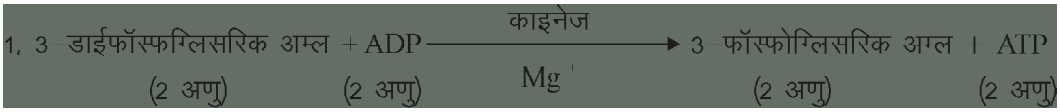
(iii) **ikb:fod vEy dk fuek.k** : 3-QkLQkfXyljyfMgkbM d nk v.k fuEu vfHkfØ;kvk }kjk vkDlhÑr gkdj ikb:fod vEy d nk v.kvk dk fuek.k djr gA

(a) **3 PGAL dk QkLQkfjyhdj.k** : 3 PGAL fMgkbMkftut ,Utkbe dh mifLFkfr e H_3PO_4 l vfHkfØ;k dj 1-3 MkbQkLQkfXyljyfMgkbM dk fuek.k djrk gA



(b) **1-3 MkbQkLQkfXylfjd vEy dk fuek.k** : ,Utkbe fMgkbMkftut dh mifLFkfr e 1-3 MkbQkLQkfXyljyfMgkbM vkDlhÑr gkdj 1-3 MkbQkLQkfXylfjd vEy dk fuek.k djrk gA

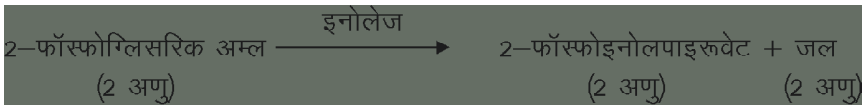
bl vfHkfØ;k e NAD+ gkbMk tuxkgh dk dk; dj $NADH_2$ dk fuek.k djrk g tk ETS e ço'k dj e ATP dk fuek.k djrk gA



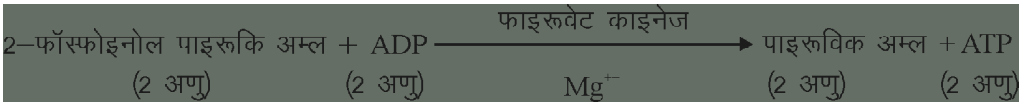
(c) **3-QkLQkfXylfjd vEy ,o ATP dk fuek.k** : 1-3 MkbQkLQkfXylfjd dkbut ,Utkbe dh mifLFkfr e ,d v.k ATP ,o 3 QkLQkfXylfjd vEy dk fuek.k djrk gA

(d) **leko;ohdj.k }kjk 2-QkLQkfXylfjd vEy dk fuek.k** % 3-QkLQkfXylfjd vEy d QkLQV leg d nlj dkcu ij LFkkukUrfjr gku l 2-QkLQkfXylfjd vEy dk fuek.k gkrk gA

(e) **ty fo;ktu }kjk QkLQkbuk yikb:oV (PEP) dk fuek.k** : bukyt ,Utkbe dh mifLFkfr e 2-QkLQkfXylfjd vEy e l ,d ty dk v.k fudy dj 2-QkLQkbuky ikb:fod vEy dk fuek.k gkrk gA



(f) **ikb:fod vEy rFkk ATP dk fuek.k** % ikb:oV dkbut dh mifLFkfr e 2-QkLQkbuky ikb:oV l QkLQV leg fudy dj ikb:fod vEy o ATP dk fuek.k gkrk gA



ikb:fod vEy Xykbdkykbfll dk vfUre mRikn gkrk gA bldk Hkfo"; dkf'kdk d i;koj.k ij fuHkj djrk gA dkf'kdk dk i;kIr vkDlhtu miyC/k gku ij ;g vkDlh; 'olu djrk g ,o vkDlhtu dh vuifLFkfr e ;g vukDlh; 'olu dh vfHkfØ;k, djrk gA

Xykbdkykbfll dk lkj &

1- çR;d 6 dkcu ijek.k ;Dr Xydkt v.k l 2 v.k ikb:fod vEy ¼3-dkcu ijek.k½ dk fuek.k gkrk gA

2- bl vfHkfØ;k e 4 v.k ATP fufer gkr g ijUr 2 ATP dk mi;kx gk tkrk gA vr% 'k) ykHk 2 ATP v.kvk dk gkrk gA

3- 2 v.k $NADH_2$ dk fuek.k gkrk g tk byDVku vfHkxeu r= }kjk 6 vfrjDr ATP v.kvk dk fuek.k djr gA vr% dy Åtk mRiknu 8 ATP v.k gkrk gA

vkDlhtu dh mifLFkfr e dkf'kdkæ0; e Xykbdkykbfll vfHkfØ;k l mRiUu ikb:fod vEy ØCl pØ d fy, ekbVkdkfUM;k e ço'k djrk gA ;g vfHkfØ;k nk pj.kk e lEiUu gkrh gA

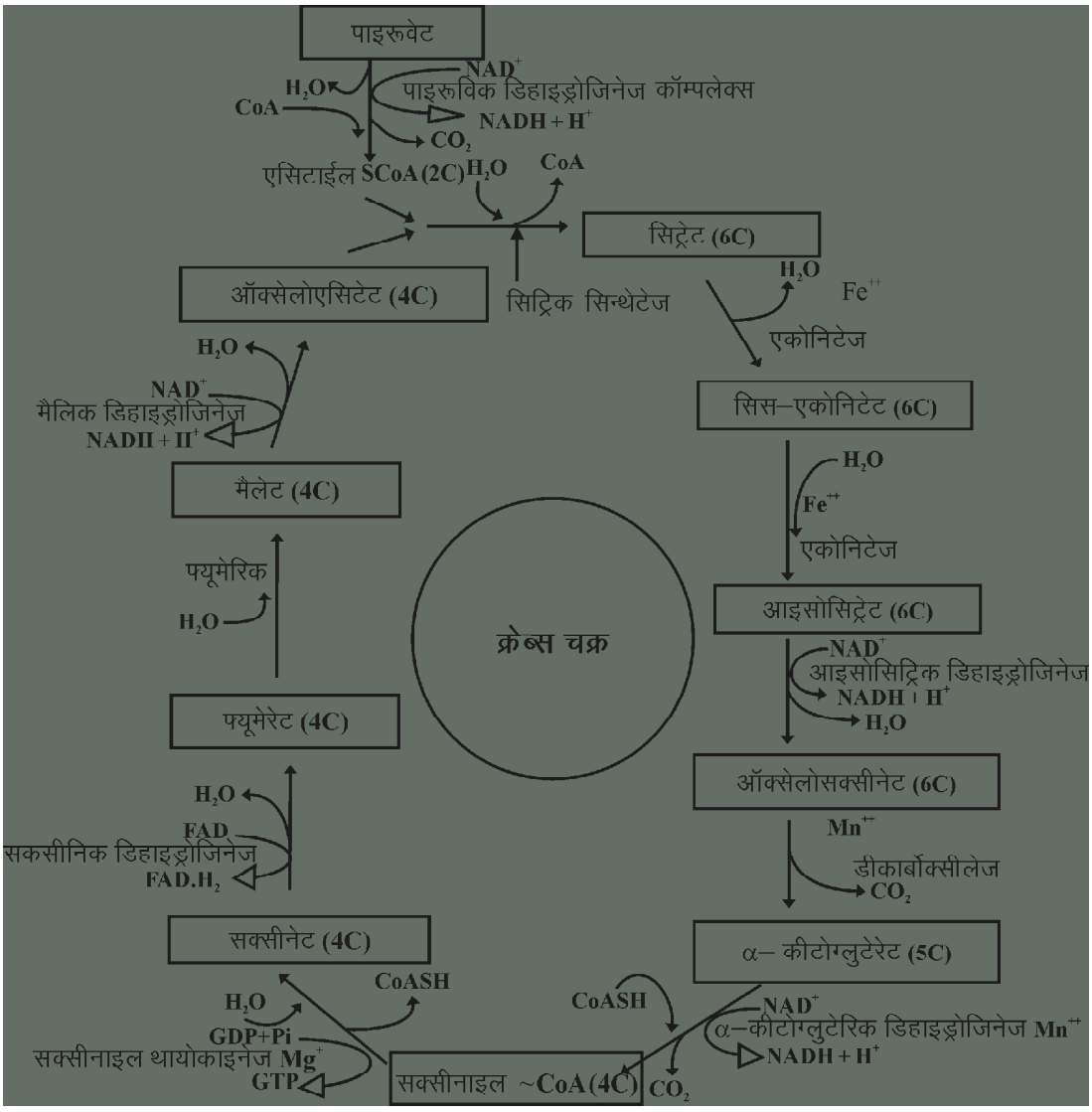
¼d½ ikb:fod vEy dk ok;oh; vkDlhdj.k (Aerobic oxidation of pyruvic acid)

¼[k½ ØCl pØ@flfVd vEy pØ ¼fp= 22-2½

¼d½ **ikb:fod vEy dk ok;oh; vkDlhdj.k** (Aerobic oxidation of pyruvic acid) : vkDlhtu dh miyC/krk ij ikb:fod vEy d v.k ekbVkdkfUM;k e ço'k dj 'olu dk nljk pj.k çkjEHk djr gA ekbVkdkfUM;k e bl ikb:fod vEy d rhu dkcu ijek.kvk e l ,d CO_2 d :i e vkDlhÑr gk tkrk gA rRi'pkr bldk ikb:fod fMgkbMkftut dh mifLFkfr e vkDlhdj.k gkrk g ,o bld ckn dk,Utkbe&, (COA) l l;Dr gkdj ,lhfVy dk,Utkbe , dk fuek.k gkrk gA ,lhfVy dk,Utkbe&, gh ekbVkdkfUM;k dh vUrf>Yyh d Hkn dj efVDl e ço'k dj ldrk gA blfy, bl Xykbdkykbfll ,o ØCl pØ d e/; ;ktd dMh dgk tkrk gA

vr% ikb:fod vEy d 2 v.k ok;oh; vkDlhdj.k }kjk nk&nk v.k ,flVkby dk,Utkbe ,] $NADH_2$ o CO_2 d 2 v.k cukr gA

¼[k½ **ØCl pØ** : ekbVkdkfUM;k e lEiUu gku okyh bl çfØ;k dh [kkt fcfV'k to jlk;u'kkL=h lj ,p-,- ØCl (Sir H.A. Krebs, 1937) u dh Fkh ftl ij bUg 1953 e ukcy ijLdkj l lEekfur fd;k x;k FkkA bl vfHkfØ;k dk çkjEHk flfVd vEy d fuek.k l gkrk g vr% bl flfVd vEy pØ Hkh dgk tkrk gA ØCl pØ dh vfHkfØ;k, ekbVkdkfUM;k dh vk/kk=h e fuEukulkj lEiUu gkrh g &



fp= 22-2 % ØCl pØ dh e[; vfHkfØ;k,

1- **flfVd vEy dk fuek.k %** ,flVkby dk,Utkbe ,] vkDlyk,flfVd vEy l l?kud ,Utkbe dh mifLFkfr e fØ;k dj ty ;ktu }kjk flfVd vEy dk fuek.k djrk g vkj dk,Utkbe , eDr gk tkrk gA

एसिटाइल कोएन्जाइम ए + ऑक्सेलोएसिटिक अम्ल $\xrightarrow[H_2O]{\text{संघणक एन्जाइम}}$ सिट्रिक अम्ल + कोएन्जाइग ए

2- **fl l ,dkfufVd vEy dk fuek.k %** flfVd vEy d ty fo;ktu fl l ,dkfufVd vEy mRiUu gkrk gA

सिट्रिक अम्ल $\xrightarrow{\text{एकोनिटेज}}$ सिस–एकोनिटिक अम्ल + H_2O

3- **vkblkflfVd vEy dk fuek.k %** fl l ,dkfufVd vEy ty ;ktu }kjk vkblkflfVd vEy dk fuek.k djrk gA

रिरा–एकोनिटिक अम्ल + H_2O $\xrightarrow{\text{एकोनिटेज}}$ आइसोसिट्रिक अम्ल

4- **vkDlyk&lfDlfud vEy dk fuek.k %** vkblkflVd vEy d fMgkbMkftut ,Utkbe dh mifLFkfr e fogkbMkftuhdj.k l vkDlyk&lfDlfud vEy ,o $NADH_2$ cur gA

5- **α dhVkXyVfjd vEy dk fuek.k %** vkDlyklfDlfud vEy d fMdkckDlhdj.k l α dhVkXyVfjd vEy curk gA

6- **lfDlfuy&dk,Utkbe , dk fuek.k %** α dhVkXyVfjd vEy d vkDlhdh; fodkckDlhfydj.k l pkj dkcu ;Dr lDlhfuy&dk,Utkbe , dk fuek.k gkrk gA vfHkfØ;k e eDr gku oky gkbMktu ijek.k NAD^+ dk $NADH_2$ e vipf;r dj nr g ,o CO_2 eDr gkrh gA

7- **lDlhfud vEy dk fuek.k %** lDlhfud Fkk;kdkbut ,Utkbe dh mifLFkfr e lDlhfuy dk,Utkbe , d ty vi?kVu l lDlhfud vEy dk fuek.k gkrk g rFkk COA iu% eDr gk tkrk gA bl fØ;k e aTP d :i e Åtk eDr gkrh g tk ckn e ATP d fuek.k e ç;Dr gkrh gA

8- **¶;efjd vEy dk fuek.k %** lDlhfud fMgkbMkftut ,Utkbe dh mifLFkfr e lDlhfud vEy vkDlhÑr gkdj ¶;efjd vEy dk fuek.k djrk gA bl fØ;k e eDr gku oky gkbMktu ijek.k FAD }kjk xg.k dj $FADH_2$ e ifjofrr gk tkrk gA

9- **efyd vEy dk fuek.k %** ¶;ejt ,Utkbe dh mifLFkfr e ty ;ktu }kjk ¶;efjd vEy efyd vEy e ifjofrr gk tkrk gA

10- **vkDlyk ,flfVd vEy dk fuek.k %** ØCl pØ d vfUre pj.k e efyd fMgkbMkftut ,Utkbe dh mifLFkfr e efyd vEy d vkDlhdj.k l vkDlyk ,flfVd vEy curk gA

;g vkDlyk ,flfVd vEy iu% ØCl pØ dk çkjEHk djrk gA

ØCl pØ dk egRo

1- bl pØ e ATP v.kvk dk fuek.k gkrk g tk fofHkUu tfod dk;k dk lEiUu dju e lgk;rk djrh gA

2- bl pØ e db ,l e/;orh ;kfxdk dk fuek.k gkrk g ftldk mi;kx vU; to v.kvk d l'y"k.k e gkrk gA

Xydkt d ok;oh; vkDlhdj.k dk lkj

Ø-l-	çfØ;k	mRiUu Åtk
1-	Xykbdkykbfll ¼Xydkt e ikb:fod vEy dk fuek.k½	8 ATP
2-	e/;LFk pj.k ¼ikb:fod vEy e ,flVkby dk,Utkbe½	6 ATP
3-	ØCl pØ ¼,flVkby dk,Utkbe dk i.k vkDlhdj.k½	24 ATP
		38 ATP

vukDlh; 'olu dh fØ;k fof/k

vkDlhtu dh vuifLFkfr e ikb:fod vEy dkf'kdkæ0; e ,df=r gku yxrk gA bl voLFkk e vukDlh 'olu dh fØ;k çkjEHk gk tkrh gA ik/kk ,o tUrvk e ;g fØ;k fHkUu&fHkUu çdkj l gkrh g&

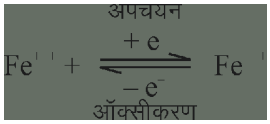
1- ik/kk e ;g fØ;k nk pj.kk e i.k gkrh gA çFke pj.k e ikb:fod vEy ,flVfYMgkbM e ifjofrr gkrk g ,o nlj pj.k ea, fl VsYMgkbM }kjk NADH$_2$ dh gkbMktu xg.k dj ,fFky ,Ydkgy dk fuek.k gkrk gA

2- tUrvk e ;g fØ;k ,d pj.k e i.k gkrh g ,o yfDVd vEy curk gA

byDVku vfHkxeu r= rFkk vkDlhQkLQkfjyhdj.k

(Electron Transport System and Oxidative Phosphorylation)

Xykbdkykbfll ,o ØCl pØ e vkDlhdj.k&vip;u vfHkfØ;kvk l fufer $NADH_2$,o $FADH_2$ mPp Åtk ;Dr v.k gkr gA bul Åtk eDr gkdj ATP dk l'y"k.k djrh gA vipf;r $NADH_2$,o $FADH_2$ l byDVku vfHkxeu r= }kjk ATP fuek.k dh çfØ;k dk vkDlhQkLQkfjyhdj.k dgr gA ;g vfHkfØ;k ekbVkdkfUM;k d fØLVh ij mifLFkr vkDlhlke@F d.k e lEiUu gkrh gA bl vfHkxeu r= e gkbMktuxkfg;k dk Øe NAD l FAD, ;fcfDouku (CoQ), Cyt b, Cyt c, Cyt a o Cyt a_3 gkrk gA lkbVkØke a, b, c, a_3 l;fXer çkVhu gkr g ftue Fe ,d çkLFkfVd leg d :i e feyrk gA ble vkDlhdj.k&vip;u dh fØ;k fuEukulkj lEiUu gkrh g ¼fp= 22-3½A



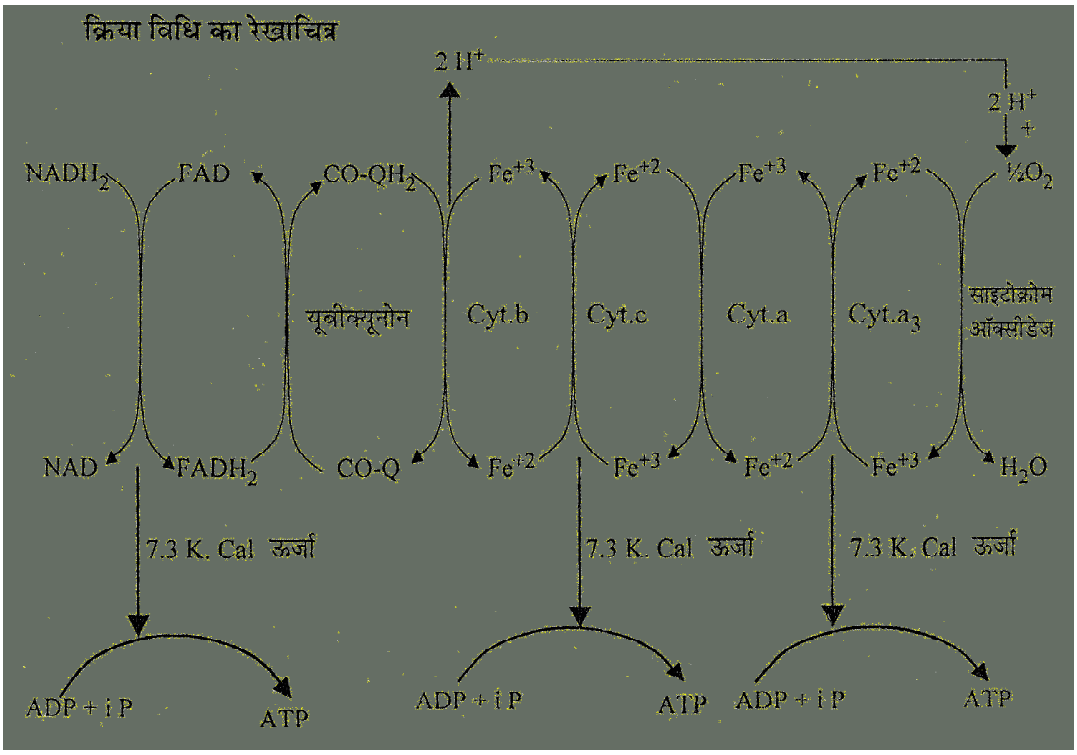
bl vfHkxeu r= e loçFke gkbMktu dk LFkkukUrj.k gkrk g] ftll $NADH_2$ vkDlhÑr gkdj NAD e ifjofrr gk tkrk g ,o gkbMktu dk FAD xg.k dj $FADH_2$ e vipf;r gk tkrk gA ;g vipf;r $FADH_2$ viu gkbMktu dk ;fcfDouku dk ndj FAD e vkDlhÑr gk tkrk gA ;fcfDouku gkbMktu v.k dk çkVku (H^+) ,o byDVku e fo;kftr dj nrk g ftll çkVku dkf'kdkæ0; e çokfgr gk tkr g rFkk byDVku byDVku vfHkxeu r= dk LFkkukUrfjr gk tkr gA byDVku dk LFkkukUrj.k bl r= ij Øe'k% Cytb, Cytc, Cyta ,o Cyta$_3$ dk gkrk gA

bl LFkkukUrj.k e rhu LFkyk ij vf/kd ek=k e Åtk eDr gkrh g] tk ATP fuek.k e ç;Dr gkrh gA ; rhu LFky fuEu çdkj l g &

¼d½ $NADH_2$ rFkk $FADH_2$ d e/;

¼[k½ lkbVkØke b ,o lkbVkØke c d e/;

¼x½ lkbVkØke a ,o lkbVkØke a_3 d e/;



fp= 22-3 % vkDlh & 'olu dh fØ;k fof/k

byDVku vfHkxeu r= d vfUre xkgh cy + a_3 rd igpr&igpr byDVku Åtk jfgr gk tkr g bl byDVku dk Cyt a_3 }kjk vkDlhtu ijek.k dk LFkkukUrfjr dj fn;k tkrk gA ;g vk;fur vkDlhtu nk çkVku l fØ;k dj ty d v.k dk fuek.k dj yrk gA

$$\frac{1}{2}O_2 + 2e^- \longrightarrow O^{--} \xrightarrow{2H^+} H_2O$$

lEi.k byDVku vfHkxeu r= e ,d $NADH_2$ d çо'k l rhu ATP v.k ,o ,d $FADH_2$ d çо'k l 2 ATP v.k dk fuek.k gkrk gA

'olu x.kkd (Respiratory Quotient)

'olu x.kkd fØ;k e fu"dkflr CO_2 rFkk vo'kkf"kr O_2 d vk;ru d vuikr dk 'olu x.kkd dgr gA

$$\text{श्वसन गुणांक (RQ)} = \frac{\text{श्वसन में मुक्त } CO_2 \text{ का आयतन}}{\text{श्वसन में प्रयुक्त } O_2 \text{ का आयतन}}$$

'olu x.kkd dk eku 'olu fØ;k e fo?kfVr gku oky inkFk dh jklk;fud çÑfr ij fuHkj djrk gA

RQ d fofHkUu eku

(i) RQ = 1 tc 'olu vfHkdkjd dkckgkbMV gkrk gA

(ii) RQ = ,d l de (RQ < 1)

½d½ olk d fy, RQ = 0.7

½[k½ çkVhu d fy, RQ = 0.8 ;k 0.9

(iii) RQ = 0 ekly ikni

(iv) RQ dk eku 1 l vf/kd (RQ > 1) : dkcfud vEy

(v) RQ dk eku vok; 'olu e vuUr gkrk gA

'olu dk çHkkfor dju oky dkjd

'olu dh nj db dkjdk }kjk çHkkfor gkrh gA bu dkjdk dk nk oxk e foHkkftr fd;k tk ldrk g&

½v½ cká dkjd ½c½ vkUrfjd dkjd

½v½ cká dkjd % 'olu nj dk çHkkfor dju oky cká dkjd fuEu g &

(i) **rkieku** (Temperature) : rkiØe 'olu ij çHkko Mkyu okyk lcl egRoi.k dkjd gA0°C l 30°C rd rkieku

c<u ij 'olu nj c<rh gA 0°C l de rkieku ij ;g nj cgr de gk tkrh gA

(ii) **vkDlhtu** (Oxygen) : okrkoj.k e vkDlhtu dh ek=k dk dkQh lhek e ?kVku&c<ku ij Hkh 'olu nj ij dkbZ çHkko ugh iMrk gA ok; e O_2 dh ek=k 1.9% rd ?kVku ij 'olu nj cgr de gk tkrh g ijUr vok; 'olu gkrk jgrk gA

(iii) **çdk'k** (Light) : 'olu fnu ,o jkf= e fujUrj gkrk jgrk gA çdk'k ijk{k : i l 'olu dh nj dk çHkkfor djrk g] t l çdk'k }kjk rkieku e of)] çdk'k l'y"k.k }kjk 'kdjk dk fuek.k ,o j/k dk xlh; vknku&çnku gr [kyk j[kukA

(iv) **ty** (Water) : ty dh ek=k c<u l ,d lhek rd 'olu nj c<rh gA 'k"d ekSle e ty dh deh l 'olu nj de gkrh g ,o ekSle }kjk ty dk vUr%'kk"k.k dju ij 'olu nj c< tkrh gA

(v) **dkcu MkbvkDlkbM dh lkUærk** (Concentration of CO_2) : CO_2 d vf/kd lkUæ.k l j/k cUn gk tkr g] ftl O_2 dh ikni e deh gku yxrh g ,o 'olu nj de gk tkrh gA bldk çfrdy çHkko ekSle d vdj.k ,o ikni of) ij iMrk gA

vkUrfjd dkjd

dkf'kdkæ0; ,o ble ik; tku oky 'oluh; fØ;kèkkj çe[k vkUrfjd dkjd gA

1- **thoæ0;** % dkf'kdkæ0; ,o ble ik; tku oky 'oluh; fØ;k/kkj çe[k vkUrfjd dkjd gA

2- **'oluh; inkFk** % dkf'kdkvk e mifLFkr fofHkUu çdkj dh 'kdjk, çe[k 'oluh inkFk g budh lkUærk c<u ij ,d lhek rd 'olu nj e of) gkrh gA

ikni gkekUl

(Plant Hormones)

gkeku 'kCn dk ç;kx loçFke LVjfyx (Sterling) u fd;k FkkA ikni gkeku o dkcfud inkFk gkr g tk fd ikèkk d ,d Hkkx e l'yf"kr gkdj vU; Hkkxk e LFkkukUrfjr gk tkr gA ; vfrl{e ek=k e iknik dh of) dk çHkkfor djr gA ; inkFk ikni dh dkf;dh; xfrfof/k;k (Physiological activities) dk çHkkfor o fu;f=r djr gA gkekUl dk ge ikp çe[k oxk e foHkkftr dj ldr gA ; g & ¼1½ vkfDlu ¼2½ ftcjfyu ¼3½ lkbVkdkbfuu ¼4½ bFkkbfyu ¼5½ of) fujkèkd inkFkA

bud vfrfjä tLekfud vEy (Jasmonic acid), lyhflfyd vEy (Salicylic acid), clhukLVjkbM (Brassinosteroid), rFkk dN foVkfeUl (Vitamins) Hkh iknik dh of) dk fu;f=r djr gA

vkfDlUl (Auxins)

vkfDlUl 'kCn dh 0;RifÙk xhd 'kCn vkfDlu (auxin) l gb gA bldk vFk gkrk g of) djuk (To grow)A ; ,l ikni gkekUl gkr g ftUg loçFke [kktk x;kA bUg lcl igy ekuo e= l iFkd fd;k x;kA b.Mky ,flfVd vEy (Indole acitic acid) rFkk bld leku x.k oky lHkh çkÑfrd rFkk Ñf=e l'yf"kr inkFk vkfDlu dgykr gA

,l inkFk tk vkfDlu e :ikUrfjr gk ldr g mUg vkfDlu ioorh (Auxin precursor) dgr gA vkfDlu dh dk;fof/k dk ckf/kr dju oky ikni çfrvkfDlu (Antiauxin) dgykr g rFkk ,l vkfDlu ftUg dkf'kdkvk l vklkuh l iFkd fd;k tk ldrk g mUg eä vkfDlu o ftUg vklkuh l iFkd ugh fd;k tk ldrk g ;k dkcfud foyk;dk (Organic solvents) dh lgk;rk l çkIr fd;k tkrk g mUg cfU/kr vkfDlu (Bounded auxin) dgr gA

ik/kk e vkfDlu vR;Ur l{e ek=k e ik; tkr g vr% budh mifLFkfr n'kku d fy; l{e lonh tfod ijh{k.k (Sensitive biological test) ç;kx e yk; tkr g] ftUg to vkekiu (Bioassay) dgr gA to vkekiu d }kjk vkfDlu dh ek=k rFkk mud ikni of) ij iMu oky çHkko dk Kkr fd;k tk ldrk gA vkfDlu d to vkekiu gr tb çkdjpky oØrk ijh{k.k (Avena coleoptile curvature test) dk ç;kx fd;k x;kA ck;lu&tUlu (Boysen-Jensen 1910-13) u tb d çkdjpky dk 'kh"kkPNfnr (Decapitate) dj fn;k rFkk ik;k fd og oØ.k (Curvature) çnf'kr ugh djrk gA dVg, Hkkx dk iuLFkkfir dju ij oØ.k vFkok çdk'kkuoru (Phototropism) {kerk iuLFkkfir gk tkrh gA

mijkä ç;kx d vk/kkj ij mUgku ;g fu"d"k fudyk fd çdk'kkuoru vFkok oØ.k d fy; mÙkjnk;h inkFk vçnhlr ik'o l uhp dh vkj LFkkukUrfjr gkrk gA

vkfDlUl d dkf;dh; çHkko

(Physiological Effects of Auxins)

vkfDlu dh lkUærk dk ik/k d fofHkUu Hkkxk dh of) ij fuEu çdkj l çHkko gkrk g &

1- **'kh"k çHkkfork** (Apical dominance) : 'kh"kLFk dfydk dh mifLFkfr d dkj.k ik'o vFkok d{kLFk dfydkvk

dh of) vkf'kd :i l vo:) gk tkrh gA bl 'kh"k çHkkfork dgr gA 'kh"k dfydk }kjk vkfDlu dk l'y"k.k gkrk g tk uhp dh vkj LFkkukUrfjr gkdj ik'o dfydkvk dh of) dk likfnr djrk gA ;fn 'kh"k dfydk dk dkV fn;k tk; rk ik'o ;k d{kLFk dfydk, fodflr gku yxrh gA

2- **[kjirokj dk mUeyu** (Eradication of weeds) : 2,4-D (2, 4-Dichlorophenoxy acitic acid) uked vkfDlu }kjk [krk e Qlyk d lkFk mxu oky vuko';d [kjirokjk dk u"V fd;k tkrk gA

3- **dV ru ij tM foHknu** (Root differentiation on stem cutting) : ;fn ikni d dV g, Hkkx d fupy flj dk vkfDlu e Mck fn;k tk; rk bl dV Hkkx l 'kh?k gh tM fudyrh gA bld b.Mky C;Vkfjd vEy (IBA) uked vkfDlu dk ç;kx fd;k tkrk gA mnkgj.k & xykc e dye yxkdj u;k ikni r;kj djukA)

4- **vfu"kdQyu** (Parthenocarpy) : fcuk fu"kpu d cht jfgr Qy çkIr dju d fy; i"i d idlj fudkydj ofrdkx ij vkfDlu dk fNMdko fd;k tkrk gA mnkgj.k & lrjk] uhc] vxj] dyk vkfnA

5- **çlIrkoLFkk fu;=.k** (Control of dormancy) : vkfDlu d foy;u dk fNMdko dj vky d dnk dk çLQVu l jkdk tkrk g ftll vky dk yEc le; rd lxg fd;k tk ldA

6- **i"ik dh l?kurk dk de dju** (Thinning of flowers) : o{kk ij Qyk dh l[;k o vkdkj c<ku d fy; vfrjkä i"iu çfØ;k dk jkdu e vkfDlu lgk;d gA mnkgj.k d fy; vke ij NAA rFkk NAAM dk fNMdko dj i"iu fØ;k dk fu;f=r fd;k tk ldrk gA

7- 2, 4-D, IAA rFkk IBA dk fNMdko dj vifjiDo Qyk dk >Mu l jkdk tk ldrk gA

8- uk'kikrh] lc vkfn ij NAA dk fNMdko dj nh?k 'kk[kkvk d iok dk y?k dj budh l[;k e of) dh tk ldrh g rkfd bu ij Hkh Qy vf/kd yxA

9- **mÙkd lo/ku** (Tissue culture) : vktdy vkfDlu d vuç;kx l mÙkdk o vxk dk Ñf=e lo/ku 0;kid :i l fd;k tk jgk gA vkfDlu ey fuek.k o dyl foHknu e egRoi.k Hkfedk fuHkkr gA

ftcjfyu (Gibberellin)

tkiku d /kku d [krk e lu 1890 e dN ik/k vlkekU; :i l yEc gk x;A bl cdu jkx (Bakane disease) uke fn;k x;kA gkjh (Hori 1898) u bl jkx dk v/;;u fd;k ,o ik;k fd bl jkx l xflr ik/k vlkekU; :i l yEc o iry gkr gA bue i"iu ugh gkrk rFkk ; Qy o cht mRiUu dju e vleFk gkr gA lkekU; Hkk"kk e bUg codQ uoknfHkn (Foolish seedling) dgk tkrk gA /kku dk ;g jkx ,d dod *ftcjyk ¶; thdkjkb* (*Gibberella fusikuroi*) }kjk gkrk gA

djklkok (Kurosawa, 1926) u ;g çekf.kr fd;k fd bl dod d L=ko dk ik/kk ij fNMdu l ;g jkx gk tkrk gA ;kcrk rFkk gk;klh (Yabuta and Hayashi 1939) u bl dod l 'k) fØLVyh; jlk;u çkIr fd;k rFkk ml ftcjfyu uke fn;kA fofHkUu dodk ,o mPp iknik l vc rd 100 l vf/kd çdkj d ftcjfyu çkIr fd; tk pd gA bldk GA_1, GA_2, GA_3, GA_{100} vkfn ukek l tkuk tkrk gA bue GA_3 lcl igy [kkt tku oky rFkk lkekU; :i l ik; tku oky ftcjfyu e l ,d gA

jklk;fud nf"V l lHkh ftcjfyu ftcjfyd vEy (Gibberellic acid) gkr gA

ftcjfyu d dkf;dh; çHkko

(Physiological Effects of Gibberellins)

1- **i.k nh?ku** (Internode elongation) : ftcjfyu iknik e i.k nh?ku dj iknik dh yEckb e of) dk çfjr djrk gA

2- **cht dj.k** (Seed germination) : dN iknik d cht enk l ty vo'kkf"kr dj Qy tkr gA bud Hk.k ftcjfyu l'y"k.k djr g tk ,Y;jku ijr (Aleurone layer) e folfjr gkdj Hk.k dh of) ,o chtkdj.k dk çfjr djr gA

3- **çlflr Hkkx dju** (Breaking of seed dormancy) : vud o{kk dh dfydkvk rFkk chtk e ikb tku okyh çlflr dk ftcjfyu dh mPp lkUærk }kjk fu"çHkkoh fd;k tk ldrk gA

4- **i"iu** (Flowering) : ftcjfyu dN iknik e i"iu d fy; çjd 'khru (Vernalization) mipkj vFkok vkif{kr nhflrdky (Photoperiod) dk çfrLFkkiu dju e l{ke gkr gA

5- **vfu"kd Qyu** (Parthenocarpy) : ftcjfyu vkfDlu dh ryuk e vfu"kd Qyu dk vf/kd çfjr djrk gA

lkbVkdkbfuu (Cytokinins)

t- gcjy.M (J. Haberlandt) u loçFke ç{k.k fd;k fd dN iknik e ¶yk,e mÙkdk e foy; inkFk (soluble substance) ik;k tkrk rk {kfrxLr vky dh enÙkdh; dkf'kdkvk d dkf'kdk foHkk tu dk çfjr djrk gA fyFke o feyj (Letham and Miller) u eDdk d Hk.kdk"k l ,d inkFk foeä fd;k ft ldk uke ft ,fVu (Zeatin) j[kA lkbVkdkbfuu uke Hkh fyFke }kjk fn;k x;k FkkA çkÑfrd :i l ik; tku oky lkbVkdkbfuu e ft ,fVu lokf/kd lfØ; ekuk tkrk gA lkbVkdkbfuu dk l'y"k.k iknik e mu LFkkuk e gkrk g tgk dkf'kdk, foHkkftr gkrh jgrh gA mnkgj.k d fy; 'kh"k çjkg] ey 'kh"k] fodkl 'khy dfykdk,] r :.kQy bR;kfnA

lkbVkdkbfuu d dkf;dh; çHkko

(Physiological Effects of Cytokinins)

iknik e lkbVkdkbfuu d fuEufyf[kr çHkko fn[kkb nr g &

1- lkbVkdkbfuu dkf'kdk foHkk tu dk çfjr djr gA
2- ; dkf'kdk nh?ku dk çfjr djr gA rEckd dh ey dkf'kdk, lkbVkdkbfuu d çHkko l lkekU; dh ryuk e pkj xuk vf/kd nhf?kr gkrh gA
3- dkf'kdk foHknu ij Hkh lkbVkdkbfuu dk çHkko n[kk x;k gA vkfDlu d lkFk feydj ; ik/kk d dN vxk d fuek.k dk fu;f=r djr gA lo/ku ek/;e e ;fn lkbVkdkbfuu dh ek=k vf/kd o vkfDlu dh ek=k de gk rk çjkg dk fodkl gkrk gA bld foijhr ;fn lkbVkdkbfuu dh ek=k de rFkk vkfDlu dh ek=k vfèkd gku ij doy tMk dk fodkl gkrk gA
4- lkbVkdkbfuu 'kh"k çHkkfork dk de dju rFkk th.krk dk LFkfxr dju e l{ke gkr gA

bFkkbfyu (Ethylene)

vkj- xu (R. Gane, 1935) u ;g çekf.kr fd;k fd bFkkbfyu ,d çkÑfrd xlh; gkeku gA iknik d yxHkx lHkh Hkkxk e bFkkbfyu fufer gkrk gA bldh vf/kd lkUærk lkekU; r% ifÙk;k] l"klr dfydkvk o i"ik e ikb tkrh gA Qyk d ifjiDou d lkFk gh bFkkbfyu dk fuek.k Hkh c< tkrk gA

bFkkbfyu d dkf;dh; çHkko

(Physiological Effects of Ethylene)

iknik e bFkkbfyu d fuEufyf[kr çHkko fn[kkb nr g &

1- **of) ij çHkko** (Influence on growth) : bFkkbfyu lkekU; r% çjkg o ey dh yEckb e of) dk jkdrk g rFkk çjkg o ey dh ekVkb e of) dk çfjr djrk g ft l l iknik e viLFkkfud tMk dk fuek.k c< tkrk gA QyLo:i iknik e {kfrt of) c< tkrh gA
2- **i"iu ij çHkko** (Influence on flowering) : vf/kdk'k iknik e bFkkbfyu i"iu çfØ;k dk jkdrk g ijUr vke] vukukl vkfn e ;g i"iu dk çfjr djrk gA
3- **fyx ifjoru** (Sex modification) : bFkkbfyu iknik e eknk i"ik dh l[;k e of) djrk g rFkk uj i"ik dh l[;k dk de djrk gA
4- **foyxu** (Abscission) : bFkkbfyu ifÙk;k] Qyk ,o i"ik d foyxu dk çfjr djrk gA vr% ; 'kh?k >M tkr gA
5- **Qyk dk iduk** (Ripening of fruits) : Qyk d çkÑfrd ifjiDou e bFkkbfyu dk egRoi.k ;kxnku gkrk gA bFkkbfyu d çHkko l dN thu lfØ; gkr g rFkk ,Utkbe dk l'y"k.k djr g tk fd Qy ifjiDou e egRoi.k Hkfedk fuHkkr gA
6- **v/kkdpu e lgk;d** (Help in epinasty) : bFkkbfyu d çHkko l i"i ,o ifÙk;k uhp dh vkj >d tkrh g ft l v/kkdpu dgr gA ;g fØ;k i"ik ,o ifÙk;k dh Åijh lrg dh dkf'kdkvk e nh?ku d dkj.k gkrh gA vktdy bFkQku (2-Chloroethyl phosphoric acid) dk Ñf=e :i l Qyk dk idku d dke e fy;k tkrk gA bl inkFk l bFkkbfyu xl fudyrh g tk Qyk dk idku dk dke djrh gA Hkkjr lfgr vf/kdk'k n'kk e Qyk tl vke] vxj] dyk] irhrk vkfn dk idku d fy; bFkQku dk ç;kx vk|kfxd Lrj ij fd;k tk jgk gA bl çdkj id Qy jx] :i o lx/k e çkÑfrd Qyk tl gh gkr gA

,fclfld vEy (Abscisic Acid)

bFkkbfyu Qy ifjiDou e lgk;d g] ijUr lkekU; r% of) jk/kd dk dk; djrk gA blh çdkj ,fclfld vEy Hkh of) jk/kd gkrk gA

,fclfld vEy iknik e çkÑfrd :i e ik;k tkrk gA ;g çe[k of) fu;=d gkeku gA ;g ikni dh çfrdy okrkoj.kh; ifjfLFkfr;k dk lkeuk dju e lgk;rk djrk g vr% bl LVl gkeku (Stress hormone) Hkh dgr gA

dkUl ,o ,fMdkV (1961-65) u dikl (*Gossypium* spp) d ik/k d i"ik dh dfy;k (Buds) l ,d ,lk inkFk

fudkyk ftldk uke mUgku ,fcIflu (Abscisin) j[kk tk fdlh Hkh ik/k ij fNMdu ij 'kh?k gh ifÙk;k dk foyxu dj nrk FkkA o;fjx (Wareing, 1963) e bldk uke Mkfeu (Dormin) j[kkA ckn e ;gfl) gvk fd Mkfeu vkj ,fcIflu ,d gh inkFk g vkj mldk uke ,fcIfld vEy (Abscisic acid = ABA) j[kkA

,fcIfld vEy d dkf;dh; çHkko

(Physiological Effects of Abscisic Acid = ABA)

1- **ifÙk;k dk foyxu** (Abscission of leaves) : ABA d ?kky dk ifÙk;k ij fNMdu l mudk 'kh?k gh foyxu gk tkrk gA

2- **dfy;k rFkk cht dh çlIrrk** (Dormancy of buds and seeds) : iknik e ABA dh mifLFkfr bud dfy;k dh of) rFkk chtkdj.k dk jkd dj mudh çlIrrk dk cuk; j[krk gA

3- **th.krk** (Senescence) : ABA vud iknik e th.krk dk çfjr djrk gA bl çfØ;k e lEHkor% i.kgfjr] çkVhu rFkk RNA dk rho gkl gkrk gA

4- **dkf'kdk foHkktu ,o dkf'kdk ifjo/ku** (Cell division and cell development) : ABA dkf'kdk foHkktu ,o dkf'kdk ifjo/ku tlh nkuk çfØ;kvk dk vo:) djrk gA

5- **jU/kk dk cn gkuk** (Stomatal closure) : ABA jèkk dk cn dju e çHkkoh gkrk g vr% ok"ikRltu dh nj dk de dj nrk gA

egRoi.k fcUn

1- 'olu ,d vip;h fØ;k g tk lthok e fujUrj gkrh jgrh g bl vfHkfØ;k e tfVy dkcfud ;kfxdk dk ljy ;kfxdk e fo?kVu gkrk g o Åtk eDr gkrh gA

2- 'olu e[;r% nk çdkj dk gkrk g & vkDlhtu dh mifLFkfr e gku okyk vkDlh 'olu ,o vkDlhtu dh vuifLFkfr e gku okyk vukDlh 'oluA

3- vkDlh ,o vukDlh 'olu dh çFke çfØ;k Xykbdkykbfll dgykrh g tk dkf'kdkæ0; e lEiUu gkrh gA

4- Xykbdkykbfll vfHkfØ;k e Xydkt dk fo[k.Mu 3 dkcu oky ikb:fod vEy d 2 v.kvk e gkrk g rFkk 2 $NADH_2$,o 4 ATP v.k dk fuek.k gkrk gA

5- vukDlh 'olu e Xydkt dk vi.k@vkf'kd fo?kVu gkrk g ,o ,Ydkgy rFkk CO_2 dk fuek.k gkrk g ,o 2 ATP v.k dk ykHk gkrk gA

6- vkDlh 'olu e Xykbdkykbfll }kjk fufer ikb:fod vEy dk i.k vkDlhdj.k ekbVkdkfUM;k e lEiUu gkrk gA

7- ikb:fod vEy d vkDlhdj.k }kj lcl igy ,flVkby dk,Utkbe , dk fuek.k gkrk g tk ØCl pØ e ço'k dj CO_2 ,o ty e vkDlhÑr gk tkrk g rFkk GTP, $FADH_2$,o $NADH_2$ dk fuek.k djrk gA

8- $NADH_2$,o $FADH_2$ ekbVkdkfUM;k d byDVku ifjogu r= e ço'k djr g ,o QkLQkfjyhdj.k }kjk ATP dk fuek.k djr gA

9- ,d v.k Xydkt d vkDlh 'olu l dy 38 ATP v.k Åtk dk ykHk gkrk gA

10- 'olu fØ;k e eDr gku okyh CO_2 ,o ç;Dr O_2 d vk;ru dk vuikr 'olu x.kkd dgykrk g ,o ;g 'olu e ç;Dr gku oky 'olu fØ;k/kkjk dh çÑfr ij fuHkj djrk gA

vH;klkFk ç'u

oLrfu"B ç'u

1- Xykbdkykbfll dkf'kdk e dgk ij lEiUu gkrk g &

¼v½ dUæd ¼c½ dkf'kdkæ0;

¼l½ ekbVkdkfUM;k ¼n½ xkYthdk;

2- vukDlh 'olu e fdru ATP v.kvk dk fuek.k gkrk g &

¼v½ vkB ¼c½ pkj

¼l½ nk ¼n½ N%

3- ØCl pØ lEiUu gkrk g &

¼v½ ekbVkdkfUM;k d efVDl e

¼c½ fØLVh e

¼l½ gfjryod e

¼n½ dkf'kdkæ0; e

4- EMP ifjiFk e dy fdru ATP dk 'k) ykHk gkrk g &

¼v½ 4 ¼c½ 2

¼l½ 6 ¼n½ 8

5- ØCl pØ e fufer 5 dkcu ;Dr ;kfxd dkulk g &

¼v½ flVhd vEy

¼c½ lDlhfud vEy

¼l½ α dhVkXyVfjd vEy

¼n½ efyd vEy

6- vok; 'olu dk 'olu x.kkd gkrk g &
¼v½ ,d ¼c½ ,d l de
¼l½ ,d l vf/kd ¼n½ vUur

7- byDVku ifjogu r= mifLFkr gkrk g &
¼v½ efVDl e
¼c½ ekbVkdkfUM;k dh vUr% f>Yyh
¼l½ ekbVkdkfUM;k dh ckÅ f>Yyh
¼n½ ifjekbVkdkfUM;y LFky

8- vkDlh 'olu e vkf.od O_2 dk mi;kx gkrk g &
¼v½ Xykbdkykbfll e
¼c½ ØCl pØ e
¼l½ ETS e
¼n½ ¼c½ o ¼l½ nkuk

vfry?kÙkjkRed ç'u

1- Xykbdkykbfll dk vfUre mRikn D;k g\
2- Xydkt d ,d v.k d i.k vkDlhdj.k l fdru v.k ATP cur g\
3- vkDlh 'olu dgk ij lEiUu gkrk g\
4- ØCl pØ dh [kkt fdlu dh Fkh\
5- vukDlh 'olu dk vfUr mRikn D;k g\
6- Xykbdkykbfll ,o ØCl pØ dh ;ktd dMh fdl dgr g\
7- 'olu x.kkd dk ifjHkkf"kr dhft ;A
8- vok; 'olu e 'olu x.kkd vuUr gkrk gA D;k\
9- byDVku ifjogu r= dk vfUre byDVku xkgh dku g\
10- ATP ,o NAD dk ijk uke fyf[k,A

y?kÙkjkRed ç'u

1- 'olu ,o ngu e vUrj Li"V dhft ,A
2- vkDlh 'olu ,o vukDlh 'olu e D;k vUrj g\
3- QkLQkfjyhdj.k l vki D;k le>r g\
4- vukt l Hkj Hk.Mkj e ço'k dju ij ?kVu ,o xeh D;k egl l gkrh g\
5- 'olu x.kkd fdl dgr g\ ;g fofHkUu fØ;k/kkjk l fdl çdkj çHkkfor gkrk g\
6- 'khrxgk e Qy ,o lfCt ;k vf/kd le; rd ljf{kr jgrh gA D;k\

fucU/kkRed ç'u

1- Xykbdkykbfll l vki D;k le>r g bldh fofHkUu vfHkfØ;kvk dk foLrkjiod le>kb;A
2- ØCl pØ dh fØ;k fof/k dk o.ku dhft ;A
3- vkDlhdh; QkLQkfjyhdj.k l vki D;k le>r g\ byDVku ifjogu r= (ETS) dk lfoLrkj o.ku dhft ,A
4- 'olu dk çHkkfor dju oky dkjdk ij lf{kr y[k fyf[k,A

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mÙkjekyk % 1 ¼c½ 2 ¼l½ 3 ¼v½ 4 ¼c½ 5 ¼l½ 6 ¼n½ 7 ¼c½ 8 ¼n½

bdkb & xv

v/;k; & 23

tUr txr dk oxhdj.k

(Classification of Animal Kingdom)

lkj e vc rd 18 yk[k l Hkh vfèkd çdkj d tUr oKkfudk }kjk igpku x; gA lHkh tUrvk dk fdlh Hkh eUk"; }kjk viu thou e vè;;u dj ikuk vlEHko gA vr% de l de le; e vfèkd l vfèkd çkf.k;k dk vè;;u dju gr tUrvk dk mudh fofHkUu lekurkvk vFkok fo"kerkvk d vkèkkj ij igpkuu rFkk fofHkUu oxk e j[ku dk oxhdj.k dgr gA

oxhdj.k dk egRo

1- oxhdj.k d ekè;e l tUrvk d y{k.k ,o ikjLifjd lcèkk dh tkudkjh feyrh gA
2- oxhdj.k l tUrvk d fodkl Øe dh tkudkjh feyrh gA
3- tUrvk d Yk{k.kk d vkèkkj ij mudh vudyrk d ckj e Kku ikIr gkrk gA tl uHkpj] typj] LFkypj bR;kfnA
4- oxhdj.k }kjk l;kth dfM;k dh fLFkfr dh tkudkjh çkIr gkrh gA

f}inuke i)fr

LohMu d djkyl yhfu;l u 1758 e çdkf'kr viuh iLrd flLVek upj e thok d ukedj.k dh fo'k"k i)fr dk o.ku fd;kA bl i)fr d fu;e fuEufyf[kr g &

1- tfod uke çk;% yfVu Hkk"kk e gkr gA
2- tfodk uke e igyk 'kCn o'k uke gkrk gA tcfd nljk 'kCn tkfr ldr in gkrk gA
3- o'k uke dk igyk v{kj cMk ,o tkfr ldr in e NkVk v{kj gkuk pkfg,A
4- nkuk 'kCnk dk vyx vyx j[kkfdr vFkok Nikb e frjNk fy[kuk pkfg, mnkgj.k& *Homo sapiens*
5- tfod uke d vr e y[kd dk uke fy[kr gA

oxhdj.k d vkèkkj

thok d dN fo'k"k vkdkfjdh y{k.kk dk oxhdj.k d vkèkkj d :i e ç;Dr fd;k x;k gA bue l dN fuEufyf[kr g &

¼1½ lxBu d Lrj&

¼v½ tho n0; Lrj ¼c½ dkf'kdh; Lrj
¼l½ Ård Lrj ¼n½ vx&rU= Lrj

¼2½ lefefr d vkèkkj ij &

¼v½ vlefefr ¼c½ vfj; lefefr
¼l½ f}ik'o lefefr

¼3½ ngxgk &

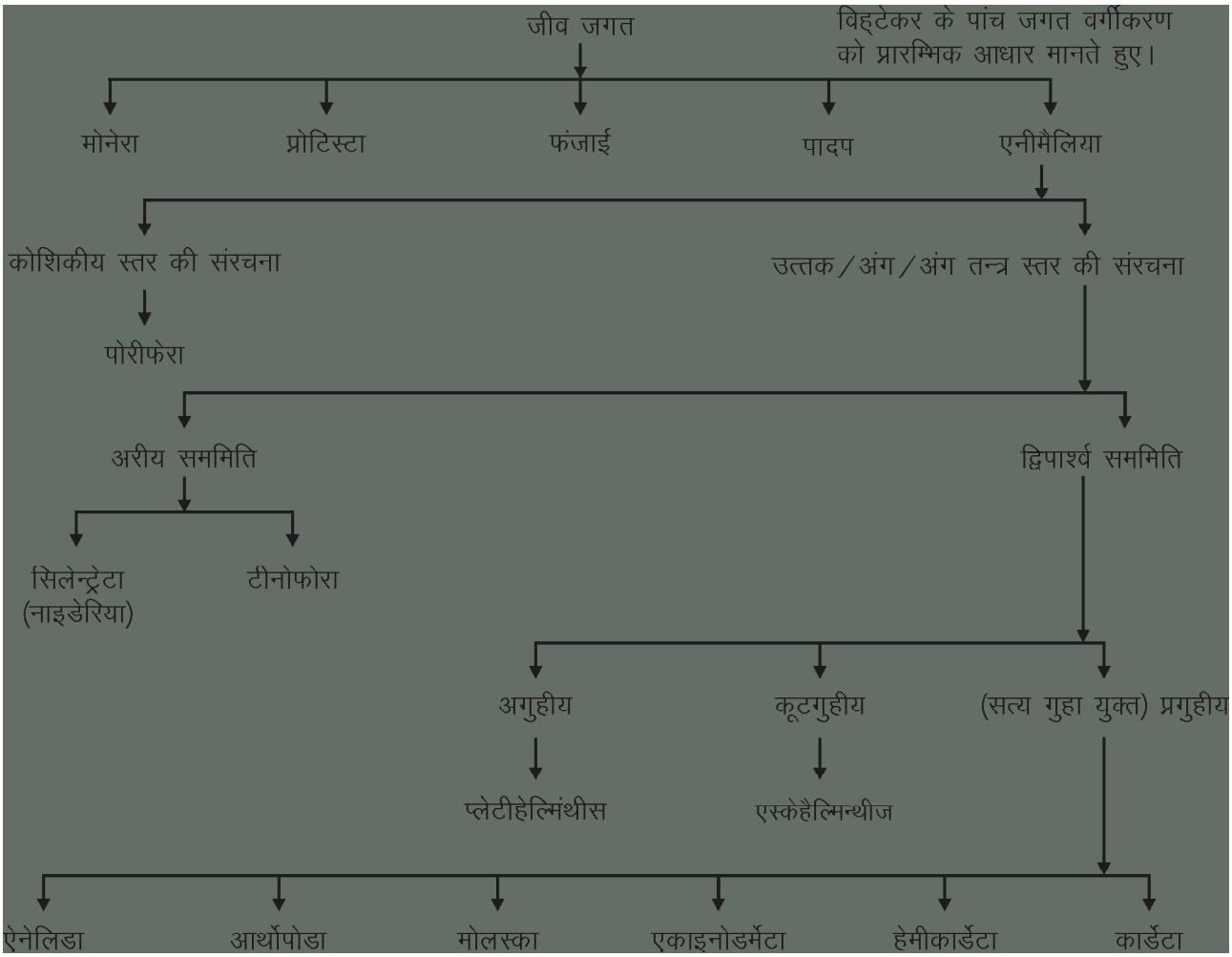
¼v½ vxgh; ¼c½ dVxfgd
¼l½ çxgh;

¼4½ [kMh Hkou & ¼v½ lrgh [k.Mh Hkou
¼c½ fo[k.Mu@okLrfod [k.MhHkou½

¼5½ f}dkjdh o f=dkjdh lxBu

¼6½ **ukVk dkM&**dN tUrvk e eè; i"B ij fLFkr ,d 'kykdkdkj jpuk ikb tkrh gA tk ehtkMe l mRiUu gkrh gA bld vkèkkj ij tUrvk dk nk legk e ckVk tkrk g &

¼v½ ukudkMVk@vjTtdh&ukVkdkM vuifLFkr



¼c½ dkMVk@jTtdh& ukVkdkM mifLFkr

(I) l?k & ikjhQjk (porifera)

(Pores - ostia, fNæ $ Fera = èkkj.k djuk)

e[; Yk{k.k

1- bl l?k d çk.kh çk;% yo.kh; ty e pÍkuk l fpid jgr gA dN vyo.kh; ty e Hkh ik, tkr gA

2- ;g ,dy ;k fuogh (colonial) çk.kh gkr g tk LFkkuc) gkr gA

3- vfèkdk'k çkf.k;k e vjh; lefefr ikb tkrh g ijr dN çk.kh vlefer Hkh gkr gA

4- budk 'kkjhfjd lxBu dkf'kdh; Lrj dk gkrk g vFkkr bue mÙkd vx ugh ik; tkr gA

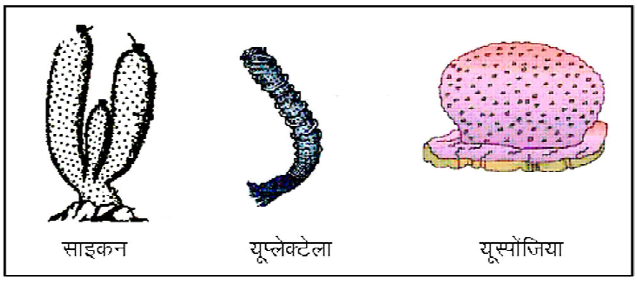
5- ; f}tuLrjh; gkr gA

6- bud ij 'kjh ij vkfLV;k uked fNæ ik; tkr gA bud }kjk ty 'kjh e ço'k djrk g rFkk 'kjh d vx Hkkx e ik;k tku okyk cMk fNæ vkLdye d }kjk ikuh ckgj fudyrk gA

7- bud 'kjh e mifLFkr xgk Litxgk dgykrh gA

8- bl l?k dk e[; y{k.k bue uky rU= (canal system) dk ik;k tkuk gA

9- ; mHk;fyxh çk.kh gA



fp= 23.1

10- bue iu:nHkou dh vikj {kerk ikb tkrh gA mnkgj.k&lkbdu] ;lyDVyk] ;Likft;k] Likftyk

(II) l?k lhyUVVk ;k fuMfj;k

e[; Yk{k.k

1- bl l?k d vfèkdk'k tho leæoklh gkr gA ijUr LoPN ty e Hkh ik; tkr gA

2- budk 'kkjhfjd lxBu dkf'kdk&mÙkd Lrj dk gkrk gA

3- ; f}tuLrjh; gkr gA ckÁ o vUr%tuu Lrj d eè; eh tkXyh;k ikb tkrh gA

4- bl l?k d tUr çk;% vfj; lefer gkr gA

5- okLrfod ngxgk dk vHkko gkrk gA 'kjhj d eè; e ,d xgk ik;h tkrh gA ftl tBjk= xgk ;k lhyUVku dgk tkrk gA

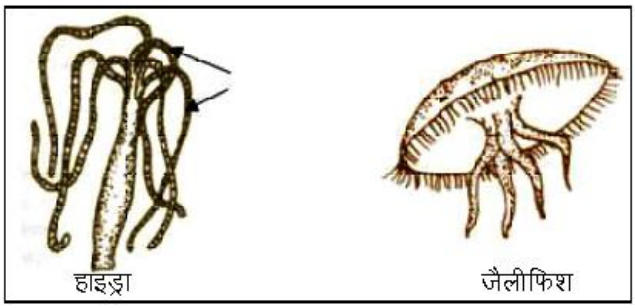
6- 'kh"k ij ,d e[; fNæ ik;k tkrk gA tk xnk o e[k nkuk dk dk; djrk gA

7- ;g fNæ [kk[ky Li'kdk l f?kjk jgrk gA tk f'kdkj idMu o xeu e lgk;rk djr gA

8- bu tUrvk e n'k dkf'kdk, ikb tkrh g tk f'kdkj idMu e lgk;rk djrh gA

9- ; f}&:ih çk.kh gkr gA 1- ikfyi 2- eM;lk

10- bue iu:nHkou dh vikj {kerk ikb tkrh gA



fp= 23-2

mnkgj.k & gkbMk] vkjhfy;k] Qkblfy;k] vkchfy;k] tyh fQ'k ¼eM;lk½

(III) VhukQkjk

e[; y{k.k

1- ; lkekU;r% leæh çk.kh gkr gA

2- budk 'kkjhfjd lxBu mÙkd Lrj dk gkrk gA

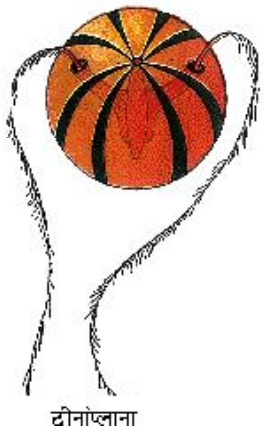
3- ; f}Lrjh; ,o f}ik'olefer çk.kh gkr gA

4- bl l?k d vfèkdk'k çk.kh LQjnhflr'khy gkr gA vFkkr ; jkr e çdk'k mRiUu dj pedr gA

5- bue xeu 8 Ük[kykvk e 0;ofLFkr flfy;kvk }kjk gkrk gA bl ljpuk dk Vhuh ;k dkEc tyh dgr gA blfy; bu ikf.k;k dk lenh v[kjkV ;k dkEc tyh dgr gA

6- bue ,d tkMh mikx&dkykC;kLV ik, tkr gA

7- bue LVVkflLV uked lonkx ik, tkr gA ;g lryu



fp= 23-3

cuku dk dk; djr gA

mnkgj.k & *Vhuklyuk] foykeu] lyjkcfUd;k* vkfnA

(IV) l?k lyVh gfYeUFkht

(platys = flat piV, helminthes = worm Ñfe)

e[; y{k.k

1- bl l?k d tUr çk;% nlj tkuojk o eu";k d 'kjhj e vUr%ijthoh d :i e jgr gA dN LorU= thoh gkr gA

2- i"B&vèkj lrg l piV gku d dkj.k bUg piV Ñfe dgr gA

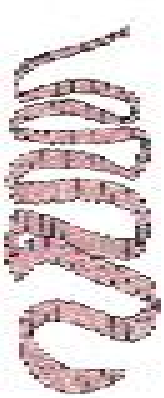
3- ; tUr f=tuLrjh;] f}ik'o lefer ,o ngxgkfoghu ¼vxgh;½ gkr gA 'kjhj lxBu vx&r= Lrj dk gkrk gA

4- 'kjhj ij ekVk D;fVdy ik;k tkrk g tk ,d ijthoh vudyu gA

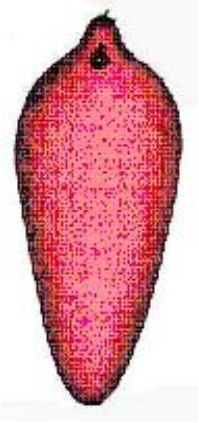
5- bue e[k ik;k tkrk g ijUr xnk vuifLFkr gkrh gA ijik"kh l fpidu d fy, p"kd ik; tkr gA

6- bue mRltu d fy, Tokyk dkf'kdk, ikb tkrh gA

7- ; f}fyxh gkr gA fu"kpu vkUrfjd gkrk gA ifjoèku çR;{k ;k vçR;{k gkrk gA



(A)
Vhfu;k



(B)
Qf'k;kyk

fp= 23-4

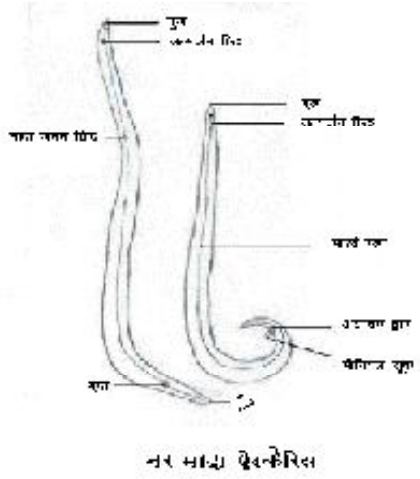
mnkgj.k & *Vhfu;k] Qf'k;kyk] fLVkLkek* vkfn

(V) l?k&,LdgfYeUFkht ¼Askos-xgk] helminthes-worm Ñfe½

e[; Yk{k.k

1- bUg xgk Ñfe] xky Ñfe ,o l= Ñfe Hkh dgk tkrk gA
2- ; tyh; ,o LFkyh;] eDr thoh vFkok ijthoh gkr gA
3- ; dVçxgh] f=dkjdh] f}ik'o lefer çk.kh gkr gA
4- budk 'kkjhfjd lxBu vx&rU= Lrj dk gkrk gA
5- vkgkj uky e[k l xnk rd i.k gkrh gA
6- uj o eknk ,dfyxkJ;h gkr gA çk;% eknk uj l cMh gkrh gA

mnkgj.k&*,Ldfjl* ¼*xkyÑfe½ ,ulkbDykLVkek*



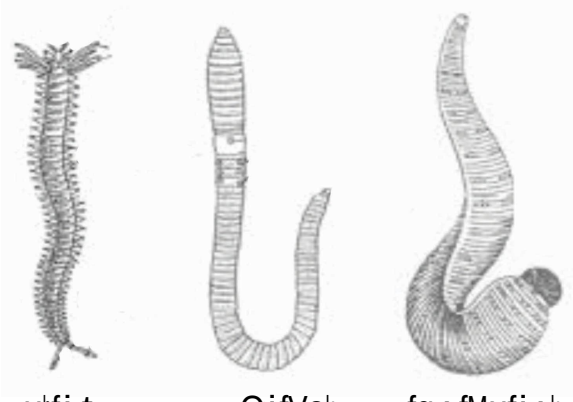
fp= 23-5

¼*vd'kÑfe½]opjfj;k* ¼*Qkbyfj;kÑfe* &gkFkh iko jkxdkjd½

(VI) l?k ,ufyMk (Annelus - ring, lidus-form)

e[; y{k.k

1- bl l?k d tUrvk dk 'kjhj f=tuLrjh;] f}ik'o lefer] okLrfod ng xgh; o okLrfod [k.MhHkou ;Dr gkrk gA
2- budk 'kkjhfjd lxBu vx rU= Lrj dk gkrk gA
3- ,ufYkMk dk 'kjhj uyh d leku gkrk g ,o ble uyh d leku vkgkj uyh ikb tkrh gA vr% budk 'kjhj uyh d Hkhrj uyh d leku gkrk gA
4- vkgkj uky i.k ,o cká dkf'kdh; ikpu ik;k tkrk gA
5- ifjlpj.k r= cUn çdkj dk ,o ghekXykfcu jDr lykTek e ?kyk gvk gkrk gA
6- ijkikfM;k] lhVk] p"kd o if'k;k dh lgk;rk l xeu fd;k tkrk gA
7- oDdd ¼ufÝfM;k½ dh lgk;rk l mRl tu gkrk gA
8- rfU=dk rU=] rkfU=dk oy; ,o nkgjh rkfU=dk jTt }kjk cuk gkrk gA
9- ,dfyxh ;k f}fyxh çk.kh ik, tkr gA
10- ifjoèku çR;{k ;k vçR;{k çdkj dk ,o VkdkQkj ykok ik;k tkrk gA



uhfjt QjfVek fg:fMufj;k

fp= 23-6

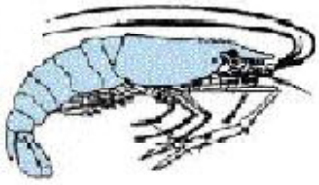
mnkgj.k&*Qjfvek* ¼*dpvk½] fg:fMufj;k* ¼*tkd½ uhjht&jrÑeh*

(VII) l?k vkFkkikMk (Arthos- Jointed, poda-foot) ;g tUr txr dk lcl cMk l?k gA

e[; y{k.k

1- ; f}ik'o lefer] f=dkjdh] fo[kfMr rFkk çgxh çk.kh gA
2- bue vx&r= Lrj dk 'kjhj lxBu gkrk gA
3- lfUèk;Dr mikxk dh mifLFkfr d dkj.k bl l?k dk uke vkFkkikMk fn;k x;kA
4- 'kjhj ij dkbfVu l cuk ckÁ ddky ik;k tkrk gA
5- ngxgk] ghekfyEQ l Hkjh gkrh gA vr% bl ghekl hy dgr gA
6- 'olu] cd yXl] 'olu ufydk] Vfd;k ;k fxYl vkfn d }kjk gkrk gA
7- 'kjhj flj] o{k rFkk mnj e foHkkftr gkrk gA
8- ifjlpj.k rU= [kyk gkrk gA
9- mRl tu eyfixh ufydkvk d }kjk gkrk g

(A) fyeyl



(B) >hxk

(C) fcPN

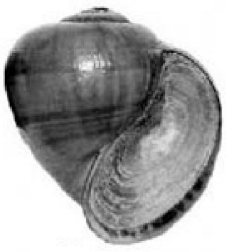
fp= 23-7

10- lonh vx tl&Jfxdk,] u= ¼ljy ,o l;Dr½ ,o lryu iVh mifLFkr gkr gA mnkgj.k & ckfcDl ¼j'ke dhV½] ,fil ¼eèkeD[kh½] thfor thok'e ¼fyeyl½ >hxk (Prawn)] ddMk (Crab)] fcPN (Scorpion) vkfnA

(VIII) l?k&ekyLdk (mollusca) ;g nljk lcl cMk l?k gA

e[; y{k.k

1- ; f}ik'o lefer] f=dkjdh rFkk çxgh ik.kh gA
2- ; LFkyh; vFkok tyh; rFkk vx r= Lrj d lxBu oky tho gkr gA
3- bu tUrvk e [k.MhHkou ugh ik;k tkrk gA
4- budk 'kjhj flj] ikn] vkUrjkx ,o e.Vy e foHkfnr gkrk gA
5- budk 'kjhj dkey ijUr dfYl;e dkckuV d j{kkRed dop l <dk jgrk gA vkDVkil e dop vuifLFkr ,o lhfi;k e vkUrfjd dop ik;k tkrk gA
6- bud vèkj lrg ij jxu] fcy cuku o rju d fy, ikn ik;k tkrk gA



Qkbyk

vkDVkil

;fu;k

fp= 23-8

7- bl l?k d çkf.k;k e ghek lk;fuu o.kd d dkj.k uhyk jDr ik;k tkrk gA
8- vkgkj uky "U" vkdkj dh gkrh gA e[k e Hkk tu dk ihlu d fy, jrh d leku vx jM;yk gkrk gA
9- ; ,dfyxh rFkk vMçt d gkr gA
mnkgj.k&*ikbyk ¼?kk?kk½] lhfi;k ¼dVyfQ'k½] ;fu;k ¼lhih½ vkDVkil ¼crky eNyh½* lkbfç;k ¼dkMh½

(IX) l?k&,dkbukMeVk (Echinos 'ky] derma- Ropk)

1- bl l?k d lHkh lnL; len e ik; tkr gA
2- bud 0;Ld çkf.k;k e çk;% ip vjh; lefer ik;h tkrh g ; f=Lrjh; ,o vx&rU= Lrj d gkr gA
3- budh dVdh; Ropk ij dydfj;l dVd ik, tkr gA
4- lkekU;r% e[k vèkj ry ij ,o ey}kj i"B ry ij gkr gA
5- bue fo'k"k çdkj dk ty loguh rU= ik;k tkrk gA

(A) ddefj;k

(B) rkjk eNyh

(C) leæh vfpu

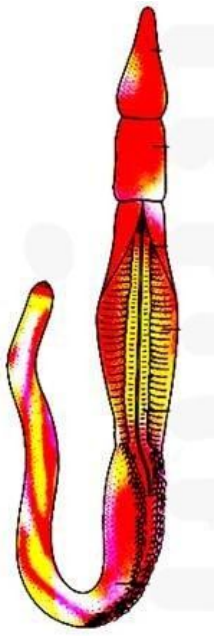
fp= 23-9

6- Li"V mRl tu rU= vuifLFkr gkrk gA
7- ; ,dfyxh çk.kh gkr ,o fu"kPku ckÁ gkrk gA
8- bue iu:nHkou dh vikj {kerk ikb tkrh gA
mnkgj.k&,LVfj;l ¼rkjk eNyh½] ,dkbul ¼leæh vfpu½] ,VhMku ¼leæh fyyh½] ddefj;k ¼leæh [kh jk½

(X) l?k gehdkMVk& (Hemi-Half)

e[; y{k.k

1- ; leæokl h] ,dy ;k fuogh gkr gA
2- ; f}ik'o lefer] f=Lrjh;] ngxgh; gkr gA
3- bue vx rU= Lrj dk lxBu ik;k tkrk gA
4- budk 'kjhj dkey] Ñfe:fi gkrk g rFkk 'kjhj 'k.M (Proboscis), dkyj (Collar) ,o èkM (Trunk) e foHkkftr gkrk gA
5- bl l?k e çf.k;k d 'k.M e[k&vèkuky ik;h tkrh gA
6- e[k&vèkuky (buccal diverticulum) dk igy ukVkdkM ekudj bUg dkMVk l?k e j[kk x;k Fkk] ijUr vc ;g uku&dkMVk e vkr gA
7- mRl tu] 'k.M e ik, tku oky ,dek= Xyke:yl d }kjk gkrk gA
8- vkgkj uky 'U' vkdkj dh ;k lhèkh gkrh gA
mnkgj.k& *cyukXykl l] jCMkIY;jk] Vkbdkmkjk] lQykfMLdlA*



fp= 23-10 : cyukXykl l

(XI) l?k dkMV& (chorde = jLlh ata = /kkjd)

e[; y{k.k

1- bl l?k d ikf.k;k e thou dh fdlh uk fdlh voLFkk e ukVkdkM vo'; ikb tkrh gA d'k:dh tUrvk e ukVkdkM Hk.kh; voLFkk e gh ik;h tkrh g] ckn e ;g :ikUrfjr gkdj d'k:d n.M cukrh gA

2- ' 'kjhj d eè; i"B Hkkx e [kk[kyh ufydk rfU=dk jTt gkrh gA

3- thou e fdlh u fdlh voLFkk e 'olu e lgk;d Dyke njkj ik;h tkrh gA tyh; dkMV e ; thou i;Ur ik, tkr gA mPp dkMV l e ; Hk.k voLFkk e gh ik, tkr gA

dkMVk d lkekU; y{k.k

1- ; çk.kh f}ik'o lefer] f=Lrjh;] ngxgh; tUr gkr gA

2- ân; ng&xgk e vèkj lrg ij fLFkr gkrk gA

3- :fèkj ifjogu r= cUn çdkj dk gkrk gA

4- 'olu o.kd ghekXykfcu ;Dr yky :fèkj df.kdk, ikb tkrh gA

5- bue ;Ñr fuokfgdk rU= mifLFkr gkrk gA

6- ; ,dfyxh gkr gA e[; :i l yfxd tuu gh ik;k tkrk gA

7- vUrª ,o cká ddky mifLFkr gkr gA

8- iu:nHkou dh {kerk de fodfl r gkrh gA

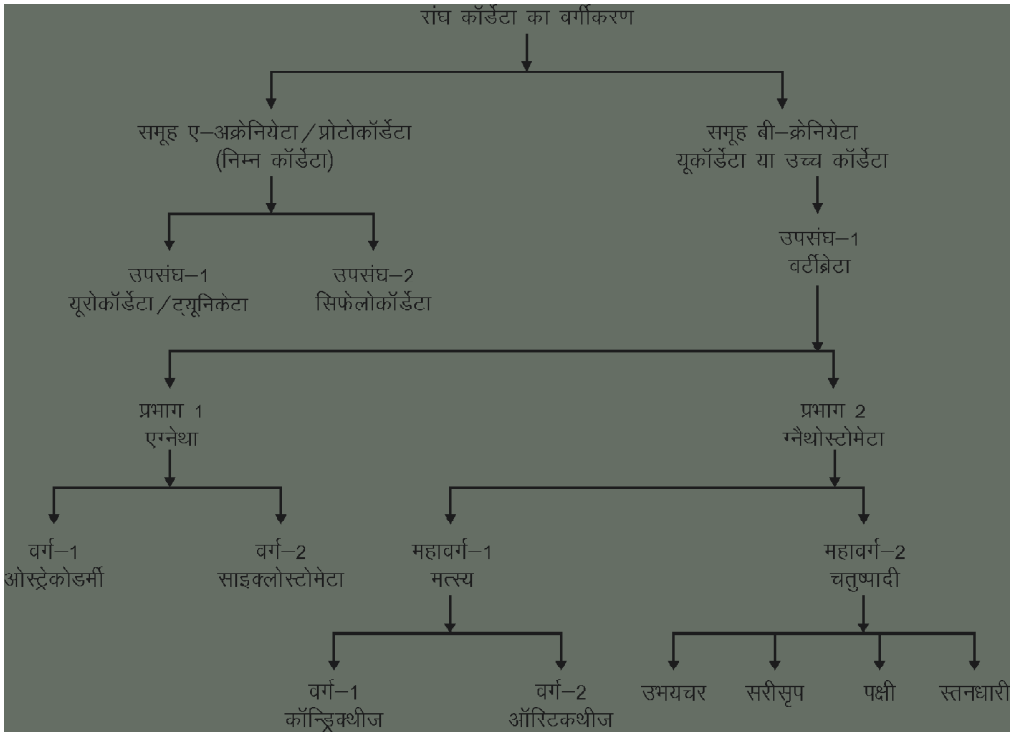
(XI) A leg vØfu;Vk@çkVkdkMVk

1- ; çkphu dkMVk çk.kh gA

2- bue diky ugh ik;k tkrk gA

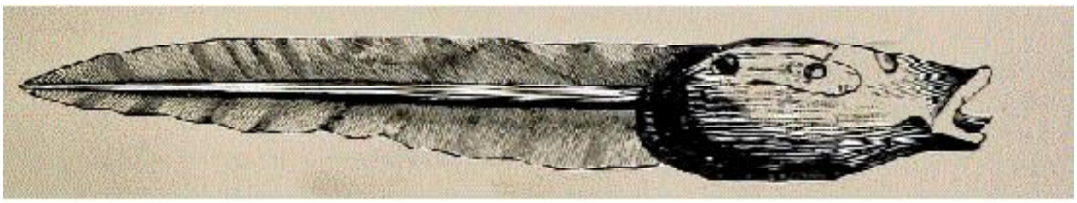
uku dkMVk o dkMVk e vUrj &

Ø-l-	uku dkMVk	dkMVk
1.	i"B jTt vuifLFkr gkrh gA	i"B jTt mifLFkr gkrh gA
2.	dUæh; rfU=dk rU= Bkl ,o vèkj ry e mifLFkr	dUæh; rfU=dk rU= [kk[kyk ,o i"B ry e mifLFkr
3.	Dyke fNæ vuifLFkr	xluh e Dyke fNæ mifLFkr
4.	yky jDr df.kdk, vuifLFkr o o.kd ghekXykfcu] lYkkTek e ik;k tkrk gA	yky jDr df.kdk, mifLFkr] ghekXykfcu RBC e ik;k tkrk gA
5.	;Ñr fuokfgdk rU= vuifLFkr	;Ñr fuokfgdk rU= mifLFkr
6.	tuu dkf;d] vyfxd ;k yfxd çdkj dk gkrk gA	tuu doy yfxd gkrk gA
7.	i:nHkou dh {kerk vfèkd gkrh gA	iu:nHkou dh {kerk cgr de ik;h tkrh gA



3- bue xluh; Dyke njkj mifLFkr gkrh gA
vØfu;Vk dk nk mil?kk e ckVk x;k gA

¼1½ mil?k&;jkdkMVk@V;fudVk (oura= tail, chorda= jTt)



fp= 23-11 : ,flfM;k

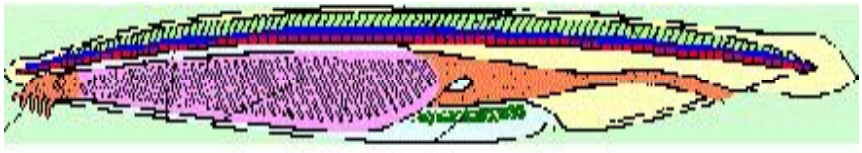
e[; y{k.k

1- bl leg d thok e jTt iN rd gh lhfer gkrh gA
2- 0;Ld tho dk 'kjhj V;fuflu l cu dop l f?kjk jgrk gA ftl V;fud dgr gA blfy, bl mil?k dk V;fudVk Hkh dgr gA
3- budh xluh e fxy dh njkj ik;h tkrh gA
4- budk ykok vfèkd fodflr o 0;Ld de fodflr gkr gA vr% bue ifrxkeh dk;kUrj.k ik;k tkrk gAmnkgj.k&*gMekfu;k] ,flfM;k] Mkfyvkye* vkfnA

¼2½ mil?k&flQykdkMVk

e[; y{k.k

1- bue i"B jTt flj l iN rd ik;h tkrh gA
2- 'kjhj cyukdkj ,o ikjn'kh gkrk gA
3- xluh ij fxYl njkj ik;h tkrh gA
mnkgj.k&,*fEQvkDll ;k cfd;kLVkek] ,lheVku*



fp= 23-12 % ,fEQvkDll

XI (B) Øfu;Vk ;k ;dkMVk

1- bu thok e efLr"d] efLr"d [kky (cranium) e ljf{kr ik;k tkrk gA vr% bUg Øfu;Vk dgr gA
2- ble ,d mil?k oVhcVk ik;k tkrk gA

mil?k&oVhcVk

e[; y{k.k

1- bue ukVkdkM doy Hk.kh.k voLFkk e gkrh gA ckn e ;g d'k:d n.M (vertebral column) e :ikUrfjr gk tkrh gA
2- budk 'kjhj flj] èkM] xhok ,o iN e foHkfnr gkrk gA
3- bud 'kjhj ij 'kYd] i[k ;k jke d :i e ckÁ ddky ik;k tkrk gA
4- tcMk dh mifLFkfr ;k vuifLFkfr d vkèkkj ij oVhcVk dk nk çHkkxk e oxhÑr fd;k x;k gA

¼1½ ,XuFkk ¼2½ XuFkkLVkeVk

¼1½ çHkkx&,XuFkk

e[; y{k.k

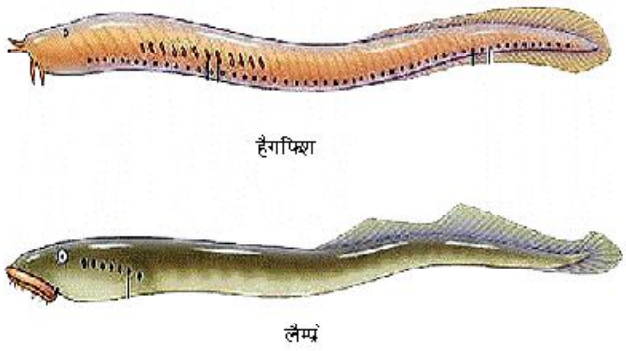
1- bl çHkkx e thok e okLrfod tcM vuifLFkr gkr gA
2- 'kjhj ij mikx ,o tuu okfgfu;k vuifLFkr gkrh gA
3- bl nk oxk e foHkkftr fd;k x;k gA

¼1½ ox&vkLVdkMeh

mnkgj.k&*flQyfll*

¼2½ lkbDykLVkeVk

mnkgj.k&*iVkekbtku@yEi* gx fQ'k½



fp= 23-13

¼2½ çHkkx&XuFkkLVkeVk

e[; y{k.k

1- bue okLrfod tcM o tkMhnkj mikx ik; tkr gA
2- ;g d'k:d n.M i.k fodflr gkrk gA
3- ân;] xeu vxk] 'olu vxk o Ropk d vkèkkj ij nk egkoxk e foHkkftr fd;k x;k gA

¼1½ filht ¼2½ VVkikMk

¼1½ egkox&filht

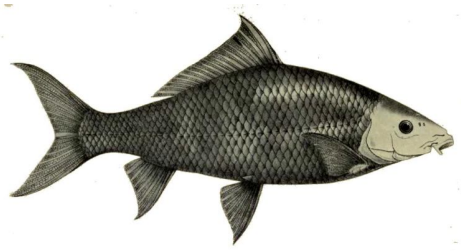
e[; y{k.k

1- ; i.k :i l tyh; tho gA ; yo.kh; o vyo.kh; ty e ik; tkr gA
2- budk 'kjhj flj] èkM o iN e foHkfnr gkrk gA
3- bue 'kjhj èkkjk j[kh; ,o rd:ih gkrk gA
4- rju d fy, ,d 'kfDr'kkyh iN ,o nk tkMh i[k ¼iDVkjy@vl ,o ifYod@Jk.kh½ ik, tkr gA
5- bue vèkj ;k xnh;] i"Bh; i[k o iPNh; i[k Hkh ik; tkr gA
6- bud 'kjhj ij 'kYdk dk cuk cká ddky ik;k tkrk gA
7- 'olu d fy, 5&7 tkMh 'olu fxYl ik, tkr gA tk [ky ;k fxy vkPNnd (operculum) }kjk <d gk ldr gA
8- ân; f}dk"Bh; gkrk gA ,d vkfyUn o ,d fuy; ik;k tkrk g ;g ohul ân; gkrk gA ble ge'kk O_2 jfgr :fèkj ik;k tkrk gA
9- bud 'kjhj dk rkieku cká okrkoj.k vulkj cnyrk jgrk gA vr% ; vlerkih gkr gA
10- fxYl dh ljpuk] 'kYdk d çdkj ,o vURkh ddky d

ox ¼1½ dkfUMDFkh t
mnkgj.k &Ldkfy;kMku
¼dÙkk eNyh½
Vkjihk Mk ¼foèkr j½
vkjk eNyh

ox ¼2½ vkfLVDFkh t
mnkgj.k&jkg] by
fglikdEil ¼lenh ?kkMk½

(A) vkjk eNyh



(B) jkg

fp= 23-14

vkèkkj ij bUg nk oxk e oxhÑr fd;k gA

¼2½ egkox &VVkikMk

e[; y{k.k

1- bu tUrvk e xeu d fy, nk tkM] ipkxfy (penta dactyle) ikn gkr gA
2- budh Ropk ij 'kYdk] ijk] vFkok jkek dk cká ddky ik;k tkrk gA bUg pkj oxk e oxhÑr fd;k x;k g &

¼1½ mHk;pj ;k ,EQhfc;k ¼2½ ljhli ;k jlVhfy;k ¼3½ i{kh ;k ,oh t ¼4½ LRkuèkkjh ;k eefy;k

¼1½ ox&mHk;pj@,EQhfc;k ¼Amphi-nk] Bios-thou½

e[; y{k.k

1- bl ox d çk.kh ty&LFkypj vFkkr mHk;pj gkr gA
2- budk 'kjhj] èkM o iN e foHkfnr gkrk gA dN thok e iN vuifLFkr gkrh gA
3- xhok vuifLFkr gkrh gA
4- vxikn e pkj ,o i'p ikn e ikp vxfy;k ikb tkrh gA vikMk x.k e ikn vuifLFkr gkr gA
5- Ropk ue o xfUFky gkrh gA bl ij 'kYd ugh ik, tkrA
6- dN thok dh Ropk e jx cnyu dh {kerk gkrh gA ftl eVkØkfll dgr gA
7- 'olu e[kxgk] Ropk o Q¶Ql }kjk gkrk gA ykok voLFkk e fxYl ik, tkr gA
8- ân; f=dk"Bh; gkrk gA nk&vkfyUn o ,d fuy;A
9- ;Ñr o oDd fuokfgdk r= ik;k tkrk gA
10- yky jDr dkf.kdk; ¼RBC) dUæd ;Dr gkrh gA
11- ifjoèku vçR;{k gkrk gA VMiky ykok voLFkk ik;h tkrh gA

mnkgj.k&*jkukfVxhuk ¼e<d½ cQk ¼VkM½] lykeMj] gk;yk*

jkukfVxhuk

lykeMj

fp= 23-15

¼2½ ox&ljhli ;k jlVhfy;k (Reptum=jxuk)

e[; y{k.k

1- ; i.kr¼ LFkyh; çk.kh g] ijUr dN tkfr;k ty e Hkh ik;h tkrh gA
2- bl ox d tUr çk;¼ jxdj pyu oky ;k fcYkdkjh gkr gA
3- budk 'kjhj flj] èkM o iN e foHkfnr gkrk gA
4- bue ikp u[kj ;Dr vxfy;k oky nk tkMh ij ik; tkr gA lik e ij ugh gkrA
5- bue ân; vi.k pkj dk"Bh; gkrk g] nk Li"V vkfyUn gkr g] ijURk fuy; vi.k gkr gA exjePN o ?kfM;ky e ân; Li"V pkj o'eh gkrk gA
6- budh yky jDr dfudkvk (R.B.C) e mHk;kÙky dUæd ik;k tkrk gA

7- budk 'kjhj 'k"d ,o 'kYd ;Dr Ropk l <dk jgrk gA

8- ; vlerkih tUr gkr gA

mnkgj.k&*ukt k& dkcjk] geMDVkbYl* ¼fNidyh½ *fdyku*] ¼leæh dNvk½] exjePN] Mdk ¼mMu fNidyh½

(A) **uktk**

(B) **fdyku**

(C) **exjePN**

fp= 23-16

¼3½ ox&,oh t ;k i{kh

e[; Yk{k.k

1- bue vx ikn i[kk e :ikUrfjr gkr gA tk mMu e lgk;d gkr gA

2- i'p ikn ij 'kYd ik, tkr gA bue pkj u[kj ;Dr vxfy;k ik;h tkrh gA

3- Ropk ij fdjfVu d cu g, ij ik; tkr gA

4- Ropk 'k"d gkrh g ijUr iN d vkèkkj ij ry xfUFk ¼çhu xfUFk½ ik;h tkrh gA

5- nkr jfgr pkp ik;h tkrh gA

6- vr¼ddky [kk[kyh] ok; l Hkjh vfLFk;k dk cuk gkrk g tk 'kjhj dk gYdk j[k] mMu e lgk;d gkrk gA

7- ân; i.k pkj dk"Bh; gkrk g&nk vkfyUn o nk fuy;

8- bue èofu ;= flfjDl (Syrinx) ik;k tkrk gA

9- ; lerkih gkr gA vFkkr bud 'kjhj dk rkieku fu;r jgrk gA

10- ; ?kkly cukr gA bue ird lj{kk fodflr çdkj dh gkrh gA

mnkgj.k&*dkol* ¼dkvk½] *iok fØLVVl* ¼ekj½ xkMkou] *dkyEck* ¼dcrj½ vkfn

(A) **dkvk**

(B) **dcrj**

(C) **ekj**

fp= 23-17

¼4½ ox eefy;k @ Lruèkkjh

e[; y{k.k

1- bl ox dh eknk çkf.k;k e LruxfUFk;k gkrh g] ftl ; viu f'k'k dk ikyu djrh gA
2- Ropk ij jke (Hairs) ik, tkr gA
3- ; çk.kh lerkih gkr gA
4- Ropk e Lon ¼ilhuk½ xfUFk;k] ry xfUFk;k o Lru xfUFk;k ik;h tkrh gA
5- ckÁ d.k e d.k fiUuk ik;k tkrk gA
6- budh xhok e lkr d'k:dk, ik;h tkrh gA
7- o{k xgk ,o mnj xgk d eè; ekVk i'kh; ruiVV (diaphragm) ik;k tkrk gA
8- ân; i.k pkj dk"Bh; ¼nk vkfYkUn o nk fuy;½ ik;k tkrk gA
9- yky jDr df.kdk; ¼vkj-ch-lh-½ dUnd jfgr gkrh gA ÅV o ykek e yky jDr df.kdkvk e ¼vkj- ch-lh-½ e dUæd ik;k tkrk gA
10- bue doy ;Ñr fuokfgdk rU= ik;k tkrk g bl ox dk oxhdj.k fuEukulkj gA

(A) Mdfcy lyVhil

(B) dxk:

(C) phrk

fp= 23-18

vehck

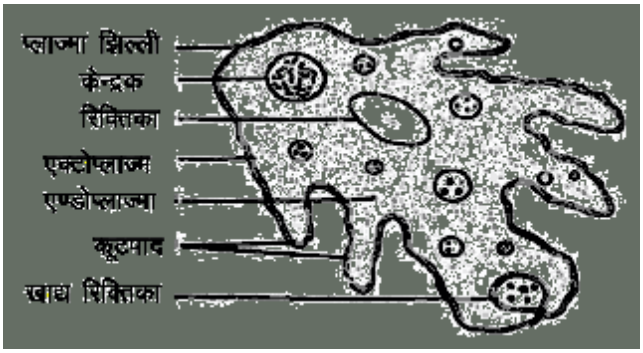
(Amoeba)

ifjp;

vehck çkfVLVk txr d ,d ek= l?k çkVktkvk dk çk.kh gA vehck uke dh mRifÙk xhd Hkk"kk d 'kCn (Amoibe-change;) vekbc = cnyuk l gb gA vehck lno viuh vkÑfr ifjofrr djrk jgrk gA

oxhdj.k

txr (Kingdom)	&	çkfVLVk
l?k (Phylum)	&	çkVkt kvk
mil?k (Sub phylum)	&	lkdk eLVhxkQkjk
ox (Class)	&	lkdkfMuk
x.k (Order)	&	ykcklk
o'k (Genus)	&	vehck
tkfr (species)	&	çkfV;l



fp= 23-19 % vehck çkfV;l

vkokl ,o LoHkko

vehck dh fofHkUu tkfr;k vyo.kh; ty] dhpM] lM&xy] dkcfud inkFkk] ue feÍh vkfn e ik;h tkrh g] fdUr dN tkfr;k yo.kh; ty e Hkh feyrh gA ;g eDr thoh tUrd gA ;g lokgkjh çk.kh gA

ljpuk

vehck l{en'kh ,o vdkf'kdh; çk.kh gA ; ljyre llhedUæh; tUr gA

1- **ifjeki %** vehck dk ifjeki 200 l 500 rd gk ldrk gA
2- **vkdkj %** ;g vkdkjghu gkrk g D;kfd ;g viuk vkdkj ifjoru djrk jgrk gA ;g vlefer gkrk gA ble èkork ikb tkrh g vFkkr ble vx rFkk i'p Hkkx Li"V gkr gA
3- **jx %** ; jxghu vFkok LyVh ,o ikjn'kh gkr gA
4- **dVikn %** vehck e dVikn ;k feF;k ij] 'kjhj d ço) gkr gA vehck d vfuf'pr vkdkj dk dkj.k bu dViknk dk cuuk ,o ylr gkuk gA dVikn vxyh d leku dUn (blunt) gkr gA ft ld dkj.k budk ikfyikn (lobopodia) dgr gA vehck d i'p flj ij >fj;k ikb tkrh gA ft l ;jkbM (uroid) dgr gA dVikn Hkk tu xg.k ,o pyu dk dk; djr gA
5- **thoæ0;dyk %** vehck dkf'kdk pkjk rjQ l dkf'kdk dyk ;k thoæ0;dyk ;k lykTekyek l f?kjh jgrh gA ;g yphyh ,o oj.kkRed ikjxE; gkrh gA bl f>Yyh ij l{ekdj (microvilli) ik; tkr gA tk vkèkkj ry ij fpidu e lgk;d gkr gA
6- **dkf'kdkæ0; %** dkf'kdkæ0;] thoæ0; dyk l f?kjk jgrk gA ;g nk {k=k e foHkkftr gkrk gA
   (i) ,DVklykTe ;k ckÁ çæ0;
   (ii) ,.MklykTe ;k vUr%çæ0;
   (i) **,DVklykTe ;k ckÁ çæ0; %** ;g thoæ0; d rjUr vUnj ik;k tkrk gA ;g LoPN] ikjn'kh rFkk iryk Hkkx gkrk gA ;g dVikn d 'kh"k ij ,d dkpkHk dk Vkh dk fuek.k djrk gA
   (ii) **,.MklykTe ;k vUr%çæ0; %** ;g ,DVklykTe l f?kjk gkrk gA ;g df.kdke; ,o v) ikjn'kh gkrk gA ;g nk çdkj dh voLFkk e cVk gkrk gA ; nkuk voLFkk, vkil e ifjoru'khy gkrh gA
   (a) lykTek ty % ;g ,.MklykTe dk ckgjh] tyh ln'; Hkkx gkrk gA
   (b) lykTek lky % ;g dUæh; Hkkx gkrk gA
7- **dUæd %** ;g pkjk rjQ l eghu] nkgjh rFkk fNfær dUæd dyk l vkofjr gkrk gA ble vud dfUædk, rFkk yxHkx 500&600 x.kl= ik, tkr gA ;g lHkh tfod fØ;kvk ij fu;U=.k djrk gA
8- **[kk| fjfDrdk, %** bu fjfDrdkvk e Hkk tu dk ikpu gkrk gA ; ykblklke l f?kjh jgrh gA vip [kk| inkFk ckgj fudkydj ; Lo; Hkh ckgjh lrg ij foylr gk tkrh gA
9- **ldpu'khy fjfDrdk, %** ; vehck d 'kjhj e ty fu;eu dk dk; djrh gA ; bdkb f>Yyh l f?kjh gb Linu'khy ljpuk gkrh gA ;g vuko';d ty dk ,d= dj ckgj fudkyrh jgrh gA
10- **ty fjfDrdk, %** ; ikjn'kh] jxghu ,o vldpu'khy gkrh gA
11- **ekbVkdkf.M;k %** ; ldpu'khy fjfDrdk d pkjk vkj ikb tkrh gA
12- **xkYthdk; %** ; vehck d lkoh dkf'kdkx gA vehck e bud vfrfjDr vUr%çæ0; tkfydk] jkbcklke] ykblklke bR;kfn lHkh dkf'kdkx ik, tkr gA

vehck e xeu % vehck e dViknk dh lgk;rk l xeu gkrk gA ; dVikn fujUrj cur jgr gA ,d le; e vud dViknk dk fuek.k gkrk gA ijUr çpyu dh fn'kk cM dVikn dh vkj gkrh gA ; dVikn dkf'kdkæ0;

d vkx dh vkj çokfgRk gku d dkj.k cur gA bl fØ;k dk le>u d fy, vud oKkfudk u fofHkUu er fn; gA t l vkl tu er] ldpu er] i"B ruko er] lky ty er bR;kfnA

vehck e ik"k.k

vehck ,d lokgkjh ,o çk.kh le Hkkth çk.kh gA ;g l{e ¶y tYkV] flfy;V] cDVhfj;k] NkVh 'koky ,o vU; çkVk tkvk dk Hk{k.k djrk gA vehck e ik"k.k fuEu ink e gkrk gA

(a) Hkkt u dk idMuk rFkk vUr%xg.k

(b) ikpu

(c) vo'kk"k.k ,o Lokxhdj.k

(d) cfg%{ki.k

vehck e 'olu % vehck viu 'kjhj dh lrg l ty e ?kyh gb vkDlhtu vo'kkf"kr djrk gA 'olu fØ;k e vkDlhtu ,o dkcu Mkb vkDlkbM x lk dk fofue; folj.k fofèk d }kjk gkrk gA Åtk ATP d :i e lfpr jgrh gA

mRltu % mikip;h fØ;kvk d QyLo:i mRiUu vekfu;k] ;fj;k vkfn mRlth inkFkk dk 'kjhj dh lrg l folj.k }kjk ckgj R;kx fn;k tkrk gA ldpu'khy fjfDrdk; Hkh ikuh e ?kfyr inkFkk dk ckgj fudkyu e lgk;rk djrh gA

ijklj.k fu;eu % vehck e ijklj.k d }kjk fujUrj ty ço'k djrk jgrk gA bl ty dk fu;U=.k uk fd;k tk, rk vR;fèkd ty ,df=r gku l vehck QV tk,xkA vr% ty dh cnk d feyu l ldpu'khy fjfDrdk dk fuek.k gkrk gA bl Mk;LVky (diastole) dgr gA ;g fjfDrdk cMh gkdj lrg ij vkdj QV tkrh gA ftll vfrfjDr ty ckgj fudy tkrk gA bl flLVky (systole) dgr gA bl fØ;k d fy, Åtk] ATP v.kvk }kjk çklr gkrh gA

mÙktu'khyrk % vehck viu okrkoj.k l çklr míhiuk d çfr vufØ;k çnf'kr djrk gA okrkoj.k e fdlh Hkh çdkj dk ifjoru&çdk'k] Li'k] rki] fo|r] vEy] x:Ro] bR;kfn mnnhiu d lkr gk ldr gA mnnhiu d çfr vufØ;k vupyu dgykrh gA ; fuEu çdkj l g çdk'kkuoru] Li'kkuoru] rkikuoru] èkkjkuoru] jlk;ukuoru] x:Rokuoru vkfnA

vehck e tuu % vehck dh LoHkkfod eR; ugh gkrh] blfy, vehck dk ^vej* dgk tkrk gA iVhHkou bl çfrdy ifjfLFkfr;k l cpkrh gA iu:nHkou dh {kerk d dkj.k bldk çR;d ¼dUæd Hkkx ;Dr½ Hkkx LorU= vehck e ifjofrr gk tkrk gA ble vud çtuu fofèk;k ikb tkrh gA tl&f}foHkktu] cgfoHkktu] fct k.k tuu] l;Xeu bR;kfnA

,Ldfjl ¼xky Ñfe½

(Ascaris)

ifjp;

,Ldfjl dk 'kjhj cyukdkj gku d dkj.k bUg xky Ñfe dgk tkrk gA budk 'kkjhfjd xBu vx Lrjh; gkrk gA ; f}ik'o lefer] feF;k ngxgh; çk.kh gkr gA

oxhdj.k

txr (kingdom) & tUr ¼,fuefy;k½

l?k (phylum) & fueVkMk

ox (class) & QfLefM;k

o'k (genus) & ,Ldfjl

tkfr (species) & yEchdk;fMl

vkokl ,o LoHkko

lkekU; ckypky dh Hkk"kk e bl iV dk dpvk Hkh dgk tkrk gA ;g ue o fpduh enk e Hkh ik;k tkrk gA ;g eu"; dh NkVh vkr e ijthoh d :i e ik;k tkrk gA ;g eu"; d vfrfjDr lvj] HkM] cUnj rFkk db ikyr i'kvk dh vkr e Hkh ik;k tkrk gA ;g eu"; e fo'k"kdj cPpk e vUr% ijthoh d :i e vkrk e feyrk gA eu"; e ik;h tku okyh bldh mitkfr g& ,Ldfjl yEchdkbfMl gkfeful gA

,Ldfjl e ijthfork d vudyu

1- ik"kn dh vk= e jgu gr ,Ldfjl dk 'kjhj yEck] iryk ,o rd:ih gkrk gA

2- ,Ldfjl dh mipe ekVh o db Lrjh; gkrh g] tk bl ik"kn dh vk= e mifLFkr ikpd ,Utkbe l cpkrh gA

3- ;g ifpr Hkktu xg.k djrk gA vr% bldh vkgkj uky ljy gkrh gA

4- ,Ldfjl dh xluh p"kd vx dk dk; djrh gA

5- bld gkBk ij lonkx ik; tkr gA

6- ik"kn dh vk= e O_2 dh deh gku d dkj.k ble vukDlh 'olu ik;k tkrk gA

7- ;g ljyrk l vud u, ik"knk dk lØfer dj ldA bl gr ble cgr vfèkd tuu {kerk ik;h tkrh gA

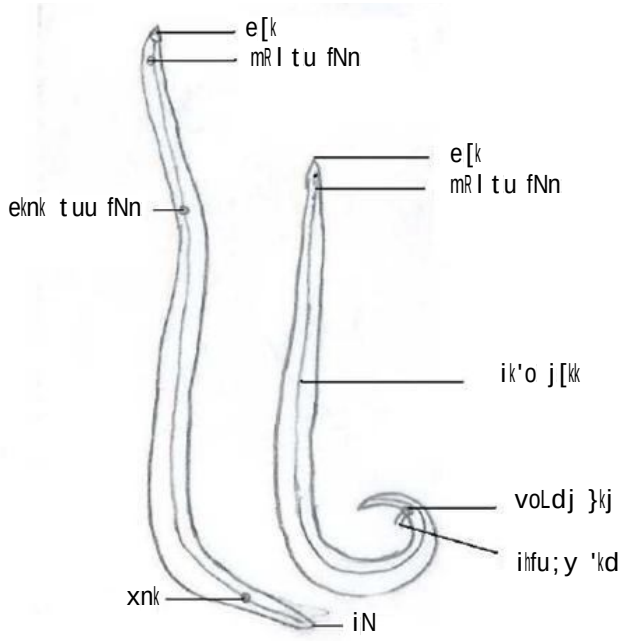
ckÁ ljpuk

,Ldfjl yEck] iryk] fljk ij vfèkd ldjk] rd:ih ,o Ñfe ln'; tho gA ;g gYd Hkj jx dk gkrk gA bld 'kjhj ij pkj èkkfj;k fn[kkb nrh g & ,d eè; i"B lrg ij]

,d eè; vèkj lrg ij vkj nkuk ik'o lrg ij ,d&,d èkkjhA

,Ldfjl d vx flj ij f=dk.kh; e[k fLFkr gkrk gA ;g rhu vk"Bk l f?kjk gkrk gA vk"Bk d Hkhrjh fdukjk ij mipe l cu nkr gkr g rFkk ckgjh fdukjk ij lonh vdj gkr gA bld i'p flj l dN vkx dh vkj lonkx] QfLeM gkr gA vx flj l yxHkx 2 feeh- ihN mRl tu fNæ gkrk gA

i'p flj l 2 feeh- vkx xnk gkrh gA uj e ;g tuu fNæ Hkh gkrk gA vr% bl voLdj }kj dgr gA bel l nk ihfu;y 'kd ;k dfVdk; fudyh jgrh gA eknk e tuu fNæ] vx flj l yxHkx 1@3 Hkkx ij gkrk g] bl Hkx (vulva) dgr gA



fp= 23-20 % ¼v½ eknk ¼c½ uj ,Ldfjl

tuu r=

¼v½ uj tuu r=

1- **o"k.k %** ,Ldfjl e ,d o"k.k ik;k tkrk gA ;g o"k.k viu lehiLFk] Lor= flj ij cUn rFkk njLFk flj ij 'kØokfguh e [kyrk gA

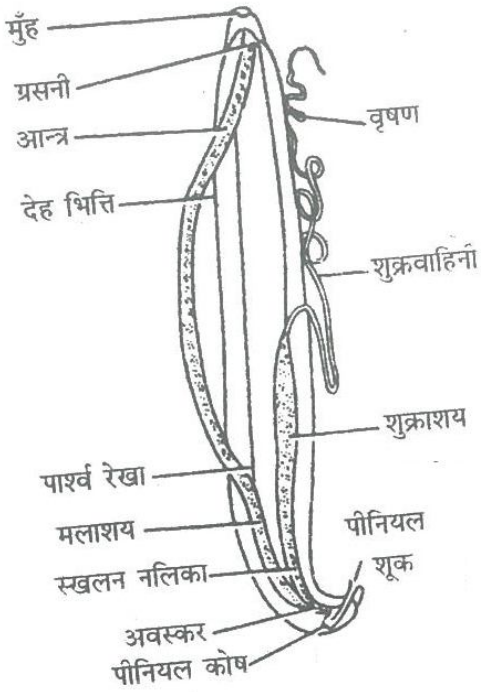
2- **'kØokfguh %** ,Ldfjl e ,d ekVh] lhèkh o de yEch 'kØokfguh gkrh g tk o"k.k l fudyrh gA

3- **'kØk'k; %** 'kØokfguh ,d lhèkh] yEch o ekVh ljpuk e [kyrh g ftl 'kØk'k; dgr gA bldh fHkfÙk;k i'kh; gkrh gA 'kØk'k;] L[kyu ufydk e [kyrh gA

4- **L[kyu ufydk %** ;g NkVh o ldjh ufydk gkrh gA bldh fHkfÙk xfFky o i'kh; gkrh gA ;g ldpu'khy gkrh gA

5- **voLdj ekx %** ;g voLdj }kj d }kjk ckgj dh vkj [kyrh gA

6- **ihfu;y 'kd %** ,Ldfjl e nk ihfu;y dk"k ik; tkr g] bue dkVk d leku ljpuk& ihfu;y 'kd ik;h tkrh gA



fp= 23-21 % uj tuu r=

¼c½ eknk tuu r=

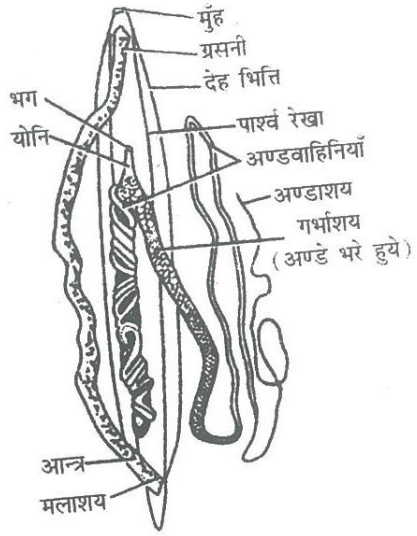
1- **v.Mk'k; %** eknk ,Ldfjl e ,d tkMk v.Mk'k; ik;k tkrk gA ; f}v.Mk'k;h gkr gA ; èkkx tlh iryh] yEch uyhdkdkj o d.Mfyr ljpuk gkrh gA ;g v.Mokfguh e [kyrh gA

2- **v.Mokfguh %** ; l[;k e nk gkrh gA çR;d v.Mokfguh v.Mk'k; l lehiLFk flj l ,o xHkk'k; l njLFk flj }kjk tMh jgrh gA

3- **xHkk'k; %** ; Hkh l[;k e nk gkr gA budh fHkfÙk i'kh; ,o xfFky gkrh gA ;g ldpu'khy gkr gA

4- **;kfu %** nkuk vkj d xHkk'k; feydj ,d NkVh] ldjh o ldpu'khy ;kfu dk fuek.k djr gA

5- Hkx % ;kfu ,d uUg eknk tuu fNæ vFkok Hkx }kjk 'kjhj l ckgj dh vkj [kyrh gA



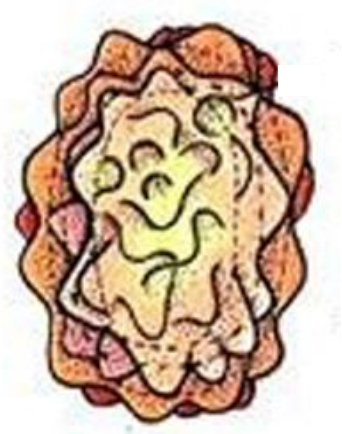
fp= 23-22 % eknk tuu r=

uj o eknk ,Ldfjl d ckÁ y{k.kk e vUrj

	uj ,Ldfjl	eknk ,Ldfjl
1-	;g 15&30 leh- yEck ,o 3&5 feeh- ekVk gkrk gA	bldh yckb 20&40 leh- rFkk ekVkb 6&8 feeh- gkrh gA
2-	bldk i'p fljk eMk gvk gkrk gA	bldk i'p fljk lhèkk gkrk gA
3-	bldk xnk ,o tuu fNn ,d gh gkrk gA ;g voLdj }kj dgykrk gA	bldk xnk ,o tuu fNn vyx&vyx gkr gA xnk vdj vuifLFkr gkr gA
4-	xnk vdj mifLFkr gkr gA	
5-	voLdj }kj l ,d tkMh ihfu;y 'kd fudy jgr gA	ihfu;y 'kd vuifLFkr gkr gA

eFku ,o fu"kpu

uj ,Ldfjl d o"k.k e 'kØk.k fodflr gkdj 'kØk'k; e ,df=r gkr jgr gA eknk ,Ldfjl d v.Mk'k;k e v.Mk.k fodflr gkdj xHkk'k; e igp tkr gA



fp= 23-23

eFku fØ;k ik"kn dh vkr e lEiUu gkrh gA uj d ihfu;y 'kd ckgj fudy vkr g vkj eknk dh ;kfu dk Qyk nr gA bld i'pkr uj L[kyu ufydk dk ckj&ckj ldfpr dj] 'kØk.kvk dk eknk dh ;kfu e Mkyrk jgrk gA ;kfu l 'kØk.k xHkk'k; rd py tkr gA

,d 'kØk.k ,d v.Mk.k e ço'k djrk gA v.Mk.k o 'kØk.k nkuk d dUnd lefdr gkdj ;Xeut cukr gA bl fu"kpu dgr gA

;Xeut

xHkk'k; dh fHkfr dk L=ko ;Xeut d pkjk vkj ,d j{kkRed [kky cukrk gA ;g [kky Hkj jx] dMk] [kjnjk rFkk ygjnkj vFkok eLlnkj gkrk gA ;g voLFkk efeyVM v.M dgykrh gA

v.Mkjki.k

efeyVM v.M ;kfu l gkr g, eu"; dh vkr e vk tkr gA ; v.M] vkDlhtu dh deh] mPp rki o ueh d dkj.k eu"; dh vkr e ifjof)r ugh gk ikrA vr% ; ey d lkFk eu"; d 'kjhj l ckgj fudy tkr gA

Hk.kh; ifjo)u

efeyVM v.M dk ifjo)u vudy ifjfLFkfr;k& tl ueh;Dr eknk rFkk de rkieku e gkrk gA ,Ldfjl e fonyu lfiy ,o fu'p;kRed çdkj dk gkrk gA v.M e fonyu d QyLo:i CykLVyk ,o mld i'pkr xLVyk voLFkk fodflr gkrh gA 5&6 fnu i'pkr xLVyk ,d uUg f'k'k e ifjofrr gk tkrk g ftl jgfCMfVQke ykjok vFkok çFke voLFkk dk r:.k dgr gA

u; ik"kn dk lØe.k

f'k'k;Dr v.M lØe.k dju e l{ke gkr gA nf"kr Hkk tu d }kjk ; eu"; d 'kjhj e ço'k dj tkr gA mi;Dr ik"kn u feyu ij ; 4&5 o"k rd ue feVVh e thfor jg ldr gA eu"; dh vkr e igpu ij uUg f'k'k] v.Mk d [kky ?ky tku d ifj.kkeLo:i eDr gk tkr gA ;g r:.k vkr dh fHkfÙk e ?kldj f'kjkvk e ço'k dj tkrk gA bld i'pkr ;g :fèkj çokg d lkFk ;Ñr fuokfgdk r= d }kjk ;Ñr e vk tkrk gA ;gk l i'p egkf'kjk }kjk ân; e vk tkrk gA ân; l Q¶Ql èkeuh }kjk QQMk e ok; dk"Bdk d vUnj vk tkrk gA ok; dk"Bdk e ykjok f}rh; fuekpu djrk g ftld QyLo:i rrh; voLFkk ykjok fodflr gk tkrk gA yxHkx 4 fnu i'pkr QQMk e gh rrh; fuekpu d ifj.kkeLo:i prFk voLFkk ykjok fodflr gk tkrk gA 10 fnu i'pkr ;g ok;dk"Bk l ok;uky e gkrk gvk xluh e vk tkrk gA xluh e bldh xeu fØ;k d ifj.kkeLo:i ik"kn dk [kklh gku yxrh gA [kklh d dkj.k ;g xkluyh e ço'k dj tkrk g] tgk l gkrk gvk ;g ykok vkek'k; l vkr e vk tkrk gA vkr e bldk prFk fuekpu gkrk g ftld QyLo:i ;g i.k o;Ld e ifjofrr gk tkrk gA

,Ldfjl }kjk eu"; ij diHkko

,Ldfjl }kjk eu"; e ,Ldfj,fll jkx mRiUu gkrk gA eu"; ij bl jkx d y{k.k o çHkko fuEu g &

- iV e nn gkrk g ,o Hk[k ugh yxrhA vfuæk ,o ?kcjkgV dh f'kdk;r jgrh gA
- ,Ldfjl l fudyu okyk fo"k ,Bu ink djrk gA
- bl jkx e vfrlkj (diarrhoea), oeu (vomiting), Toj (fever), cpuh jgrh gA
- vkr e nn rFkk ltu vk tkrh gA
- lØfer cPpk d 'kjhj dh of) vo:) gk tkrh gA
- ,Ldfjl dk ykjok o;Ldk l vfèkd gkfudkjd gkrk gA ; QQMk e igpdj :fèkj lko (haemorrhage), ,o ok;dk"Bk e ltu mRiUu dj nrk gA bul :fèkj {kh.krk (anaemia) Hkh gk tkrk gA ;g efLr"d d fodkl d fy, Hkh gkfudkjd gA

fpfdRlk

,Ldfjl l ihfMr jkfx;k d mipkj gr dke e yh tku okyh vk"kfèk;k fuEu g &

(i) Mhdfjl (ii) ,.Vhikj (iii) gYekflM (iv) ,Ydkikj phukikfM;e -dk ry ç;Dr dj ijthoh dk jkxh dh vkr l fu"dkflr fd;k tk ldrk gA

lØe.k d cpko

- Qyk o lfCt;k dk Hkyh çdkj èkkdj ç;kx e ykuk pkfg,A
- Hkk tu l io gkFkk dk èkkuk pkfg, ,o uk[ku dV g, j[ku pkfg,A
- dM o dpj l futkr iku gr oKkfud fofèk;k ç;Dr djuh pkfg,A

,Ldfjl dk thou pØ

QjfVek ¼dpvk½

(Earthworm)

ifjp;

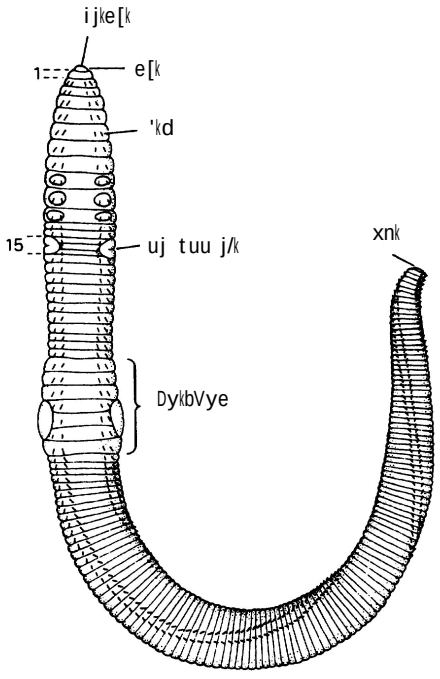
dpvk tUr txr d l?k ,ufyMk dk çk.kh gA lkekU; r% Hkkjr e ikb tku okyh çe[k tkfr QjhfVek ikLF;ek gA ;g tho vx Lrj d lxBu okyk f}ik'o lefer] okLrfod ngxgk okyk gkrk gA ble fo[k.Mu ckgj l Hkh fn[kk;h nrk gA ;g Ñfe ln'; gkrk gA

oxhdj.k

txr (kingdom)	&	,fuefy;k
l?k (phylum)	&	,ufyMk
ox (class)	&	vkfyxkdhVk
x.k (order)	&	vkfiLFkkikjk
o'k (genus)	&	QjfVek
tkfr (species)	&	ikLF;ek

vkokl ,o LoHkko

dpvk ,d LFkyh; vd'k:dh çk.kh gA ;g ue enk e fcy cukdj jgrk gA bl feÍhÑfe (earth worm) Hkh dgr gA ;g jkf=pj çk.kh gA ;g feÍh lMh&xyh ifÙk;k] çkVk tkvu vkfn dk feêh d lkFk gh vUr% xfgr dj yrk gA vifpr Hkk tu NkVh&NkVh xkfy;k d :i e 'kjhj l ckgj fudky nrk gA bUg oe dkfLVx vFkkr Ñfe dpd dgr gA



fp= 23-24 % QjfVek

ckÁ ljpuk

1- **vkÑfr ,o ifjek.k %** dp, dk 'kjhj yEck] ldjk o cyukdkj gkrk gA bld nkuk flj dUn(blurt) gkr gA bld 'kjhj dh yECkkb 15-20 cm rFkk ekVkb 3-6 mm gkrh gA

2- **jax %** dp, dh ngfHkÙkh e ikjQkbfju uked o.kd ik;k tkrk gA ftld dkj.k bldk jx gYdk Hkjk gkrk gA

3- **[k.MhHkou %** dp, d lEi.k 'kjhj ij vuçLFk oy; ,o okLrfod [k.MhHkou ik;k tkrk gA bldk 'kjhj 100-120 NkV [k.Mk e cVk gkrk gA çR;d [k.M d [kkp e vUrj[k.Mh; iÍ ik, tkr g] tk vkUrfjd 'kjhj dk dk"Bk e foHkkftr djr gA

4- **ifje[k ,o ijke[k %** dp, d çFke [k.M dk ifje[k dgr gA ifje[k dk Åijh Hkkx ,d NkV ekly çoèk d :i e fudyk jgrk gA bl ijke[k dgr gA dp, dk vfUre [k.M dk xnk [k.M (Pygidium) dgr gA

5- **i;kf.kdk %** dp, dk 14 ok] 15ok rFkk 16ok [k.M ,d xgj Hkj jx dh NYynkj jpuk cukrk gA ftl DykbVye ¼i;kf.kdk½ dgr gA bll 'y"ek rFkk ,YC;feu dk lko.k gkrk gA

(i) io DykbVye Hkkx % ;g 1 l 13 [k.M rd gkrk gA

(ii) DykbVye Hkkx % ;g 14o l 16 o [k.M dk gkrk gA

(iii) i'p % DykbVye Hkkx&;g 17 o l vfre [k.M rd gkrk gA

6- **'kd** (Setae) : ; dp, d çFke] DykbVye rFkk vfUre [k.Mk dk NkMdj lHkh e ik;h tkrh gA ; çkFkfed pyukx gkr gA ; S vkÑfr d gkr gA

7- **ckÁ fNæ %** dp, e fuEu çdkj d fNæ ik, tkr gA

(i) **e[k %** ;g çFke [k.M ijke[k ij vèkj lrg ij vuçLFk fNæ d :i e ik;k tkrk gA

(ii) **xnk %** ;g vfre [k.M ¼ikbthfM;e½ ij ik;k tkrk gA

(iii) **i"“B fNæ %** ;g çFke l 11 o rFkk vfUre [k.M e vuifLFkr gkr gA 'k"k lHkh [k.Mk d vUrjk[k.Mh; [kkp e eè; i"B j[kk ij fLFkr gkr gA

(vi) **oDdd jèk %** ;g çFke nk [k.Mk dk NkMdj lEi.k 'kjhj e feyr gA bud }kjk oDd ckgj dh vkj [kyr gA

(v) **'kØ xkfgdk jèk %** ; pkj tkMh gkr gA ; vèkj ik'o lrg ij 5@6] 6@7] 7@8 rFkk 8@9 [k.Mk d eè; ik, tkr gA ; nlj dp, l 'kØk.k xg.k dj 'kØxkfgdk e lxfgr j[kr gA

(vii) **uj tuu fNæ** % ; 18 o [k.M d vèkj ik'o lrg ij ,d tkMh fNæ gkr gA bue çkLVV æ0; o 'kØk.k ckgj fudyr gA

(viii) **eknk tuu fNæ** % ;g eè; vèkj Hkkx e 14o [k.M ij fLFkr gkr gA

8- **tufud vdj** % 17o o 19o [k.M d vèkj ry d ik'o e mHkkjk d :i e eFkuh ifiy ik, tkr gA ; eFku d le; dpvk dk fpidu e lgk;rk çnku djr gA

ng fHkfÙk % dp, dh ng fHkfÙk iryh] dkey] yphyh rFkk ue gkrh gA ble rhu Lrj ikj tkr gA

(i) **D;fVdy** % ;g fNæ ;Dr gkrh gA ftud }kjk vfèkpe dh 'y"ek xfUFk;k ckgj dh vkj [kyrh gA ;g ,d lj{kkRed vkoj.k gA

(ii) **vfèkpe** % ble pkj çdkj dh dkf'kdk, ik;h tkrh gA 'y"ek] dkf'kdk,] voyEcu dkf'kdk,] lonh dkf'kdk, ,o vkèkkjh; dkf'kdk,A

(iii) **i'kh Lrj** % ;g rhu mi Lrjk dk gkrk gA

(a) cká ory i'kh Lrj

(b) eè; vunè; i'kh Lrj

(c) vkUrfjd ory i'kh@çxgh; midyk Lrj

ng fHkfÙk d dk;

1- ;g 'kjhj dk lj{kk çnku djrh gA

2- ;g 'kjhj dk ue cukrh gA bld Åij gkfudkjd thok.kvk dk çHkko ugh iMrk gA

3- ;g 'olu e lgk;d gkrh gA

4- ;g lonuk, xg.k djrh gA

5- ,YC;feu dkdu e mifLFkr Hk.k d fy, HkkT; inkFk dh rjg dk; djrk gA

6- ;g xeu e lgk;rk djrh gA

ng xgk

dp, dh ng ^ufydk e ufydk* d leku gkrh gA cká ufydk ng fHkfÙk rFkk vkUrfjd ufydk ikpu uky gkrh gA bu nkuk ufydkvk d eè; d LFkku dk çxgk dgr gA

ng xgk e {kkjh;] nfèk;k æo Hkkjk gkrk gA ftl çxgh; ;k ngxfgfd; æo dgr gA ble vud df.kdk, ik;h tkrh gA tl&vehch; df.kdk, Hk{kdk.k] oÙkkdkj dkf'kdk, ,o E;dklkbVlA

ng xfg; æo d dk;

1- ;g xeu e lgk;rk çnku djrk gA

2- ;g Ropk dk ue cukdj] 'olu e lgk;d gkrk gA

3- ;g mRltu e lgk;d gkrk gA

4- ;g cDVhfj;k o gkfudkjd inkFkk dk u"V dj 'kjhj dh j{kk djrk gA

5- ;g vkUrjkxk dh cká vk?kkrk l lj{kk çnku djrk gA

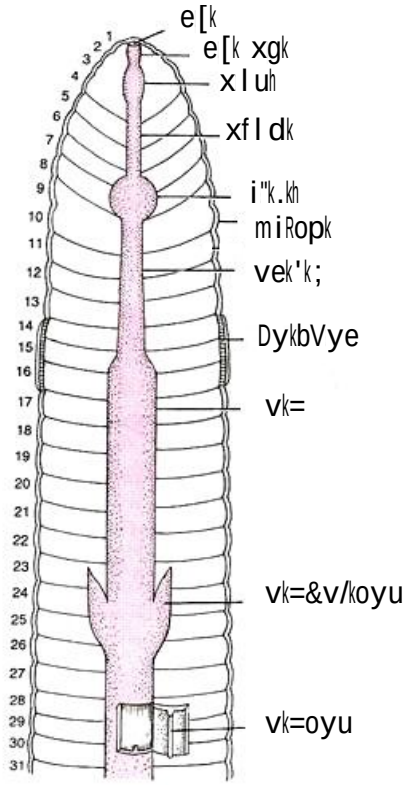
6- ifpr Hkktu dk lEi.k 'kjhj e forj.k djrk gA

xeu

dp, e xeu ngfHkfÙk e mifLFkr if'k;k ,o 'kdk dh lgk;rk l gkrk gA xeu gr dp, dh e[k xfgdk o ngxgh; æo Hkh lgk;d gkr gA bld 'kjhj e çpyu] rkyc) ldpu ,o çlkj.k l gkrk gA

ikpu r=

dp, dh vkgkj uky ,d lhèkh ufydk d leku gkrh gA ;g e[k}kj l xnk rd ik;h tkrh gA dpvk dk e[k 1 l 3 [k.M rd ik;h tku okyh e[k xgk e [kyrk gA e[k xgk] ,d ekly xluh l tMk gkrk gA tk 3 l 4 [k.M rd ik;h tkrh gA ;g xluh ykj lkfor djrh g] ftle 'y"ek vkj çkVhu vi?kVudkjh ,UtkbEl ik; tkr g ¼fp= 23-25½A



fp= 23-25 % QjfVek dk ikpu r=

xluh d ihN] 5o l 7o [k.M rd xfldk Qyh jgrh gA xfldk] i"k.kh l tkdj feyrh gA ;g 8o [k.M e gkrh g ,o Hkk tu ihlu dk dk; djrh gA i"k.kh] 9o l 14o [k.M rd ik, tku vek'k; l feyrh gA

15o [k.M l vfUre [k.M rd vk= ikb tkrh gA ble 26o [k.M e ,d tkMh lhdh ik;h tkrh gA vk= rhu Hkkxk e foHkkftr gkrh gA

(i) io vk=oyu {k= % 15o l 26o [k.M rd

(ii) vk=oyu {k= % 27o l vfUre 25 [k.M NkMdj

(iii) i'p&vk=oyu {k= % vfUre 25 [k.Mk e i'p vk=oyu Hkkx] xnk d }kjk ckgj [kyrk gA

'olu

dp, e fof'k"V 'olukxk dk vHkko gkrk gA ;g vkæng fHkfÙk }kjk 'olu djrk gA vkDlhtu dk ifjogu jDr lykTek e mifLFkr ghekXykfcu }kjk gkrk gA

ifjlpj.k rU=

dp, e cn ifjlpj.k rU= ik;k tkrk gA ble ân;] :fèkj okfgdk, ,o dkf'kdk, gkrh gA 4] 5] 6o [k.M e :fèkj xfUFk;k ik;h tkrh g tk jDr dk fuek.k djrh gA dp, e 7] 9] 12 o 13o [k.M e ,d&,d tkMh ân; ik, tkr gA vr% ble pkj tkMh ân; gkr gA

mRlth r=

dpvk d mRlth inkFkk e 55 çfr'kr ;fj;k gkrk gA vr% ;g ;fj;kVfyd çk.kh gA dp, e mRlth vx ufÝfM;k ;k mRlfxdk, ;k oDdd gkr gA ; oDdd çFke rhu [k.Mk dk NkMdj lHkh [k.Mk e ik, tkr gA ; fuEu rhu çdkj d gkr gA

(i) iÍh; oDdd (ii) xluh oDdd (iii) Roph; oDdd ; oDdd 'kjhj e ty dk lryu cuk; j[kr gA ty jfgr mRlth inkFk vk= l ey }kjk ckgj fudky fn; tkr gA

rf=dk r=

dp, e nkgjh vèkj rf=dk jTt ik;h tkrh gA cgr lh rf=dk dkf'kdk, bdëh gkdj xfPNdk dk fuek.k djrh gA ; [kMh; xfPNdkvk d :i e rf=dk jTTk ij 0;ofLFkr gkr gA vx flj ij ½3 o 4 [k.M e½ rf=dk oy; ik;k tkrk gA ;g rf=dk oy;] çefLr"d xfPNdk d lkFk feydj efLr"d dk fuek.k djrh gA rf=dk r= d rhu Hkkx gkr gA

(i) dUæh; rf=dk r= (ii) ifjèkh; rf=dk r= (iii) vudEih; rf=dk r=

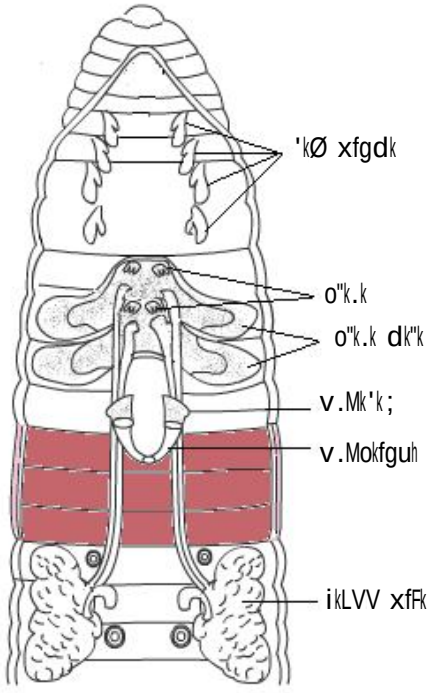
dp, e rhu çdkj d lonh vx ;k xkgh ik; tkr gA

(i) Li'k xkgh (ii) Lokn xkgh (iii) çdk'k xkgh

çtuu r=

dpvk mHk;fyxh gkrk gA vFkkr ,d gh çk.kh e eknk ,o uj tuukx] nkuk ik; tkr gA

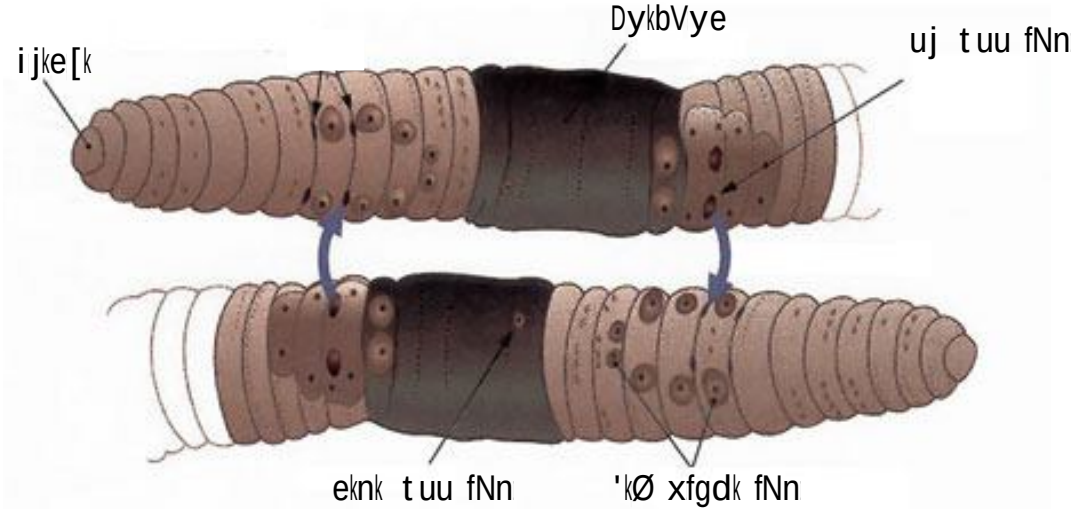
1- **uj tuu r=** % bld 10o o 11o [k.M e nk tkMh o"k.k gkr gA 10o o 11o [k.Mk e gh ,d&,d o"k.k dk"k ik; tkr gA bUgh [k.Mk l 'k: gkdj 18o [k.M rd 'kØokfgfu;k gkrh gA 18o [k.M e uj tuu fNæ mifLFkr gkr g ¼fp= 23-26½A



fp= 23-26 % QjfVek dk tuu r=

2- **eknk tuu r=** % 12o o 13o [k.M d vUrj[k.Mh; iV ij ,d tkMh v.Mk'k; fLFkr gkr g] bud uhp v.Mokfgfu;k ikb tkrh g] tk tMdj ,d eknk tuu fNæ }kjk 14o [k.M e [kyrh gA 6] 7] 8] o 9o [k.M e ,d&,d tkMh 'kØxkfgdk, ik;h tkrh g ¼fp= 23-27½A

3- **eFku fØ;k** % dpvk f}fyxh çk.kh gkrk g] ijUr ble ge'kk ^ij&fu"kpu** ik;k tkrk gA eFku fØ;k gM vku Vy (Head on tail) voLFkk e gkrh gA ,d dp, d uj tuu fNæ }kjk] nlj dp, d 'kØk.k xkfgdk fNæ e 'kØæ0; ço'k dj tkrk gA



fp= 23-27 % QjfVek d tuukx

4- **dkdu dk fuek.k** % dp, e DykbVYke }kjk dkdu dk fuek.k gkrk gA fu"kpu ,o ifjoèku dkdu d vnj gkrk gA ;g Hk.k dk ik"k.k Hkh djrk gA

5- **fu"kpu** % fu"kpu dh fØ;k dkdu e gh gkrh gA ,d dkdu e doy ,d gh fu"kfpu v.M ifjofèkr gk ikrk gA vU; fu"kfpr v.M u"V gk tkr gA

6- **ifjoèku** % dp, e Hk.kh; fodkl nk l <kb eghu e i.k gkrk gA CykLVyk d fuek.k d i'pkr xLVYkk curk gA ifjoèku çR;{k gkrk gA ble ykok voLFkk ugh ik;h tkrh gA

vkfFkd egRo

dpvk eNyh idMu d dke vkrk gA bl fdlku dk fe= dgk tkrk gA dp, dk ey inkFk to&[kkn dh rjg mi;kx e yk;k tkrk gA dp, d }kjk feÍh dk fNfær dj] c<r ikèkk d fy, ok; dh miyCèkrk lxe dj nh tkrh gA ftll feÍh mi tkÅ curh gA ;g fofèk oeh dEikLV [kkn fuek.k dgykrh gA

ifjlyuVk ¼frypêk½

(Cockroach)

ifjp;

dkdjkp 'kCn Lifu'k Hkk"kk d 'kCn ddjpk (cucaracha) l mRiUu gvk gA ftldk vFk rth l xfr dju okyk gA ;g Hkj rFkk dky jx d likV 'kjhj okyk çk.kh gA budk vkdkj 0.5–7.5 leh gkrk gA ; vkFkkikMk l?k d ox bUlDVk e lfEefyr gA bld lfèk;Dr mikx vkj rhu tkMh Vkx ik;h tkrh gA bld 'kjhj ij dkbfVu l cuk ckÁ ddky gkrk gA

oxhdj.k

l?k (phylum)	&	vkFkkikMk
ox (class)	&	bUlDVk
miox (sub class)	&	VjhxkVk
x.k (order)	&	vkFkklVjk
o'k (genus)	&	ifjlyuVk
tkfr (species)	&	vefjdkuk

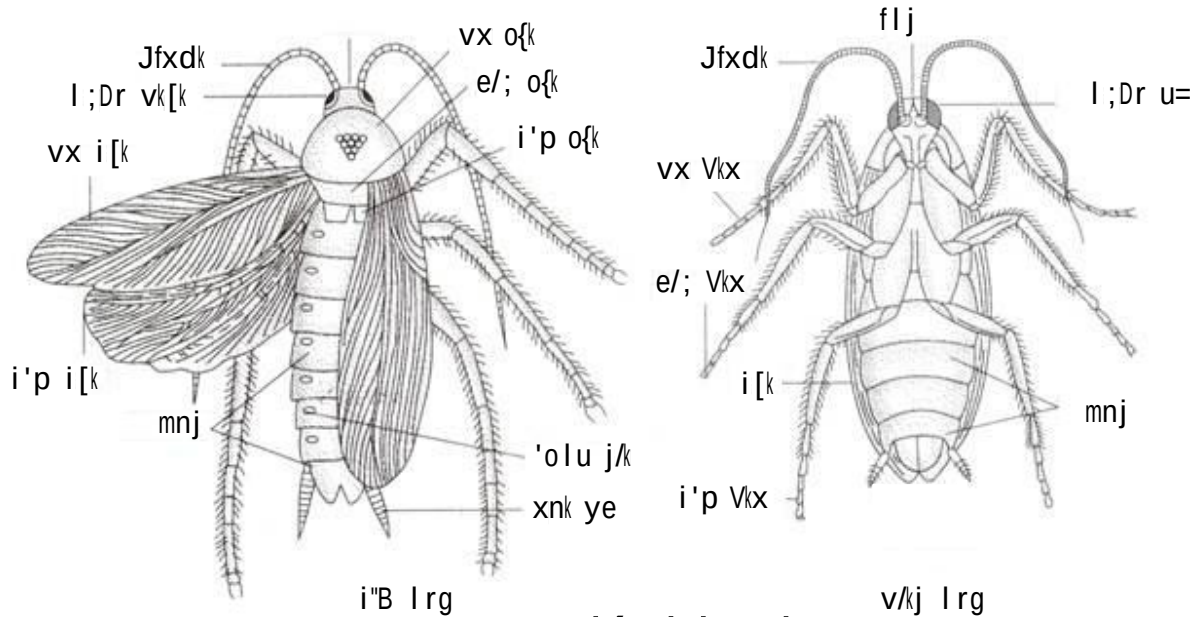
vkokl ,o LoHkko

;g lokgkjh ,o jkf=pj çk.kh gA ;g èkoh; {k=k dk NkMdj leLr llkj e ik;k tkrk gA ;g eDr thoh gA ;g ue] vèkj oky LFkkuk tl Hk.Mkj xg] jlkb?kj] 'kkpky;k vkfn LFkkuk ij vfèkd ik;k tkrk gA bldk HkkT; inkFk jkVh] cM] Qy] lM&xy inkFk] ydMh bR;kfn gA ;g Lotkfr Hk{k.k Hkh djrk gA ;g rt nkMu okyk çk.kh gA [krj d le; NkVh mMku Hkh Hkj ldrk gA dkdjkp ?kj e jgdj xHkhj ihMd ,o vud jkxk dk okgd gkrk gA

ckÁ ljpuk

dkdjkp dk 'kjhj i"B&vèkj ij piVk ,o f}ik'o lefer gkrk gA bldk 'kjhj&flj] o{k rFkk mnj e foHkkftr gkrk gA

(i) **flj** % 'kjhj d vx Hkkx e f=dk.kh; flj gkrk gA ;g xhok dh lgk;rk l 90 fMxh dk.k ij o{k l yxk gvk gkrk gA ;g N% [k.Mk l cuk ,o vèkkgu (hypognathous)



fp= 23-28 % frypVVk dh ckÁ ljpuk

çdkj dk gkrk gA flj ij oDdkdkj ,d tkMh l;Dr u= o ljy u= ik; tkr gA vk[kk d vkx èkkx leku ,d tkMh Jfxdk, ik;h tkrh gA flj d vkx mikx ik; tkr gA tk dkVu o pcku oky e[kkx cukr gA

(ii) **o{k** % dkdjkp e o{k rhu [kMk l feydj cuk gvk gkrk gA ¼1½ vxo{k ¼2½ eè;o{k ¼3½ i'p o{k çR;d o{kh; [kM e ,d tkMh Vkx ikb tkrh gA i[kk dk igyk tkMk eè;o{k ij rFkk nljk tkMk i'po{k ij ik;k tkrk gA nk tkMh 'okl jèk Hkh o{k e ik; tkr gA

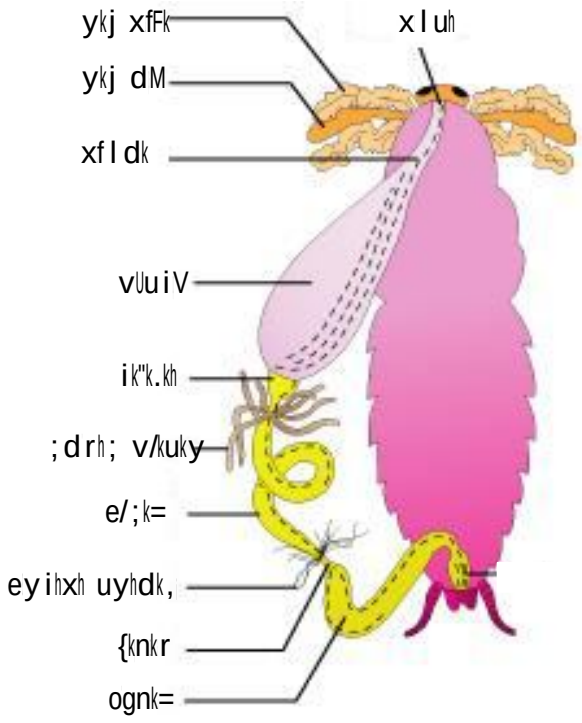
(iii) **mnj** Hk.kh; voLFkk e dkdjkp d mnj e 11 [k.M rFkk o;Ld voLFkk e 10 [k.M ik; tkr gA çFke 8 mnj [k.Mk ij 8 'okl jèk Hkh gkr gA uj o eknk nkuk e nlo [k.M ij ,d tkMh xnh; ye gkr gA ;g èofu rjxk d çfr lonh gkr g ¼fp= 23-28½A

ikpu rU=

dkdjkp dk ikpu r= rhu Hkkxk e ckVk tk ldrk gA ¼1½ vxk= ¼2½ eè;k= ¼3½ i'pk=

1- **vxk=** % e[k ,d NkVh xluh e [kyrk g tk ,d uyh xfldk l tM tkrh gA xfldk ,d Fkyuek Hkkx vUuiV l [kyrh gA vUuiV e Hkktu lxfgr jgrk gA bld ihN ,d NkVh fdUr ekVh jpuk i"k.kh ikb tkrh gA ble 6 D;fVD;yj nkr ik, tkr gA tk Hkktu dk ihlu d dke vkr g ¼fp= 23-29½A

2- **eè;k=** % vxk= o eè;k= d lfèkLFky ij vxyh d leku 6 l 8 vèk ufydk, ik;h tkrh gA bUg ;Ñfr; vèkuky dgr gA ; ikpd jl cukrh gA eè;;k= o i'pk= d lfèk LFky ij yxHkx 100&150 iryh] ihyh eyihxh ufydk, ik;h tkrh gA



fp= 23-29 % frypVVk ikpu r=

3- **i'pk=** % ;g {kæk=] dkyku ¼ognk=½ ,o e=k'k; e foHkDr gkrk gA eyk'k;] xnk d }kjk ckgj [kyrk gA

'olu r=

dkdjkp e 'olu vx 'okl jUèk (Spiracles) ,o 'okl uyh (Trachea) gkr gA dkdjkp e nl tkMh 'okl jUèk ik; tkr gA ; 'kjhj dh ik'o lrg ij fLFkr gkr gA gok 'olu fNæk }kjk vnj ço'k djrh gA 'okluky] 'oklufydkvk e foHkkftr gkrh gA ;g gok dk 'kjhj d lHkh Hkkxk rd igpkrh gA folj.k }kjk xlk dk vknku&çnku 'okl&ufydkvk ij gkrk gA

mRltu rU=

dkdjkp e mRltu fuEu vxk }kjk gkrk gA ; vx g eyihxh ufydk,] olk dk; dkf'kdk,] ;fjdkl xfUFk;k] D;fVfdy ,o oDdk.kA

eyih?kh ufydk, e[; mRlth vx gA ; eè;kU= vkj i'pkU= d eè; e ik;h tkrh gA ; 6&8 leg e 50&150 dh l[;k e] iryh] yEch] ihyh rFkk eghu ufydk, gkrh gA ; ukbVk tuh vif'k"V inkFkk dk vo'kk"k.k dj mUg ;fjd vEy e ifjofRkr dj nrh gA ;fjd vEy i'pk= }kjk mRlftr dj fn;k tkrk gA vr% dkdjkp ;fjdkVfyd çk.kh gA

rf=dk r=

dkdjkp e rf=dk r= xfPNdkvk dk cuk gkrk gA ; xfPNdk, J.khc) gkrh gA rhu xfPNdk, o{k e ,o N% mnj e fLFkr gkrh gA dkdjkp e lonh vx&Ükfxdk] ljy u=] l;Dr u=] yfCk;y Li'kd] efDlyjh Li'kd] xnk jke bR;kfn gkr gA dkdjkp dk ,d gh oLr dh vud çfrNk;k, fn[krh gA bl çdkj dh nf"V dk ektd (Mosaic) nf"V dgr gA

ituu r=

dkdjkp ,dfyxh çk.kh gA ble yfxd tuu ik;k tkrk gA

uj tuu r=

uj dkdjkp e ,d tkMh o"k.k] mnj xnk e fLFkr gkr gA nkuk vkj d o"k.k] 'kØ okfgfu;k l tM gkr gA ; 'kØ okfgfu;k 8o [k.M d eè; e feydj L[kyu ufydk cukrh gA tk uj tuu fNæ }kjk [kyrh gA uj lgk;d tuu vxk e N=d&xfUFk] Qfyd&xfFk rFkk ckà&tuukx gkr gA ftUg xkuikQkbfll dgr gA ; rhu Qykfe;l d :i e gkr gA budk lko 'kØk.kvk dk fpidkdj 'kØk.kèkj cukrk gA

eknk tuu r=

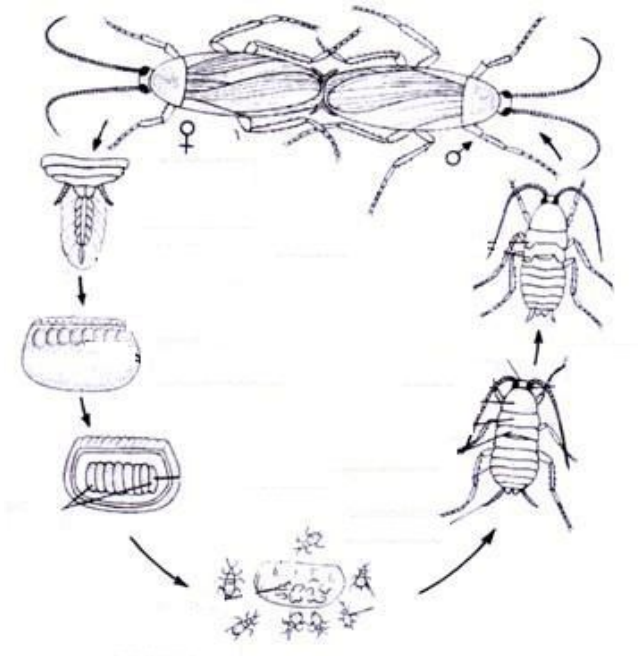
eknk dkdjkp e ,d tkMk v.Mk'k; gkr gA çR;d v.Mk'k; 8 yEch ufydkvk dk cuk gkrk gA v.Mk'k; l v.Mokfguh fudyrh gA nkuk v.Mokfgfu;k ;kfu cukrh gA ;g tuu dk"B e [kyrh gA eknk e 'kØèkku o lxkgd xfUFk;k] lgk;d vxk d :i e gkrh gA ckà tuukx rhu tkMh çoèk d :i e gkr gA

eFku rFkk fu"kpu

;g iPN&iPN voLFkk gkrh gA eFku fØ;k jkf= d le; gkrh gA bldk çtuu dky ekp l flrEcj gkrk gA uj Qykfe;l d }kjk 'kØk.kèkj dk] eknk e tuu d{k e ço'k djkrk g bll 'kØk.k 'kØxkgh e ço'k dj tkr gA ifjiDo v.Mk.k nkuk vkj d v.Mk'k;k l (8–8) tufud ifjdk"B e vk tkr gA rc 'kØk.k budk fu"kPku djr gA

Hk.kh; ifjoèku ,o dk;kUrj.k

16 fu"kfpr v.Mk l Hkj v.Mdop dk eknk viu ifjdk"B e vkèkk ckgj fudyk gvk 7&8 fnu rd fy, ?kerh gA fQj bUg ljf{kr LFkku ij NkM nrh gA yxHkx 70 fnu v.Mdop e v.M fuEQ cu tkr gA v.Mdop d QVu ij ; 16 fuEQ ckgj fudy vkr gA ble ykok voLFkk ugh ik;h tkrh g fuEQ dkey rFkk i[k foghu gkrh gA bue tuukx Hkh vuifLFkr gkr g ¼fp= 23-30½A



fp= 23-30 % frypVVk e Hk.kh; ifjoru

dk;kUrj.k e 7&10 ckj fuekpu gkrk gA bl fØ;k dk Rod&iru Hkh dgk tkrk gA fuEQ l 0;Ld cuu e 6 ekg l 2 lky rd yxr gA dkdjkp e vi.k dk;kUrj.k ik;k tkrk gA

vkfFkd egRo

;g ,d ihMd gA ;g [kku&ihu dh oLr,] ydMh] dkxt bR;kfn [kk tkrk gA ;g db jkxk dk okgd gkrk gA bldk mi;kx foPNnu dj 'kkèk dk;k e fd;k tkrk gA

egRoi.k fcUn

1- djkfyl fyfu;l }kjk f}uke i)fr nh xbA
2- oxhdj.k d vkèkkj&lxBu d Lrj] lefefr] ngxgk] [kMhHkou] dkf'kdk lxBu] i"B jTt vkfnA
3- ikjhQjk ¼Lit½& dkf'kdh; Lrj dk lxBu ,o uky r= ik;k tkrk gA
4- lhyUVVk&n'k dkf'kdk, ,o lhyUVjku uked xgk ik;h tkrh gA
5- VhukQkjk&vkB Ük[kykvk e 0;ofLFkr flfy;k oky ,o LQjnhflr'khy çk.kh ik, tkr gA
6- lyVhgfYeUFkht&piV 'kjhj oky ,o mRltu d fy, Tokyk dkf'kdk, ;Dr tho ik, tkr gA
7- ,LdgfYeUFkht&dV çxgh] xky Ñfe çk.kh gkr gA
8- ,ufyMk& okLrfod ngxgk o okLrfod [k.MhHkou ;DrA
9- vkFkkikMk lcl cMk l?k lfèk;Dr ikn mifLFkr gkr gA
10- ekyLdk&nljk lcl cMk l?k] dkey 'kjhj $CaCO_3$ d dop l <dk gkrk gA
11- bdkbukMeVk&i.kr% leæh] Ropk dkVnkj] ty logu rU= ik;k tkrk gA
12- gehdkMVk&cyukdkj 'kjhj] e[k&vUèkuky mifLFkr] ftl igy ukVkdkM ekuk tkrk Fkk ijUr vc ugh] vr% uku dkMVA
13- dkMVk&ukVkdkM] rf=dk jTt ,o Dyke fNæ mifLFkr
14- vØfu;Vk&diky vuifLFkr
15- ;jkdkMVk V;fudVk& çfrxkeh dk;kUr.k ik;k tkrk gA
16- flQykdkMVk&i"BjTt flj l iN rdA
17- Øfu;Vk&efLr"d [kky mifLFkr ,d mil?k&oVhcVkA
18- oVhcVk&ukVkdkM] d'k:d n.M (Vertabral Column) e :ikUrfjr
19- ,XuFkk&okLrfod tcM vuifLFkr
20- XuFkkLVkeVk&okLrfod tcM o tkMhnkj mikx ik, tkr gA
21- ihlht&xeu gr fQUl] f'kjkdkVjh; ân; ¼ohul gkV½ mifLFkr
22- ,EQhfc;k&ty LFky pj çk.kh gkr gA
23- jflVfy;k ljhli & jxdj pyu oky çk.khA Ropk l[kh] fdjfVu ;Dr
24- i{kh&vxikn :ikUrfjr i[k e] gfì;k [kk[kyh ik;h tkrh gA
25- Lruèkkjh&LruxfUFk;k mifLFkr] Ropk ij cky] d.k fiUuk ik;k tkrk gA
26- jk"Vh; tUr&iUFkjk Vkbfxl ¼ck?k½] jk"Vh; i{kh iok fØLVVl ¼ekj½
27- jktLFkku dk jkT; tUr&xtyk xtyk ¼fpdkjk½
28- jktLFkku dk jkT; i{kh&dkjhvkfVl ukbxhli ¼xkMkou½
29- txr çkfVLVk] l?k çkVktkvk dh çe[k tkfr vehck çkfV;l (Amoeba proteus) gA
30- ;g ,d ldUædh;] vdkf'kdh; tho gA
31- bldk cká vkoj.k thoæ0;dyk gA
32- bldk thoæ0; ,DVklykTe rFkk ,.MklykTe e foHkfnr gA
33- ,.MklYkkTe ty rFkk lky voLFkk e cnyrk jgrk gA
34- bldh dkf'kdk e dUæd] [kk| fjfDrdk,] ty fjfDrdk, ldpu'khy fjfDrdk,] ekbVkdkfUM;k] xkY thdk; bR;kfn dkf'kdkx ik, tkr gA
35- vehck e dVikn dh lgk;rk l xeu gkrk gA
36- vehck e ikpu] 'olu] mRltu vkfn lHkh tfod fØ;k, ik;h tkrh gA
37- ;g çdk'k] rki] fo|r] Li'k vkfn d çfr mÙktu'khyrk çnf'kr djrk gA
38- vehck e tuu dh vud fofèk;k gk ldrh g tl&f}foHktu] cgfoHktu] fctk.ktuu] l;Xeu vkfnA
39- vehck e vejRo ik;k tkrk gA
40- ,Ldfjl dk 'kjhj cyukdkj gku d dkj.k bUg xky Ñfe Hkh dgk tkrk gA
41- ;g vUr%ijthoh d :i e ik;k tkrk gA vr% ble ijthfork gr vud vudyu ik, tkr gA
42- ;g ,dfyxh gkr g] uj o eknk e Li"V :i l vUrj fd;k tk ldrk gA

Ø- l-	l?k	lxBu dk Lrj	lefefr	xgk	[kMhHkou	ifjlpj.k r=	ikpu r=	'olu r=	fof'k"V y{k.k
1-	ikfjQjk	dkf'kdk	fofHkUu çdkj dh	vuifLFkr	vuifLFkr	vuifLFkr	vuifLFkr	vuifLFkr	'kjhj e vud fNæ rFkk uky r=
2-	flyUVVk ;k fuMfj;k	Ård	vjh;	vuifLFkr	vuifLFkr	vuifLFkr	vi.k	vuifLFkr	n'k dkf'kdk ,o lhyUVku
3-	VhukQkjk	Ård	vjh;	vuifLFkr	vuifLFkr	vuifLFkr	vi.k	vuifLFkr	ddy pyu d fy, iêhdk, ,o LQjnhflr'khy
4-	lyVhg fYeFkh t	vx rFkk vxr=	f}ik'o	vuifLFkr	vuifLFkr	vuifLFkr	vi.k	vuifLFkr	piVk 'kjhj o p"kd
5-	,Ldg fYeFkh t	vxr=	f}ik'o	dV çxgh	vuifLFkr	vuifLFkr	i.k	vuifLFkr	yEc o Ñfe:ih
6-	,ufyMk	vxr=	f}ik'o	çxgh	mifLFkr	mifLFkr	i.k	vuifLFkr	'kjhj oy;k dh rjg [kfMr
7-	vkFkkikMk	vxr=	f}ik'o	çxgh	mifLFkr	mifLFkr	i.k	mifLFkr	lf/kikn o cká ddky dkbfVuh
8-	ekyLdk	vxr=	f}ik'o	çxgh	mifLFkr	mifLFkr	i.k	mifLFkr	çk;h cká ddky dop mifLFkr
9-	,dkbuk MeVk	vxr=	vjh;	çxgh	mifLFkr	mifLFkr	i.k	mifLFkr	vjh; lefer ,o ty& logu r=
10-	gehdkMVk	vxr=	f}ik'o	çxgh	mifLFkr	mifLFkr	i.k	mifLFkr	'kjhj 'kM dkyj o /kM e foHkkftr
11-	dkMVk ¼jTtdh½	vxr=	f}ik'o	çxgh	mifLFkr	mifLFkr	i.k	mifLFkr	i"B jTt] [kk[kyh i"B rf=dk& jTt] Dyke fNæ mifLFkr

43- ,Ldfjl e ,d o"k.k ,o ihfu;y 'kd ik, tkr gA
44- eknk ,Ldfjl e ,d tkMk v.Mk'k; ik;k tkrk gA
45- fu"kpu d QyLo:i ;Xeut dk fuek.k gkrk gA
46- ;Xeut d pkjk vkj j{kkRed [kky cu tkrk g rc ;g efeyVM v.M dgykrk gA
47- xLVyk] ,d uUg f'k'k çFke voLFkk dk r:.k vFkok jgfCMfVQke ykjok e ifjofrr gk tkrk gA
48- ,Ldfjl nf"kr Hkktu d lkFk eu"; d 'kjhj e ço'k dj tkr gA
49- prFk fuekpu d ifj.kkeLo:i ;g i.k o;Ld e cny tkrk gA
50- ,Ldfjl }kjk eu"; e mRiUu jkx ,Ldfj,fll dgykrk gA
51- bl jkx l ihfMr jkxh dk&Mhdfjl] ,.Vhikj] gYefyM] ,Ydkikj vkfn vk"kfèk nh tkrh gA
52- QjfVek ikLV;ek ¼dpvk½ ,ufyMk l?k dk çk.kh gA
53- ;g ikjQkbfju o.kd d dkj.k gYd Hkj jx dk gkrk gA
54- bld 14o 15o ,o 16o [k.M e DykbVye ik;k tkrk gA
55- ble (S) vkÑfr d 'kd ik, tkr gA
56- xeu gr 'kd] if'k;k] e[k xfgdk ,o ngxgh; æo lgk;rk djr gA
57- dp, e 26o [k.M e lhdh ik;h tkrh gA
58- vkgkjuky e e[k] e[k xgk] xfldk] i"k.kh] vek'k;] vk= vkj xnk gkrh gA
59- O_2 dk ifjogu jDr lykTek e mifLFkr ghekXykfcu djrk gA
60- ble pkj tkMh ân; ¼7] 9] 12 o 13 [k.M e½ gkr gA
61- ;g ;fj;kVfyd tho gA
62- ;g f}fyxh çk.kh gA ijUr ble ij fu"kPku ik;k tkrk gA
63- ;g fdlku dk fe= dgykrk gA
64- dkdjkp l?k vkFkkikMk ,o ox blDVk dk lnL; gA
65- ;g lokgkjh ,o jkf=pj çk.kh gA
66- flj vèkkgu çdkj dk gkrk g ,o e[kkx dkVu o pcku oky gkr gA
67- o{k rhu [k.Mk & vx] eè; o i'p foHkkftr gkrk gA
68- ikpu r= rhu Hkkxk e vxk=] eè;= o i'pk= e foHkfnr gkrk gA
69- vxk= o eè;k= d lfèkLFky ij 6 l 8 ;Ñrh; vèkuky ik;h tkrh gA
70- eè;k= o i'pk= d eè; 100&150 eyihxh ufydk, ik;h tkrh gA
71- 'olu] 'oklj Uèkk o 'okl ufy;k dh lgk;rk l gkrk gA
72- dkdjkp ;fj;kVfyd çk.kh gA
73- dkdjkp e ektd nf"V ik;h tkrh gA
74- dkdjkp e v.Mdop l 16 fuEQ ckgj fudyr gA
75- vi.k dk;kUrj.k ik;k tkrk gA 7 l 10 ckj fuekpu gkrk gA

vH;klkFk ç'u

1- fuEu e l fdl lÄ dk 'kkjhfjd lxBu dkf'kdh; Lrj dk gkrk g &
¼v½ VhukQkjk ¼c½ ikjhQjk
¼l½ ekyLdk ¼n½ vkFkkikMk
2- fdl lÄ e n'k dkf'kdk ikb tkrh g &
¼v½ fuMfj;k ¼c½ ikjhQjk
¼l½ dkMVk ¼n½ ,ufyMk
3- lyVhgfYeuFkht dk vU; uke g &
¼v½ yEc Ñfe ¼c½ ekV Ñfe
¼l½ piV Ñfe ¼n½ xky Ñfe
4- Lkcl cMk tUr lÄ g &
¼v½ ,dkbukMeVk ¼c½ gehdkMVk
¼l½ ikjhQjk ¼n½ vkFkkikMk
5- fdl ox e ân; vi.k pkj dk"Bh; gkrk g &
¼v½ ,dkbukMeVk ¼c½ gehdkMVk
¼l½ ikjhQjk ¼n½ vkFkkikMk
6- vehck uke dh mRifÙk fdl Hkk"kk l gb g &
¼v½ fgUnh ¼c½ vxth
¼l½ xhd ¼n½ yfVu
7- vehck dlk çk.kh g &
¼v½ eklkgkjh ¼c½ 'kkdkgkjh
¼l½ erkithoh ¼n½ lokgkjh
8- vehck dk ijheki g &
¼v½ 2µ l 5µ ¼c½ 20µ l 50µ
¼l½ 200µ l 500µ ¼n½ 2000µ l 5000µ

9- vehck fdl lÄ dk çk.kh g &
(v) çkVk tkvk (c) ikjh Qjk
(l) lhyUVk (n) VhukQkjk

10- ,Ldfjl dk dgk tkrk g &
(v) piV Ñfe (c) xky Ñfe
(l) l{e Ñfe (n) dkb ugh

11- ,Ldfjl }kjk mRiUu jkx dgykrk g &
(v) eyfj;k (c) Lokbu ¶y
(l) gtk (n) ,Ldfj,fll

12- ,Ldfjl fdl ox dk tho g &
(v) QfLefM;k (c) fueVkMk
(l) lkdkfMuk (n) ykcklk

13- ,Ldfjl d lonkx dgk ik, tkr g &
(v) vk[kk ij (c) gkBk ij
(l) xluh ij (n) dgh ugh

14- ,Ldfjl d 'kjhj ij fdruh /kkfj;k ik;h tkrh g &
(v) ,d (c) nk
(l) rhu (n) pkj

15- dp, e fu"kpu gkrk g &
(v) dkdu e (c) 'kØ xfgdk e
(l) o"k.k e (n) v.Mk';e

16- dp, e DykbVye dku l [k.Mk e ik;k tkrk g &
(v) 10 l 13o (c) 14 l 16o
(l) 12 l 15o (n) 15 l 18o

17- dp, e fdl vkdfr d 'kd lkk, tkr g &
(v) Y (c) Z
(l) S (n) M

18- dp, e fdru tkMh ân; ik, tkr g &
(v) pkj (c) nk
(l) ,d (n) ugh ik, tkr

19- dkdjkp g &
(v) vekukVfyd (c) ;fj;kVfyd
(l) ;fjdkVfyd (n) dkb ugh

20- dkdjkp d v.Mdop e fdru fuEQ ik, tkr g &
(v) 8 (c) 4
(l) 16 (n) 2

21- Hkktu lxfgr djrh g &
(v) xluh (c) vUuiV
(l) i"k.kh (n) dkb ugh

22- dkdjkp e fuekpu gkrk g&
(v) 2 l 5 ckj (c) 4 l 8 ckj
(l) 5 l 10 ckj (n) 7 l 10 ckj

vfry?kÙkjkRed ç'u

1- o{k xgk vkj mnj xgk d e/; ikb tku okyh ekVh i'kh D;k dgykrh g\
2- if{k;k dh iN ij ik;h tku okyh ry xfUFk D;k dgykrh g\
3- Ropk d jx cnyu dh {kerk D;k dgykrh g\
4- lÄ ;jkdkMVk dk V;fudVk D;k dgk tkrk g\
5- lÄ gehdkMVk dk io e dkMVk e D;k j[kk x;k\
6- vehck d lk'p flj dk D;k dgr g\
7- vehck dk thoæ0; fdu nk Hkkxk e cVk g\
8- vehck e 'olu fdl fof/k l gkrk g\
9- vehck }kjk mRlftr inkFkk d uke fyf[k,A
10- vehck çfrdy ikfjfLFkfr;k e viuk cpko dl djrk g\
11- ,Ldfjl d çFke voLFkk ykjok dk uke crkb,A
12- efeyVM v.M fdl dgr g\
13- lkekU; ckypky e ,Ldfjl dk D;k dgr g\
14- fu"kpu fdl dgr g\
15- dp, dk ,ufyMk lÄ e D;k j[kk x;k g\
16- oe dkfLVx fdl dgr g\
17- dp, dh ng fHkfÙk e ik, tku oky o.kd dk uke crkb,A
18- dp, dh ng ^ufydk e ufydk* D;k dgk tkrk g\
19- dp, e ik, tku oky oDddk d uke crkb,A
20- dkdjkp dk oKkfud uke fyf[k,A
21- eyihxh ufydk, dgk ik;h tkrh g\
22- ikpu r= dk fdu rhu Hkkxk e foHkfnr fd;k x;k g\
23- dkdjkp e dlh nf"V ik;h tkrh g\
24- dkdjkp e v.Mdop l D;k ckgj vkr g\

y?kÙkjkRed ç'u

1- f}uke i)fr fdl dgr g\ bl i)fr d fu;e fyf[k,A

2- 0gy dh vkÑfr eNyh d leku gkr g, Hkh bl Lruèkkjh ox e D;k j[kk x;k\ dkj.k crkb,A
3- vjTtdh ,o jTtdh d fof'k"V y{k.kk dh ryuk dhft ,A
4- Lru/kkfj;k d e[; y{k.kk ,o oxhdj.k dk mYy[k dhft ,A
5- vkFkkikMk d e[; y{k.k ,o mnkgj.k fyf[k,A
6- dVikn dk ;g uke D;k fn;k x;k\
7- vehck e xeu fdl çdkj gkrk g\
8- vehck e Mk;LVky ,o flLVky 'kCnk dk D;k vFk g\
9- vehck vej D;k g\
10- vehck dh mÙktu'khyrk le>kb,A
11- ,Ldfjl dk oxhdj.k fyf[k,A
12- ,Ldfjl e ijthfork d vudyu crkb,A
13- ,Ldfjl d vkokl d ckj e vki D;k tkur g\
14- ,Ldfjl d uj tuu r= dk fp= cukb,A
15- ,Ldfjl e Hk.kh; ifjo)u fdl çdkj dk gkrk g\
16- dp, dh ng fHkfÙk d dk; crkb,A
17- dp, dk fdlku dk fe= D;k dgk tkrk g\
18- dp, dk oxhdj.k fyf[k,A
19- dp, e ng xfg; æo d dk; fyf[k,A
20- dp, e ik, tku oky fofHkUu ckÁ fNæk d ckj e crkb,A
21- v/k uky dk dk; crkb,\
22- dkdjkp dk oxhdj.k fyf[k,A
23- dkdjkp dk lÄ blDVk e D;k j[kk x;k g\
24- dkdjkp e eFku fØ;k fdl çdkj gkrh g\

fuc/kkRed ç'u

1- oxhdj.k d fofHkUu vk/kkjk dk foLRkkj l le>kb,
2- lÄ dkMVk dk oxhdj.k ,o y{k.k fyf[k,A
3- tho txr d oxhdj.k dk pkV }kjk çnf'kr dhft ,A
4- vehck dh vkrfjd ljpuk dk lfp= o.ku dhft ,A
5- vehck dk oxhdj.k] vkokl ,o ckÁ vkÑfr crkb,A
6- ,Ldfjl e uj o eknk e vUrj dk fp= lfgr le>kb,A
7- ,Ldfjl dk thou&pØ j[kkfp= }kjk lfoLrkj le>kb,A
8- ,Ldfjl }kjk mRiUu jkx] cpko ,o mipkj d ckj e fyf[k,A
9- dp, dh ckÁ ljpuk dk lfp= o.ku dhft ,A
10- dp, e ikpu r= dk lfoLrkj fp= lfgr o.ku dhft ,A
11- dp, dk çtuu r= dk fp= cukdj mle eFku fØ;k ,o ifjo/ku le>kb,A
12- dkdjkp d ikpu rU= dk lfoLrkj o.ku djd fp= cukb,A
13- dkdjkp d uj ,o eknk tuu r= dk o.ku dhft ,A
14- dkdjkp dk thou pØ n'kkr g, Hk.kh; ifjo/ku ,o dk;kUrj.k le>kb,A

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mÙkjekyk % 1 ¼c½ 2 ¼v½ 3 ¼l½ 4 ¼n½ ¼5½ v ¼6½ v ¼7½ n ¼8½ l ¼9½ v ¼10½ c ¼11½ n ¼12½ v ¼13½ n ¼14½ v ¼15½ c ¼16½ l ¼17½ v ¼18½ c ¼19½ l ¼20½ c ¼21½ n ¼22½ c

bdkb & XVI

v/;k; & 24

ikpu r=

(Digestive System)

ifjp;

leLr çkf.k;k e fodkl] of)] {kfrifr fofHkUu mikip;h fØ;kvk ,o Åtk d fy, Hkkstu dh vko';drk gkrh gA gekj Hkkstu d e[; vo;o dkckgkbMV çkVhu] olk foVkfeu ,o [kfut yo.k g] ; lHkh ik"kd inkFk dgykr gA ty mikip;h çfØ;kvk e egRoi.k Hkfedk fuHkkrk gA

;kf=d ,o jklk;fud fofèk;k }kjk tfVy ik"kd inkFkk dk vo'kk"k.k ;kX;] ljy :i e ifjofrr dju dh fØ;k dk ikpu dgr gA ikpu dh ;g fØ;k ikpu r= e lEiUu gkrh gA

ik"k.k fofèk d vkèkkj ij thok dk oxhdj.k

1- **Loik"kh** % ; çdk'k l'y"k.k }kjk viuk Hkkstu Lo; cukr gA tl& ikni

2- **fo"keik"kh** % ; fofHkUu jhfr;k }kjk Hkkstu çkIr djr g &

(i) **'kkdkgkjh** % ; ikèkk l Hkkstu çkIr djr gA tl& cdjh] xk;

(ii) **ekalkgkjh** % ; vU; çkf.k;k dk ekl [kkr gA tl& 'kj] phrk

(iii) **lokgkjh** % ; 'kkd rFkk ekl nkuk [kkr gA tl& ekuo] Hkky

(iv) **dhVkgkjh** % ; dhV [kkr gA tl&fNidyh] e<d

(v) **:fèkj ik"kh** % ; :fèkj plr gA tl&t] ePNj

(vi) **dfucYl** % ; viuh gh tkfr dk Hk{k.k djr gA tl& li] dkdjkp

3- **erik"kh** % ; lM&xy dkcfud inkFkk l viuk Hkkstu çkIr djr gA tl& fxnn

4- **eyHkkstkh** % ; ey l ik"k.k çkIr djr gA tl [kjxk'k

5- **ijthoh** % ; nlj thok ij Hkkstu d fy, fuHkj jgr gA ; vkUrfjd o cká nk çdkj d gkr gA tl&tkd] ,Ldfjl

lrfyr vkgkj

og vkgkj ftle 'kjhj dk LoLFk cuk, j[ku gr lHkh vko';d ik"kd inkFk ¼dkckgkbMV] çkVhu] olk] foVkfeUl] [kfut] yo.k½ lefpr ek=k e miyC/èk gkr g] og lrfyr vkgkj dgykrk gA

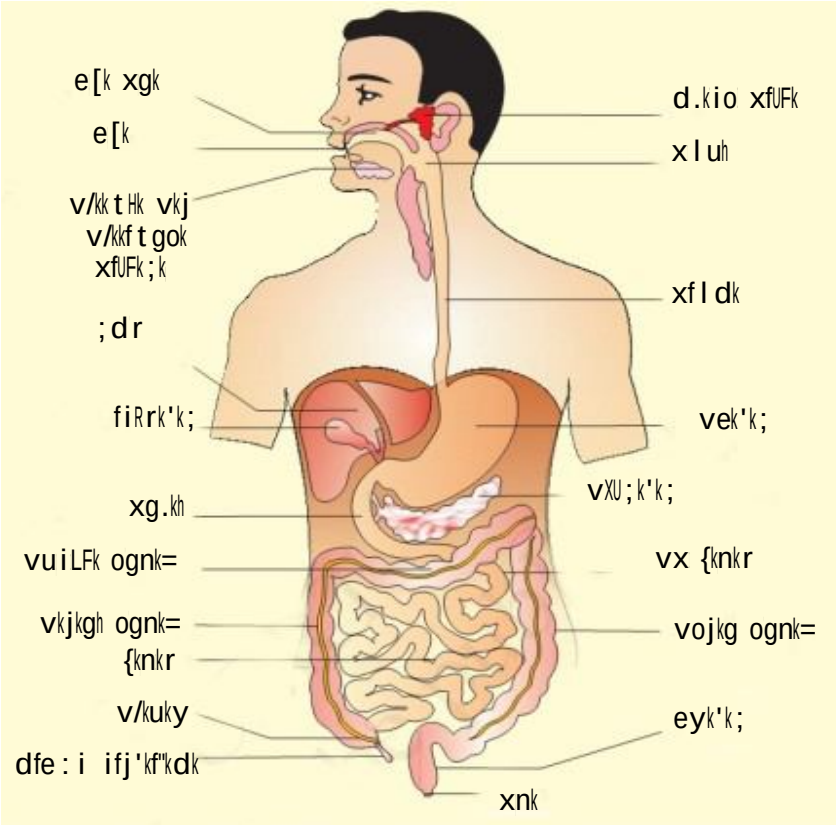
ikpu r=

ekuo e ikpu r= nk Hkkxk e foHkfnr fd;k x;k g& 1- vkgkj uky 2- lgk;d ikpu xfFk;k

1- **vkgkj uky** % vkgkj uky e[k xgk l vkjEHk gkdj xluh] xkluky] vkek'k;] NkVh vkr] cMh vkr l gkr g, ey}kj ij lekIr gkrh gA

(i) **e[k ,o e[k xgk** % e[k ,d vuçLFk njkj d :i e gkrk g tk ekly gkBk }kjk f?kjk gkrk gA e[k] e[k xgk e [kyrk gA e[k xgk e nkr vkj ekly ftgok ikb tkrh gA thHk ij Lokn dfydk, gkrh gA thHk dk dk; Hkkstu pku e lg;kx djuk] pck, Hkkstu dk xkluyh e èkdyuk ,o Lokn dk Kku djkuk gkrk gA eu"; e nkr& f}ckjnrh ,o xrnrh gkr g budk nrl= $\frac{2123}{2123}$ gkrk gA e[k xgk e ykj xfFk;k }kjk ykj lkfor gkrh gA ftle ,ekbyt ,Utkbe ik;k tkrk gA ,ekbyt ek.M (Starch) dk ekYVkt e ifjofrr djrk gA

(ii) **xl uh** % xluh ok; ,o Hkkstu nkuk dk gh iFk gA Hkkstu dk fuxyr le; ?kkVh <Ddu] ?kkVh }kj dk <d yrk g ftll Hkkstu 'okl uyh e ugh tkrkA



fp= 24-1 % ikpu r=

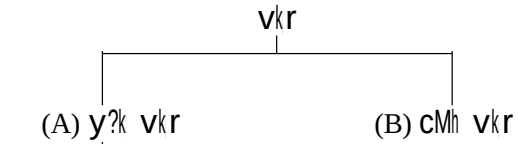
(iii) **xkluyh** % xluh] xkluyh e [kyrh gA xkluyh ,d iryh] yEch uyh g tk i'p Hkkx e vkek'k; l tMh gkrh gA

(iv) **vek'k;** % vek'k; i'kh; ,o Fkyhuek ljpuk gkrh gA bl rhu Hkkxk e ckVk tk ldrk g& tBjkxe Hkkx (Cardiac Part) ftle xfldk [kyrh g] QfMd Hkkx ,o tBj fuxeh Hkkx (Pyloric Part) ftldk NkVh vkr e fudkl gkrk gA bld vkxe ,o fuxe Nkj ij ,d&,d dikV ik, tkr g ftUg Øe'kh dkfM;d ldkpd ,o ikbykfjd ldkpd dgk tkrk gA

(v) **vkr**

vkr % vkr dk nk Hkkxk e ckVk x;k gA bld vx Hkkx dk NkVh vkr tcfd i'p Hkkx dk cMh vkr dgk tkrk gA

(A) **y?k@NkVh vkr** % NkVh vkr] cMh vkr l vR;fèkd yEch gku d ckotn] de 0;kl d dkj.k NkVh vkr dgykrh g ¼fp= 24-1½A



(i) xg.kh (duodenum)
(ii) ttue ¼e/;k=½
(iii) {knkU= ¼bfy;e½

(i) lhde ¼v/kuky½
(ii) dkyku ¼ognkU=½
(iii) eyk'k; ¼jDVe½

(i) **xg.kh** % ;g 'C' vkdkj dh ufydk gkrh gA ble lg&fiÙk ufydk o vXU;k'k; ufydk nkuk l;Dr :i l [kyrh gA

(ii) **ttue** % ;g xg.kh dk {kækU= l tkMrh gA

(iii) **{knkU=** % ;g NkVh vkr dk lcl yEck o d.Mfyr Hkkx gkrk gA bldk vfUre Qyk gvk Hkkx ldyl jkV.Ml dgykrk gA ;g bfy;k&lhdy dikV }kjk lhde e [kyrk gA

(B) **cMh vkr %** ;g {kækU= l tMh gkrh gA ;g rhu Hkkx& lhde] ognkU= ,o eyk'k; e foHkkftr gkrk gA

(i) **lhde %** bld i'p Hkkx l Ñfe:i ifj'kf"kdk ;k oehQke ,ifUMDl yxh gkrh gA ekuo e ;g vo'k"kh vx d :i e ik;h tkrh gA ble lgthoh thok.k ik, tkr gA 'kkdkgkjh çkf.k;k e ;g lyykt d ikpu e lgk;rk djr gA

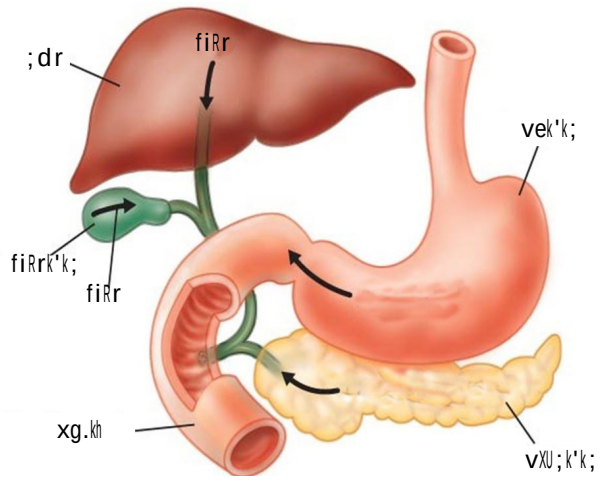
(ii) **dkyku %** ble txg&txg ij mHkkj ik; tkr gA bld rhu Hkkx gkr g& vkjkgh] vuçLFk ,o vojkgh dkyku

(iii) **eyk'k; %** ;g vkgkj uky dk vfUre Hkkx gA ble vifpr Hkktu dk vLFkk;h lxg gkrk gA eyk'k; l tMh xnkuky] 'kjhj d ckgj xnk fNæ }kjk [kyrh gA

lgk;d ikpd xfUFk;k

1- **ykj xfFk;k %** eu"; dh e[kxluh xgk e rhu tkMh ykj xfFk;k ik;h tkrh g& vèkkftgok] vèkkgu ,o ijkfVM xfFk;kA ; xfFk;k e[k xgk e ykj lkfor djrh gA

2- **;Ñr %** ;g ekuo 'kjhj dh lcl cMh xfFk gA ;g mnj Hkkx e eè;iV d uhp fLFkr gkrk gA ble e[; :i l nk ikfy;k gkrh g& cMh nkfguh ikyh rFkk NkVh ck;h ikyhA nk; fiM d uhp fiÙkk'k; ik;k tkrk gA ;Ñr dkf'kdkvk }kjk lkfor fiÙk] fiÙkk'k; e lfpr jgrk gA fiÙk {kkjh; çÑfr dk] ihy gj jx dk gkrk gA ble fiÙk yo.k rFkk fiÙk o.kd ik; tkr gA nkuk ;Ñr ikfy;k l ;Ñr okfgfu;k fudydj lkekU; ;Ñr okfguh cukrh gA lkekU; ;Ñr okfguh ,o fiÙkk'k; dh fiÙkokfguh feydj lkekU; fiÙk okfguh cukrh gA ;g fiÙk jl dk xg.kh e igpkrh gA lkekU; ¼ey½ fiÙk okfguh ,o vXU;k'k;h ufydk] nkuk feydj ;Ñr vXU;k'k;h okfguh }kjk xg.kh e [kyrh g ¼fp= 24-2½A



fp= 24-2 % lgk;d ikpd xfUFk;k

vXU;k'k;

vXU;k'k;] xg.kh d eè; fLFkr gkrh gA ;g ,d fefJr xfFk g tk cfg%L=koh vkj vUr%L=koh nkuk gh xfFk;k dk dk; djrh gA bld cfg%L=koh Hkkx l vXU;k'k;h jl fudyrk gA ble ,UtkbEl ik, tkr gA vXuk'k; e dkf'kdkvk dk leg ik;k tkrk g ftUg yxjgl dh }hfidk, dgr gA ; bldk vUr% L=koh Hkkx gA bll blfyu vkj Xydxku gkeku dk L=ko gkrk gA

Hkktu dk ikpu

Hkktu d ikpu dh çfØ;k ikpu r= e ;kf=d ,o jlk;fud fofèk;k }kjk fuEufyf[kr pj.kk e gkrh gA

1- Hkktu dk vUrxg.k

2- ikpu

3- vo'kk"k.k

4- Lokxhdj.k

5- cfg% {ki.k

1- **Hkktu dk vUrxg.k %** Hkktu dk e[k }kj l vUnj yu dh fØ;k vUrxg.k dgykrh gA nkr vkj ftgok Hkktu dk pcku ,o iyVu dk dk; djr gA ykj dh 'y"ek Hkktu d.kk dk fpidku ,o ckYl cuku d dke vkrk gA

2- **ikpu %** Hkktu e dkckgkbMV] çkVhu] olk] [kfut] yo.k] foVkfeUl ,o ty ik; tkr gA bue l [kfut yo.k] foVkfeUl ,o ty dk ikpu dh vko';drk ugh gkrh] ; lhèk vo'kkf"kr gk tkr gA dkckgkbMV] çkVhu rFkk olk dk ,UtkbeA dh mifLFkfr e ikpu }kjk ljyre v.kvk e cnyuk gh ikpu dgykrk gA

¼v½ **e[k&xgk e ikpu %** e[k xgk e mifLFkr ykj e dN fo|r vi?kV; $(Na^+, K^+, Cl^-, HCO_3^-)$ vkj dN ,tkbe ¼Vkbfyu o ykblktkbe½ ik, tkr gA ykblktkbe thok.kvk d lØe.k dk jkdrk gA

$$\text{LVkp} \xrightarrow[\text{pH 6.8}]{\text{Vkbfyu}} \text{ekYVkt}$$

¼c½ **vkek'k; e ikpu %** vkek'k; e xLVhu gkeku lkfor gkrk gA ;g tBj jl d lko.k dk çfjr

djrk gA tBj jl e 99 çfr'kr ty o 'k"k HCl, ifllukttu] çkjfuu o tBj ykbit uked ,Utkbe ik; tkr gA

HCl d dk;

1- ;g fuf"Ø; ,Utkbek dk lfØ; djrk gA

ifllukttu $\xrightarrow{HCl}$ ifllu

çkjfuu $\xrightarrow{HCl}$ jfuu

2- ;g gkfudkjd thok.kvk dk u"V djrk gA

3- Hkkttu d ekè;e dk vEyh; (pH 1.8) cukrk gA

vkek'k; e ikVhu dk ikpu

1- çkVhu $\xrightarrow{ifllu + HCl}$ çkfVvkt $ ilVkUl

2- dlhu ¼nX/k çkVhu½ $\xrightarrow{jfuu}$ ijkdlhu ¼v?kyu'khy½

ijkdlhu $+Ca^{++}$ $\longrightarrow$ dfY'k;e ijkdlhuV

dfY'k;e ijkdlhuV $\xrightarrow{ifllu}$ çkfVvkttt $ ilVkUl

3- nX/k olk $ tBj ykbit $\longrightarrow$ olh; vEy $ fXyljky

¼l½ **NkVh vkr e ikpu %** ;Ñr vXU;k'k;h ufydk }kjk fiÙk ,o vXU;k'k;h jl vkr e NkM tkr gA vk= d }kjk vkU=h; jl lkfor fd;k tkrk gA vXU;k'k;h jl e fVfllukttu] dkbekfVfllukttu] çkdkckDlhiflVMl] ,ekbyt vkj U;fDy,t ,tkbe fuf"Ø; :i e gkr gA vk= E;dkk d }kjk lkfor ,Vjkdkbut fuf"Ø; fVfllukttu dk lfØ; fVfllu e cny nrk gA ;g vXU;k'k;h jl d vU; ,Utkbek dk lfØ; djrk gA fiÙk olk dk beYlhdj.k djrk g vkj ykbit ,tkbe dk Hkh lfØ; djrk gA

vk= jl e vud ,tkbe gkr gA tl& Xykbdkflmt] Mk;iflVMt] ,LVjt] U;fDy;kflMt vkfnA vXU;k'k; d ckbdkckuV d lkFk feydj E;dl] {kkjh; ekè;e (pH 7.8) r;kj djrk gA

vXuk'k;h jl

1- vXuk'k; jl d çkVhu vi?kVuh; ,tkbe fuEu çdkj l fØ;k djr g &

çkVhu@ilVku@çkfV;kt $\xrightarrow{fVfllu@dkbekfVfllu\ dkckDlhiflVMt}$ Mk;ilVkbM

2- vXuk'k;h jl d ,ekbyt }kjk LVkp dk Mk;ldjkbM e ifjofrr dj fn;k tkrk g&

ikfyldjkbM ¼LVkp½ $\xrightarrow{,ekbyt}$ Mk;ldjkbM

3- olk dk ykbit }kjk vi?kVu] fiÙk dh lgk;rk l

olk $\xrightarrow{ykbit}$ MkbfXyljkbM $\longrightarrow$ ekukfXyljkbM

4- U;fDyd vEyk dk] U;fDy,l }kjk ikpu&

U;fDyd vEy $\xrightarrow{U;fDy,l}$ U;fDy;kVkbM $\longrightarrow$ U;fDy;klkbM

vk= jl }kjk ikpu

(i) Mk;ilVkbM $\xrightarrow{Mk;iflVMtt}$,ehuk vEy

(ii) ekYVkl $\xrightarrow{ekYVl}$ Xydkl $ Xydkl

yDVkl $\longrightarrow$ Xydkl $ xyDVkl

lØkl $\longrightarrow$ Xydkl $ ÝDVkl

(iii) Mkb o ekukfXyljkbM $\xrightarrow{ykbit}$ olh; vEy $ fXyljky

(iv) U;fDy;kVkbM $\xrightarrow{U;fDy;kVkbMl}$ U;fDy;klkbM % 'kdjk $ {kkjd

bl çdkj ekuo vkU= e yxHkx i.k ikpu gk tkrk gA lyykt dk ikpu uk gku d dkj.k ;g jQt dk dk; dj] ikpu e lgk;rk djrk gA

¼l½ **vo'kk"k.k %** ifpr Hkkttu dk lfØ; ,o fuf"Ø; nkuk fofèk;k l] vk= dh fHkfr }kjk jDr dkf'kdkvk ;k yfldk e igpuk vo'kk"k.k dgykrk gA

¼n½ **Lokxhdj.k %** vo'kkf"kr Hkkttu dk jDr d ekè;e l 'kjhj dh fofHkUu dkf'kdkvk e igpdj Åtk mRiUu djuk ;k dkf'kdk æ0; dk Hkkx cu tkuk Lokxhdj.k dgykrk gA

¼;½ **cfg%{ki.k %** vifpr Hkkttu dk 'kjhj l ckgj fu"dkflr dju dh fØ;k cfg%{ki.k dgykrh gA cMh vkr dk dk; g& 1- ty] [kfut o vk"kèk dk vo'kk"k.k djuk 2- 'y"e dk lkoA vifpr Hkkttu dk ey dgr gA ;g ey xnk fNæ }kjk ckgj R;kx fn;k tkrk gA

ikpu r= dh vfu;ferrk,

ikpu r= e jkxk.k lØe.k vFkok ,tkbe lko.k dh vfu;ferrkvk d dkj.k vud fodkj mRiUu gk tkr gA

1- **ihfy;k** (Jaundice) : bl jkx e Ropk vkj vk[k e fiÙk o.kdk d ,d= gku d dkj.k ihyk jx fn[kkb nrk gA ble ;Ñr çHkkfor gkrk gA

2- **çokfgdk** (Diarrhoea) : vk= dh vlkekU; xfr d dkj.k] ey vR;fèkd iryk gk tkrk gA ble vo'kk"k.k dh fØ;k ?kV tkrh gA

3- **oeu** (Vomiting) : vkek'k; e lxfgr Hkk tu] e[k d }kjk ckgj fudy tkrk gA oeu l cpuh egll gkrh gA

4- **dCt** (Constipation) : eyk'k; e ey dk :d tkuk dCt dgykrk g] ble vk= dh xfr'khyrk vfu;fer gk tkrh gA

5- **vip** (Indigestion) : iV Hkjk&Hkjk lk egll gkuk] Hkk tu dk i.k :i l u ipuk vip dgykrk gA

egRoi.k fcUn

1- ikpu r= e tfVy ik"kd inkFkk dk ljyre :i e ifjoru dh fØ;k dk ikpu dgr gA

2- lrfyr vkgkj e lHkh ik"kd inkFk lefpr ek=k e ik; tkr gA

3- vkgkj uky e[k] e[k&xnk] xluh] xkluky] vkek'k;] NkVh vkr] cMh vkr] eyk'k;] xnk l cuh gkrh gA

4- ykj xfFk;k] ;Ñr ,o vXU;k'k; ikpd xfFk;k gA

5- e[k e ik; tku okyh ykj e] ykj ,ekbyt gkrk g tk ekM dk ekYVkl e ifjofrr dj nrk gA

6- Hkk tu xluh l xkluyh e gkrk gvk vek'k; e ço'k dj tkrk gA

7- vek'k; e e[;r% çkVhu dk ikpu gkrk gA

8- vXU;k'k;h jl] fiÙk jl vkj vk= jl d ,tkbek }kjk dkckgkbMV] çkVhu vkj olk dk] NkVh vk= e i.k ikpu gk tkrk gA

9- ikpu d i'pkr dkckgkbMV dk ekukl djkbM ¼Xydkl½ e] çkVhu dk ,ehuk vEyk e rFkk olk dk olh; vEyk vkj fXyljky e ifjoru gk tkrk gA

10- ifpr Hkk tu dk vo'kk"k.k dj Lokxhdj.k dj fy; tkrk gA

11- vifpr Hkk tu] ey d :i e xnk }kjk cfg% {kfiÙk dj fn;k tkrk gA

vH;klkFk ç'u

oLrfu"B ç'u

1- dfucy tho g &
¼v½ xk; ¼c½ 'kj
¼l½ t ¼n½ li

2- e[k e ik;k tku okyk ,Utkbe g &
¼v½ ,ekbyt ¼c½ ekYVl
¼l½ ifllu ¼n½ jfuu

3- yxjgl dh }hfidk, ikb tkrh g &
¼v½ ;Ñr e ¼c½ vXU;k'k; e
¼l½ vek'k; e ¼n½ vk= e

4- ihfy;k jkx çHkkfor djrk g &
¼v½ vk[k dk ¼c½ vk= dk
¼l½ ;Ñr dk ¼n½ vek'k; dk

5- vifpr Hkk tu dk 'kjhj l ckgj fudkyuk dgykrk g &
¼v½ vo'kk"k.k ¼c½ Lokxhdj.k
¼l½ cfg%{ki.k ¼n½ dkb ugh

vfry?kÙkjkRed ç'u

1- vkek'k; d vkxe vkj fuxe Nkj ij ik, tku oky dikVk d uke crkb,A

2- ekuo dk nUrl= fyf[k,A

3- Lokxhdj.k fdl dgr g\

4- olk dk ykbit }kjk viÄVu fdl dh enn l gkrk g\

5- vkek'k; e e[;r% fdldk ikpu gkrk gA

y?kÙkjkRed ç'u

1- lrfyr vkgkj fdl dgr g\

2- vXU;k'k; d cfg%lkoh ,o vUr%lkoh dk; fyf[k,\

3- ;Ñr dh ljpuk le>kb,A

4- lkk"k.k fof/k d vk/kkj ij thok dk oxhdj.k fyf[k,\

5- lkkpu r= l lcf/kr fdUgh rhu jkxk d ckj e crkb,A

fucU/kkRed ç'u

1- Ekkuo d ikpu r= dk lfp= o.ku dhft,A

2- Ekkuo d vkek'k; e Hkk tu dk ikpu le>kb,A

3- vXU;k'k;h jl dh Hkk tu ij fØ;kfof/k fyf[k,A

---

mÙkjekyk % 1 ¼n½ 2 ¼v½ 3 ¼c½ 4 ¼l½ 5 ¼l½

v/;k; & 25

'olu r=

(Respiratory System)

ifjp;

lHkh çkf.k;k e vud to&jlk;fud fØ;k,¡ fujUrj pyrh jgrh gA bu fØ;kvk d lpkyu d fy, Åtk dh vko';drk gkrh gA ;g Åtk [kk| inkFkk d vkDlhdj.k l çklr gkrh gA

'olu ,d vip;h fØ;k g ftl d vUrxr dkf'kdkvk e lfpr Hkk tu ¼Xydkl½ dk vkDlhdj.k gkrk g] ftl d QyLo:i Åtk fudyrh g tk ATP d :i e lfpr jgrh gA bl çfØ;k e CO_2 ,o ty mimRikn d :i e cur gA

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38\,ATP$$

Xydkt vkDlhtu dkcuMkbvkDlkbM ty Åtk

'olu d çdkj

'olu nk çdkj dk gkrk g &

- **ok;oh; ;k vkDlh'olu** % bl çdkj d 'olu e [kk| inkFk ¼Xydkt½ dk vkDlhdj.k ok; dh mifLFkfr e gkrk gA ble Xydkt d i.k vkDlhdj.k d QyLo:i CO_2, ty o Åtk mRiUu gkrh gA
- **vok;oh; ;k vukDlh 'olu** % ;g 'olu vkDlhtu dh vuifLFkfr e gkrk gA bl çfØ;k e Xydkl dk vi.k fo?kVu gkrk g] ftl d ifj.kkeLo:i CO_2, ,fFky ,Ydkgky ;k yfDVd vEy rFkk vYi ek=k e Åtk eDr gkrh gA

'olu vx

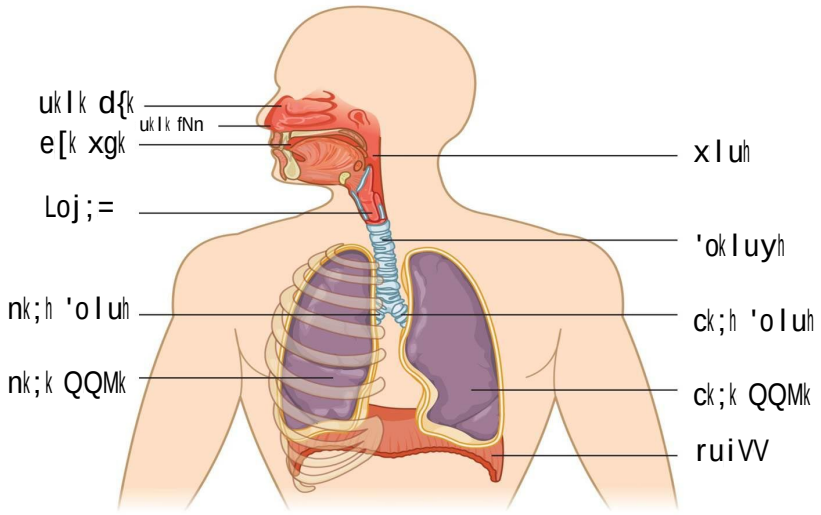
fofHkUu thoèkkfj;k e 'olu gr fofHkUu çdkj d 'olu vx gkr gA ; fuEu çdkj d gkr g &

- **'kjhj dh lkekU; lrg }kjk 'olu** % çkVk tkvk] ikjhQjk] lhyUVVk l?k d çk.kh rFkk ty o ueh;Dr çkf.k;k e 'kjhj dh lkekU; lrg }kjk 'olu gkrk gA
- **Dyke }kjk 'olu** % dN vkFkkikMk] ekyLdk o lHkh eNfy;k e Dyke d }kjk 'olu gkrk gA Dyke e vud fxy rUr ik, tkr gA
- **Vfd;k ;k 'okl uyh }kjk 'olu** % ;g dhVk e ik;k tkrk gA dkdjkp] edMh] fVìk vkfn e 'kjhj d fofHkUu Hkkxk rd igpku gr 'okl ufy;k dk tky Qyk jgrk gA
- **QQM** % mHk;pjk] ljhlik] i{kh rFkk Lruèkkfj;k e 'olu QQMk }kjk gkrk gA

eu"; dk 'olu r=

eu"; dk 'olu r=&ukfldk] uklkekx] xluh] Loj;=] 'okluky rFkk QQMk dk cuk gkrk gA

- **ukfldk ,o uklkekx** % eu"; e nk ckÁ uklkjUèk ik, tkr g] tk nk iFkd uklk o'ek e [kyr gA ; uklk&o'e] nk; ,o ck; uklkekxk e [kyr gA uklkekx] uklk xluh e [kyr gA
- **xluh** (Pharynx) : e[k&xgk dk i'p Hkkx xluh dgykrk gA xluh d i'p Hkkx e nk fNæ ik; tkr g ftUg Øe'k xyV ¼fuxy}kj½ ,o XykfVl ¼?kkVh}kj½ dgr gA XYkkfVl ij ,d <Ddu ,ihXykfVl ;k dBPNn ik;k tkrk gA Hkk tu fuxyr le; dBPNn] XykfVl dk cn dj nrk g] ftl Hkk tu lhèkk xyV }kjk xkluky e pyk tkrk gA
- **Loj;=** (Larynx) : Loj;= e okdjTt ik, tkr gA bUgh okdjTt vk e dEiu d ifj.kkeLo:i èofu mRiUu gkrh gA



fp= 25-1 % 'olu r=

- **'okluyh %** Vfd;k e 'C' vkdkj d mikfLFk d NYy ik; tkr gA ; NYy Vfd;k dk fipdu l cpkr g ble mifLFkr jke o 'y"ek] jkxk.kvk vkj èky feêh d d.kk dk QQMk rd ugh tku nrA ;g Vfd;k] nkb vkj ckb nk 'olfu;k e foHkkftr gk tkr gA ; 'olfu;k viuh&viuh vkj d QQMk e ço'k dj tkrh gA ; 'olfu;k db ckj foHkkftr gkr g, f}rh;d ,o rrh;d Lrj dh 'oluh] 'olfudk vkj iryh vrLFk 'olfudkvk e lekIr gkrh gA ; vrLFk 'oklfudk, ok; dk"Bk e [kyrh gA

QQM

eu"; e ,d tkMh QQM ik; tkr gA ; gYd xykch jx d] dkey vkj Lith ljpuk oky gkr gA QQMk ij ,d f}Lrjh; Q¶Qlkoj.k ik;k tkrk gA bl vkoj.k d chp Q¶Qlkoj.kh æo Hkjk gkrk gA ;g æo ?k"k.k dk de djrk gA ; o{k xgk e Mk;Ýke d Åij lyjy xgk e mifLFkr gkr gA QQMk dh lcl NkVh ljpukRed ,o fØ;kRed bdkb dfidk, gkrh gA bu dfidkvk d pkjk vkj jDr df'kdkvk dk l?ku tky ik;k tkrk g ¼fp= 25-1½A

'olu dk fuEu pj.kk e le>k tk ldrk g&

1- **QQlh; lokru %** ok;e.Myh; ok; vnj [kphp tkrh g vkj CO_2 l Hkjij ok; ckgj eDr dh tkrh gA
2- dfidkvk e xlk ¼O_2 vkj CO_2½ dk fofue;A
3- :fèkj }kjk O_2 ifjoguA
4- :fèkj vkj Årdk d chp O_2 vkj CO_2 dk folj.kA
5- vip;h fØ;kvk gr dkf'kdkvk }kjk O_2dk mi;kx vkj mld QyLo:i CO_2 mRiUu gkukA
6- :fèkj }kjk CO_2 dk ifjoguA

o{kh; ckDl@dt

;g o{k Hkkx e ik;k tkrk gA bld vèkj Hkkx mjkfLFk ;k LVjue ,o i'p Hkkx d'k:d n.M dk cuk gkrk gA bldh nkuk ik'o lrg ilfy;k dh cuh gkrh gA bld i'p Hkkx e Mk;Ýke gkrk gA eu"; e 12 tkMh ilfy;k gkrh gA nk Øekxr ilfy;k d chp ,d tkMh vUrjki'kd if'k;k ¼cká ,o vUr½ ik;h tkrh g ¼fp= 25-2½A

QQlh; lokru

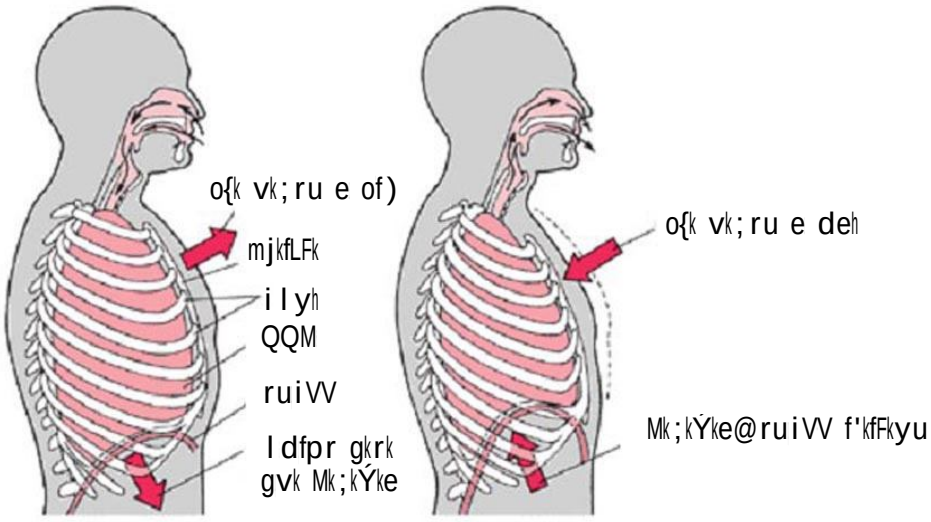
cká 'olu dk] lkl yuk (breathing) vFkok lokru (ventillation) Hkh dgr gA ;g ,d Hkkfrd fØ;k gA bld nk Hkkx gkr g&

1- **vUr%'olu** (Inhalation) : ok; dk 'kjhj e ço'k djukA
2- **fu%'olu** (Exhalation) : CO_2 l Hkjij ok; dk 'kjhj l ckgj fudyukA

vUr%'olu (Inspiration)

vkDlhtu ;Dr ok; dk QQMk e ço'k vUr%'olu dgykrk gA ;g fØ;k rHkh lEHko gkrh g tc QQMk dh ok; dk nkc ok;e.Myh; nkc l de gkA vr% bl gr fuEu fØ;k, gkrh g &

- loiFke Mk;Ýke dh vjh; if'k;k e ldpu gkrk gA ftld QyLo:i Mk;Ýke piVk gk tkrk gA
- bld i'pkr ckg; vrjki'kd if'k;k e ldpu gkrk g] ftld ifj.kkeLo:i mjkfLFk Åij dh vkj ,o ilfy;k ckgj dh vkj mB tkrh gA



fp= 25-2 % o{kh; ckDl

- o{k xgk dk vk;ru c< tkrk g rFkk QQM Qy tkr gA QQMk d vUnj ok; nkc de gk tkrk g] ftl ok; ckgj l QQMk e ço'k dj tkrh gA
- ;g ,d lfØ; fØ;k g] ble Åtk dk 0;; gkrk gA

ok; ekx& ckÁ uklk fNæ → uklk ekx → vUr%uklk fNæ → xluh → ?kkVh}kj → 'okl uyh → 'olfu;k → 'olfudk, → ok; dfidk → okfguh → ok; dfidk,

fu%'olu (Expiration)

CO_2 ;Dr ok; dk 'kjhj l ckgj fudkyuk fu%'olu dgykrk gA bl fØ;k d fy, QQMk dk nkc ok;e.Myh; nkc l vfèkd gkuk pkfg,A

- ckÁ vrjki'kd if'k;k dk f'kfFkyu gkrk g] ftl ilfy;k o mjkfLFk iu% viuh io fLFkfr e vk tkr gA
- Mk;Ýke dh vjh; if'k;k e f'kfFkyu gku d dkj.k ;g xEcn d vkdkj dk gk tkrk gA
- o{k xgk dk vk;ru de gk tkrk g vkj QQMk ij nkc c< tkrk gA QQMk l ok; ckgj fudy tkrh gA
- ;g ,d fuf"Ø; fØ;k g] ftl Åtk 0;; ugh gkrhA ,d LoLFk eu"; vkl ru çfr feuV 12&16 ckj 'olu djrk gA 'olu e ok; d vk;ru dk vkdyu LikbjkehVj dh lgk;rk l fd;k tk ldrk gA 'olu y; efLr"d d eM;yk {k= fLFkr 'olu dUæ d }kjk cukb tkrh gA

xlk dk ifjogu

¼v½ vkDlhtu dk ifjogu

1- **:fèkj lykTek }kjk %** O_2 dk 3% Hkkx :fèkj lykTek e ?kydj Ård dkf'kdkvk rd igpkrk gA

2- **yky :fèkj df.kdkvk }kjk %** O_2 dk 97% Hkkx yky jDr df.kdkvk (RBC) e mifLFkr ghekXykfcu d lkFk l;kx djd ,d vLFkk;h ;kfxd vkDlh&ghekXykfcu dk xBu dj ifjogu djrh gA

$$Hb + O_2 \rightarrow Hb(O_2)_4$$

ghekXykfcu vkDlhtu vkDlhghekXykfcu

¼c½ dkcu MkbvkDlkbM dk ifjogu

Hkkstu ¼Xydkst½ d vkDlhdj.k d QyLo:i mRiUu CO_2 dk ifjogu fuEu ¼3½ çdkj l gkrk g&

1- **dkcfud vEy d :ie %** CO_2 dh yxHkx 7% ek=k dk ifjogu] :fèkj lykTek d ty l fØ;k dj dkckfud vEy d :ie gkrk gA

$$CO_2 + H_2O \rightarrow H_2CO_3$$

dkckfud vEy

- **ckbdkckuV d :ie %** CO_2 dk yxHkx 70% ek=k ckbdkckuV d :ie :fèkj lykTek d lkfM;e vk;u (Na^+) rFkk yky jDr df.kdkvk d ikVf'k;e vk;u (K^+) l tMdj lkfM;e rFkk ikVf'k;e d ckbdkckuV cukr g&

$$HCO_3^- + Na^+ \rightarrow NaHCO_3$$

lkfM;e ckbdkckuV

$$HCO_3^- + K^+ \rightarrow KHCO_3$$

ikVf'k;e ckbdkckuV

- **dkcehuk&ghekXykfcu d :i e** % yxHkx 23% CO_2 ghekXykfcu }kjk dkcehuk&ghekXykfcu d :i e ifjogu djrh gA dfidkvk e] dkcehuk&ghekXykfcu l CO_2 dk foekpu gku yxrk gA

$$Hb.NH_2 + CO_2 \rightarrow Hb.NH.COOH$$

¼QQMk e½ $Hb.NH.COOH \rightarrow Hb.NH_2 + CO_2$

'olu d fodkj

- **nek** % ;g ,d ,yth jkx gA ;g fo'k"k :i l èkvk] èky] èkeiku vkfn d dkj.k gkrk gA nek dk nkjk iMu ij jkxh dk fujUrj [kkl vkrh g ,o 'okl yu e dfBukb gkrh gA
- **'oluh 'kkFk ;k ckdkbfVl** % ;g 'oluh dk 'kkFk gA ble jkxh dk yxkrkj [kkl vkrh g ,o 'oluh e l tu rFkk tyu jgrh gA
- **U;ekfu;k** % ;g jkx] LVIVkdkdl U;ekuh uked thok.k d }kjk gkrk gA bld lØe.k l QQMk dh dfidk, er dkf'kdkvk vkj rjy inkFk l Hkj tkr gA bue l tu vk tkrh gA

egRoi.k fcUn

1- 'olu og vip;h fØ;k g ft le Xydkl d vkDlhdj.k d QyLo:i Åtk fudyrh gA

2- 'olu&vkDlh; ,o vukDlh; nk çdkj dk gkrk gA

3- fofHkUu ox d thoèkkfj;k e fHkUu&fHkUu çdkj d 'olu vx ik, tkr gA tl& Dyke] Vfd;k] 'kjhj dh lkekU; lrg] QQM vkfnA

4- eu"; dk 'olu r=&ukfldk] uklkekx] xluh] Loj;=] 'okluky] 'olfu;k] QQMk dk cuk gkrk gA QQlh; lokru d nk Hkkx gkr g& vUr%'olu ,o fu%'oluA

5- QQlh; lokru e lfEefyr ok; d fofHkUu vk;ru dk Likbjkehvj dh lgk;rk l ukik tk ldrk gA

6- O_2 dk ifjogu :fèkj lykTek }kjk ,o yky :fèkj df.kdkvk }kjk fd;k tkrk gA

7- CO_2 dk ifjogu e[;r% dkcfud vEy d :i e] lkfM;e o ikVf'k;e ckbdkckuVk d :i e ,o dkckehuk&ghekXykfcu d :i e gkrk gA

8- 'olu lEcUèkh db jkx eu";k e ik, tkr gA tl& nek] ckdkbfVl] U;ekfu;k vkfnA

vH;kl lkFk ç'u

oLrfu"B ç'u

1- /keiku l gku oky jkx dk uke g &
¼v½ lyx ¼c½ Lokbu ¶y
¼l½ nek ¼n½ U;ekfu;k

2- 'olu fdl çdkj dh fØ;k g &
¼v½ vip;h ¼c½ mip;h
¼l½ mikip;h ¼n½ dkb ugh

3- LVIVkdkdl U;ekuh g &
¼v½ fo"kk.k ¼c½ thok.k
¼l½ Ñfe ¼n½ okbjl

4- Eku"; e fdru tkMh ilfy;k ik;h tkrh g &
¼v½ 10 ¼c½ 12
¼l½ 14 ¼n½ 16

vfry?kUkjkRed ç'u

1- dhVk e dkulk 'olu vx ik;k tkrk g\

2- ekuo e efLr"d e 'olu dUæ dgk fLFkr g\

3- 'olu vfHkfØ;k fyf[k,A

4- dB l /ofu fdl çdkj mRiUu gkrh g\

5- vkDlhtu dk vf/kdre logu fdld }kjk gkrk g\

yÄUkjkRed i'u

1- LikbjkehVj D;k g\

2- 'olu fdru çdkj dk gkrk g\ le>kb,A

3- Ok{kh; ckDl ¼dt½ dh ljpuk crkb,A

4- 'olu d dkb 3 fodkj le>kb,A

5- 'olu d fy, fofHkUu tho/kkfj;k e dkul 'olu vx ik; tkr g\

fucU/kkRed i'u

1- Ekkuo d 'olu rU= dk lfp= o.ku dhft,A

2- Q¶Qlh; lokru dh fØ;kfof/k fp= lfgr le>kb,A

3- vkDlhtu ,o dkcu MkbvkDlkbM dk ifjogu fdl çdkj gkrk g\

mÙkjekyk % 1 ¼l½ 2 ¼v½ 3 ¼c½ 4 ¼c½

v/;k; & 26

ifjlpj.k r=

(Circulatory System)

thfor dkf'kdkvk dk lpk: :i l dk; dju d fy, fujrj ik"kd inkFkk] vkDlhtu] ty vkfn dh vko';drk gkrh gA bu dkf'kdkvk l vif'k"V inkFkk dk yxkrkj fu"dkl Hkh vko';d gkrk gA vr% vko';d inkFkk dk dkf'kdkvk rd y tku ,o vif'k"V inkFkk dk fudkyu gr ,d fof'k"V ifjlpj.k r= dh vko';drk gkrh gA

ekuo e ifjogu dk dk; jDr ,o yfldk d }kjk fd;k tkrk gA lkekU;r% thok e nk çdkj dk ifjlpj.k r= ik;k tkrk gA

- **[kyk ifjlpj.k r=%** ;g vkFkikMk o ekyLdk l?k d thok e ik;k tkrk gA ble jDr] okfgdkvk l ckgj vk dj cM&cM dkVj e vk tkrk g] ftUg lkefgd :i l :fkj xgk ;k ghek lhy dgr gA mnkgj.k& dkdjkp o ?kk?kk
- **cUn ifjlpj.k r=%** ;g ,ufyMk o d'k:dk e ik;k tkrk gA ble :fkj i.kr;k :fkj okfgfu;k e cUn jgrk gA mnkgj.k& ekuo

jDr

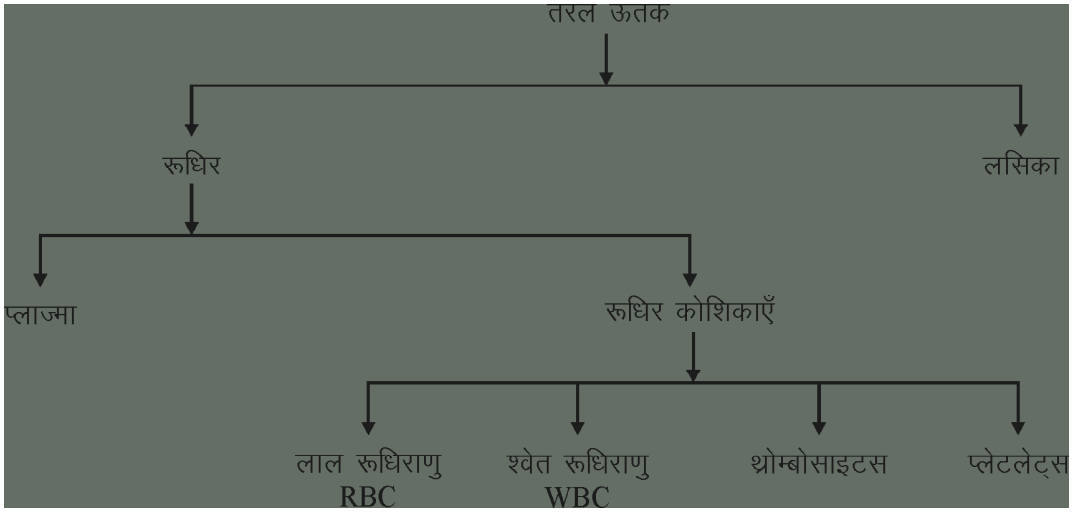
jDr ,d rjy l;kth Ård gA ble æ0; vèkk=h lykTek ,o dkf'kdk, ¼RBC, WBC ,o lyVyVl½ ik;h tkrh gA :fkj d vè;;u dk gheVkykth ,o :fkj ifjlpj.k d vè;;u dk ,fUtvkykth dgr gA bldk pH 7.3 to 7.5 ¼{kkjh;½ gkrk gA

lykTek

;g jDr dh vèkk=h gA ;g gYd ihy jx dk xk<k æo gkrk gA ble 90-92% ty ,o 6-8% çkVhu inkFk gkr gA ble Qkbfcuk tu] ,Ycfeu ,o Xykcfyu e[; çkVhu gkr gA lykTek e vud [kfut vk;u tl&Na^+, Ca^{++}, Mg^{++}, HCO_3^-, Cl^- vkfn Hkh mifLFkr gkr gA :fkj dk FkDdk cuku vFkok Ldnu d vud dkjd çæ0; d lkFk fuf"Ø; voLFkk e jgr gA FkDdk@Ldnu dkjdk d fcuk lykTek dk lhje dgr gA

lxfBr inkFk

yky :fkj df.kdk, (RBC bfjFkk lkbVs] 'or :fkj df.kdk, ¼WBCY;dk lkbV½] rFkk ifVdk.k ¼lyVyVl½ dk lfEefyr :i l lxfBr inkFk dgr gA



- **yky :fèkj df.kdk,** % LoLFk eu"; e ; 50 l 55 yk[k çfr ?ku feeh gkrh gA o;Ld voLFkk e RBC yky vfLFk eTtk e curh gA ; mHk;kory (Bicocave) vkj dUæd foghu gkrh gA budk yky jx ykg ;Dr çkVhu] ghekXykchu d dkj.k gkrk gA ;g 'olu xlk dk ifjogu djrh gA budh vk; 120 fnu gkrh gA budk fouk'k lyhgk (Spleen - RBC dk dfcLrku½ e gkrk gA
- **'or :fèkj df.kdk,** (WBC) : ; jxghu] vfu;ferkdkj] dUæd ;Dr gkrh gA budk thou dky 4-7 fnu gkrk gA ; 6000-8000 çfr ?ku feeh gkrh gA
- **ifVVdk.k ¼lyVyVl] FkkEcklkbVl½** % budh l[;k 1-5 l 3-5 yk[k çfr ?ku feeh gkrh gA ;g db çdkj d inkFk lkfor djrh g tk :fèkj dk FkDdk teku e lgk;d gA

:fèkj ox

ABO leg] yky jDr df.kdkvk dh lrg ij nk çfrtu@,Vhtu (A, B) dh mifLFkfr ;k vuifLFkfr ij fuHkj djrk gA :fèkj d lykTek e çfrj{kh@,VhckMh ¼,Vh& arFkk ,UVh b½ ik, tkr gA çfrj{kh o çkVhu g tk çfrtu d fo:) ink gkr gA ¼lkj.kh½

Rh leg

yxHkx 80% eu";k e ,d vU; çfrtu@,.Vhtu Rh ik;k tkrk gA ;g Rh çfrtu jhll (Rhesus) cUnj e ik; tku oky ,UVhtu d leku gkrk gA ftu 0;fDr;k e ;g Rh çfrtu ik;k tkrk g mUg Rh lfgr (Rh+ve) ,oftue ;g ugh gkrk mUg Rh ghu (Rh-ve) dgr gA

:fèkj Ldnu

okfgfu;k l ckgj] ok; d lEid e vkr gh :fèkj ,d tyh leku inkFk e ifjofrr gk tkrk gA :fèkj dk ;g x.k Ldnu ;k FkDdk cuuk dgykrk gA

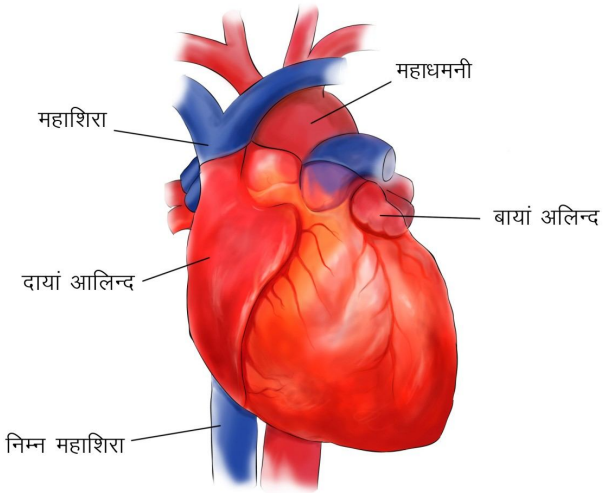
dN ykxk e :fèkj dk FkDdk u teu l :fèkj cguk cUn ugh gkrk vkj vfèkd :fèkj cg tku l vUrr% mudh eR; gk tkrh gA ;g jkx ghekQhfy;k dgykrk gA ;g ,d vkuof'kd jkx gA

ylhdk

ylhdk jxghu æo g ftle fyQklkbV ik, tkr gA fyQklkbV 'kjhj dh çfrj{kk vufØ;k gr ftEenkj gkrk gA ylhdk ik"kd inkFkk vkj gkeku d ifjogu e egRoi.k Hkfedk fuHkkr gA ;g olk ¼fXylj.ky ,o olk vEy½ d ifjogu e lgk;d gA lyhgk ,d cMh ylhdk xfFk gA VkfUlYl Hkh ylhdk xkB gA

ekuo ân; dh cká ljpuk

;g cUn eëh d cjkcj f=dk.kkdkj ljpuk gA ;g nkuk QQMk d eè;] o{k xgk e] FkkMk lk ckb vkj >dk gvk gkrk gA bld Åij nkgjk ân;koj.k ik;k tkrk g ftle ân;koj.kh æo ik;k tkrk gA ;g æo ân; dk ue cuk, j[krk g ,o ckgjh vk?kkrk l bldh j{kk djrk gA ân; dh fnokj vufPNd ân;h if'k;k dh cuh gkrh g ¼fp= 26-1½A



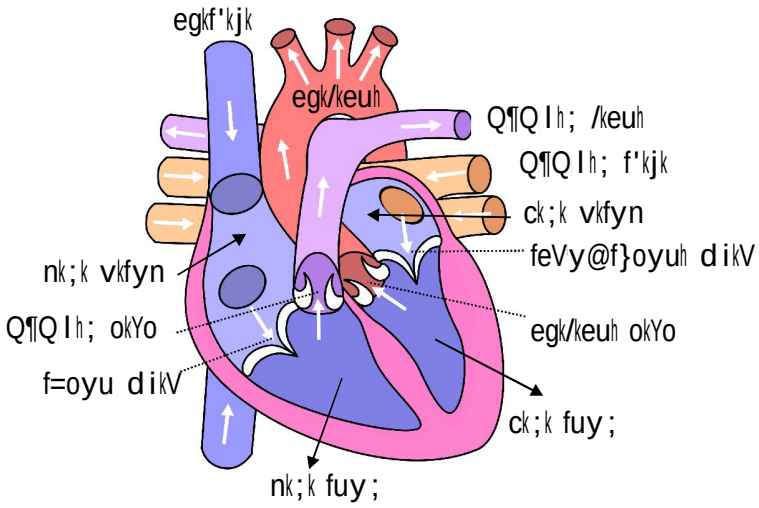
fp= 26-1 % ân; dh cká ljpuk

ân; dh vkUrfjd ljpuk

ekuo ân; e pkj d{k gkr gA nk Åijh d{k tk iryh fHkfr d ,o NkV gkr g vkfyUn Auricles dgykr gA nk

lkj.kh & jDr leg rFkk jDrnkrk l;kX;rk

jDr leg	RBC e çfrtu	lykTek e çfrj{kh	jDrnkrk leg
A	A	b	A, O
B	B	a	B, O
AB	AB	vuifLFkr	AB, A, B, O
O	vuifLFkr	a rFkk b	O



fp= 26-2 % ân; dh vkrfjd ljpuk

fupy d{k tk vi{kÑr ekVh fHkfr d ,o cM gkr gA fuy; Ventricles dgykr gA nk;k o ck;k vkfyUn ,d nlj l vrj vkfyn iV }kjk foHkkftr gkr gA ,d ekVh fHkfr ftl vUrj&fuy;h iV dgr g] nk; ,o ck; fuy; dk vyx djrh gA viuh&viuh vkj d vkfyn ,o fuy; ,d nlj l vkfyn&fuy; iV }kjk iFkd jgr gA ck; vkfyn ,o ck; fuy; d eè; f}oyuh ;k feVy dikV ik;k tkrk gA nk; vkfyUn ,o nk; fuy; d eè; f=oyu dikV ik;k tkrk gA nk, fuy; l Q¶Q lh; èkeuh dk ,o ck; fuy; l egkèkeuh dk fudkl gkrk gA Q¶Q lh; èkeuh rFkk egkèkeuh dk.Mk d vUnj rhu&rhu vèkpUækdkj dikV ik; tkr gA ; dikV :fèkj dk okil ân; e tku l jkdr gA QQMk l Q¶Q l f'kjk }kjk vkDlhtfur :fèkj ck; vkfyUn e yk;k tkrk gA 'kjhj d lHkh Hkkxk l vukDlhÑr :fèkj egkf'kjkvk }kjk nk; vkfyUn e yk;k tkrk gA ân; e ,d fo'k"k çdkj dk i'khU;kl ik;k tkrk gA ftl ukMy Ård dgr gA nkfgu vkfyn d Åijh dku ij f'kjk vkfyn io (SAN) mifLFkr gkrk gA nkfgu vkfyn d fupy dku ij] vkfyn fuy;h iV d ikl vkfyn fuy; io (AVN) fLFkr gkrk gA ukMy ¼xfFky½ j'kk dk ,d cMy] ftl vkfyn fuy; cMy (AV cMy½ Hkh dgr g] vrj fuy; iV d Åijh Hkkx l ¼vkfyn fuy; io l½ çkjHk gkrk g ,o 'kh?k gh nk 'kk[kkvk ¼nk;h ,o ck;h½ e foHkkftr gkdj vrj fuy; iV d lkFk i'p Hkkx e c<rk gA bu nkuk 'kk[kkvk l j'k fudyr g ftUg ijfdt rr dgr gA ; rr nkuk fuy;k d i'khfoU;kl e Qy jgr gA nk;h o ck;h 'kk[kkvk lfgr ; rr fgt d cMy dgykr gA f'kjk vkfyn io ân; dk y;kRed ldpu çkjHk djrk g blfy, bl xfrçjd ¼il edj½ dgk tkrk g ¼fp= 26-2½A

ân; dh fØ;kfofèk

ân; ,d i'kh; iEi gA ân; e Øec) :i l ldpu vkj vuf'kfFkyu gkrk jgrk gA blh dk ân; dh èkMdu ;k Linu dgr gA bldh ldpu çkoLFkk dk çdpu ;k flLVky rFkk vuf'kfFkyu çkoLFkk dk çlkj.k ;k Mk;LVky dgr gA ân; Linu dh bl iujkofr dk ân; pØ dgr gA eu"; e ;g 72 ckj çfr feuV gkrh gA ân; pØ fuEu çkoLFkkvk e ijk gkrk g &

- **vkfynk dk vuf'kfFkyu %** bl çkoLFkk e vkfyUn foJkUr voLFkk e gkr gA bl le; QQMk l vkDlhÑr :fèkj] Q¶Q lh; f'kjkvk }kjk ck; vkfyUn e rFkk 'kjhj d vU; Hkkxk l vukDlhÑr :fèkj egkf'kjkvk }kjk nk; vkfyUn e vk tkrk gA çkjEHk e f}oyu vkj f=oyu dikV cUn jgr g ijUr :fèkj dk nkc c<u l ;g dikV [ky tkr g rFkk vfèkdk'k :fèkj yxHkx 75% fuf"Ø; çokg }kjk fuy;k e Hkj tkrk gA
- **vkfynk dk çdpu %** vkfyUnk d vuf'kfFkyu d i'pkr nkuk vkfyn ,d lkFk ldfpr gkr g vkj yxHkx 25% :fèkj tk vkfyUnk e cpk gvk Fkk fuy;k e vkdj mUg i.kr% Hkj nrk gA vkfynk dk çdpu f'kjk vkfyn io (SAN) d }kjk mRiUu fØ;kfoHko }kjk çfjr gkrk gA
- **fuy;k dk çdpu %** fuy; e fØ;kfoHko dk lpkyu vkfyn fuy; io (A.V. node) }kjk gkrk gA ;gk l fgt d cMy rFkk ijfdt d rUr bl fuy; dh if'k;k rd igpkr gA vc fuy;h if'k;k e ldpu gkrk gA f=oyu ,o f}oyu dikV cn gk tkr g ftl jDr

foijhr fn'kk e vFkkr vkfyUnk e ugh tk ldrkA vèk pUæk dkj dikV tk Q¶QIh; èkeuh ¼nkb vkj½ ,o egkèkeuh ¼ckb vkj½ ij fLFkr gkr g] [ky tkr g vkj jDr èkefu;k e vk tkrk gA

- **fuy;k dk vuf'kfFkyu %** fuy; vc f'kfFky gk tkr g fuy;k dk nkc de gk tkrk gA vèkpæk dkj dikV rjUr cUn gk tkrk g ftll :fèkj dk foijhr çokg uk gk ldA vkfyn e jDr dk nkc c<u yxrk g vkj f}oyu ,o f=oyu dikV [ky tkr gA io e of.kr lkjh fØ;k fQj l nkgjkrh g] ftll ;g çfØ;k fujUrj pyrh jgrh gA

  ân; pØ d nkjku nk èkofu;k LVFkLdki }kjk luh tk ldrh gA çFke&f=oyuh rFkk f}oyuh dikV cn gku ij ¼yc½] nljh vèkpædikV d cn gku ij ¼Mc½ dh èofuA

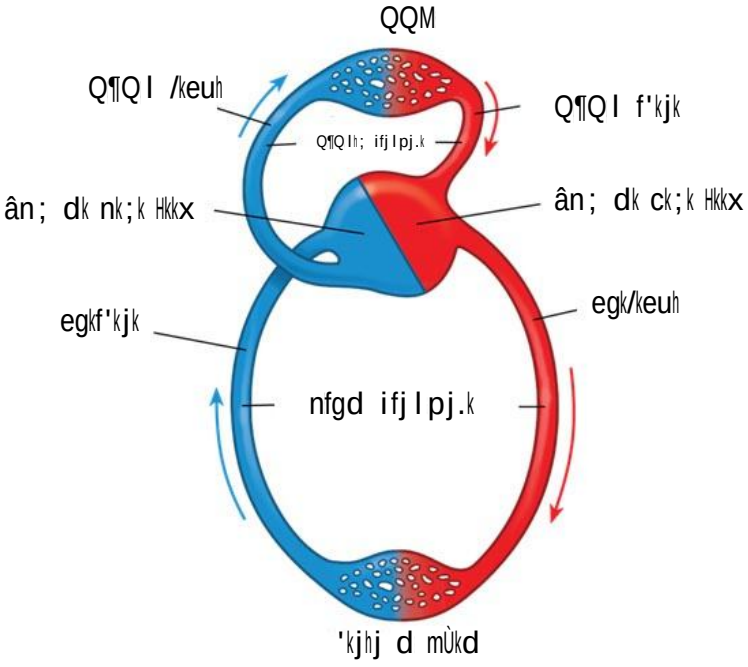
nkgjk jDr ifjlpj.k

Lruèkkfj;k d ân; e ifjlpj.k d le; 'k) ,o v'k) jDr ,d nlj l i.kr% iFkd jgr gA 'k) jDr] egkèkeuh }kjk 'kjhj d fofHkUu vxk dk forfjr fd;k tkrk gA bu vxk l v'k) jDr egkf'kjkvk }kjk ân; d nk; vkfyn e vk tkrk gA nk; vkfyn l nk; fuy; e gkrk gvk Q¶QIh; èkeuh }kjk QQMk e 'kf)dj.k gr pyk tkrk gA xlh; fofue; d i'pkr 'k) jDr] Q¶QIh; f'kjkvk }kjk ck; vkfyn l ck; fuy; l gkrk gvk egkèkeuh e çokfgr gk tkrk g ¼fp= 26-3½A

bl çdkj i.k ifjlpj.k iFk e jDr ân; e nk ckj xtjrk gA vr% bl nkgjk ifjlpj.k dgk tkrk gA

ifjlpj.k lEcUèkh jkx

- **mPp jDr nkc %** bl jkx e jDrpki lekU; ¼120@80½ l vfèkd gk tkrk gA ;g efLr"d rFkk xnk dk çHkkfor djrk gA
- **ân; 'ky %** bl jkx e ân; i'kh e i;kIr ugh igprh gA lhu e ihMk gku yxrh gA
- **ân; vk?kkr %** :fèkj okfgdk e :dkoV bldk e[; dkjd gA vR;fèkd ekVkik] èkeiku] de 0;k;ke] mPp jDr pki] vfèkd dkyLVky bld e[; dkj.k gA
- **jDrkyirk %** RBC ;k ghekXykchu dh deh ,uhfe;k dgykrh gA ;g foVkfeu B_{12}, Qkfyd vEy vk;ju dh deh l gk tkrk gA
- **ghekQhfy;k ;k 'kkgh jkx %** ;g jkx doy i#"kk e gkrk gA eknk bldh okgd gkrh gA ;g ,d vkuof'kd jkx gA ble pkV yxu ij :fèkj dk FkDdk ugh cu ikrk gA ;g bXy.M dh egkjkuh foDVkfj;k d o'k tk e n[kk x;kA



fp= 26-3 % nkgjk jDr ifjlpj.k

egRoi.k fcUn

1- ifjlpj.k r= nk çdkj dk gkrk g& [kyk ,o cUn ifjlpj.k r=

2- jDr ,o yfldk rjy l;kth Ård gA

3- :fèkj dk vè;;u gheVkykth ,o :fèkj ifjlpj.k dk vè;;u ,fUtvkykth dgykrh gA

4- jDr lykTek ,o lxfBr inkFkk dk cuk gkrk gA

5- ekuo dk jDr pkj leg A, B, AB, O e oxhÑr fd;k x;k gA

6- ,.Vhtu Rh dh [kkt jhll uked cUnj e dh xb FkhA

7- ghekfQfy;k ¼'kkgh jkx½ e :fèkj dk FkDdk ugh terkA

8- ekuo ân;] vufPNd ân;h if'k;k dk cuk gkrk gA

9- f'kjk vkfyn io dk xfr çjd ;k il edj Hkh dgr gA

10- ân; dh Øfed ?kVukvk dk ,d pØ d :i e ckj&ckj nkgjk;k tkrk g ftl ân; pØ dgr gA

11- LoLFk eu"; e çfr feuV 72 pØ çnf'kr gkr gA

12- ekuo e nkgjk ifjlpj.k r= ik;k tkrk gA

vH;klkFk ç'u

oLrfu"B ç'u

1- LoLFk eu"; e çfr feuV fdru ân; pØ çnf'kr gkr g &

¼v½ 70 ¼c½ 72

¼l½ 60 ¼n½ 80

2- rjy l;kth mÙkd g &

¼v½ jDr ¼c½ ykfldk

¼l½ nkuk ¼n½ dkb ugh

3- ,.Vhtu (Rh) dh [kkt fdle dh xb FkhA

¼v½ cUnj ¼c½ pgk

¼l½ [kjxk't ¼n½ xk;

4- dkulk jDr leg lHkh dk jDr n ldrk g&

¼v½ A ¼c½ B

¼l½ B ¼n½ O

vfryÄÙkjkRed i'u

1- :f/kj dk v/;;u D;k dgykrk g\

2- f}oyuh dikV dk nljk uke fyf[k,\

3- xfr çjd ân; e dgk fLFkr gkrk g\

4- ifjlpj.k fdru çdkj dk gkrk g\ uke fyf[k,A

5- fdl jkx e :f/kj dk FkDdk ugh curk\

yÄÙkjkRed i'u

1- ;fn ân; d fofHkUu dikVk dk u"V dj fn;k tk; rk bldk D;k çHkko iMxk\

2- jDr dh ljpuk d ckj e fyf[k,A

3- ân; /ofu;k dh 0;k[;k dhft,A

4- ylhdk d ckj e vki D;k tkur g\

5- ân; dh ckÁ ljpuk dk fp= cukb,A

fucU/kkRed i'u

1- ekuo e jDr leg fdru çdkj dk gkrk g\ bld oxhdj.k ,o jDrnkrk dk D;k vk/kkj g\

2- ân; dh vkUrfjd ljpuk dk lfp= o.ku dhft,A

3- ân; dh fØ;kfof/k le>kb,A

4- nkgjk jDr ifjlpj.k dk fp= lfgr le>kb,A

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mÙkjekyk % 1 ¼c½ 2 ¼l½ 3 ¼v½ 4 ¼n½

bdkb & XVII

v/;k; & 27

mRltu r=

(Excretory System)

lHkh thok e dkf'kdh; mikip; d QyLo:i cgr l vif'k"V inkFk fujUrj cur jgr g tk 'kjhj d fy, gkfudkjd gkr gA dkckgkbMV ,o olkvk d mikip; d QyLo:i CO_2 ,o H_2O cur g tcfd çkVhu d mikip; d QyLo:i ukbVktuh vif'k"V inkFk tl vekfu;k] ;fj;k ,o ;fjd vEy cur gA vr% ,l ukbVktuh vif'k"V inkFkk dk 'kjhj l ckgj fudkyu dh to fØ;k dk mRltu dgr gA

çkVktkvk] ikjhQjk ,o lhyUVVk l?k d tUrvk e mRlth inkFkk dk ckgj fudkyu d fy, fo'k"k vx ugh gkr g tcfd vU; tUrvk e bld fy, mRlth vxk dk r= gkrk g ftl mRltu r= dgr gA

ukbVktuh vif'k"V inkFk

(Nitrogenous Waste Product)

1- **vehuk vEy** (Amino Acid) : çkVhu ikpu d QyLo:i fufer vko';drk l vf/kd vehuk vEyk dk dN çk.kh tl ekyLdk ,o bdkbukMeVk vkfn e ; gh mRltu dj fn;k tkrk gA ,l mRltu dk vehukVfyd (aminotelic) dgr gA

2- **vekfu;k** (Ammonia) : ;g vehuk vEyk d Mh,ehu'ku d QyLo:i curh gA ;g vR;Ur fo"kyh ,o ty e ?kyu'khy gkrh gA blhfy, vf/kdk'k tyh; tUr tl& çkVktkvk] ikjhQjk] lhyUVVk] ikyhdhVk] tyh; vkFkkikMk] vfLFky eNfy;k vkfn ty d lkFk bldk mRltu djr gA ,l mRltu dk vekukVfyd dgr gA

3- **;fj;k** (Urea) : ;g vekfu;k l de fo"kyh ,o ty e de ?kyu'khy gkrh gA blhfy, vf/kdk'k LFkyh; tl& o;Ld mHk;pj] Lruh ,o ,l tyh; tUr ftue ty dh cgrk;r ugh gkrh gA ;fj;k d :i e mRlth inkFkk dk mRlftr djr gA ,l mRltu dk ;fj;kVfyd dgr gA

4- **;fjd vEy** (Uric Acid) : ;g ;fj;k l Hkh de fo"kyk ,o ikuh e v?kyu'khy gkrk gA vr% 'k"d okrkoj.k e jgu oky LFkyh; tl& i{kh] ljhli] dhV vkfn mRlth inkFkk dk ;fjd vEy d :i e mRlftr djr gA ,l mRltu dk ;fjdkVfyd dgr gA

bud vfrfjDr vU; ukbVktuh vif'k"V tl& VkbfeFkkby ,ehu vkDlkbM] ,y.Vkbu] ,y.Vkbd vEy] Xokfuu] vkfufFkd vEy] fØ,fVu ,o fØ,fVfuu vkfn Hkh tUrvk e fufer gkr gA

mRltu r= dh ljpuk

(Structure of Excretory System)

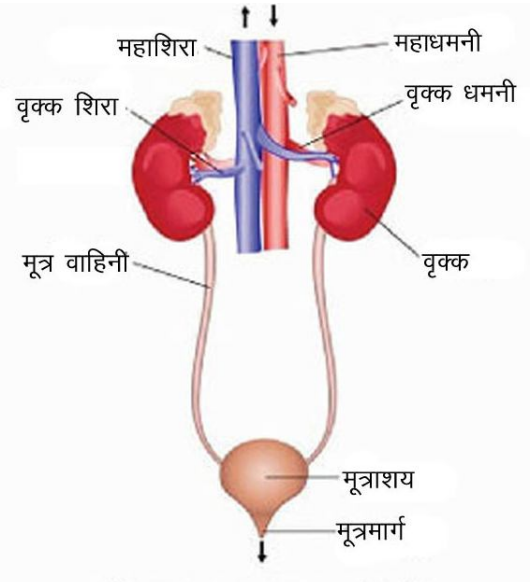
eu"; e ,d tkMh eVkufÝd oDd mnjxgk e d'k:d n.M d nkuk vkj fLFkr gkr gA çR;d oDd dh vkÑfr le d cht d leku gkrh gA oDd d Hkhrjh Hkkx dh vkj ,d NkVk lk jU/k ik;k tkrk g ftl gkbye dgr gA

çR;d oDd d gkbye oky Hkkx l ,d e=okfguh fudydj mnjxgk d ihN dh vkj c<rh gA nkuk oDdk dh e=okfgfu;k mnjxgk d i'p Hkkx e e=k'k; e [kyrh gA e=k'k; ihN dh vkj ldjh ufydk d leku e=ekx(urethra) e cny tkrk gA uj eu"; e e=ekx] f'k'u (penis) d vx fljij fLFkr e=tuu fNæ }kjk ckgj [kyrk gA tcfd eknk e njkj:ih fNæ e [kyrh g ftl ;kfu fNæ (vulva) dgr g ¼fp= 27-1½A

oDd ufydk ;k uÝku

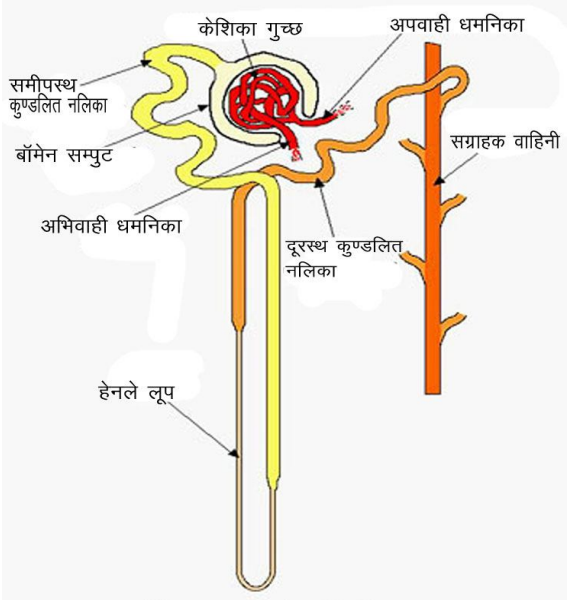
(Uriniferous tubule or Nephron)

çR;d oDd vud NkVh&NkVh d.Mfyr jpukRed ,o fØ;kRed bdkb;k dk cuk gkrk gA eu"; d nkuk oDdk e yxHkx 20 yk[k oDd ufydk, gkrh gA oDd d ckgjh dkVDl Hkkx e oDd ufydk dk l;kyuek ckeu lEiV fLFkr gkrk gA bld Hkhrj vfHkokgh ,o viokgh /kefudkvk dh



fp= 27-1 % eu"; dk mRltu r=

df'kdkvk }kjk fufer tfVy xPNk gkrk g ftl df'kdkxPN ;k Xyke:yl (Glomerulus) dgr gA ckeu lEiVd ihN dkVDl Hkkx e gh vR;f/kd d.Mfyr lehiLFk d.Mfyr ufydk gkrh gA bld ckn ufydk iryh gkdj gUy yid :i e oDd deM;yk Hkkx e fLFkr gkrh gA çR;d oDd ufydk d gUy yi dh vkjkgh Hktk okil dkVDl Hkkx e igpu ij njLFk d.Mfyr ufydk e [ky tkrh gA ;g ,d lh/kh vkj yEch lxg ufydk e [kyrh gA ftle lehi fLFkr db oDd ufydk, [kyrh gA lxg ufydk, dkVDl Hkkx l çkjEHk gkdj oDd deM;yk Hkkx l gkrh gb ifYol e [kyrh g %fp= 27-2%A



fp= 27-2 % uÝku dh ljpuk

mRltu dh dkf;dh

(Physiology of Excretion)

Lrfu;k e ;fj;kVfyd mRltu gkrk gA mRltu e nk çe[k çfØ;k, gkrh g&

1- ;Ñr e ;fj;k&l'y"k.k (Synthesis of urea)

2- oDdk e e= fuek.k ,o mRltu (Urire formation and excretion)

1- **;fj;k l'y"k.k %** ;Ñr e vekfu;k d nk v.k CO_2 l feydj ;fj;k cukr gA

$$2NH_3+CO_2 \rightarrow NH_2\text{-}\overset{O}{\overset{\|}{C}}\text{-}NH_2+H_2O$$

;fj;k dk l'y"k.k db jklk;fud çfØ;kvk dk ,d tfVy pØ gkrk g tk ;Ñr dkf'kdkvk e ,Utkbek dh mifLFkr e fujUrj pyrk jgrk gA bl pØ e vkfuFkhu] flVyhu ,o vkftuhu vehuk vEyk dk pØh; mi;kx gkrk gA blhfy, bl vkfuFkhu pØ ;k ØCl&gUlyhV pØ dgr gA

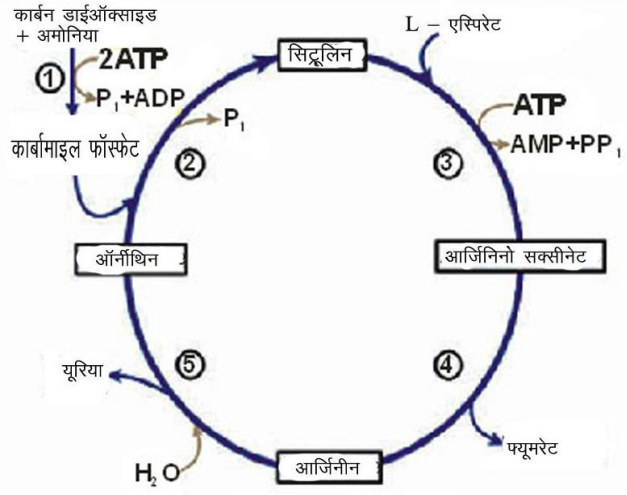
2- **e= fuek.k ,o mRltu %** oDd ufydkvk e e= fuek.k fuEufyf[kr rhu pj.kk e gkrk g &

(i) ijkfuL;nu (Ultrafiltration)

(ii) p;ukRed vo'kks"k.k (Selective absorption)

(iii) lko.k (Secretion)

(i) **ijkfuL;nu** (Ultrafiltration): df'kdkxPN e jDr dk ,d vfHkokgh /kefudk (afferent arteriole) ykrh g bldh df'kdk, okil tMdj ,d viokgh /kefudk (efferent arteriole) cukrh g tk df'kdkxPN dk ifjufydk tky l tkMrh gA bll df'kdkxPN e :fèkj mPp nkc yxHkx 60 mm Hg d lkFk cgrk gA



fp= 27-3 % vkfuFkhu pØ

df'kdk xPN dh jDr df'kdkvk ,o ckeu lEiV dh nhokj cgr eghu ,o fNfær gkrh gA ; nkuk nhokj vkil e feydj ,d eghu df'kdkxPN dyk (Glomerular membrane) cukrh gA bl dyk dh ikjxE;rk lkeku; jDr df'kdkvk dh ryuk e 100 l 1000 xuk vf/kd gkrh gA vr% df'kdkxPN dh df'kdkvk l jDr d lykTek dh yxHkx 12% ek=k Nudj ckeu lEiV e pyh tkrh gA bl rjy dk df'kdkxPN fuL;n (Glomerular filtrate) vkj bl çfØ;k dk ijkfuL;nu dgr gA bl fuL;n e :f/kjk.kvk ,o lykTek çkVhu d vfrfjDr jDr d lHkh ?kVd tl& ty] yo.k] Xydkt] ;fj;k] vehuk vEy vkfn gkr gA ijkfuL;nu e[;r% df'kdkxPN dh jDr df'kdkvk e mifLFkr jDr nkc yxHkx 60mm Hg d dkj.k gkrk gA ;g fuL;n T;k dk R;k e= d :i e ckgj mRlftr ugh gkrk g cfYd ble mifLFkr ykHknk;d inkFkk dk oDd ufydk dh dkf'kdk, p;ukRed vo'kk"k.k }kjk okil jDr e igpkrh gA

(ii) **p;ukRed vo'kk"k.k** (Selective absorption) : oDd ufydk dh lehiLFk d.Mfyr ufydk dh dkf'kdk, fuL;n d yxHkx 65-80% Hkkx dk vo'kk"k.k djd ifjufydk df'kdktky dh df'kdkvk d :f/kj e igpk nrh gA bl çfØ;k e yxHkx lkj Xydkt] dkcfud inkFkk ,o vdkcfud vk;uk dk vo'kk"k.k gk tkrk gA ty, Na ,o Cl^- vk;uk dk vo'kk"k.k e[;r% guy yi ,o lxg ufydk oky Hkkx e gkrk gA

(iii) **lko.k** (Secretion) : lehiLFk ,o njLFk d.Mfyr ufydkvk dh dkf'kdk, ifjufydk tky dh df'kdkvk d jDr l dN inkFkk dk xg.k djd fuL;n e eDr dj nrh gA bl çfØ;k dk gh lko.k dgr gA bl çfØ;k }kjk ;fjd vEy tl gkfudkjd inkFkk ,o K^+, H^+ vkfn dk lko.k gkrk gA

lxg ufydkvk l oDd d ifYol Hkkx e igpu rd fuL;n e= cu tkrk gA ble 95% ty] 2.6% ;fj;k rFkk yo.k] ;fjd vEy] vekfu;k] fØ,fVu vkfn inkFk gkr gA e= dk ihyk jx ;jkØke o.kd dh mifLFkr d dkj.k gkrk gA

e=.k (Micturition)

'kjhj l e= dk ckgj fudkyu dh çfØ;k dk e=.k dgr gA oDd d ifYol l e=] e= ufydk }kjk e=k'k; e igprk gA e=k'k; e= dk lxg dju ,o fuf'pr vUrjky d i'pkr ckgj fudkyu dk dk; djrk gA e=k'k; e nk çfrorh fØ;k, lxg çfror ,o fjfDru çfror gkrh gA bue l lxg çfror e=k'k; e e= dk lxg dju ,o fjfDru çfror tk e=k'k; dk [kkyh dju d fy, çfjr djrh gA

e= fuek.k ,o gkeku fu;=.k

(Urine formation and Hormone control)

e= fuek.k dh fØ;k e[;r% fuEu gkekuk }kjk çHkkfor gkrh g &

(i) **,YMkLVhjku** (Aldosterone) % ;g ,Mhuy xfUFk }kjk lkfor gkrk gA ;g fuL;n l Na^+ d vo'kk"k.k dk c<krk g rkfd 'kjhj e Na^+ dh mi;Dr ek=k cuh jgA bl gkeku dh deh l jDr e K^+ dh ek=k c< tkrh gA bll ,Mhlu jkx gk tkrk gA

(ii) **,UVhMkb;jfVd ;k olkiflu gkeku** (ADH) : ;g ih;"k xfUFk d i'p Hkkx }kjk lkfor gkrk gA ;g e= e ty dh ek=k dk fu;f=r djrk gA ADH dk lko.k de gk tku l e= dh ek=k c< tkrh gA bl e=yrk (Diuresis) dgr g rFkk bl vlkeku;rk dk cge= jkx (Diabetes insipidus) dgr gA ADH d vf/kd lko.k gku ij e= xk<k gk tkrk gA

lefLFkfr (Homeostasis)

oDd e= fuek.k ,o mld ckgj fu"dklu d vykok ty lryu] yo.k lryu ,o vEy&{kkj lryu cuk; j[ku dk dk; Hkh djr gA bll 'kjhj dk fLFkj voLFkk (steady state) e cuk, j[kk tkrk gA bl çfØ;k dk okYVj duu (Walter Canon) u lefLFkfr ;k gkfe;kLVfll uke fn;kA

egRoi.k fcUn

1- ukbVk tuh vif'k"V inkFk& vehuk vEy] vekfu;k] ;fj;k] ;fjd vEy] VkbfeFkkby vkDlkbM vkfnA

2- eu"; d mRltu r= e ,d tkMh oDd] e=okfgfu;k] e=k'k; ,o e= ekx gkr gA

3- oDd vud NkVh&NkVh d.Mfyr ljpukRed ,o fØ;kRed bdkb;k dk cuk gkrk g ftUg uÝku dgr gA

4- e= fuek.k dh çfØ;k e (i) ijkfuL;nu (ii) p;ukRed vo'kk"k.k (iii) lko.k pj.k gkr gA

5- e= fuek.k fØ;k dk fu;=.k e[;r% ,YMkLVhjku ,o ,UVh Mkb;jfVd gkeku }kjk gkrk gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- vuko';d vehuk vEyk l ;fj;k dk l'y"k.k dgk gkrk g &
¼v½ oDd ¼c½ e=k';
¼l½ ;Ñr ¼l½ oDd ufydk,

2- ijkfuL;nu gkrk g &
¼v½ :f/kj df'kdkvk e
¼c½ Ård n0; e
¼l½ ckeu lEiV e
¼n½ ;Ñr e

3- gUy dk yi gkrk g &
¼v½ oDd d dkVDl Hkkx e
¼c½ oDd d eM;yk e
¼l½ vf/koDd xfUFk d dkVDl e
¼n½ vf/koDd xfUFk d eM;yk e

4- Lrfu;k dk ie[k mRl th inkFk g &
¼v½ ;fj;k ¼c½ ;fjd vEy
¼l½ vekfu;k ¼n½ vehuk vEy

5- i{kh gkr g &
¼v½ vekukVfyd ¼c½ ;fjdkVfyd
¼l½ vehukVfyd ¼n½ ;fj;kVfyd

vfry?kÙkjkRed ç'u

1- ukbVk tuh vif'k"V inkFkk dk 'kjhj l ckgj R;kxu dh çfØ;k dk dgr gA
2- eu"; d e= e mifLFkr çe[k ukbVk tuh vif'k"V gA
3- oDd dh ljpukRed ,o fØ;kRed bdkb gkrh gA
4- e= fuek.k dh çfØ;k d çe[k pj.k dku l gA
5- ckeu lEiV oDd d fdl Hkkx e fLFkr gkr gA

y?kÙkjkRed ç'u

1- vehukVfyd] ;fj;kVfyd ,o ;fjdkVfyd tUrvk l vki D;k le>r g\
2- gkfe;kLVfl l ij lf{kIr fVli.kh fyf[k,A
3- vkuhfFku pØ dk o.ku dhft ,A
4- ijkfuL;nu fdl dgr g\
5- e=.k fdl dgr g\
6- p;ukRed vo'kk"k.k ij lf{kIr fVli.kh fyf[k,A
7- mRl tu r= dk ukekfdr fp= cukb;A
8- uÝku dk ukekfdr fp= cukb;A
9- cge= jkx fdl dgr g\
10- e= fuek.k dk gkeku dl çHkkfor djr g\

fuc/kkRed ç'u

1- mRl tu D;k g\ Lrfu;k e vkuhFkhu pØ d pj.kk dk o.ku dhft ,A
2- Lrfu;k e mRl tu r= dh ljpuk dk lfp= o.ku dhft ,A
3- e= d fuek.k dh ifØ;k dk foLrr o.ku dhft ,A
4- mRl tu D;k g\ uÝku dh ljpuk dk lfp= o.ku dhft ,A
5- fofHkUUk çdkj d ukbVk tuh vif'k"V inkFkk dk o.ku dhft ,A

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mÙkjekyk % 1 ¼l½ 2 ¼l½ 3 ¼c½ 4 ¼v½ 5 ¼c½

v/;k; & 28

vUr%L=koh xfUFk;k

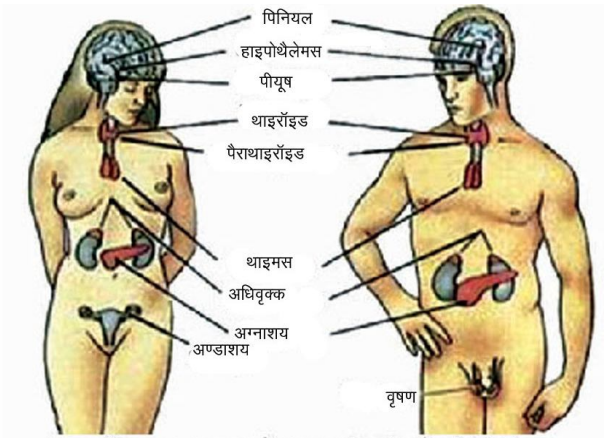
(Endocrine Glands)

çkf.k;k e gkfe;kLVfl l dk cuk; j[ku d fy, rf=dk r= ,o vUr% lkoh r= l;Dr :i l dk; djr gA vUr% lkoh r= gkeku d }kjk to fØ;kvk dk fu;eu djr gA lkekU;r% gkekU l çkVhu ;k LVhjk;M çÑfr d gkr gA ; ty e ?kyu'khy gkr g rFkk dk; lekIr gkr gh Uk"V gk tkr gA vUr% lkoh r= ,o bldh dk; ç.kkyh d v/;;u dk vUr% lkoh foKku (Endocrinology) dgr gA Fkkel ,Mhlu dk vUr% lkoh foKku dk tud dgk tkrk gA

d'k:d çkf.k;k e rhu çdkj dh xfUFk;k gkrh g &

1- **cfg% lkoh xfUFk;k** (Exocrine glands) : ; okfguh&;Dr xfUFk;k gkrh gA bud }kjk lkfor inkFk okfgfu;k }kjk fofHkUUk vxk rd igpr gA tl& Lon xfUFk] ry xfUFk] 'y"ek xfUFk] ykj xfUFk] ;Ñr vkfnA

2- **vUr% lkoh xfUFk;k** (Endocrine glands) : ; ufydkfoghu xfUFk;k gkrh gA bud }kjk lkfor inkFk jDr }kjk y{; vxk o Årdk rd igpr gA tl& ih;"k xfUFk] Fkkbjkbdl] ,Mhuy vkfn ¼fp= 28-1½A



fp= 28-1 % eu"; e vUr%L=koh xfUFk;k dh fLFkfr

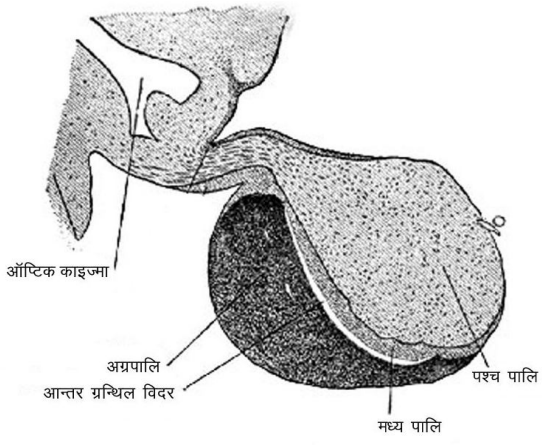
3- **fefJr xfUFk;k** (Mixed glands) : ; cfg% ,o vUr% lkoh nkuk idkj dh xfUFk;k d :i e dk; djrh gA ; okfguh;Dr gkrh g yfdu bue cfg% ,o vUr% lkoh nkuk gh çdkj d Hkkx gkr gA tl& vXuk'k;

eu"; e fuEu vUr% lkoh xfUFk;k ik;h tkrh g &

1- ih;"k xfUFk (Pitutary glands)
2- Fkkbjkbdl xfUFk (Thyroiod glands)
3- ijkFkkbjkbdl xfUFk (Parathyroid glands)
4- vf/koDd xfUFk (Adrenal glands)
5- Fkkbel xfUFk (Thymudts glands)
6- ihfu;y ckMh (Pineal Body)
7- fefJr xfUFk (Mixed glands) & vXuk'k;
8- tun (Gonad)

ih;"k xfUFk (Pitutary glands)

;g LQhukbdl vfLFk dh lyk Vkfldk xgk e fLFkr gkrh gA ;g buQUMhcye }kjk gkbiFkyel l tMh jgrh gA ;g



fp= 28-2 % ih;"k xfUFk dh ljpuk

yxHkx lHkh çfØ;kvk d lkFk gh egÙoi.k vUr% lkoh xfUFk;k d lko.k dk Hkh fu;=.k djrh gA blhfy, bl ekLVj xfUFk Hkh dgk tkrk g ¼fp= 28-2½A

ih;"k xfUFk fØ;kRed :i l ,fMukgkbik&Qkbfll ,o U;jk gkbikQkbfll nk Hkkxk e cVh gkrh gA

,fMukgkbikQkbfll % ;g ih;"k xfUFk dk yxHkx 75% Hkkx gkrk gA ,fMukgkbikQkbfll }kjk lkr çkVhu gkekUl lkfor gkr g bue l of) gkeku] feyuklkbV çjd gkeku o çkyfDVu d vfrfjDr lHkh vU; Vkfid gkeku gkr gA tk vUr% lkoh xfUFk;k dk lko.k d fy, çfjr djr gA

(i) **lkeVkVkfiu ;k of) gkeku** (Somatotropin or Growth Hormone- STH-GH) : ;g 'kkjhfjd of) dk fu;f=r djrk gA ;g DNA, RNA, çkVhu l'y"k.k] gfì;k e of) dk c<kok ndj 'kkjhfjd of) dk çfjr djrk gA

(ii) **çkyfDVu gkekUk %** fL=;k e xHkdky d nkjku vf/kd ek=k e lkfor gkdj Lruk dh of) dk çfjr djrk gA f'k'kqtUe d ckn nX/k d lko.k dk çfjr djrk gA

(iii) **ifVdk çjd gkeku** (Follicle Stimulating Hormone-FSH) : ;g i#"kk e 'kØtuu ,o fL=;k e v.Mtuu rFkk eknk gkeku ,LVktu d lko.k dk çfjr djrk gA

(iv) **Y;Vhukbftx gkeku ,o vUrjkyh dkf'kdk çjd gkeku %** i#"kk e ;g o"k.k dh vUrjkyh dkf'kdkvk dk ,.Mktu ¼uj gkeku½ ,o fL=;k e ;g v.MkRlx] dkil Y;fV;e d fodkl rFkk çktLVhjku d lko.k dk çfjr djrk gA

(v) **,Mhuk dkfVdkVkfid gkeku&** ;g ,Mhuy xfUFk d dkVDl Hkkx dk gkeku lko.k d fy, çfjr djrk gA

(vi) **FkkbjkVkfiu ;k FkkbjkbM çjd gkeku %** ;g FkkbjkbM xfUFk dh of) ,o gkeku lko.k d fy, çfjr djrk gA

(vii) **feyuklkbV çjd gkeku %** ;g feyukQkl dk mÙkftr djrk gA

U;jkgkbikQkbfll % ;g vi{kkÑr NkVk ,o Bkl gkrk gA bld }kjk olkçflu ,o vkDlhVkflu gkeku lkfor gkr gA olkçflu dk ,UVhMkb;jfVd gkeku Hkh dgr gA bldh deh l MkbfcVht bUlhfiMl jkx gk tkrk gA

vkDlhVkflu gkeku Lru xfUFk;k l nX/k d fu"dklu ,o f'k'k tUe e lgk;d gkrk gA

FkkbjkbM xfUFk (Thyroid glands)

eu"; e FkkbjkbM xfUFk f}ikfyor ljpuk d :i e dB d uhp 'okluyh d nkuk vkj fLFkr gkrh gA ;g lcl cMh vUr% lkoh xfUFk gA eu"; e FkkbjkbM xfUFk dk Hkkj 25-30 gm gkrk gA fL=;k e ;g dN cMh gkrh gA ;g xfUFk Fkyhuek ifVdkvk dh cuh gkrh gA ifVdk, l;kth Ård l cu LVkek e fuyfEcr jgrh gA ifVdkvk dh xgk e FkkbjkXykcfyu Hkjk jgrk gA

FkkbjkbM xfUFk d gkeku ,o dk; % FkkbjkbM xfUFk }kjk FkkbjkfDlu ;k VVkvk;kMkFkkbjkuhu (T_4) ,o Vkbvk;kMkFkkbjkuhu (T_3) lkfor gkr gA

FkkbjkbM gkeku mikip; nj e of) djd O_2 dh [kir] ân; Linu nj] çkVhu] Xykbdktu] olk d l'y"k.k ,o 'kjhj rki dk c<kok nr gA ;g Ård d foHknu ,o VMiky d dk;kUrj.k d fy, vko';d gkrk gA

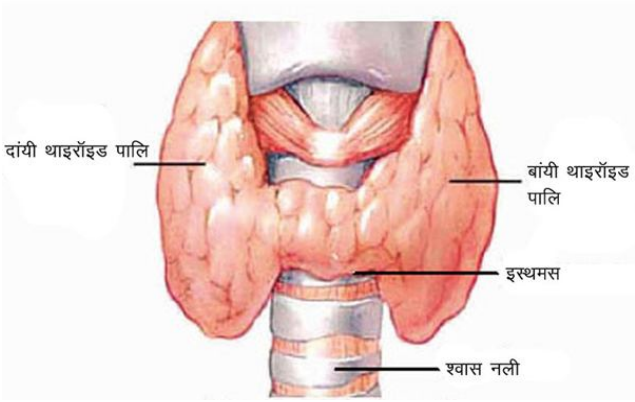
FkkbjkbM dh vfu;fer;k, (Abonormality of Thyroid)

gkbikFkkbjk;fMTe (Hypothyroidism) : vk;kMhu ;k FkkbjkbM gkeku dh deh l xyx.M ;k ?k?kk jkx gk tkrk gA ble xnu Qydj ekVh dkyj d leku gk tkrh gA

cpiu e FkkbjkbM d vYilko.k l tMekuork (Cretinism) jkx gk tkrk gA ftle cPp cku ,o encf) gkr gA

o;Ldk e FkkbjkbM d vYilko.k l fefDlMhek jkx gk tkrk gA ftle tMekuork d nk"kk d lkFk gh Ropk ty d ,df=r gku l Qy tkrh g ¼fp= 28-3½A

gkbij Fkkbjk;fMTe (Hyperthyroidism) : FkkbjkbM gkeku d vfrlko.k l u=kRl/kh xyx.M (Exopthalmic Goitre) gk tkrk gA ble u=xkydk d uhp 'y"ek d ,df=r gk tku l u=xkyd ckgj dh vkj mHkj vkr gA



fp= 28-3 % FkkbjkbM xfUFk

Fkkbjk dfYlVkfuu gkeku (Thyrocalcitonin hormone) : ;g FkkbjkbM d LVkek dh ijkifVdk ;k 'C' dkf'kdkvk }kjk lkfor gkrk gA ;g gfì;k d fo?kVu dk de djd o e= e Ca^{++} dh ek=k dk c<kdj ECF e Ca^{++} dh ek=k dk de djrk gA

ijkFkkbjkbM xfUFk;k (Parathyroid Glands)

eu"; e Fkkbjkbm xfUFk ij fLFkr pkj NkVh ijkFkkbjkbM xfUFk;k gkrh gA ; xfUFky dkf'kdkvk d l?ku fi.M d #i e gkrh gA

ijkFkkbjkbM d gkeku ,o dk; % ; xfUFk;k ijkFkkeku (Parathormone-PTH) uked gkeku dk lko.k djr g ftl dkfyi dk gkeku Hkh dgr gA

;g jDr e foVkfeu ^Mh^ d lkFk feydj dfY'k;e dh vkn'k ek=k dk cuk; j[krk gA o;Ld eu"; e yxHkx 1 kg dfY'k;e gkrk gA bl dk 99% vfLFkvk e gkrk gA ijkFkkeku vk= ,o oDd ufydkvk e dfY'k;e d vo'kk"k.k ,o QkLQV d mRltu dk c<krk gA

ijkFkkbjkbM dh vfu;ferk, (Abonormalities of Parathyroid) % ijkFkkeku d vYilko.k l ECF e 'Ca^{++}'dh ek=k de ,o QkLQV dh ek=k vf/kd gk tkrh gA bll if'k;k e ,Bu vkj dEiu gku yxrk gA bl fVVuh jkx dgr gA

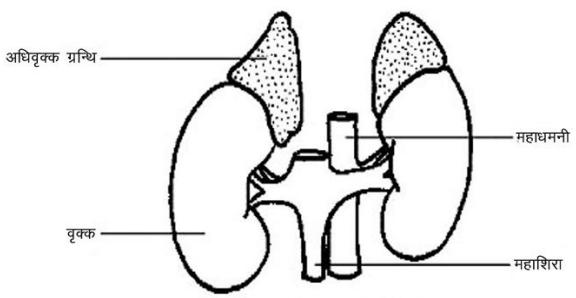
ijkFkkeku d vfrlko.k l vfLFk;k detkj o Hkxj gk tkrh gA bl vkfLVvkikjkfll (Osteoporosis) jkx dgr gA

vf/koDd xfUFk;k (Adrenal Glands)

çR;d oDd d vxy flj ij Vkih leku vf/koDd xfUFk gkrh gA ;g nk Hkkxk e foHkfnr gkrh gA ckgjh ,Mhuy dkVDl ,o Hkhrjh ,Mhuy eM;yk ¼fp= 28-4½A

,Mhuy dkVDl d gkeku ,o bud dk; % bl Hkkx }kjk lkfor gkeku ¼yxHkx 50½ dk rhu Jf.k;k e ckVk x;k g &

1- **feujyk dkjfVdkbMl** % bue ,YMkLVhjku çe[k gkrk gA ;g oDd e Na^+ o Cl^- d vo'kk"k.k rFkk K^+ vk;uk d mRltu dk c<kok ndj jDr e ijklj.k nkc dk fu;eu djrk gA



fp= 28-4 % vf/koDd xfUFk dh ljpuk

2- **Xydk dkjfVdkbMl** % bue dkjfVlky o dkfVdkLVhjku çe[k gkr gA ; ;Ñr e Xykbdk& tufll ¼Xydkt l Xykbdktu½ Xydkfu;ktufll ¼olk o vehuk vEyk l Xydkt½ rFkk ;fj;k l'y"k.k dk c<krk gA

3- **fyx gkeku** % lHkh eu";k e dN ek=k e ,UMktu ¼uj gkeku½ o ,LVktu ¼eknk gkeku½ lkfor gkr gA ; gkeku if'k;k rFkk tuukxk d fodkl dk çfjr djr gA

,Mhuy eM;yk d gkeku ,o bud dk; % bl Hkkx }kjk ,Mhuyhu ;k ,ihuÝhu ,o ukj,Mhuyhu ;k ukj ,ihuÝhu gkeku lkfor gkr gA ; gkeku eu"; dk ldVkoLFkk e ,d mx çfrfØ;k d fy, r;kj djr gA

,Mhuy gkeku dh deh l lkfM;e ,o ty dk vf/kd mRltu gk tku l futyhdj.k gk tkrk gA bl ,Mhlu jkx dgr gA ble 0;fDr dh eR; rd gk tkrh gA blhfy, ,Mhuy xfUFk;k d gkeku ^^thou j{kd gkeku** gkr gA

Fkkbel xfUFk (Thymus Gland)

;g ân; d vkx fLFkr f}ikfyor xfUFk gkrh gA ;g tUe d le; fodflr gkrh gA 8-10 o"k dh vk; rd cMh gkr jgu d i'pkr] /kh&/kh NkVh gkdj o)koLFkk e rUr d leku ljpuk d :i e jg tkrh gA

bl xfUFk }kjk lkfor Fkkbekflu gkeku xfUFk }kjk fufer fyEQklkbV dkf'kdkvk dk ckgjh çfrtu inkFkk dk u"V dju d fy, çfjr djrk gA

ihfu;y dk; (Pineal Body)

;g efLr"d d çefLr"d xkyk/kk d chp ,d [kk[ky oUr ij fLFkr gkrh gA bld }kjk feyVkfuu gkeku lkfor gkrk gA ;g gkeku fuEu d'k:d e ih;"k xfUFk }kjk lkfor feyuklkbV çjd gkeku d foijhr dk; djrk gA bld çHkko l feyukQkl d jx inkFk dUæh; Hkkx e ,df=r gk tkr gA ftll Ropk dk jx gYdk gk tkrk gA Lrfu;k e ;g gkeku tuukxk d fodkl ,o bud dk; dk vojk/ku djrk gA

vXuk'k; (Pancreas)

eu"; e ;g mnjxgk e vkek'k; d ihN fLFkr fefJr xfUFk gkrh gA bldk 98-99% Hkkx cfg% lkoh gkrk gA 'k"k vUr% lkoh dkf'kdkvk d NkV&NkV v.Mkdkj Bkl leg gkr gA bUg yxjgUl dh }hfidk, (Islets of Langerhans) dgr gA bue e[;r% β– dkf'kdk, (Beta Cells) ,o α-dkf'kdk, (Alpha Cells) mifLFkr gkrh gA

gkeku ,o bud dk; % chVk ,o ,YQk dkf'kdk, Øe'k% bUlfyu o Xydkxku gkeku dk lko.k djrh gA bUlfyu jDr e Xydkt dh ek=k de dju ,o Xydkxku jDr e Xydkt dh ek=k dk c<ku dk dk; djrk gA

bUlfyu gkeku dh deh l jDr vkj e= e Xydkt dh ek=k c< tkrh gA bll e/keg jkx gk tkrk gA

tun (Gonad)

tun ;k tuu xfUFk;k lkbVktfud (Cytogenic) vx g] budk e[;% dk; tuu dkf'kdk, fufer djuk gA vUr% lo.k dk dk; xk.k gA uj tuu xfUFk dk o"k.k ,o eknk tuu xfUFk dk v.Mk'k; dgr gA

o"k.k (Testis) e vud d.Mfyr ufydkdkj 'kØtu ufydk, ik;h tkrh g bud e/; l;kth Ård e NkVh&NkVh dkf'kdkvk d leg ik; tkr gA ftUg vUrjkyh ;k yfMx dkf'kdk, dgr gA ; uj gkeku VLVkLVhjku dk lko.k djrh gA ;g lgk;d tuukxk ,o f}rh;d yfxd y{k.kk d fodkl dk fu;eu djrk gA

v.Mk'k; (Ovary) dh xkfQ;u ifVdkvk dh Fkhdk bUVjuk }kjk ,LVktu (Estrogen) gkeku lkfor gkrk gA ;g lgk;d tuukxk ,o f}rh;d yfxd y{k.kk d fodkl dk fu;eu djrk gA v.Mk'k; d dkil Y;fV;e }kjk çktLVjku ,o fjyfDlu gkeku lkfor gkr gA çktLVjku xHkk'k; dk xHkkoLFkk d fy, r;kj djrk g rFkk Hk.k d vkjki.k ,o Lruk e nX/k mRiUu dju dk dk; djrk gA fjyfDlu gkeku f'k'k tUe l igy Jkf.k e[kyk d l;fcd flEQkbfll tkM dk f'kfFky dj f'k'k d tUe dk lxe cukrk gA

egRoi.k fcUn

1- ih;"k xfUFk e fØ;kRed :i l ,fMuk gkbikQkbfll ,o U;jkgkbikQkbfll Hkkx gkr gA
2- Fkkbjkbl f}ikfyor xfUFk gkrh gA bld }kjk Fkkbjkfdlu gkeku lkfor gkrk gA
3- ,Mhuy xfUFk e dkVDl o eM;yk nk Hkkx gkr gA
4- ,YMkLVhjku gkeku dh deh l ,Mhlu jkx gk tkrk gA
5- vXuk'k; fefJr xfUFk gkrh gA
6- vXuk'k; }kjk bUlfyu gkeku lkfor gkrk gA bldh deh l e/keg jkx gk tkrk gA

vH;klkFk ç'u

oLrfu"B ç'u

1- eu"; e ekLVj xfUFk dku lh g\
   ¼v½ ,Mhuy ¼c½ vXuk'k;
   ¼l½ Fkkbjkbl ¼n½ ih;"k
2- ,YMkLVhjku d vYilko.k l gkrk gA
   ¼v½ ,Mhlu jkx ¼c½ e/keg
   ¼l½ ckukiu ¼n½ ?k?kk jkx
3- yxjgl }hfidk, dgk ik;h tkrh g\
   ¼v½ Fkkbjkbl ¼c½ ihfu;y dk;
   ¼l½ vXuk'k; ¼n½ ,Mhuy
4- dku lh xfUFk cfg% ,o vUr% lkoh nkuk gkrh g\
   ¼v½ ih;"k ¼c½ ,Mhuy
   ¼l½ vXuk'k; ¼n½ ijkFkkbjkbl
5- Fkkbjkbl gkeku dh deh l gku okyk jkx gA
   ¼v½ e/keg ¼c½ ,Mhlu jkx
   ¼l½ ?k?kk jkx ¼n½ fVVuh

vfry?kÙkjkRed ç'u

1- lcl cMh vUr% lkoh xfUFk dku lh g\
2- olkçflu dh deh l gku okyk jkx gA
3- Fkkbjkbl xfUFk dgk fLFkr gkrh g\
4- e/keg jkx fdl gkeku d vYilko.k l gkrk g\
5- of) gkeku fdl xfUFk }kjk lkfor gkrk g\

y?kÙkjkRed ç'u

1- vUr% ,o cfg% lkoh xfUFk;k e vUrj fyf[k,A
2- ih;"k xfUFk d U;jkgkbikQkbfll Hkkx }kjk lkfor gku oky gkeku ,o budk dk; fyf[k,A
3- vUr% lkoh xfUFk fdl dgr g\ eu"; e çe[k dku lh vUr% lkoh xfUFk;k ik;h tkrh g\
4- ih;"k xfUFk d ,fMukgkbikQkbfll Hkkx }kjk lkfor gkekUl d uke fyf[k,A
5- gkeku fdl dgr g\ 'kjhj e budk egRo crkb;A
6- ih;"k xfUFk dk ekLVj xfUFk D;k dgk tkrk g\
7- ihfu;y dk; ij fVli.kh fyf[k,A
8- Fkkbel xfUFk ij lf{kr fVli.kh fyf[k,A
9- ?k?kk jkx fdl gkeku dh deh l gkrk g\ bl jkx d y{k.k fyf[k,A
10- olkçflu dk ,UVh Mkb;jfVd gkeku D;k dgk tkrk g\

fuc/kkRed ç'u

1- vUr% lkoh xfUFk fdl dgr g\ ijkFkkbjkbM xfUFk ,o bld }kjk lkfor gkeku d dk;k dk o.ku dhft ,A

2- ih;"k xfUFk d gkekU l d dk;k dk o.ku dhft ,A

3- FkkbjkbM xfUFk ij foLrr y[k fyf[k ,A

4- ,Mhuy xfUFk ,o bld gkekU l d dk;k dk o.ku dhft ,A

5- vXuk'k; xfUFk dk foLrr o.ku dhft ,A

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mÙkjekyk % 1 ¼n½ 2 ¼v½ 3 ¼l½ 4 ¼l½ 5 ¼l½

v/;k; & 29

rf=dk r=

(Nervous System)

Lrfu;k e ckáo vkUrfjd okrkoj.k e gku oky ifjoruk rFkk lHkh to fØ;kvk dk vUr% lkoh ,o rf=dk r= }kjk fu;f=r fd;k tkrk gA vUr% lkoh r= fof'k"V gkekUl }kjk tcfd rf=dk r= rf=dk vkoxk }kjk tfod fØ;kvk dk fu;=.k djrk gA rf=dk r= dh fØ;k'khyrk vUr% lkoh r= dh ryuk e vf/kd rho gkrh gA

lHkh d'k#d çkf.k;k d leku gh eu"; e Hkh rf=dk r= dk e[;r% rhu Hkkxk e ckVk tkrk g &

1- dUæh; rf=dk r= (Central Nervous System)
2- ifj/kh; rf=dk r= (Peripheral Nervous System)
3- Lok;Ùk rf=dk r= (Autonomous Nervous System)

dUæh; rf=dk r= (Central Nervous System)

efLr"d ,o e:jTt feydj dUæh; rf=dk r= cukr gA ;g çk.kh dh lHkh fØ;kvk dk fu;=.k ,o fu;eu djrk gA

efLr"d (Brain) : ;g dkey ,o [kk[kyk vx gkrk gA ;g djkfV dh diky xgk e fLFkr gkrk gA bl lgkjk nu ,o ckgjh vk?kkrk l lj{kk çnku dju d fy, bld pkjk vkj rUre; l;kth Ård dh rhu f>fYYk;k dk vkoj.k gkrk gA ckgj lHkhrj dh vkj ; Øe'k% n<rkfudk (Duramater)] tkyrkfudk (Arachnoid) ,o enrkfudk (Piamater) gkrh gA ftUg diky; efuUtt dgr gA

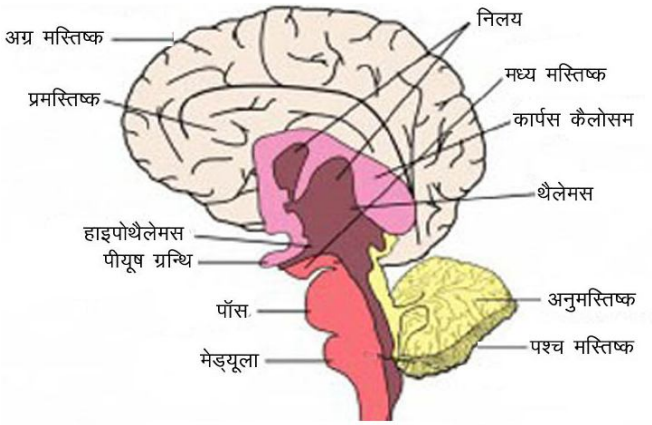
efLr"d f}ik'oh; gkrk g ,o bl rhu Hkkxk e ckVk tk ldrk g &

(i) vx efLr"d (ii) e/; efLr"d (iii) i'p efLr"d

(i) **vx efLr"d** (Fore brain) : ;g ?kk.k fi.M] çefLr"d xkyk) ,o Mk,uflQyku rhu Hkkxk l cuk gkrk gA ?kk.k fi.M v/kj ry ij ?kk.k ekx l tM gkr g ,o i"B ry ij çefLr"d xkyk)k l <d jgr gA ?kk.k fi.Mk d ihN nk cM çefLr"d xkyk) gkr gA ; ij efLr"d dk yxHkx nk frgkb Hkkx cukr gA nkuk fi.Mk d e/; xgjh njkj gkrh gA ftl vuyEc e/; i"B fonj dgr gA

vx efLr"d i'p (Diencephelon) çefLr"d xkyk)k ,o e/; efLr"d d chp fLFkr vx efLr"d dk lcl NkVk Hkkx gkrk gA i"B lrg ij ;g doy ,d NkV xkykdkj ihfu;ydk; d :i e fn[kkb nrh gA v/kj lrg ij nk nf"V rf=dk, Økluek ljpuk ,o nf"V rf=dk fd,Tek cukrh gA bld Bhd ihN ih;"k xfUFk fLFkr gkrh g ¼fp= 29-1½A

(ii) **e/; efLr"d** (Mid brain) : ;g efLr"d dk lcl NkVk Hkkx gkrk gA i"B Hkkx ij pkj xky mHkkjk d :i e nf"V fi.M (Optic lobes) gkr gA ftUg l;Dr :i l dkikjk DokMh tehuk dgr gA Lrfu;k e nf"V fi.M Bkl gkr gA v/kj ,o ik'o Hkkx nk ekVh ifê;k d :i e gkrk gA ftUg çefLr"d oUr ;k Øjk ljckb dgr gA



fp= 29-1 % eu"; d efLr"d dh ljpuk

(iii) **i'p efLr"d** (Hind brain) : i'p efLr"d e[;r% eVuflQyku ,o eM;yk vkCykxVk e cVk gkrk gA eVuflQyku i"B lrg l rhu fi.Mk e cVk fn[kkb nrk gA ftue e/; ofel rFkk ik'ok e ,d&,d ik'o fi.M gkr gA vuefLr"d dh v/kj lrg ij fLFkr iêh dk ikUl ojkykb dgr gA

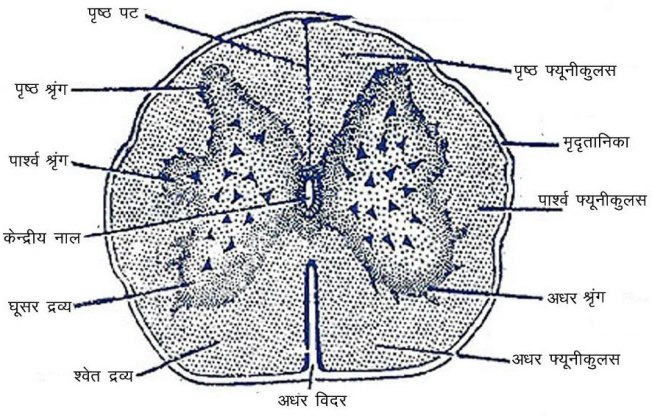
eM;yk vkCykxVk ikUl ojkykb ,o e: jTt d chp fLFkr gkrk gA ;g ihN dh vkj ldjk gkdj e: jTt l tMk gkrk gA

e: jTTk (Spinal cord) : efLr"d dh eM;yk vkCykxVk djkfV d egkjU/k (Foramen Magnum) l fudydj ,d yEch ufydkdkj e: jTt dk fuek.k djrh gA tk d'k:d n.M dh rf=dk uky e fLFkr gkrh gA

efLr"d d leku e: jTt d pkjk vkj Hkh rhu rUre; f>fYy;k dk vkoj.k gkrk gA ftUg efuUt t dgr gA ckgjh f>Yyh n<rkfudk] e/; tkyrkfudk ,o Hkhrjh enrkfudk gkrh g ¼fp= 29-2½A

e: jTt cyukdkj ,o [kk[kyh ljpuk gkrh gA bldh e/; i"B j[kk e i"B [kkp ,o v/kj j[kk e dN xgjh v/kj [kkp gkrh gA

e: jTTk dh vkUrfjd ljpuk % e: jTt d v{kh; Hkkx e çefLr"d e: æ0; l Hkjh U;jklhy gkrh gA bld pkjk vkj biUMkbey ,ihFkfy;e dk vkoj.k gkrk gA e: jTt dh ekVh nhokj Hkhrj dh vkj /klj æ0; ,o ckgj dh vkj 'or æ0; e foHkfnr jgrh gA ;g foU;kl efLr"d dh nhokj e bud foU;kl l mYVk gkrk g] lHkh Lrfu;k e Fklj æ0; dk Lrj e/; Hkkx e ldjk gkdj frryh d i[kuek vkÑfr dk gkrk gA bld pkjk vkj d i[kuek Hkkx i"B ,o v/kj vxk d :i e fudy gkr gA lkekU;r% i"B ey e doy lonh ,o v/kj ey e pkyd rf=dk d rr ik; tkr gA



fp= 29-2 % e# jTt dk vuçLFk dkV

e: jTt d dk;

1- ;g efLr"d l vku okyh çj.kkvk d fy, ekx çnku djrh gA

2- ;g çfrorh fØ;kvk dk lpkyu ,o fu;eu djrh gA bu fØ;kvk dk efLr"d l lEcU/k ugh gkrk gA

ifj/kh; rf=dk r=
(Peripheral Nervous System)

efLr"d ,o e: jTt l fudyu okyh rf=dk, ifj/kh; rf=dk r= cukrh gA efLr"d l fudyu okyh rf=dkvk dk diky (Cranial) ,o e: jTt l fudyu okyh rf=dkvk dk e: rf=dk, (Spinal Nerve) dgr gA ; rf=dk, ,fPNd fØ;kvk dk fu;eu djrh gA

lonh rf=dk, çj.kkvk dk lonh vx l dUæh; rf=dk r= rd] pkyd rf=dk, çj.kkvk dk dUæh; rf=dk r= l dk;dkjh vxk (Effector Organs) rd igpkrh gA tcfd dN rf=dk, çj.kkvk dk lonh vxk l dUæh; rf=dk r= ,o dUæh; rf=dk r= l dk;dkjh vxk rd igpkrh gA bUg fefJr rf=dk, dgr gA

diky rf=dk, (Cranial Nervous) : e<d d foijhr ¼10 tkMh½] Lrfu;k e 12 tkMh diky rf=dk, ik;h tkrh gA Lrfu;k e 1] 2 ,o 8 uEcj dh rf=dk, lonh] 3] 4] 6] 11 ,o 12 uEcj dh pkyd rFkk 5] 7] 9 ,o 10 uEcj dh fefJr rf=dk, gkrh gA 3] 7] 9 ,o 10 uEcj dh rf=dkvk e Lok;Ùk rf=dkvk d rr Hkh ik; tkr gA

e: rf=dk, (Spinal Nerves) : e: jTt l fudyu okyh rf=dkvk dk e: rf=dk, dgr gA eu"; e dy 31 tkMh e: rf=dk, ik;h tkrh gA bue l 8 tkMh xhok] 12 tkMh o{kh;] 5 tkMh dfV (Lumber)] 5 tkMh f=d (Sacral) ,o 1 tkMh dkDlh th;y rf=dk, gkrh gA lHkh e: rf=dk, fefJr çdkj dh gkrh gA ; /klj æ0; d nkuk Hkkxk d eyk l fudyrh gA i"B ey lonh ,o v/kj ey pkyd rUrvk dk cuk gkrk gA Lrfu;k e d'k:d n.M l fudyu d lkFk gh çR;d e: rf=dk rhu 'kk[kkvk & i"B 'kk[kk] v/kj 'kk[kk ,o lEcU/kd 'kk[kk e foHkkftr gk tkrh gA

Lok;Ùk rf=dk r=
(Autonomous Nervous System)

;g 'kjhj dh vufPNd fØ;kvk d fu;eu ,o lpkyu dk dk; djrk gA ;g ân;] vkek'k;] vk=] xHkk'k;] ;Ñr] vXuk'k;] vUr%kkoh xfUFk;k] e=k'k;] QQMk vkfn dh vufPNd fØ;kvk dk fu;=.k djrk gA Lok;Ùk rf=dk r= dk nk Hkkxk e ckVk tk ldrk gA

(i) vudEih rf=dk r= (Sympathetic Nervous System)

(ii) ijkudEih rf=dk r= (Para Sympathetic Nervous System)

(i) **vudEih rf=dk r=** (Sympathetic Nervous System) : ble nk xfPNdk;Dr vudEih dfM;k gkrh gA ble io xPNdh; rUr NkV ,o e: jTt l vudEih xfPNdk rd Qy jgr gA i'p xPNdh; rUr xfPNdkvk l fofHkUu vkrjkxk dh vufPNd if'k;k ,o xfUFk;k rd tkr gA io xPNdh; rUr ,lhVkbydkyhu i'p xPNdh; rUr flEifFku mRiUu djr gA

(ii) **ijkudEih rf=dk r=** (Para Sympathetic Nervous System) % bldk mnHko dUæh; rf=dk r= d vx ,o i'p Hkkx l gkrk gA ble io xPNdh; rUr dkQh yEc gkr g ,o dUæh; rf=dk r= l vxk rd Qy gkr gA i'p xPNdh; rUr NkV ,o vx rd gh lhfer jgr gA nkuk çdkj d rUr çk;% ,lhVkby dkyhu mRiUu djr gA

egRoi.k fcUn

1- rf=dk r= dk dUæh;] ifj/kh; ,o Lok;Ùk rf=dk r= rhu Hkkxk e ckVk tkrk gA

2- efLr"d d pkjk vkj n<rkfudk] tkyrkfudk ,o enrkfudk uked rhu f>fYy;k dk vkoj.k gkrk gA

3- efLr"d l 12 tkMh diky rf=dk, fudyrh gA

4- eu"; e e: jTt l dy 31 tkMh e: rf=dk, fudyrh gA

vH;klkFk ç'u

oLrfu"B ç'u

1- e: jTt dh v{kh; uky gkrh gA
(v) CykLVklhy (c) U;jklhy
(l) 'kkbtklhy (n) dkb ugh

2- efLr"d lcl ckgjh n< vkoj.k gkrk gA
(v) n<rkfudk (c) tkyrkfudk
(l) enrkfudk (n) dkb ugh

3- eu"; e fdru tkMh e: rf=dk, gkrh g\
(v) 34 (c) 39
(l) 31 (l) 44

4- e: rf=dkvk d i"B ey gkr gA
(v) lonh (c) pkyd
(l) fefJr (n) dkb ugh

5- eu"; e fdru tkMh diky rf=dk, gkrh g\
(v) 10 (c) 12
(l) 11 (l) dkb ugh

vfry?kÙkjkRed ç'u

1- rf=dk r= dk fdu rhu çe[k Hkkxk e ckVk tkrk g\

2- efLr"d d rhu çe[k Hkkxk d uke fyf[k,A

3- efLr"d d pkjk vkj fdu rhu f>fYy;k dk vkoj.k ik;k tkrk g\

4- efLr"d dk lokf/kd cMk Hkkx dku lk gkrk g\

5- dkikjk DokMh tfeuk fdl dgr g\

y?kÙkjkRed ç'u

1- e: jTt d vuiLFk dkV dk ukekfdr fp= cukb;A

2- diky; efuUtt fdl dgr g\

3- nf"V rf=dk dkbTek fdl dgr g\

4- eu"; e fdruh tkMh diky rf=dk, gkrh g\

5- eu"; e dy fdruh tkMh e: rf=dk, ik;h tkrh g\ ,o fofHkUu Hkkxk e fLFkr e: rf=dkvk dh l[;k fyf[k,A

6- Lok;Ùk rf=dk r= d dk; fyf[k,A

7- efLr"d dk ukekfdr fp= cukb;A

8- e/; efLr"d (mid brain) dk o.ku dhft ,A

9- Lok;Ùk rf=dk r= d v{kh; rUrvk }kjk mRiUu jlk;uk d uke o dk; fyf[k,A

10- ifj/kh; rf=dk r= fdl dgr g\

fucU/kkRed ç'u

1- efLr"d dh ljpuk dk lfp= o.ku dhft ,A

2- e: jTt dh ljpuk dk lfp= o.ku dhft , ,o bld dk; Hkh fyf[k,A

3- Lok;Ùk rf=dk r= dk o.ku dhft ,A

4- ifj/kh ;k rf=dk r= dk foLrr o.ku dhft ,A

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mÙkjekyk % 1 (c) 2 (v) 3 (l) 4 (v) 5 (c)

v/;k; & 30

tuu r=

(Reproductive System)

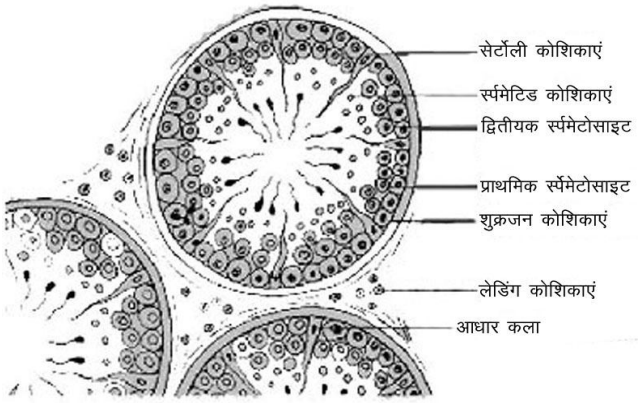
Lruh ,dfyxh gkr g vFkkr uj o eknk çk.kh iFkd iFkd gkr gA vU; d'k:d d leku gh bue ,d tkMh tun gkr g] tk uj e o"k.k (testes) rFkk eknk e v.Mk'k; (ovaries) dgykr gA bue ;Xedk dk fuek.k gkrk gA uj ,o eknk ;Xedk dk Øe'kh 'kØk.k ,o v.Mk.k dgr gA bUg tunk l y tku okyh okgfu;k dk tuu okgfu;k dgr gA tun ,o lgk;d tuukx feydj tuu r= cukr gA

Lrfu;k e fu"kpu ,o Hk.kh; ifjo/ku xHkk'k; e gkrk gA vr% lUrku f'k'k d :i e tUe yrh gA ,l çkf.k;k dk tjk;t ;k f'k'kçtd dgr gA

uj tuu r= (Male Reproductive System)

uj tuu r= e ,d tkMh o"k.k d vfrfjDr lgk;d tuukx tl&'kØk'k;] ,fifMMkbel] e= ekx] çkLVV xfUFk] dkmij xfUFk vkfn gkr gA

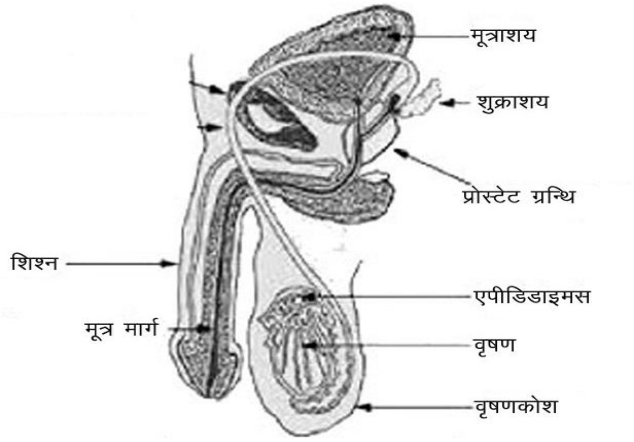
Lrfu;k e ,d tkMh o"k.k mnj xgk l ckgj o"k.k dk'k (scrotal sac) e fLFkr gkr gA o"k.k d pkjk vkj V;fudk ,Yc thfu;k dk vkoj.k gkrk gA çR;d o"k.k e vud d.Mfyr ufydkdkj 'kØtu ufydk, (Seminiferous tubules) ik;h tkrh gA ; pkjk vkj l V;fudk çkfç;k }kjk vkofjr gkrh gA lHkh 'kØtu ufydk, l;kth Ård }kjk vkil e lEc) gkrh gA budk Hkhrjh Lrj tuu midyk Lrj dgykrk gA ftud chp&chp e yEch dkf;d dkf'kdk, ik;h tkrh gA ftUg lVkyh dkf'kdk, dgr gA 'kØtu ufydkvk d e/; l;kth Ård e NkVh&NkVh dkf'kdkvk d leg ik; tkr gA ftUg vUrjkyh ;k yfMx dkf'kdk, dgr gA ; uj gkeku ¼VLVkLVhjku½ dk lko.k djrh gA tuu midyk dkf'kdkvk l 'kØtuu dh fØ;k }kjk 'kØk.kvk dk fuek.k gkrk gA lVkyh dkf'kdk, ifjo/ku'khy 'kØk.kvk dk ik"k.k djrh gA o"k.k l ,d yEch] ldjh ljpuk d :i e ,fifMMkbel fpidh gkrh gA ;g o"k.k d vx] i'p ,o Hkhrjh Hkkx dk <d jgrk gA bld vx Qy Hkkx dk diV ,fifMMkbel ,o fiNy Qy Hkkx dk dkMk ,fifMMkbel dgr gA bldk 'k"k] çe[k Hkkx o"k.k d i"B ry ij Qyk gkrk g bl ,fifMMkbel dk; ;k dkil ,fifMMkbel dgr g ¼fp= 30-1] 2½A



fp= 30-1 % o"k.k dk vuçLFk dkV

dkMk ,fifMMkbel l dN ekVh ,o lh/kh 'kØokfguh bXohuy uky e gkrh gb mnj xgk e igprh gA ;g ihN dh vkj e=ekx d vk/kkj Hkkx e [ky tkrh gA blh txg e=ekx e ,d NkVk Fkyhuek 'kØk'k; (seminal vesecle) Hkh [kyrk gA ble 'kØk.kvk dk lp; ugh gkrk gA cfYd ;g xfUFky ljpuk d :i e xk<] fpifpi {kkjh; æ0; dk lko.k djrh gA ;g æ0; 'kØk.kvk d lkFk oh; cukrk gA

e= ekx yEck gkrk gA ;g uj eFkukx f'k'u d vx flj ij e= tuu fNæ }kjk ckgj [kyrk gA f'k'u yEck vxyhuek vx gkrk gA ;g o"k.k dk'kk d chp mnj l yVdk jgrk gA bldk vx f'k[kj Qyk gvk ,o fpduk gkrk gA



fp= 30-2 % eu"; e uj tuu r=

ftl f'k'ku e.M (Glans Penis) dgr gA f'k'u e.M d vkèkkj ij Ropk ofyr gkdj ,d Vkih lh cuk yrh gA ftl f'k'ukx (Prepuce) dgr gA

lgk;d tuu xfUFk;k % Lrfu;k e lgk;d tuukxk l lEcfU/kr fuEu xfUFk;k ik;h tkrh gA

çkLVV xfUFk % ;g e=ekx d vk/kkj d pkjk vkj cMh ,o l?ku xfUFk gkrh gA bld }kjk gYd {kkjh; rjy dk lko.k fd;k tkrk gA ;g rjy 'kØk.kvk dk lfØ; cukr j[krk gA

dkmil xfUFk % ; çkLVV xfUFk d ihN fLFkr e=ekx d nkuk vkj ,d tkMh v.Mkdkj xfUFk;k gkrh gA bul fpifpik] ikjn'kh {kkjh; æo lkfor fd;k tkrk gA tk e=ekx dh vEyh;rk dk u"V djrk gA

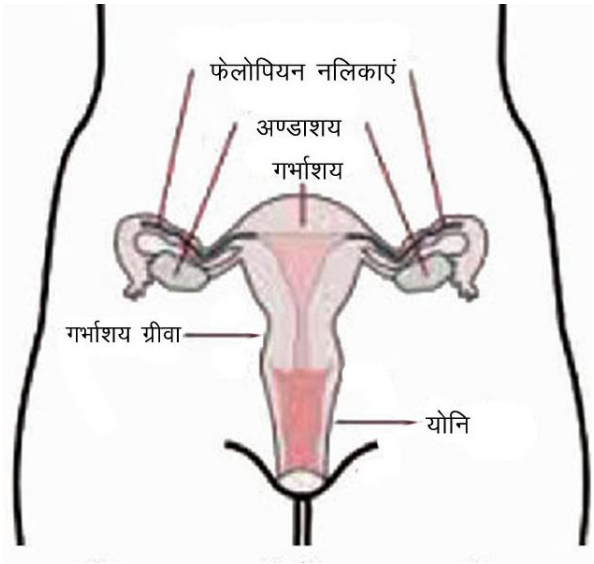
Lrfu;k e ifjfu;y ,o ey k';h xfUFk;k Hkh ik;h tkrh gA tk rho x/k;Dr æo dk lko.k djrh gA

eknk tuu r= (Female Reproductive System)

Lrfu;k d tuu r= e ,d tkMh v.Mk';] v.Mokfgfu;k] xHkk';] ;kfu ,o lgk;d tuu xfUFk;k ik;h tkrh gA

Lrfu;k e ,d tkMh v.Mk'; lQn v.Mkdkj ljpuk d :i e mnjxgk e fLFkr gkr gA ; eh lkofj;e eh lUVjh }kjk mnjxgk dh fHkfÙk l yVd jgr gA çR;d v.Mk'; dh ckgjh lrg ij vud mHkkj ik; tkr gA ftUg v.Mk'; iVd (ovarian follicle) dgr gA bue v.Mk.kvk dk fodkl gkrk gA v.Mk'; dh vkUrfjd lrg tuu midyk }kjk vkLrfjr jgrh gA tuu midyk dkf'kdk, v.Mdkf'kdk (oocyte) e :ikUrfjr gk tkrh gA v.Mk'; iVd d QVu l ifjiDo v.Mdkf'kdk eDr gkrh g ¼fp= 30-3½A

Lrfu;k e ,d tkMh v.Mokfgfu;k ik;h tkrh gA ; ijhVkfu;e d oyu }kjk i"B ngfHkfÙk l tMh jgrh gA



fp= 30-3 % Lruh e eknk tuu r=

çR;d v.Mokfguh dk vxyk Hkkx >kyjnkj dhi d leku gkrk g] dhi d ihN okyk Hkkx Qykfi;u ufydk dgykrk g] ftle fu"kpu gkrk gA v.Mokfguh dh fHkfÙk jekHkh midyk (ciliated epithelium) }kjk Lrfjr gkrh gA

xHkk';k pkMk o i'kh; gkrk gA bldk vkUrfjd Lrj ,.MkehfV;e dgykrk gA Lrfu;k e Hk.k dk fodkl xHkk';e gkrk gA

nkuk vkj d xHkk';k mnjxgk dh e/; j[kk ij ;kfu e [kyr gA ;kfu] e=ekx d lkFk feydj e= tuu ufydk cukrh g] ftl oLVhC;y dgr gA ;g Hkx (Vulva) }kjk ckgj [kyrh gA

lgk;d tuu xfUFk;k % Lrfu;k d eknk tuu r= e fuEu lgk;d tuu xfUFk;k ik;h tkrh gA

cFkkfyu xfUFk;k % ,d tkMh cFkkfyu xfUFk;k oLVhC;y dh i"B fHkfÙk ij [kyrh gA bud }kjk {kkjh;] fpifpik inkFk lkfor gkrk gA tk oLVhC;y dk fpduk o {kkjh; cukrk gA

ijkfu;y ,o ey k';h xfUFk;k }kjk x/k;Dr rjy lkfor fd;k tkrk gA

egRoi.k fcUn

1- Lruh ,d fyxh çk.kh gkr gA
2- uj tuu r= e ,d tkMh o"k.k] 'kØk';] 'kØ okfguh] e=ekx] f'k'ku] çkLVV xfUFk] dkmij xfUFk vkfn ljpuk ik;h tkrh gA
3- eknk tuu r= e ,d tkMh v.Mk';] v.Mokfgfu;k] xHkk';] ;kfu ,o lgk;d tuu xfUFk;k ik;h tkrh gA
4- Lruh f'k'k çtd çk.kh gkr gA

vH;kl kFk ç'u

oLrfu"B ç'u

1- f'k'k dk tUe nu oky çkf.k;k dk dgr gA
   ¼v½ f'k'k çtd ¼c½ v.Mçtd
   ¼l½ v.Mtjkit ¼l½ dkb ugh
2- bue l dku lk tUr f'k'kçtd gkrk g \
   ¼v½ dNvk ¼c½ 0gy
   ¼l½ ekj ¼n½ vfLFky eNyh
3- eu"; e fu"kpu dgk gkrk g\
   ¼v½ ;kfu e ¼c½ xHkk'k; e
   ¼l½ v.Mk'k; e ¼n½ Qykfi;u ufydk e
4- dkmij xfUFk;k ik;h tkrh gA
   ¼v½ uj eu"; e ¼c½ fL=;k e
   ¼l½ e<d e ¼n½ dkb ugh
5- cFkkfyu xfUFk;k ik;h tkrh gA
   ¼v½ uj eu"; e ¼c½ fL=;k e
   ¼l½ e<d e ¼n½ dkb ugh

vfry?kÙkjkRed ç'u

1- Lrfu;k e fdl çdkj dk fu"kpu gkrk g\
2- i#"kk e ik;h tku okyh lgk;d tuu xfUFk;k d uke fyf[k,A
3- f'k'k dk tUe nu oky çkf.k;k dk dgr gA
4- ljVkyh dkf'kdk, dgk ik;h tkrh g\
5- Lrfu;k e Hk.kh; ifjo/ku 'kjhj d fdl vx e gkrk g\

y?kÙkjkRed ç'u

1- vkUrfjd o cká fu"kpu e vUrj crkb;A
2- f'k'k çtd çk.kh fdUg dgr g\ mnkgj.k Hkh fyf[k,A
3- ljVkyh dkf'kdkvk dk dk; fyf[k,A
4- uj e ik;h tku okyh lgk;d tuu xfUFk;k d dk; dk o.ku dhft ,A
5- ,fifMMkbel d fofHkUu Hkkxk dk o.ku dhft ,A
6- Lrfu;k e o"k.k mnj xgk l ckgj D;k fLFkr gkr g\
7- cFkkfyu xfUFk;k d dk; dk mYy[k dhft ,A
8- uj e ik; tku oky tuukxk d uke fyf[k,A
9- fL=;k e v.Mk.kvk dk fuek.k dgk gkrk g\ bl çfØ;k dk D;k dgr g\
10- vUrjkyh dkf'kdkvk dk dk; fyf[k,A

fucU/kkRed ç'u

1- uj tuu r= dh ljpuk dk lfp= o.ku dhft ,A
2- eknk tuu r= dh ljpuk dk fp= lfgr o.ku dhft ,A

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mÙkjekyk % 1 ¼v½ 2 ¼c½ 3 ¼n½ 4 ¼v½ 5 ¼c½

bdkb & XVIII

v/;k; & 31

tUrvk e fodkl dk lkekU; ifjp;

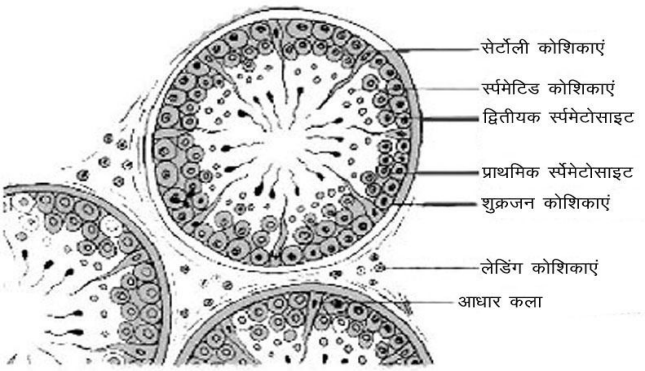
(General Introduction of Development in Animals)

;Xed tuu (Gameto genesis)

tuu dkf'kdkvk l ;Xedk d fuek.k dh çfØ;k dk ;Xed tuu dgr gA uj ;Xed dk 'kØk.k ,o eknk ;Xed dk v.Mk.k dgr gA uj ;Xed ¼'kØk.k½ d fuek.k dh çfØ;k dk 'kØtuu (Spermatogenesis) ,o eknk ;Xed ¼v.Mk.k½ d fuek.k dh çfØ;k dk v.Mtuu (Oogenisis) dgr gA

'kØtuu (Spermatogenesis)

uj çkf.k;k d o"k.k dh vkfn tuu dkf'kdkvk (Premordial germ cells) l 'kØtuu }kjk 'kØk.kvk dk fuek.k gkrk gA o"k.k e vud d.Mfyr ufydkdkj ljpuk, 'kØtuu ufydk, (Seminiferous tubules) ik;h tkrh g tk ijLij l;kth Ård e c/kh jgrh gA 'kØtuu ufydk, tuu midyk dkf'kdkvk }kjk vkLrfjr jgrh gA tuu midyk dkf'kdkvk d e/; lVkyh dkf'kdk, ik;h tkrh gA tk ifjo/ku'khy 'kØk.kvk dk ik"k.k çnku djrh gA l;kth Ård e vUrjkyh ;k yfMx dkf'kdkvk d leg ik; tkr gA bu dkf'kdkvk }kjk uj gkeku ¼VLVkLVhjku½ dk lko.k fd;k tkrk g ¼fp= 31-1½A



fp= 31-1 ¼ o"k.k dk vuçLFk dkV

'kØtuu dh fØ;k dk e[;r% nk voLFkkvk e foHkfnr fd;k tk ldrk gA

(a) LiefVM dk fuek.k (Formation of spermatid)

(b) ' 'kØk.k tuu (Spermiogenesis)

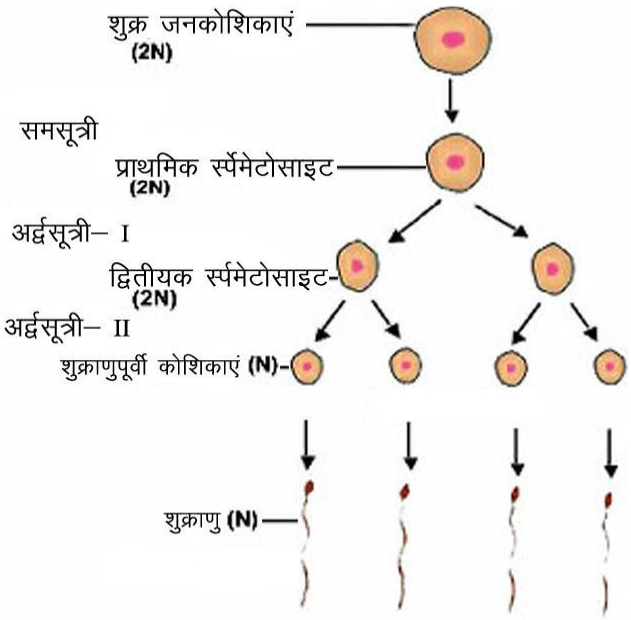
(a) **LiefVM dk fuek.k** (Formation of spermatid) : 'kØtuu ufydkvk dh vkfn tuu dkf'kdkvk }kjk LiefVM dk fuek.k gkrk gA bl rhu voLFkkvk e ckVk tkrk gA

(i) x.ku çkoLFkk (ii) of) çkoLFkk (iii) ifjiDou çkoLFkk

(i) **x.ku çkoLFkk** (Multiplication phase) : 'kØtuu ufydkvk e fLFkr tuu midyk dkf'kdkvk e fujUrj lel=h foHkktu l cgr cMh l[;k e LieVkxkfu;k curh gA

(ii) **of) çkoLFkk** (Growth phase) : bl çkoLFkk e LieVkxkfu;k dkf'kdk, vkdkj e of) djd nxuh cMh gk tkrh gA dUæd Hkh vkdkj e cMk gk tkrk gA bl çdkj fufer dkf'kdkvk dk çkFkfed 'kØk.k tud dkf'kdk, (Primary spermatocyte) dgykrh gA

(iii) **ifjiDou çkoLFkk** (Maturation phase) : çkFkfed LieVklkbV (2n) ifjiDou çkoLFkk e v)l=h foHkktu }kjk foHkkftr gkdj vxf.kr LiefVM dkf'kdk, fufer djrh gA ifjiDou çkoLFkk nk pj.kk e i.k gkrh gA çFke ifjiDou foHkktu v)l=h gkrk g] ftld QyLo:i f}rh;d LieVklkbV dkf'kdk, fufer gkrh gA tcfd f}rh; ifjiDou foHkktu lel=h gkrk gA ftll LiefVM dkf'kdk, fufer gkrh gA



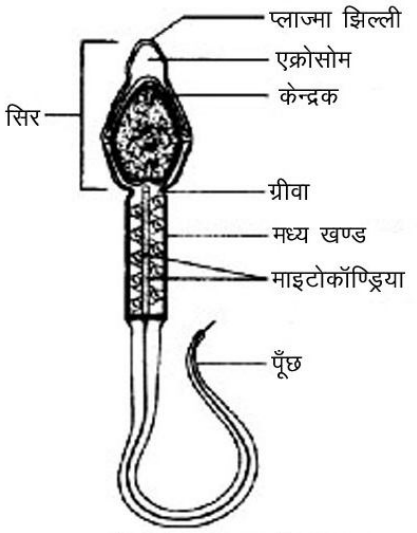
fp= 31-2 % 'kØtuu

(b) **'kØk.ktuu** (Spermiogenesis) : 'kØk.k tuu d QyLo:i fufer LiefVM dkf'kdk, gkykfd vxf.kr gkrh gA yfdu vxfr'khy gku d dkj.k 'kØk.k d leku dk; ugh dj ldrh gA vr% vxfr'khy LiefVM dkf'kdkvk l xfr'khy 'kØk.k fuek.k dh çfØ;k dk Life;ktufll dgr gA bl çfØ;k d nkjku vfrfjDr dkf'kdk æ0; dh {kfr gk tkrh g rFkk 'kØk.k 'kh"k d vkx fLFkr ,Øklke dk fuek.k xkYthdk; }kjk gkrk gA njLFk rkjd dUæ ,o v{kh; rUr dk vxHkkx 'kØk.k d e/; Hkkx dk fuek.k djr gA 'kØk.k dh iN dk fuek.k njLFk rkjd dUn }kjk gkrk g ¼fp= 31-2½A

'kØk.k dh ljpuk (Structure of Sperm)

'kØk.k dh ljpuk e(i) flj (ii) e/; Hkkx (iii) iN] rhu Hkkx ik; tkr gA

(i) **flj** (Head) : Lrfu;k e 'kØk.k 'kh"k dh vkÑfr vyx& vyx gkrh gA flj e[;r% ,Øklke ,o dUæd }kjk fufer gkrk gA ,Øklke 'kØk.k 'kh"k ij Vkihuek ljpuk d :i e gkrk gA bldk fuek.k xkYthdk; l gkrk gA ble çkfV;kykbfVd ,Utkbe tl& ,flM QkLQVt] gkb,Y;jkfuMt vkfn ,o ikyh ldjkbM ik; tkr gA ;g fu"kpu d le; 'kØk.k dk v.Mk.k e ço'k djku e lgk;d gkrk g ¼fp= 31-3½A



fp= 31-3 % 'kØk.k dh ljpuk

dUæd 'kØk.k d flj dk vf/kdk'k Hkkx cukrk gA ble e[;r% DNA ,o fgLVku çkVhu gkr gA ;g vkuokf'kd x.kk dk ogu djrk gA

(ii) **e/; Hkkx** (Middle Piece) : 'kØk.k d e/; Hkkx dk vx Hkkx xhok dgykrk gA bl Hkkx e nk rkjd dUæ gkr gA fudVLFk rkjd dUæ fu"kpu d i'pkr fonyu v{k dk fu/kkj.k djrk gA njLFk rkjd dUæ iN d v{kh; rUr dk fuek.k djrk gA Lrfu;k e ekbVkdkfUM;k v{kh; rUr d pkjk rjQ lfiykdkj d.Mfyr gkr gA ftl ucudu dgr gA ekbVkdkfUM;y vkoj.k ,o lyktek f>Yyh d e/; dkf'kdkæ0; dh iryh ir ik;h tkrh g ftl eupV dgr gA

(iii) **iN** (Tail) : 'kØk.k d i'p Hkkx e yEch ,o ldjh iN gkrh gA ;g v{kh; rUr] dkf'kdkæ0; ,o lyktek f>Yyh }kjk cuh gkrh gA

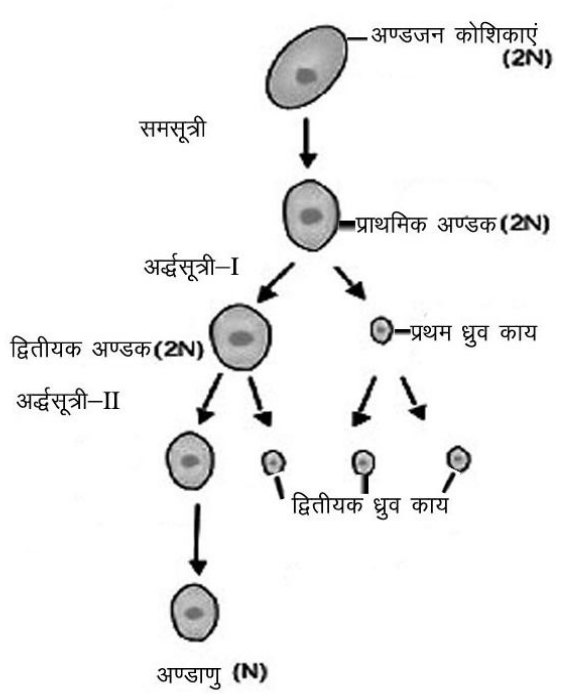
v.Mtuu (Oogenesis)

eknk çkf.k;k e eknk ;Xed ;k v.Mk.k d fuek.k dh çfØ;k dk v.Mtuu dgr gA eknk çkf.k;k e e[; tuukx v.Mk'k; gkr gA v.Mk'k; dh tuu midyk Lrj e fLFkr vkfn tuu dkf'kdkvk (Primordial germ cells) l v.Mk.kvk dk fuek.k gkrk g ¼fp= 31-4½A

v.Mtuu dh çfØ;k dk rhu voLFkkvk e ckVk tk ldrk g &

(i) x.ku çkoLFkk (ii) of) çkoLFkk (iii) ifjiDou çkoLFkk

(i) **x.ku çkoLFkk** (Multiplication phase) : bl voLFkk e v.Mk'k; d tuu midyk Lrj dh vkfn tuu dkf'kdk, fujUrj lel=h foHkktu }kjk foHkkftr gkdj v.Mtuu dkf'kdk, (Oogonia) fufer djrh gA



fp= 31-4 % v.Mtuu dh ljpuk

(ii) **of) çkoLFkk** (Growth phase) : bl çkoLFkk e v.Mtuu dkf'kdkvk e l ,d dkf'kdk vkdkj e of) djd çkFkfed v.M dkf'kdk fufer djrh gA 'k"k dkf'kdk, ik"kd dkf'kdkvk (Nurse Cells) ;k ifVdh; dkf'kdkvk (Follicular Cells) d :i e dk; djrh gA tk of) 'khy çkFkfed ÅlkbV dk ik"k.k çnku djrh gA bl çkoLFkk e vko';d ik"kd inkFk tl ihrd (yolk)] çkVhu vkfn dk l'y"k.k o lp; gkrk gA bld lkFk gh dUædh; inkFk e Hkh of) gkrh gA ftll çkFkfed ÅlkbV vkdkj e db xuk cMk gk tkrk gA

(iii) **ifjiDou çkoLFkk** (Maturation phase) : ;g çkoLFkk nk pj.kk e i.k gkrh gA çFke ifjiDou foHkktu v)l=h ,o vleku gkrk gA ftld QyLo:i ,d cM vkdkj dh f}rh;d v.M dkf'kdk (Secondary Oocyte) ,o çkFkfed /ko dk; fufer gkrh gA bue x.kl=k dh l[;k vxf.kr (Haploid) jg tkrh gA f}rh; ifjiDou lel=h gkrk gA ftld QyLo:i çkFkfed v.Mdkf'kdk l cM vkdkj dk v.Mk.k ,o ,d NkVk f}rh;d /ko dk; fufer gkrh gA çkFkfed èko dk; d foHkktu l nk f}rh;d /ko dk; fufer gkrh gA bl çdkj f}rh; ifjiDou foHkktu e pkj dkf'kdk, fufer gkrh gA bue l ,d v.Mk.k ,o rhu f}rh;d /ko dk; dkf'kdk, fufer gkrh gA

v.Mtuu dh çfØ;k e vleku ifjiDou foHkktu gku l çkFkfed ÅlkbV e lfpr vf/kdk'k dUædh; ,o ik"kd inkFkk dk forj.k leku ugh gkrk gA ftll vf/kdk'k inkFk v.Mk.k e lfpr gk tkr gA tk ifjo/ku'khy Hk.k dk ik"k.k çnku djr gA ,lk u gku ij Hk.k dk fodkl Bhd l ugh gk ik;xkA

v.M dh ljpuk ,o çdkj

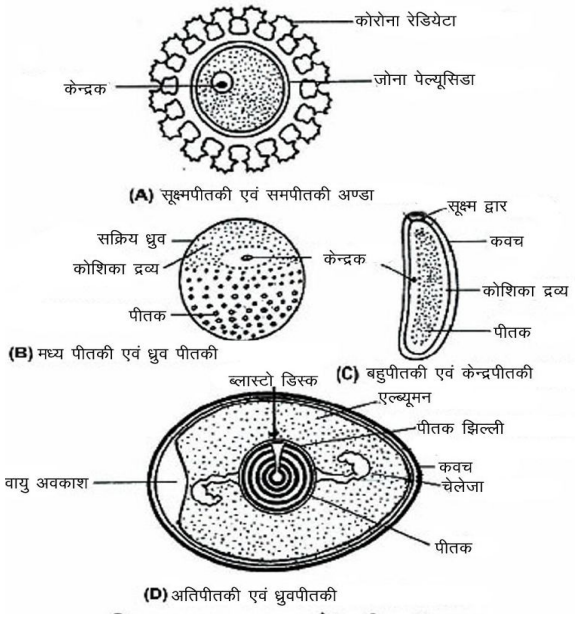
(Structure and Types of Eggs)

lHkh d'k:d d v.Mk.kvk e ihrd dh ek=k ,o forj.k fHkUu&fHkUu çdkj dk gkrk gA

(a) **ihrd dh ek=k d vk/kkj ij** % ihrd dh ek=k d vk/kkj ij v.M rhu çdkj d gkr g &

(i) **vYiihrdh ;k l{eihrdh** (Alecithal or Microlecithal) : bu v.Mk e ihrd dh ek=k cgr de gkrh g rFkk ; vkdkj e cgr NkV gkr gA tl ;Fkfj;u Lru/kkjh] ;jkdkMV ,o flQykdkMVA

(ii) **e/;ihrdh** (Mesolecithal) : bu v.Mk e ihrd u cgr vf/kd ,o u cgr de gkrk gA ,l v.M lkbDykLVkeVk ,o ,EQhfc;k ox d çkf.k;k e ik; tkr gA



fp= 31-5 % v.Mk dh ljpuk
(A) Lruh dk v.Mk (B) e<d dk v.Mk
(C) dhV v.Mk (D) exh dk v.Mk

(iii) **vfrihrdh** (Macrolecithal) : bu v.Mk e ihrd dh ek=k cgr vf/kd gkrh gA ,l v.M filht] jlVhfy;k] ,oht ,o çkVkFkhfj;k Lrfu;k e ik; tkr gA

(b) **ihrd d forj.k d vk/kkj ij** % ihrd d forj.k d vk/kkj ij v.M rhu çdkj d gkr g &

(i) **leihrdh** (Isolecithal) : bue ihrd leku :i l forfjr gkrk gA l{eihrdh v.M leihrdh çdkj d gkr gA

(ii) **dUæihrdh** (Centrolecithal) : bue ihrd dh ek=k cgr vf/kd gkrh gA bu v.Mk d e/; e ihrd fLFkr gkrk g ft ld pkjk vkj dkf'kdkæ0; ,o dUæd iryh ijr d :i e fLFkr gkrk gA tl& dhV (Insects) d v.MA

(iii) **vfrihrdh** (Telolecithal) : bu v.Mk e ihrd dh ek=k cgr vf/kd gkrh gA rFkk bldk forj.k vleku gku d dkj.k ihrd v.M d fupy flj ij ,df=r gk tkrk gA ftl ihrd /ko (Vegetal Pole) ,o dUæd o dkf'kdkæ0; Åijh lfØ; /ko (Animal pole) e fLFkr gkrk gA ,l v.Mk dk /ko ihrdh dgr gA e/; ihrdh ,o vfrihrdh v.M blh çdkj d gkr g ¼fp= 31-5½A

egRoi.k fcUn

1- 'kØk.kvk d fuek.k dh çfØ;k dk 'kØtuu ,o v.Mk.kvk d fuek.k dk v.Mtuu dgr gA
2- 'kØk.k dh ljpuk e flj] e/; Hkkx ,o iN gkrh gA
3- ;Xed tuu }kjk vxf.kr ;Xed fufer gkr gA
4- ihrd dh ek=k d vk/kkj ij v.M l{e ihrdh] e/; ihrdh ,o vfr ihrdh çdkj d gkr gA
5- ihrd d forj.k d vk/kkj ij leihrdh] dUæihrdh ,o /ko ihrdh çdkj d gkr gA

vH;kl lkFk ç'u

oLrfu"B ç'u

1- 'kØk.k d ,Øklke dk fuek.k gkrk gA
¼v½ xkYth dk; ¼c½ dUnd
¼l½ jkbcklke ¼n½ ykblklke
2- 'kØk.k d ,Øklke dk dk; D;k gkrk g\
¼v½ v.Mk.k dk lfØ; djuk
¼c½ 'kØk.k dk Åtk çnku djuk
¼l½ v.Mk.k e 'kØk.k d ço'k e lgk;rk djuk
¼n½ dkb ugh
3- dhVk e v.M gkr gA
¼v½ /koihrdh ¼c½ leihrdh
¼l½ dUæihrdh ¼n½ dkb ugh
4- ,d v.Mk.k d fuek.k d le; fdruh /ko dk; fufer gkrh g\
¼v½ ,d ¼c½ nk
¼l½ rhu ¼n½ pkj
5- if{k;k e v.M gkr gA
¼v½ l{eihrdh ¼c½ e/;ihrdh
¼l½ vfrihrdh ¼n½ dkb ugh

vfry?kÙkjkRed ç'u

1- 'kØk.k dh iN d v{kh; rUrvk dk fuek.k fdll gkrk g\
2- LiefVM l 'kØk.kvk d fuek.k dk dgr gA
3- VLVkLVhjku dk lko.k fdu dkf'kdkvk l gkrk g\
4- Lrfu;k e v.Mk dk çdkj fyf[k,A
5- /ko ihrdh v.Mk e ihrd dgk fLFkr gkrk g\

y?kÙkjkRed ç'u

1- ;Xed tuu fdl dgr g\
2- ljVkyh dkf'kdkvk d dk; crkb;A
3- 'kØk.k ,Øklke dk dk; D;k g\
4- LiefVM] 'kØk.k d leku vxf.kr gkrh gA yfdu v.Mk.k d fu"kpu e l{ke ugh gkrh gA D;k\
5- /koihrdh v.Mk dk lmnkgj.k o.ku dhft ,A
6- dhVk d v.M dk ukekfdr fp= cukb;A
7- 'kØk.k dk ukekfdr fp= cukb;A
8- 'kØtuu ,o v.Mtuu e dkb pkj vUrj fyf[k,A
9- exh d v.M dk ukekfdr fp= cukb;A
10- LiefVM l 'kØk.k d dk;kUrj.k dk o.ku dhft ,A

fucU/kkRed ç'u

1- 'kØtuu ,o v.Mtuu e vUrj fyf[k,A
2- 'kØtuu dk lfp= o.ku dhft ,A
3- 'kØk.k dh ljpuk dk lfp= o.ku dhft ,A
4- v.Mtuu dk lfp= o.ku dhft ,A
5- ihrd dh ek=k ,o ihrd d forj.k d vk/kkj ij v.Mk d çdkj dk o.ku dhft ,A

mÙkjekyk % 1 ¼v½ 2 ¼l½ 3 ¼l½ 4 ¼l½ 5 ¼l½

v/;k; & 32

tUrqvk e fu"kpu ,o fonyu

(Fertilization and Cleavage in Animals)

fu"kpu (Fertilization)

vxf.kr uj ;Xed ¼'kØk.k½ ,o eknk ;Xed ¼v.Mk.k½ d io dUædk d ledu l f}xf.kr ;Xeut (Zygote) d fuek.k dh çfØ;k dk fu"kpu dgr gA gjkYM euj d vukj fu"kpu e uj ,o eknk çkdUædk (Pronucleus) dk ly;u gkrk gA bud l;kx l iu;kftr lrfr tUe yrh gA

fu"kpu d çdkj (Types of Fertilization)

fu"kpu e[;r% nk çdkj dk gkrk g &

(i) **cká fu"kpu** (External Fertilization) : bl idkj d fu"kpu e 'kØk.k ,o v.Mk.k eknk 'kjhj d ckgj ty e lefdr gkr gA tl& vf/kdk'k vd'k:d] fiLht o ,EQhfc;uA

(ii) **vkUrfjd fu"kpu** (Internal Fertilization) : eknk 'kjhj d vUnj gku oky fu"kpu dk vkUrfjd fu"kpu dgr gA tl& vf/kdk'k dhV] jIVkby] ,oht ,o Lruh vkfnA

Lrfu;k e fu"kpu

(Fertilization in Mammals)

fu"kpu ,d tfVy fØ;k g bl v/;;u dh lfo/kk d fy, fuEu Hkkxk e ckVk tk ldrk g &

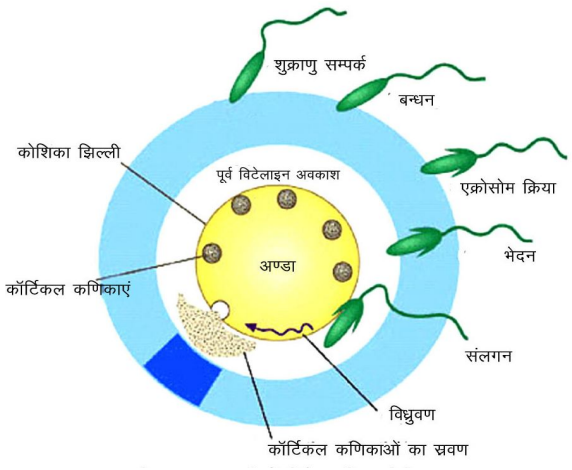
(i) **'kØk.kvk dk v.Mk.k dh vkj xeu ,o v.Mk.k l lEid %** Lrfu;k e vkUrfjd fu"kpu gkrk gA vr% uj 'kØk.kvk dk eknk dh tuu okfguh e eDr djrk gA l;kxo'k gh 'kØk.kvk dk v.Mk.k l vkdfLed feyu gkrk gA

v.Mk.k dh lrg ij QfVykbftu ,o 'kØk.k dh lrg ij ,UVhQfVykbftu uked jlk;u gkrk gA ; tkfr fof'k"V gkr gA blhfy, 'kØk.k viuh tkfr d v.Mk.k dk gh fu"kfpr djrk gA

(ii) **'kØk.kvk dk ;kX;rktu** (Capacitation) : 'kØk.kvk }kjk v.Mk.k dk fu"kfpr dju dh {kerk dk vftr dju dh çfØ;k dk ;kX;rktu dgr gA ble 'kØk.kvk d fof'k"V xkgh LFky vukofjr gk tkr gA ;g fØ;k lkekU;r% eknk tuu r= e yfdu dN çkf.k;k e vfèko"k.k (Epididymus) e gkrh gA

(iii) **'kØk.k dk v.Mk.k e ço'k** (Penetration of sperm into ovum) : Lrfu;k e ,Øk lke }kjk gkb,yjkfuMt,Utkbe lkfor gkrk gA ;g v.Mk.k d cká dkjkuk jfM;Vk vkoj.k dh dkf'kdkvk d e/; mifLFkr gkb,yjkfud vEy dk ?kkydj v.Mk.k e 'kØk.k d ço'k e lgk;rk djrk gA

'kØk.k e v.Mk.k d ço'k d lkFk gh v.Mk.k dk lfØ;.k gkrk gA bl nkjku dkfVdy fØ;k, ,o fu"kpu f>Yyh dk fuek.k gkrk gA fu"kpu f>Yyh vU; 'kØk.kvk d ço'k dk jkdrh gA v.Mk.k e ço'k djr le; 'kØk.k lekU;r% viuh iN ckgj NkM nr g ¼fp= 32-1½



fp= 32-1 % Lruh e fu"kpu dh fØ;k fof/k

(iv) **çkdUæd dk l;Xeu** (Conjugation of pronucleus) : v.Mk.k e ço'k djd 'kØk.k dk dUæd Qydj uj çkdUæd e ,o v.Mk.k dk dUæd f}rh; ifjiDo foHkktu i.k dj eknk çkdUæd e ifjofrr gk tkrk gA bu çkdUædk d l;Xeu dk mHk;feJ.k dgr gA bl çdkj fu"kpu d QyLo:i f}xf.kr ;Xeut fufer gkrk gA

fonyu (Cleavage)

vxf.kr uj ,o eknk ;Xedk d ledu l f}xf.kr ;Xeut (Zygota) fufer gkrk gA tkbxkV e fujUrj lel=h foHkktu l cgdkf'kdh; ek:yk ;k CykLVyk cuu dh çfØ;k dk fonyu dgr gA fonyu l fufer dkf'kdkvk dk dkjd [k.M (Blastomeres) dgr gA

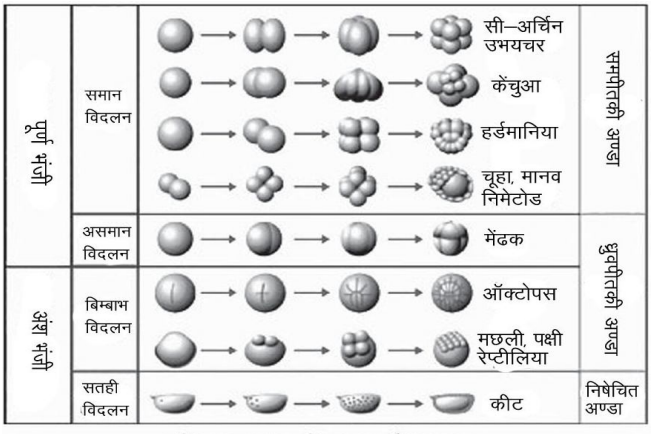
fonyu d çdkj (Types of Cleavage)

v.Mk e mifLFkr ihrd dh ek=k ,o forj.k d vk/kkj ij fonyu fuEu çdkj dk gkrk g &

1- **i.kHkkth fonyu** (Holoblastic Cleavage) : ,l fonyu ftle fonyu [kkp lEi.k v.M l xtjrh gA ml i.kHkkth fonyu dgr gA ;g fuEu nk çdkj dk gkrk g&

(a) **leku i.kHkkth fonyu** (Equal Holoblasitc) : bl çdkj dk fonyu l{eihrdh ,o leihrdh v.Mk e gkrk gA bue ihrd dh ek=k de ,o leku forj.k d dkj.k dkjd[k.M leku cur gA tl ;Fkfj;u LruhA

(b) **vleku i.kHkkth fonyu** (Unequal Holoblastic) : bl çdkj dk fonyu e/;ihrdh v.Mk e gkrk gA bld QyLo:i lfØ; /ko e NkV y?k dkjd[k.M ,o fuf"Ø; /ko e cM nh?k dkjd [k.M cur gA tl eNfy;k ,o ,EQhfc;u



fp= 32-2 % fonyu d çdkj

2- **v'kHkkth fonyu** (Meroblastic Cleavage) : bl çdkj dk fonyu vfrihrdh ,o dUæihrdh v.Mk e gkrk gA bue ihrd dh ek=k vf/kd gku d dkj.k fonyu [kkp lEi.k v.M l ughxtjrh gA v'kHkkth fonyu fuEu nk çdkj dk gkrk g &

(a) **i"Bh; ;k lrgh fonyu** (Superficial Cleavage) : bl çdkj dk fonyu dhVk d dUæihrdh v.Mk e gkrk gA ble dUæd fujUrj lel=h foHkktu }kjk foHkkftr gkrk gA ftll ifj/kh; dkf'kdkæ0; cgdUædh; gk tkrk gA lrfr dUædk d pkjk vkj dN dkf'kdkæ0; d ,df=r gku l dkjd[k.M fufer gkr g] tk dUæh; ihrd dk ?kj jgr g ¼fp= 32-2½A

(b) **fcEcckHk fonyu** (Discoidal Cleavage) : bl çdkj dk fonyu vfrihrdh ,o /koihrdh v.Mk e gkrk gA fonyu doy ihrdjfgr] tfeuy fMLd e gh gkr gA tl & jlVkby] ,oht vkfnA

fonyu dk egRo (Significance of Cleavage)

1- fonyu d QyLo:i tkbxkV cgdkf'kdh; Hk.k e :ikUrfjr gk tkrk gA

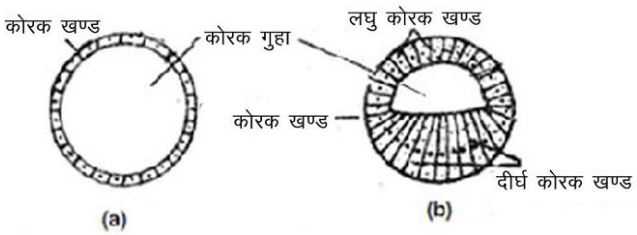
2- fonyu d nkjku dkjdxgk dk fuek.k gkrk gA

3- dkjdxgk xLVykHkou d nkjku gku okyh ljpuk fodkl xfr;k d fy, LFkku miyC/k djrh gA

ek:yk ,o dkjd (Blastula)

çkjfEHkd fonyuk l fufer dkjd[k.Mk d xPN dh vkÑfr Bkl] xkykdkj ,o 'kgrr d leku gku d dkj.k bl ek:yk dgr gA

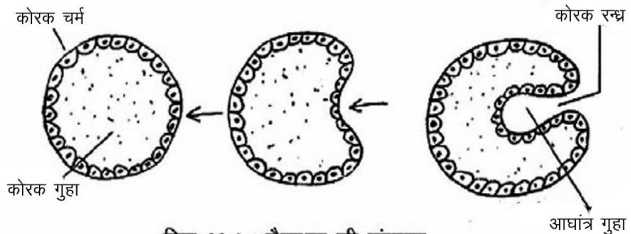
d'k:d çkf.k;k e ek:yk voLFkk ugh ik;h tkrh gA bue çkjfEHkd fonyuk l fufer dkjd[k.M e/; e fLFkr [kk[kyh dkjdxgk (Blastocoel) d pkjk vkj Lrj d :i e 0;ofLFkr gkdj dkjdpe (Blastoderm) cukr gA Hk.k dh bl [kk[kyh] xkykdkj ljpuk dk CykLVyk ,o bld fuek.k dh fØ;k dk dkjdHkou (Blastulation) dgr g ¼fp= 32-3½A



fp= 32-3 % CykLVyk ¼dkjd½ dh ljpuk

xLVyk (Gastrula)

,d Lrjh; CykLVyk l f}Lrjh; ;k f=Lrjh; xLVyk fuek.k dh fØ;k dk xLVykHkou (Gastrulalation) dgr gA bl çfØ;k d nkjku CykLVyk dh lrg ij fLFkr lEHkkoh {k=k d dkjd[k.Mk dk LFkkukUrj.k ,o iufoU;kl fuf'pr {k=k d fy, gkrk gA ftld QyLo:i ,d u;h vk|kU= (Archantron) xgk curh gA tk dkjdjU/k (Blastopore) }kjk ckgj [kyrh gA dkjd[k.M ,d LFkku l nlj LFkku ij fo'k"k ljpuk fuek.k gr lkefgd LFkkukUrj.k djr gA ,lh dkf'kdh; xfr;k dk ljpuk fodkl xfr;k ;k fuek.kh xfr;k dgr gA bu xfr;k d QyLo:i ,DVkMe] ,.MkMe ,o ehlkMe çkFkfed tuu Lrjk dk fuek.k gkrk gA tuu Lrjk dk iFkDdj.k nk pj.kk e gkrk gA Lrfu;k e xLVykHkou fØ;k d çFke pj.k e ,.MkMe dk iFkDdj.k gk tkrk gA tcfd ehlk ,DVkMe l ,DVkMe ,o ehlkMe dk iFkDdj.k f}rh; pj.k e gkrk g ¼fp= 32-4½A



चित्र 32.4 : गैस्ट्रुला की संरचना

xLVykHkou dh fØ;k fof/k

(Mechanism of Gastrulation)

xLVykHkou dh fØ;k d nkjku dkjd [k.M fof'k"V çdkj dh ljpuk fodkl xfr;k djr g, fuf'pr LFkku rd igpr gA ; xfr;k e[;r% nk çdkj dh gkrh g &

(i) v/;kjkg.k (Epiboly)

(ii) vUrjkjkg.k (Emboly)

(i) **v/;kjkg.k** (Epiboly) : bl idkj dh xfr;k mu v.Mk e gkrh g ftue vleku i.kHkkth fonyu gkrk gA ble CykLVkMe dh lEHkkoh ,DVkMey dkf'kdk, vfrof) djrh g ,o foHkkftr gkrh gA ftld QyLo:i ; y?k dkjd[k.M lfØ; /ko l Qydj vfØ; /ko d nh?k dkjd[k.Mk dk pkjk vkj l vkPNkfnr djuk ikjEHk dj nrh gA bll nh?k dkjd[k.M Lor% Hkhrj gk tkr gA bl idkj dh xfr;k dk v/;kjkg.k dgr gA tl& ,ufyMk] ekyLdk] eNfy;k ,o ,EQhfc;u vkfnA

(ii) **vUrjkjkg.k** (Emboly) : xLVykHkou fØ;k d nkjku vUrjkjkg.k d fy, ljpuk fodkl xfr;k nk ;k vf/kd çdkj l gkrh gA ble CykLVkMe dh lEHkkoh ,.MkMey dkf'kdk, foHkkftr gkdj] ljpuk fodkl xfr;k }kjk Hk.k d Hkhrj ço'k djrh gA bu xfr;k dk vUrjkjkg.k dgr gA tl jlVkby] ,oht ,o çkVkFkfj;u Lruh vkfnA

xLVykHkou dk egRo

(Significance of Gastrulation)

1- bl fØ;k }kjk ,d Lrjh; CykLVyk l nk ;k rhu Lrjh; xLVyk fufer gk tkrk gA

2- vfoHkfnr CykLVkMe l ,DVkMe] ,.MkMe ,o ehlkMe çkFkfed tuu Lrj iFkd gk tkr gA

3- rf=dk r= d foHknu d fy, xLVykHkou vko';d gkrk gA

egRoi.k fcUn

1- fu"kpu ckÁ ,o vkUrfjd nk çdkj dk gkrk gA

2- v.Mk.k dh lrg ij QfVykbftu ,o 'kØk.k dh lrg ij ,UVhQfVykbftu fof'k"V jlk;u gkrk gA

3- çkjEHk e fonyu rY;dkyh gkr gA dkjd[k.M lkFk&lkFk foHkkftr gkr gA yfdu dN çkjfEHkd foHkktuk d i'pkr fonyu vfu;fer gku yxrk gA

4- xLVykHkou d QyLo:i vfoHkfnr dkjdpe l rhu çkFkfed tuu Lrjk dk iFkDdj.k gk tkrk gA

vH;kl lkFk ç'u

oLrfu"B ç'u

1- fu"kfpr v.Mk.k e vfrjDr 'kØk.k ço'k ugh dj ikr gA D;k\

¼v½ fu"kpu f>Yyh cuu d dkj.k

¼c½ 'kØk.k ej tkr gA

¼l½ v.Mk.k e lfØ;u çkjEHk gk tkrk gA

¼n½ fu"kpu 'kd ugh curk gA

2- Lrfu;k d v.M e fdl çdkj dk fonyu gkrk g\

¼v½ vleku i.kHkkth ¼c½ lrgh v'kHkkth

¼l½ leku i.kHkkth ¼n½ dkb ugh

3- v'kHkkth fonyu gkrk g &

¼v½ l{eihrdh v.Mk e

¼c½ e/;ihrdh v.Mk e

¼l½ vfr ihrdh v.Mk e

¼n½ dkb ugh

4- fonyu d QyLo:i fufer dkf'kdkvk dk dgr gA
¼v½ dkjd pe ¼c½ dkjd[k.M
¼l½ ek:yk ¼n½ dkb ugh
5- CykLVyk l xLVyk fuek.k dk dgr gA
¼v½ dkjd Hkou ¼c½ xLVykHkou
¼l½ fonyu ¼n½ dkb ugh

vfry?kÙkjkRed i'u

1- xLVykHkou d nkjku gku okyh dkf'kdh; xfr;k dk D;k dgr g\
2- l{ehrdh ,o leihrdh v.Mk e fdl çdkj dk fonyu gkrk g\
3- Lrfu;k e 'kØk.k d ,Øklke }kjk dku lk fof'k"V jlk;u lkfor gkrk g\
4- d'k:d çkf.k;k e uj ,o eknk çkdUædk d ledu dk dgr gA
5- ,Øklke dk D;k dk; g\

y?kÙkjkRed ç'u

1- fu"kpu d çdkj lmnkgj.k fyf[k,A
2- ;kX;rk tu fdl dgr g\
3- fonyu dk egRo fyf[k,A
4- dkjdHkou fdl dgr g\
5- xLVykHkou dk egRo fyf[k,A
6- leku i.kHkkth fonyu dk lmnkgj.k o.ku dhft,A
7- xLVykHkou d nkjku gku okyh ljpuk fodkl xfr;k e[;r% fdru çdkj dh gkrh gA
8- fcEckHk v'kHkkth fonyu dk o.ku dhft,A
9- cká ,o vkUrfjd fu"kpu e vUrj fyf[k,A
10- fu"kpu d nkjku gku okyh fofHkUu ?kVukvk dk Øe'k% uke fyf[k,A

fuc/kkRed ç'u

1- xLVykHkou fdl dgr g\ bldh fØ;kfof/k dk lfp= o.ku dhft,A
2- fonyu fdl dgr g\ fonyu d çdkjk dk lfp= o.ku dhft,A
3- fu"kpu fdl dgr g\ fu"kpu d çdkjk dk o.ku dhft,A
4- Lrfu;k e fu"kpu dh fØ;kfof/k dk o.ku dhft,A
5- dkjdHkou fdl dgr g\ dkjd ,o xLVyk e vUrj fyf[k,A

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mÙkjekyk % 1 ¼v½ 2 ¼l½ 3 ¼l½ 4 ¼c½ 5 ¼c½