Unit – 16
Rays Optics
Wave Optics

SUMMARY

- The path of the light propagation is called ray, but a bundald of such rays is called beam of light.
- The relation between focal length and radius of curvature is $f = \frac{R}{2}$ (for both the mirror) or R = 2f.
- In the case of plane mirror, R is infinite and therefore its focal length is also infinite.
- For mirrors, Gauss' equation is $\frac{1}{u} + \frac{1}{v} = \frac{1}{f} = \frac{2}{R}$, where, u = object distance, v = image distance, f = focal length, R = Radius of Curvature.
- Lateral magnification for mirrors is given by $m = \frac{h'}{h} = -\frac{v}{u}$, where, h' = height of image, h = height of object.
- The ratio of the sine of the angle of incidence to the sine of the angle of refraction for the given two media is constant, i.e., $\frac{\sin\theta_1}{\sin\theta_2} = n_{21}$ = Constant.

  where n_{21} is known as the refraative index of medium–2 with respect to medium–1.
- For a compound slab of different transparent media general form of Snell's Law is written as:

  $n_1 \sin\theta_1 = n_2 \sin\theta_2$
- Lateral shift x = $t \,.\, \theta_1\left(1 - \frac{n_1}{n_2}\right)$
- If two plane mirros M_1 and M_2 are inclined at angle θ, then no. of images form $n = \left(\frac{360}{\theta} - 1\right)$
- In concave mirror, when objects is between P and F, image formed is virtual, ereect and magnified. $\therefore$ m is positive. However, when object lies beyond F, image formed is real and inverted. $\therefore$ m is negative.
- In convex mirror, image is always virtual and erect, whatever be the position of the object.
- Critical angle $C = \sin^{-1}\left(\frac{1}{n}\right)$ where, n = refractive index medium.

  As $n_v > n_r \;\therefore\; C_v < C_r$. 'C' increases with temperature.

- Refraction from a spherical surface (for lens)

(1) For refraction from rarer to denser medium : $\frac{-n_1}{u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$

(2) Form denser to rarer medium : $\frac{-n_1}{v} + \frac{n_2}{u} = \frac{n_2 - n_1}{R}$

- Lens Maker's Formula is :

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

For Convex lens : $R_1 = +$, $R_2 = -$, $f = +$

Convave lens : $R_1 = -$, $R_2 = +$, $f = -$

- Power of lens $P = \frac{1}{f}$ when f = 1m, $\therefore$ P = 1 diopter (D)

For Convex lens P = +,

Convave lens P = –

- If two lenses are in contact coaxilly,

(i) $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ (ii) $P = P_1 + P_2$ (iii) $m = m_1 \times m_2$

- For Prism equation is given by $\delta = i + e - A$ or $A + \delta = i + e$

At minimum angle of deviation, $\delta_m = 2i - A$. $(\because i = e)$

For thin prism $\delta_m = A(n-1)$

$$n = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

- Newton's formula $f^2 = x_1 . x_2$
- The relation between δ, A and n is : $\delta = A(n-1)$

Angular disperson, $\theta = \delta_V - \delta_r = (n_V - n_r)A$

Dispersive power $\omega = \frac{\delta_V - \delta_r}{\delta} = \frac{n_V - n_r}{n-1}$, Where, $n = \frac{n_V + n_r}{2}$

- (i) Resolving power of human eye = 1'

(ii) R.P. of Microscope $= \frac{2n\sin\theta}{\lambda}$

(iii) R.P. of Telescope $= \frac{D}{1.22.\lambda}$

WAVE OPTICS

- Problem Solving Skills :

(1) Resultant intensity $I = R^2 = a^2 + b^2 + 2ab\cos\phi$

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\,\cos\phi$$

If $I_1 = I_2 = I_0$ તો $I_1 = I_0 + I_0 + 2I_0 \quad \cos\phi = 4\, I_0 \cos^2\left(\frac{\phi}{2}\right)$

(2) Phase differance $\phi = \frac{2\pi}{\lambda}(\Delta x)$

⇒ Form $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\,\cos\phi$

When $\cos\phi = +1 \quad \therefore\ I_{max} = I_1 + I_2 + 2\sqrt{I_1 I_2} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

$\cos\phi = -1 \qquad \therefore\ I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

$$\therefore\ \frac{I_{max}}{I_{min}} = \frac{\left(\sqrt{I_1} + \sqrt{I_2}\right)^2}{\left(\sqrt{I_1} - \sqrt{I_2}\right)^2}$$

⇒ If the Sources are incoherent, $I = I_1 + I_2$

⇒ If W_1 and W_2 are widths of two Slis then , $\frac{W_1}{W_2} = \frac{I_1}{I_2} = \frac{a^2}{b^2}$

⇒ In the interfernce pattern $\frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2}$ where a, b = Amplitude.

⇒ In young's double slit experiment

(a) Position of bright fringes $x = n\lambda\frac{D}{d}$ (where n = 0 for centeral fringe)

(b) Positiion of dark fringes $x = \frac{(2n-1)\lambda D}{2d}$

(c) Width of each bright fringes = width of each darkfringes $\beta = \bar{x} = \frac{\lambda D}{d}$

(d) when entire apparatus is immersed in a medium of refractve index n, fringe width becomes

$$\bar{x}' = \beta' = \frac{\lambda' D}{d} = \frac{\lambda D}{nd} = \frac{\bar{x}}{n} = \frac{\beta}{n}$$

(e) Angular fringe width $= \frac{\beta}{D} = \frac{\lambda}{d}$

(f) fringe visibility is $V = I_{max} - I_{min} / I_{max} + I_{min}$

⇒ A thickness **t** of a medium of refractive index **n** is equivalent to a length **nt** in vacuum or air**.** This is called optical path length**.**

⇒ When a thin transperent plate of thickness **t** and refractive index **n** is placed in the path of one of the interfering waves, fringe width remains unaffected but the entire patern shiffts by

$$\Delta x = (n-1)\ t\ .\ \frac{D}{d} = (n-1)\,t\,\frac{\beta}{\lambda}$$

⇒ Law of Malus : $I = I_0 \cos^2\theta$

⇒ Brewster's law : $n = \tan\theta_P$

⇒ the intensity of porlarised light : $I = \frac{I_0}{2}$ where I_0 = intensity of unpolarsed light

⇒ Accoding to Doppler's effect for light waves

$$f' = f\left(1 \pm \frac{V}{C}\right)$$

where f' = apparent frequency of light

f = true frequency of light

⇒ **A symbol of refractive index is also denoted by**

MCQ Questions

(1). The velocity of light is maximum in a medium of______________.

(A) diamond (B) water (C) glass (D) vaccum

(2). A light of wavelength 320 nm enters in a medium of refractive index 1.6 from the air of refractive index 1.0 The new wavelength of light in the medium will be__________nm.

(A) 520 (B) 400 (C) 320 (D) 220

(3). "Bhautik" runs towards a plane mirror with a speed of 20 ms^{-1}, what is the speed of his image ?

(A) 45 ms^{-1} (B) 20 ms^{-1} (C) 15 ms^{-1} (D) 7.5 ms^{-1}

(4). A ray of light is incident at an angle 30^0 on a mirror, The angle between normal and reflected ray is___________.

(A) 15° (B) 30° (C) 45° (D) 60°

(5). The no. of images formed between two parallel plane mirror are ____________.

(A) ∞ (B) 0 (C) 180 (D) 360

(6). To get five images of a single object one shold have two plane mirrors at an angle of__________.

(A) 36° (B) 72° (C) 180° (D) 302°

(7). If a glass rod is immersed in a liquid of the same refractive index, then it will____________.

(A) appear bent (B) appear longer (C) disappear (D) appear shorter

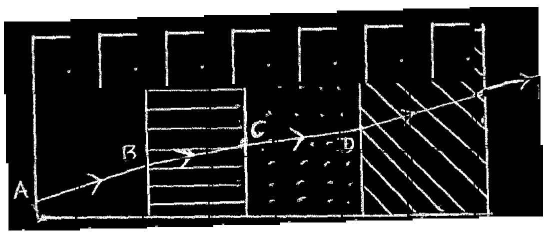
(8). For four different transperent medium $n_{41} \times n_{32} \times n_{21} =$ _____________.

(A) $\frac{1}{n_{41}}$ (B) n_{41} (C) n_{14} (D) $\frac{1}{n_{14}}$

(9). A Plane mirror produces a magnification of___________.

(A) 0 (B) +1 (C) –1 (D) ∞

(10). A ray light passes through four transperent media with refractive indices n_1, n_2, n_3, n_4 as shown in figure The surfaces of all media are parallel, if the emergent ray DE is parallel of the incident ray AB we must have_______________

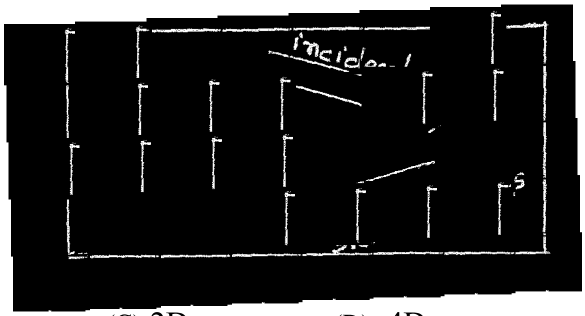


(A) $n_1 = n_2$ (B) $n_3 = n_4$ (C) $n_1 = n_4$ (D) $n_2 = n_3$

(11). A convex lens forms a real image of an object for it s two different positons on a screen if hight of the image in both cases be 16 cm and 4 cm then height of the object is_________cm.

(A) -4 (B) 4 (C) -8 (D) 8

(12). In shown figure two parallel rays incident on a mirror they are reflected as paraller rays as shown in the same figure what is the nature of the mirror ?



(A) plane mirror (B) concave

(C) convex (D) plano–concave

(13). The power of plane glass is_________.

(A) ∞ (B) 0 (C) 2D (D) 4D

(14). A convex lens is made up of three diffrent materials as shown in figure, for point object placed on its axis, the no. of imges formed are_________.

(A) 4 (B) 2

(C) 3 (D) 1

(15). Two thin lenses of focal lengths f_1 and f_2 are coaxially placed incontact with eachother then, the power of combination is_________.

(A) $\frac{f_1 + f_2}{2}$ (B) $\sqrt{\frac{f_1}{f_2}}$ (C) $\frac{f_1 f_2}{f_1 + f_2}$ (D) $\frac{f_1 + f_2}{f_1 f_2}$

(16). If thin prism of 5° gives a deviation of 2° then the refractive index of material of prism is________.

(A) 1.4 (B) 1.5 (C) 1.6 (D) 1.0

(17). It is difficult to see through the fog because ________________

(A) light is seattered by the doplets in the fog.

(B) fog absorbs light.

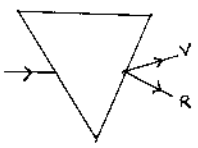
(C) rafractive index of fog is infinity.

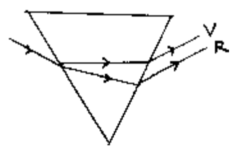
(D) light suffers totl internal reffection.

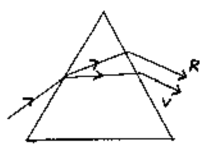
(18). what is the time taken in seconds to cross a glass plate of thikness 6 mm and $=2.0$ by light ?

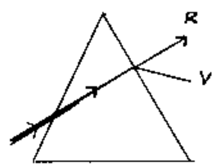
(A) 8×10^{-11} (B) 4×10^{-11} (C) 2×10^{11} (D) 16×10^{-11}

(19). Which of the following diagrams shows correctly the dispersion of white light by a prism ?

(A)


(B)


(C)


(D)


(20). Read the following quetions and choose if______________.

(A) both assertion and reason are true and the reason is correct explanation of the assertion.

(B) both assertion and reason are true but reason do not explain the assertion.

(C) Assertion is true but the reason are false.

(D) both assertion and reason are false.

(1) Assertion : Focal lengh of a lens for red colour is smaller than its focal length for violet colour

Reason : is becuse $n_r > n_V$

(A) B (B) A (C) C (D) D

(21). In which of the following cases a man will not see image grater than himself.

(A) convex mirror (B) concave mirror (C) plane mirror (D) none of these

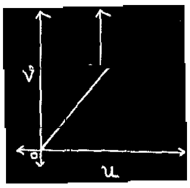
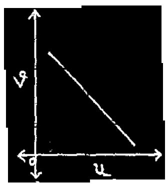
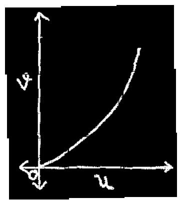
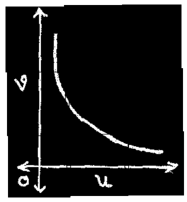
(22). A glass slab $(n = 1.5)$ of thikness 9 cm is placed over a written paper what is the Shift in the latters ?

(A) 6 cm (B) 3 cm (C) 2 cm (D) 0 cm

(23). A concave mirror of focal length 20 cm forms an virtual image having twice the linear dimensions of the object, the position of the object will be __________cm

(A) 7.5 (B) -10 (C) 10 (D) -7.5

(24). In experiment to find focal length of a concave mirror a graph is drawn between the magnitude of u and v. The graph looks like__________.

(A)  (B)  (C)  (D) 

(25). A mark at the bottom of the liquid appears to rise by 0.2 m, If depth of the liquid is 2.0 m then refractive index of the liquid is_______________.

(A) 1.80 (B) 1.60 (C) 1.33 (D) 1.11

(26). A Sound wave travels from air to water. the angle of incidence is α_1 and the angle of reflection is α_2 If the snell's Law is valid then,_________________.

(A) $\alpha_1 \geq \alpha_2$ (B) $\alpha_1 = \alpha_2$ (C) $\alpha_1 > \alpha_2$ (D) $\alpha_1 < \alpha_2$

(27). 1.6 is a refractive index of plano-convex lens, then the redius of curvature of the curved sunface is 60 cm. The focal length of the lens is______ cm

(A) 50 (B) 100 (C) -50 (D) -100

(28). One convex lens and one concave lens placed is contect with eachother. If the ratio of their power is $2/3$ and focal length of the combination is 30 cm, then individual focal lengths are_________.

(A) 15 cm and -10 cm (C) 30 cm and -20 cm

(B) -15 cm and 10 cm (D) -30 cm and -30 cm

(29). A thin prism of 3°, angle made from glass of refractive index 1.5 is combined with another thin prism made from glass of refractive index 1.3 to produce dispersion without deveation. what is the angle of Prism of second prism.

(A) 3° (B) -3° (C) -5° (D) 5°

(30). If a ray of light is incident on a plane mirror at an angle of 30° then deviation produced by a plane mirror is___________.

(A) 60° (B) 90° (C) 120° (D) 150°

(31). The frequency of a light wave in a material is 4×10^{14} H_z and wavelensth is 5000 A°. The refractive index of material will be___________ (take $c = 3\times10^{8}$ ms^{-1})

(A) 1.5 (B) 1.7 (C) 1.33 (D) None of thense

32. Mono chromatic light of wavelength 399 nm is incident from air on a water $(n = 1.33)$ Surface. The wavelength of refracted light is _______________nm

(A) 300 (B) 600 (C) 333 (D) 443

33. If the refractive index of a material of an equilateral Prism is $\sqrt{3}$, then angle of minimum deviation will be____________.

(A) 50° (B) 60° (C) 39° (D) 49°

34. If the critical angle for total internal reflection from a medium to vacuum is 30° then velocity of light in the medium is ____________ms^{-1} (take $c = 3.0\times10^{8}$ ms^{-1})

(A) 2.0×10^{8} (B) 1.5×10^{8} (C) 10^{8} (D) 1.5×10^{-8}

35. A ray of light passes from glass $(n = 1.5)$ to medium $(n = 1.60)$ The value of the critical angle of glass is__________.

(A) $\sin^{-1}\left(\frac{16}{15}\right)$ (B) $\sin^{-1}\sqrt{\frac{16}{15}}$ (C) $\sin^{-1}\left(\frac{1}{2}\right)$ (D) $\sin^{-1}\left(\frac{15}{16}\right)$

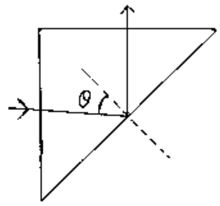
36. A double convex lens of focal length 6 cm is made of glass of refractive index 1.5, The radius of curvature of one surface is double than that of the other surface. The value of small radius of curvature is________.

(A) 6 (B) 9 (C) 12 (D) 4.5

37. When a ray of light enters in a transperent medium of refractive index n, then it is observed that the angle of refraction is half of the angle of incidence. The value of angle of incidence will be ________.

(A) $2\cos^{-1}\left(\frac{n}{2}\right)$ (B) $\cos^{-1}\left(\frac{n}{2}\right)$ (C) $2\sin^{-1}\left(\frac{n}{2}\right)$ (D) $\sin^{-1}\left(\frac{n}{2}\right)$

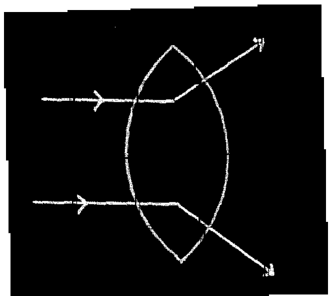
38. A prsim of glass is shown in figure A, ray incident normally on one face is totally reflected. If θ is 45°, the index of refraction of glass is____________.



(A) $<\sqrt{2}$ (B) $>\sqrt{2}$

(C) = 2 (D) None of these

39. A convex lens made up of a material of refractive index n_1 is immersed in a medium of refractive index n_2 as shown in the figure. The relation between n_1 and n_2 is__________.



(A) $n_1 = \sqrt{n_2}$ (B) $n_1 = n_2$

(C) $n_1 < n_2$ (D) $n_1 > n_2$

40. Two plano–convex lenses of radius of curvature R and refractive index $n = 1.5$ will have equivalent focal length equal to R, when they are placed__________.

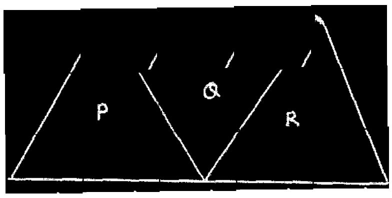
(A) at distance R (C) at distance $R/4$

(B) at distance $R/2$ (D) in contact with each other

41. A double convex lens made of glass of refractive index 1.6 has radius of curvature 15 cm each. The focal length of this lens when immersed in a fluid of refractive index 1.63 is___________.

(A) –40.75 (B) –407.5 (C) –125 (D) 12.5

42. One ray of light suffers minimum deviation in an equilateral prism P additlonal prism Q and R of indentical shown in fiqure. The ray will now suffer____________.



(A) greater devaition (C) total internal reflection

(B) same divaition as before (D) no devaition

43. Which of the following colours is scattered minimum ?

(A) Violet (B) red (C) blue (D) yellow

44. Angle of minimum devaition for a prism refractive index 1.5 is equal to the angle of the prism Then the angle of prism__________ $\left(given,\ \sin 48^\circ\ 36' = 0.75\right)$

(A) 62° (B) 82° (C) 60° (D) 41°

45. In a thin prism of glass (a_{ng} = 1.5) which of the following relation between the angle of minimum deviation δm and the angle of refraction r will be correct ?

(A) $\delta_m = \frac{r}{2}$ (B) $\frac{\delta_m}{2} = r$ (C) $\delta_m = 1.5\,r$ (D) $\delta_m = r$

46. An observer look at a tree of height 10 meters away with a telescope of magnifying power 10. To him, the tree appears______________.

(A) 10 times taller (B) 10 times smaler (C) 10 times nearer (D) 20 times nearer

47. A normal person wants to see two pillars at a distant 11 km away separately. The distance between two pillars should be approximately_________.

(A) 1 m (B) 3.2 m (C) 0.5 m (D) 1.6 m

48. When the length of microscope tube increases, its magnifying power________.

(A) decreases (B) increaes (C) does not change (D) none of these

49. The focal lengths of objective and the eye–piece of a compound microscpe are fo and fe raspectively. Then___________.

(A) $F_o > F_e$ (B) $F_o < F_e$ (C) $F_o = F_e$ (D) none of these

50. The magnifying power of a telescope is 9.0 when it is focussed for parallel rays, then the dictance between its objective and eye–piece is 20 cm The focal lengths of lenses will be___________.

(A) 15 cm, 5 cm (B) 18 cm, 2 cm (C) 10 cm, 5 cm (D) 11 cm, 9 cm

51. A plano convex lens of f = 20 cm is silvered at plane surface New f will be___________cm

(A) 20 (B) 40 (C) 30 (D) 60

52. A ray of light from denser medium strikes a rarer medium at angle of incidence i. The reflected and refracted rays make an angle of 90° with each other The angle of reflection and refration are r and r' respectively. The crictical angle is ________________.

(A) $\sin^{-1}$ (tan p) (B) $\tan^{-1}$ (tan r) (C) $\tan^{-1}$ (sin i) (D) $\sin^{-1}$ (tan r)

53. Relation between critical angle of water C_w and that of the glass C_g is _________. (given, $n_w = 4/3$, $n_g = 1.5$)

(A) $C_w < C_g$ (B) $C_w = C_g$ (C) $C_w > C_g$ (D) $C_w = C_g = O$

54. The radius of curvature of convex surface of a thin plano–convex lens is 15 cm and refractve index of its material is 1.6 The power of the lens will be___________.

(A) 6 D (B) 5 D (C) 4 D (D) 3 D

55. A ray of light passes through a prism having refractive index $\left(n=\sqrt{2}\right)$, Suffers minimum deviation If angle of incident is double the angle of refration within prism then angle of prism is____________.

(A) 30° (B) 60° (C) 90° (D) 180°

56. An air bubble inside glass slab $(n=1.5)$ appear from one side at 6 cm and from other side at 4 cm. Then the thikness of glass slab is____________cm

(A) 5 (B) 10 (C) 15 (D) 20

57. The magnifying power of objective of a compound microscope is 5.0 If the maginfying power of microscope is 30, then magnifying power of eye–piece will be_________.

(A) 3 (B) 6 (C) 9 (D) 12

58. Light of certain colour contain 2000 waves in the length of 1 mm in air. What will be the wavelength of this light in medium of refractive index 1.25 ?

(A) 1000 $\mathring{A}$ (B) 2000 $\mathring{A}$ (C) 3000 $\mathring{A}$ (D) 4000 $\mathring{A}$

59. In each of the following questions match columm-I and columm-II and select the correct match out of the four given choices.

Columm : I	Columm : II
(i) Snell's Law	(a) Frequency remais unaffected
(ii) In vacum	(b) n = sini/sinr
(iii) In glass	(c) $v_{violet} = v_{red}$
(iv) In going form one medium	(d) $v_{violet} < v_{red}$

(A) i–a, ii–b, iii–c, iv–d (C) i–b, ii–c, iii–d, iv–a

(B) i–d, ii–c, iii–b, iv–a (D) i–c, ii–b, iii–d, iv–a

60.

Columm – I	Columm – II
(i) While going from rarer to denser medium	(a) wavelength charger
(ii) While going from denser to rarer medium	(b) $= \frac{C}{V}$
(iii) While going to one medium to another	(c) Ray bends towards normal
(iv) Refractive index of medium	(d) Ray bends away from normal

(A) i–c, ii–d, iii–b, iv–a (C) i–d, ii–c, iii–b, iv–a

(B) i–a, ii–b, iii–c, iv–d (D) i–b, ii–c, iii–a, iv–d

61.

Columm – I	Columm – II
(i) Mean deviation	(a) $(n-1)A+(n'-1)A'=0$
(ii) Angular dispersion	(b) $\frac{n_v - n_r}{n-1}$
(iii) Dispersive power	(c) $(n_v - n_r)A$
(iv) Condition for no deviation	(d) $(n-1)A$

(A) i–c, ii–d, iii–b, iv–a (C) i–c, ii–b, iii–a, iv–d

(B) i–a, ii–b, iii–c, iv–d (D) i–d, ii–c, iii–b, iv–d

62. A convex lens of glass $(n=1.5)$ has focal lergth 0.2 m The lens is immersed in water of refractive index 1.33. The change in the power of convex lens is ___________.

(A) 3.72 D (B) 4.62 D (C) 6.44 D (D) 1.86 D

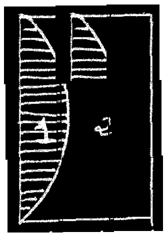
63. For a prism of refractive index $\sqrt{3}$, the angle of minimum deviation is eqviation is equal to the angle of prism, then angle of the prism is__________.

(A) 60° (B) 90° (C) 45° (D) 180°

64. A ray of light is incident normally on one of the faces of a solid prism of angle 30° and refractive index $\sqrt{2}$. The angle of minimum deviation is_________.

(A) 39° (B) 42° (C) 52° (D) 15°

65. A plano–convex lens has been fixed exactly into a plano–concave lens as shown in figure. Thier plane surface are parallel to each other. If both the lenses are made of different materials of refractive indices n_1 and n_2, R is the radius of curvature of the curved suface of the lens, their focal length of the combination will be________.



(A) $\dfrac{R}{2(n_1+n_2)}$ (B) $\dfrac{R}{n_1-n_2}$

(C) $\dfrac{R}{n_1+n_2}$ (D) $\dfrac{R}{2(n_1-n_2)}$

66. A concave mirror has a focal langth 30 cm The distance between the two position of the object for whi ch image size is double of the object is____________.

(A) 30 cm (B) 15 cm (C) –25 cm (D) –15 cm

67. A concave lens forms the image of an object such that the distance between the object and the image is 10 cm and the magnification produced is $\frac{1}{4}$, the focal length of lens will be_________cm

(A) –6.2 (B) –12.4 (C) –4.4 (D) –8.8

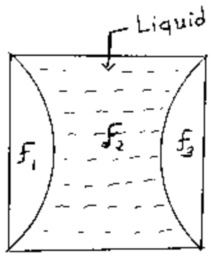
68. A prism of certain angle deviates the red and blue rays by 8° and 12° respectively. Another prism of the same prism angle deviates the red ligst at small angle and made of diffeunt materials The dispersive powers of the materials of the prisms are in the ratio________.

(A) 5:6 (B) 9:11 (C) 6:5 (D) 11:9

69. The head light of a jeep are 1.2 m apart. If the pupil of the eye of an objerver has a diameter of 2 mm and light of wavelength $5836\ A^\circ$ is used what should be the maximum distance of the jeep from the observer if two head lights are just seem to be separated apart ?

(A) 30.9 km (B) 33.4 km (C) 3.34 km (D) 30.9 km

70. The effective focal length of the lens combination shown in the curved surface of the plano convex lenses are 12 cm each and refractive index of the material of the lens is 1.5. the refractive index of liquid is_______.



(A) 1.33 (B) 1.42

(C) 1.53 (D) 1.60

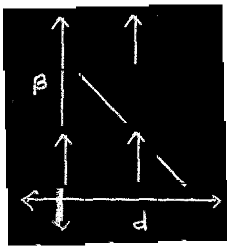
71. Interference is possible in___________.

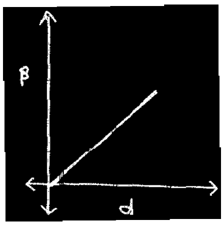
(A) light waves only
(B) Sound waves only
(C) both light and Sound waves
(D) nono of these

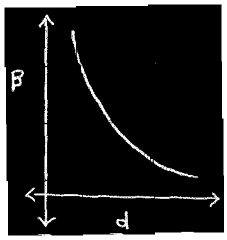
72. Huygin's wave theory of light can not explain_________phenomina.

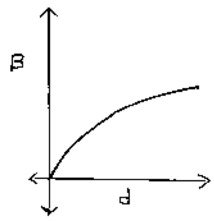
(A) Diffraction (B) Interference (C) palarization (D) Photoelectric effect

73. The correct curve between fring width β and distance between the slits d is shown below figure is_______.

(A) 

(B) 

(C) 

(D) 

74. The fringe width for red β_r $\left(\lambda_r = 8000\,A^\circ\right)$ and the fringe width for violct β_υ $\left(\lambda_\upsilon = 4000\,A^\circ\right)$ then $\frac{\beta_r}{\beta_\upsilon} =$ _________.

(A) 2:1 (B) 1:2 (C) 1:1 (D) $\sqrt{2}:1$

75. Wave ligth travels from an optically rarer medium to an optically denser medium its velocity decreaes because of change in___________.

(A) frequency (B) wavelensth (C) amplitude (D) phase

76. In young's double slite experiment if the width of 3^{rd} fringe is 10^{-2} cm, then the width of 5^{th} fringe will be_____________cm

(A) 10^{-2} (B) 5×10^{-2} (C) 2×10^{-2} (D) 10^{+2}

77. The young's double slit experiment is performed with blue and with green light of wavelensths $4360\ A^\circ$ and $5460\ A^\circ$ respectively. If x is the distance of 4^{th} maxima from the central one, then_______.

(A) $X_{blue} = X_{green}$ (B) $X_{blue} > X_{green}$ (C) $X_{blue} < X_{green}$ (D) none of these

78. The light waves from two coherent sources of same intensity interfere eachother. Then what will be maximam intensity when minimum intensity is zero ?

(A) 4 I (B) I (C) 4 I^2 (D) I^2

79. In young's doble Slit experiment the seventh maxima with wavelength λ_1, is at a distance d_1 and the same maxima with wavelength λ_2, is at a distance d_2 Then $\frac{d_1}{d_2} =$ ________ .

(A) $\frac{\lambda_2}{\lambda_1}$ (B) $\frac{\lambda_1^{\ 2}}{\lambda_2^{\ 2}}$ (C) $\frac{\lambda_2^{\ 2}}{\lambda_1^{\ 2}}$ (D) $\frac{\lambda_1}{\lambda_2}$

80. The wave length corressponding to photon is $0.016\ A^\circ$. Its K.E.____________ J.

($h = 6.66 \times 10^{-34}$ SI, $c = 3.0 \times 10^{8} ms^{-1}$)

(A) 1.237×10^{-13} (B) 1.237×10^{13} (C) 12.37×10^{-13} (D) $12.37 \times 10^{+13}$

81. In young's double slit experiment, phase diffrence between light waves reaching 3^{rd} bright fringe from central fringe with, is__________.($\lambda = 5000\,A^\circ$)

(A) zero (B) 2π (C) 4π (D) 6π

82. n^{th} bright fringe of red light $(\lambda_1 = 7500\,A^\circ)$ Coincides with $(n+1)^{th}$ bright fringe of green light $(\lambda_2 = 6000\ A^\circ)$. The value of n = ___________.

(A) 8 (B) 4 (C) 2 (D) I

83. Which of the following will undergo maximum diffration ?

(A) α - particle (B) γ - rays (C) radio waves (D) light waves

84. A Slit of width $12 \times 10^{-7}\,m$ is illminated by light of wavelenth $6000\ A^\circ$. The angular width of the central maxima is appoximately_________.

(A) 30° (B) 60° (C) 90° (D) 0°

85. The distance between the first and sixth minima in the diffraction pattern of a single slit, it is 0.5 mm. The screen is 0.5 m away from the Slit. If the wavelength of light is $5000\ A^\circ$, then the width of the slit will be______________mm

(A) 5 (B) 2.5 (C) 1.25 (D) 1.0

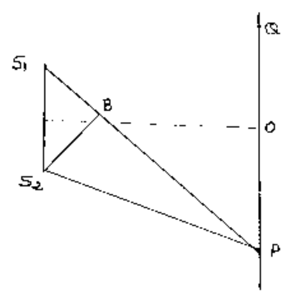
86. ___________change in the polarization phynomina of ligst ?

(A) intensity (B) wavelength (C) phase (D) frequency

87. In yong's double slit experiment the phase diffrence is constant between two sources is $\pi/2$. The intensity at a point equi distant from the slits in terms of max. intensity I_0 is____________.

(A) $3\ I_0$ (B) $I_0/2$ (C) I_0 (D) $3\,I_0/4$

88. In figure young's double slit experiment Q is the position of the first bright fringes on the right side of O, p is the 11^{th} fringe on the other side as measured from Q If $\lambda = 6000\ A^0$ then S_1B will be___________m



(A) 6.6×10^{-6} (B) 3.3×10^{-6}

(C) 6×10^{-6} (D) $6 \times 10^{+6}$

89. The two coherent sources of intensity β produce interference. The fringe visibeility will be________

(A) $2\ \beta$ (B) $\frac{\beta}{2}$ (C) $\sqrt{\beta}/_{1+\beta}$ (D) $2\sqrt{\beta}/_{1+\beta}$

90. Light of wave–length λ is incident on a slit of width d. The resulting diffraction pattern is observed on a screen placed at a distance D. The linear width of the principal maximum is equal to the width of the slit, then D = __________________.

(A) $d^2/_{2\lambda}$ (B) $2\lambda^2/_{d}$ (C) $d/_{\lambda}$ (D) $\frac{2\lambda}{d}$

91. A polariser is used for____________.

(A) producp polarised light
(C) produced unpolarised light
(B) produced unpolarised light
(D) none of these

92. Read the paragraph and chose the correct answer of the following quetions

In young expriment position of bright fringes is given by $x = n\lambda\frac{D}{d}$ and the positon of dark fringes is given by $x = (2n-1)\frac{\lambda}{2}\frac{D}{d}$ where n = 1,2,3.......... for first, second, third bright / dark fringe. The center of the fringe pattern is bright (for n = 0). The width of each briht/dark fringe is $\beta = \frac{\lambda D}{d}$, Where λ = 5000 A^0.

(i) If light of wavelength $6000\ A^{\circ}$ be used in the above experiment the fringe width would be______mm

(A) 0.36 (B) 3 (C) 0.6 (D) 6

(ii) with the light of wavelength $5000\ A^{\circ}$, If experiment were carried out under water of a $n = 4/_{3}$ the fringe width would be___________

(A) zero (B) $\frac{4}{3}$ times (C) $\frac{3}{4}$ times (D) none of these

93. The width of a single slit, if the first minimum is observed at an angle of 2° with a wavelength of light $6980\ A^{\circ}$ is__________mm

(A) 0.2 (B) 2×10^{-5} (C) 2×10^{5} (D) 0.02

94. In a fraunhofer diffraction by single slit of width d with incident light of wavelength $5500\ A^{\circ}$ the first minimum is observed at angle of 30°. The first secondary maximum is observed at an angle $\theta =$ _________.

(A) $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ (B) $\sin^{-1}\left(\frac{3}{4}\right)$ (C) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (D) $\sin^{-1}\left(\frac{1}{4}\right)$

95. The phenomenon of polarisation of electromagnetic waves proves that the electromagnetic waves are_______.

(A) mechanical (B) longitudial (C) transverse (D) nono of these

96. Light from two coherent Sources of the same amplitude A and wavelength λ, illuminates the Screen. The intensity of the central maximum is Io. If the sources were incoherent, the intensity at the same point will be__________.

(A) $I_0/2$ (B) $I_0/4$ (C) $4I_0$ (D) $2I_0$

97. When the angle of incidence is 60° on the Surface of a glass slab, it is found that the reflected ray is completely palarised. Then the velocity of light in glass is_____________ ms^{-1}

(A) $\sqrt{2}$ (B) $\sqrt{3}\times10^8$ (C) $\sqrt{3}$ (D) $\sqrt{2}\times10^8$

98. Two beams of Light of intensity I_1 and I_2 interfere to give an interference pattern. If the ratio of maximum intersity to that of minimum intensity is $\frac{16}{4}$ then I_1/I_2 = __________________

(A) 1:9 (B) 1:4 (C) 4:1 (D) 9:1

99. Which of the following phenomenon is used in optical fibres ?

(A) Reflection (B) Scatterting
(C) Total internal reflection (D) Interference

100. Two beams of light having intensities I and 4I interfere to produce a fringe pattern on a screen. The phase diffrence between the resultant intensities at A and B is____________.

(A) I (B) 4I (C) 2I (D) 6I

101. A sound source emits sound of 600 Hz frequency, this sound enters by opened door of width 0.75 m. Find the angle on one side at which fitst minimum is formed. The speed of sound = $300\,ms^{-1}$.

(A) 84.4° (B) 90° (C) 74.2° (D) 47.2°

102. A plane polarised light is incident normally on the tourmaline plate. its $\vec{E}$ vectors make an agnle of 45° with the optical axis of the plate. find the percentage difference between intial and final maximum values of $\vec{E}$ vectors.

(A) 19% (B) 92% (C) 50% (D) 29%

103. In Yong's double slit experiment, the inensity on screen at a point where path difference is λ, is K , What will be intensity at the point where path diffence is $\frac{\lambda}{4}$

(A) $\frac{K}{2}$ (B) 2 K (C) 4 K (D) zero

104. Ordinary light incident on a glass slab at the polarising angle, suffers a deviation of 22°. The value of angle of refracion in this case is__________.

(A) 44° (B) 34° (C) 22° (D) 11°

105. The ratio of inensities of rays emitted from two different coherent Sourees is α. For the inerference pattern by them, $\frac{Imax+Imin}{Imax-Imin}$ will be equal to _______________.

(A) $\frac{1+\sqrt{\alpha}}{2\alpha}$ (B) $\frac{1+\alpha}{2\alpha}$ (C) $\frac{1+\sqrt{\alpha}}{2}$ (D) $\frac{1+\alpha}{2\sqrt{\alpha}}$

KEY NOTES

1	D	26	D	51	C	76	A	100	B
2	C	27	B	52	D	77	C	101	D
3	B	28	B	53	C	78	A	102	D
4	D	29	C	54	C	79	D	103	A
5	A	30	C	55	C	80	A	104	C
6	B	31	A	56	C	81	D	105	D
7	C	32	A	57	B	82	B		
8	D	33	B	58	D	83	C		
9	B	34	B	59	C	84	B		
10	C	35	D	60	A	85	B		
11	D	36	D	61	D	86	A		
12	A	37	A	62	A	87	B		
13	B	38	B	63	A	88	C		
14	C	39	C	64	D	89	D		
15	D	40	D	65	B	90	A		
16	A	41	B	66	A	91	A		
17	A	42	B	67	C	92(i)	A		
18	B	43	B	68	C	92(ii)	C		
19	C	44	B	69	C	93	D		
20	D	45	D	70	D	94	B		
21	A	46	C	71	C	95	C		
22	B	47	B	72	D	96	A		
23	C	48	A	73	C	97	B		
24	D	49	A	74	A	98	D		
25	D	50	B	75	B	99	C		

HINTS

2. use $n = \frac{\lambda}{\lambda'}$.

5. No of image $= \frac{360^0}{\theta} = \frac{360^0}{0^0} = \infty$

11. Use $ho = \sqrt{h_1 h_2}$

22. Use, shift = $x\left(1 - \frac{1}{n}\right)$

25. Here, $n = \frac{h}{h'}$ $\quad \therefore \quad h' = 2.0 - 0.2 = 1.8 \quad \therefore \quad \frac{2}{1.5} = \frac{20}{18} = 1.11 = n$

26. Here, $i = \alpha_1 \qquad r = \alpha_2$ and $a\mu_w = \frac{V_a}{V_w}$ ________________ (i)

$$\text{Now} \quad a\mu_w = \frac{\sin i}{\sin r} = \frac{\sin \alpha_1}{\sin \alpha_2} \quad \text{\_\_\_\_\_\_\_\_} (ii)$$

$$\text{But} \quad \frac{Va}{Vw} < 1 \quad \therefore \quad \alpha_1 < \alpha_2$$

27. Here, $\frac{1}{f} = (1.6 - 1)\left(\frac{1}{60} - \frac{1}{\infty}\right) = \frac{1}{100} \quad \therefore \; f = 100$ cm

28. Here, $\frac{P_1}{P_2} = \frac{2}{3} \quad \therefore \; \frac{f_2}{f_1} = \frac{2}{3} \quad \therefore \; f_2 = \frac{2f_1}{3}$ _____(i)

Now, $\frac{1}{30} = \frac{-1}{f_1} + \frac{1}{\frac{2f_1}{3}} \quad \therefore \; f_1 = -15$ cm and $f_2 = 10$ cm

29. Here, $(n_1 - 1)A_1 + (n_2 - 1)A_2 = 0$

$\therefore \; 0.5\,A_1 + 0.3\,A_2 = 0 \qquad \therefore \; A_2 = \frac{-1.5}{0.3} = -5^o$

30. Here, $180 - 60^\circ = 120^\circ$

31. Use, $v = f\lambda$ and $n = \frac{c}{\upsilon}$

36. Use, $\therefore \frac{1}{f} = (n-1)\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$ take $R_1 = R_1,\ R_2 = -2R$

R = 4.5 cm

37. Here, $n = \sin/\sin r = \frac{\sin(i)}{\sin\left(\frac{i}{2}\right)} = \frac{2\ \sin\left(\frac{i}{2}\right).\cos\left(\frac{i}{2}\right)}{\sin\left(\frac{i}{2}\right)}$

$\therefore\ n = \cos\left(\frac{i}{2}\right) \qquad \therefore\ \frac{n}{2} = \cos\left(\frac{i}{2}\right) \qquad \therefore\ i = 2\cos^{-1}\left(\frac{n}{2}\right)$

38. Here, $i > \theta\ (= c) \quad = 45^0 \qquad \therefore\ n = \frac{1}{\sin c} = \sqrt{2}$

The value of critical angle (c) is minimum for 45°

$\therefore\ n > \sqrt{2}$

39. its divers the rays, $n_1 < n_2$

41. Here, $\frac{1}{fa} = (n - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = (1.6 - 1)\left(\frac{1}{15} \times \frac{1}{15}\right) = \frac{1.2}{15}$

$\therefore\ fa = 12.5cm$

Now, $\frac{f_2}{f_a} = \frac{(\ \ -1)}{\left(\frac{\ }{2}-1\right)} = \frac{1.6 - 1}{\left(\frac{1.6}{1.63} - 1\right)} = \frac{0.6\times1.63}{-0.03}$

$\therefore\ f_\ell = -20\ \times 1.63 \times 12.5 = -407.5\ \text{cm}$

43. wavelegth maximum, Scattering is minimum

44. Here, $n = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(A/2\right)} = \frac{\sin(A)}{\sin\left(\frac{A}{2}\right)} = \frac{2\sin\left(\frac{A}{2}\right).\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

$\frac{3}{4} = 2\cos\left(\frac{A}{2}\right),\ \frac{A}{2} = \cos^{-1}(0.75) = 41^o,\ \therefore\ A = 82^o$

45. Here $\delta m = r$ and $\delta = i_1 + i_2 - (r_1 - r_2)$

when $\delta = \delta m$ then $i_1 = i_2 = i \qquad r_1 = r_2 = r$

$$\therefore \delta m = 2i - 2r = 2nr - 2r \qquad \left(\therefore n = \frac{\sin i}{\sin p} = \frac{i}{r} \;\therefore\; i = nr\right)$$

$$= 2r\,(n-1) = 2r\left(\frac{3}{2} - 1\right)$$

$$\therefore \delta m = r$$

46. Here magnifying power is 10 there it can be seen 10 times near.

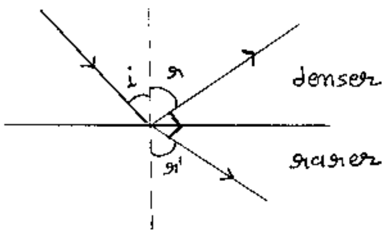
47. Use : $d = \dfrac{\pi D}{180^\circ \times 60^\circ} = 3.2$ m

51. Use $\dfrac{1}{f} = (n-1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) \quad \therefore R = 10$ cm

for rarer medium to denser, $-\dfrac{n_1}{u} + \dfrac{n_2}{\upsilon} = \dfrac{n_2 - n_1}{R} \quad (\therefore u = \infty \quad v = f)$

$$\therefore \frac{0 + 1.5}{f} = \frac{1.5 - 1}{10} \qquad \therefore f = 30 \text{ cm}$$

52.



$$\text{from fig} : 90^\circ - r + 90^\circ - r' = 90^\circ$$

$$\therefore r' = 90 - r$$

$$\therefore \text{now } \sin c = \sin i \big/ \sin(90 - r) \qquad = \frac{\sin i}{\cos(i)}$$

$$\therefore \sin c = \tan(i) = \tan(r) \qquad (\therefore i = r)$$

$$\therefore C = \sin^{-1}(\tan r)$$

53. Here $Cw = \sin^{-1}\left(\dfrac{1}{n_w}\right) = \sin^{-1}\left(\dfrac{3}{4}\right) = 48.6^\circ$

$$Cg = \sin^{-1}\left(\frac{1}{ng}\right) = 42^\circ \qquad \therefore Cw > Cg$$

54. Use $\dfrac{1}{f} = (n-1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) \qquad \therefore f = 0.25\,m, \quad P = 4D$

55. Use $\mu = \dfrac{\sin i}{\sin p} = \dfrac{\sin 2r}{\sin r} = \dfrac{2 \sin r . \cos r}{\sin r} = 2\cos r \qquad \therefore \cos = \dfrac{\sqrt{2}}{2} = \dfrac{1}{\sqrt{2}}$

$r = 45^\circ \quad \therefore\ A = 90^\circ$

56. Use $n = \dfrac{\text{Real depth}}{\text{apperntdepth}} = \dfrac{x}{y} \qquad \therefore\ x = ny = 15\ \text{cm}$

($\therefore$ apperent depth = 6+4=10)

58. Use $= \dfrac{\text{dis an t}}{\text{wave No.}} = 5000\ A^\circ$

Now $\lambda' = \dfrac{\lambda}{n} = 4000\ A^\circ$

62. Here, $wn_g = {}^{an_g}\!/_{an_g} = 1.128$

Now, $\dfrac{1}{fa} = (an_g - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) \quad \therefore\ \dfrac{1}{R_1} - \dfrac{1}{R_2} = 10$

and $\dfrac{1}{fw} = \left(w\,n_g\text{-}1\right)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right) = (1.128-1)\times 10 = 1.28$

then $\therefore\ Pa = \dfrac{1}{fa} = 5D$ and $Pw = 01.28 \quad \therefore\ Pa - Pw = 3.72\ D$

63. Use, $n = \dfrac{\sin\left(\dfrac{A+\delta m}{2}\right)/2}{\sin\left({}^{A}\!/_{2}\right)} = 2\cos\left(\dfrac{A}{2}\right) \qquad (\delta m = A)$

$\therefore \cos\left(\dfrac{A}{2}\right) = \dfrac{\sqrt{3}}{2} \quad \therefore\ A = 60^\circ$

64. Here, $i = 90^\circ \quad r_1 = 0, \qquad r_1 + r_2 = A, \ r_2 = 30^\circ$

Now, $n = \dfrac{\sin(i_2)}{\sin(r_2)} \qquad \therefore\ i_2 = 45^\circ$

$i + e = A + \delta m \qquad \therefore\ \delta m = 15^0$

65. Use $\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}=\frac{1}{n_1-1}\left(\frac{1}{\infty}+\frac{1}{R}\right)+(n_2-1)\left(\frac{1}{R}-\frac{1}{\infty}\right)$

$\therefore F = R/n_1 - n_2$

66. Here : For Real image $u=-\upsilon_1$, $\upsilon=2v_1$ $f=-30cm$

$\therefore \frac{-1}{-2u_1}-\frac{1}{u_1}=\frac{1}{-30}$ $\therefore u_1 = 45\ cm$

For virtul image $u=-u_2$ $\upsilon=+2\upsilon_2$ $f=-30$ cm

$\therefore \frac{-1}{u_2}+\frac{1}{2u_2}=-\frac{1}{30}$ $u_2=15$ cm

$u_1 - u_2 = 30$ cm

67.

Here, $m=\frac{1}{4}=\frac{\upsilon}{u}$ $\therefore u = 4v$

if $\upsilon=-x$ $u=-4x$ then

from figure, $|0\ I|$ = 4x-x , 3x = 10 cm $\therefore x=\frac{10}{3}\ cm$

Now, $u=4\upsilon=4x$ $(\therefore \text{formfig} : \upsilon=x)$

$=+40/3$ and $\upsilon=\frac{u}{4}=\frac{40}{3\times4}=\frac{-10}{3}cm$

$\therefore$ from $\frac{1}{f}=\frac{1}{u}-\frac{1}{\upsilon}$ $\therefore f = -4.4\,cm$

68. Use $\omega=\frac{\delta_V-\delta_V}{\delta}=\frac{2}{5}$ and $\omega'=\frac{\delta'\upsilon-\delta' v}{\delta'}=\frac{1}{3}$

$\therefore \frac{\omega}{\omega'}=6:5$

69. Use $d\theta=\frac{1.22\lambda}{D}=\frac{x}{r}$ where r = distant of jeep car $\therefore$ r = 3.34 km

70. For, plano-convex lens $\frac{1}{f_1}=\frac{1}{f_3}=(n-1)\left(\frac{1}{\infty}\times\frac{1}{R}\right)=\frac{1}{24}$

For, doble convex lens $\therefore \frac{1}{f_1}+\frac{1}{f_2}+\frac{1}{f_3}=\frac{-1}{60}$ $\therefore \frac{1}{f_2}=\frac{-1}{10}$

Now $\therefore \frac{1}{f_2}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$ $n=1.6$

80. A. Use K-E = $\frac{hc}{\lambda}$

82. Use $n\lambda_1 = (n+1)\frac{\lambda}{2}$ $\therefore$ n = 4

97. Here, n = tan $\theta_p = \sqrt{3}$, $n = \frac{c}{v}$ $\therefore$ $v = \sqrt{3} \times 10^8$

98. From $\frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2}$ 3 b = 9

Now $\therefore \frac{I_1}{I_2} = \frac{a^2}{b^2} = 9:1$

100. Here, $I_A = I_1 + I_2 + 2\sqrt{I_1 I_2} \quad \cos\frac{\pi}{2} = I \times 4I \times 2\sqrt{I \times 4I} \times \cos 90^\circ$

$I_A = 5I$

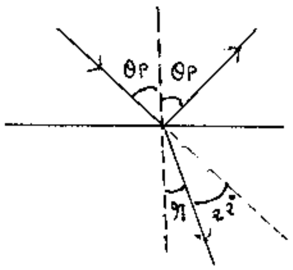
and, $I_B = 5I + 2\sqrt{I \times 4I} \times \cos\pi = 5I\text{-}4I = I$

$\therefore I_A - I_B = 4I$

102. $I = I_0 \cos^2\theta = \frac{I_0}{2}$ and $\frac{E^2}{E_0^2} = \frac{1}{2}$, $\frac{E}{E_0} = \frac{1}{\sqrt{2}}$

$\therefore \frac{|E - E_0|}{E_0} = 0.29 = 29\%$

104.



from Fig, $\theta p + 90^\circ + r = 180^\circ$

$\therefore$ $\theta p + r = 90^\circ$ and $\theta p - r = 22^\circ$

$\therefore$ $r = 34^\circ$

105. Here $\frac{I_1}{I_2} = \alpha$ $\therefore \frac{E_1}{E_2} = \sqrt{\alpha}$

and $\frac{E_1 + E_2}{E_1 - E_2} = \frac{\sqrt{\alpha}+1}{\sqrt{\alpha}-1}$ $\therefore \frac{I_{max}}{I_{min}} = \frac{(\sqrt{\alpha}+1)^2}{(\sqrt{\alpha}-1)^2}$

$\therefore \frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{2(\alpha+1)}{4\sqrt{\alpha}} = \frac{\alpha+1}{2\sqrt{\alpha}}$