CHAPTER

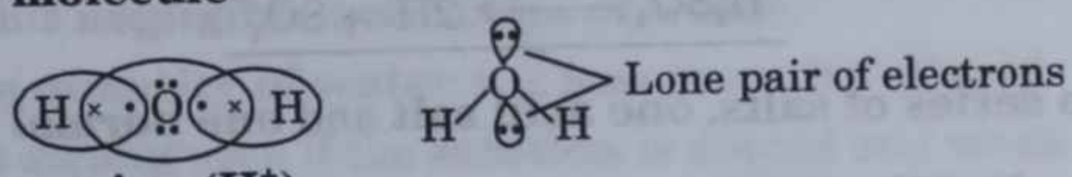
3

Study of Acids, Bases and Salts

IMPORTANT POINTS TO REMEMBER

1. **Acids :** The chemical compounds which on dissolving in water produce **Hydrogen ions** or **Hydronium ions** as the only positively charged particles. All acids essentially contain **Hydrogen**.
2. **Hydronium ion :** Hydronium ion is **hydrated hydrogen ion**. When hydrogen ion combines with water molecule it forms hydrated hydrogen ion called **hydronium ion**. The formation of hydronium ion takes place by the **coordinate bond** formation. In water molecule, oxygen atom has two lone pairs of electrons, oxygen atom shares one of its lone pair of electrons to hydrogen ion to complete its dublet thereby the formation of hydronium ion takes place.

(*i*) Formation of Water molecule

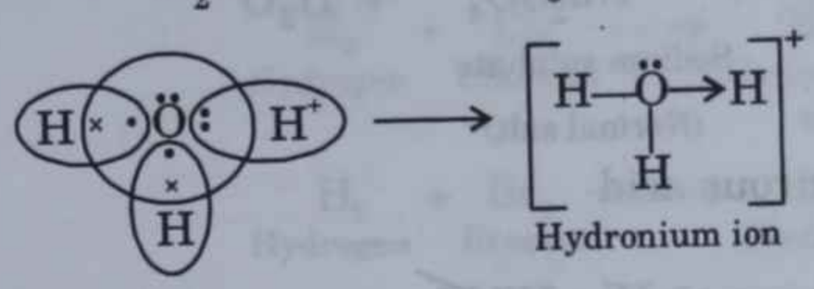


(*ii*) Formation of Hydrogen ion (H^+)

$$H - e^- \longrightarrow H^+$$

(*iii*) Formation of Hydronium ion

$$H_2O + H^+ \longrightarrow H_3O^+$$



3. Acids can be classified on the basis of
   (*i*) Strength of an acid **(*ii*) Basicity** of an acid **(*iii*) Concentration**
4. **Strong acids** are those which almost **completely ionized** in their aqueous solutions. The solution of strong acid contains **mostly ions**. *e.g.*, Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3).
5. **Weak acids** are those which **partially or incompletely ionized** in their aqueous solutions. The solution of weak acid contains **ions as well as molecules**, *e.g.*, Acetic acid (CH_3COOH), Sulphurous acid (H_2SO_3), Carbonic acid (H_2CO_3).
6. **Basicity of an acid** is defined as the **number of replaceable Hydrogen ions present per molecule** of an acid in its aqueous solution.
7. **Monobasic acids :** Acids which contain only **one replaceable Hydrogen ion per molecule** are called **Monobasic acids**. *e.g.*, HCl, HNO_3, CH_3COOH

   Monobasic acids form **single series of salts**, *i.e.*, **normal salts**

$$NaOH + HCl \longrightarrow NaCl + H_2O$$
$$HCl \longrightarrow H^+ + Cl^-$$
$$NaOH + HNO_3 \longrightarrow NaNO_3 + H_2O$$
$$HNO_3 \longrightarrow H^+ + NO_3^-$$
$$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$$
$$CH_3COOH \longrightarrow CH_3COO^- + H^+$$

8. The names of the salts formed by some monobasic acids are given below :

Monobasic acids	*Salts*
(*i*) Nitric acid	Nitrate
(*ii*) Nitrous acid	Nitrite
(*iii*) Hydrochloric acid	Chloride
(*iv*) Acetic acid	Acetate
(*v*) Hydrobromic acid	Bromide
(*vi*) Hydrofluoric acid	Fluoride

9. Dibasic acids are those which contain **two replaceable Hydrogen ions per molecule** of an acid in its aqueous solution, *e.g*, H_2SO_4, H_2SO_3, H_2CO_3, etc.

For example (*i*) **Ionization of Sulphuric acid**

$$H_2SO_4 \longrightarrow H^+ + HSO_4^-$$
$$HSO_4^- \longrightarrow H^+ + SO_4^{2-}$$
$$H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$$

Dibasic acids form **two series of salts, one acid salt** and **one normal salt**

$$NaOH + H_2SO_4 \longrightarrow \underset{\text{Sodium bisulphate (Acid salt)}}{NaHSO_4} + H_2O$$

$$NaHSO_4 + NaOH \longrightarrow \underset{\text{Sodium sulphate (Normal salt)}}{Na_2SO_4} + H_2O$$

(*ii*) The ionization/dissociation of sulphurous acid

$$H_2SO_3 \rightleftharpoons H^+ + HSO_3^-$$
$$HSO_3^- \rightleftharpoons H^+ + SO_3^{2-}$$
$$H_2SO_3 \rightleftharpoons 2H^+ + SO_3^{2-}$$

$$NaOH + H_2SO_3 \longrightarrow \underset{\text{Sodium bisulphite}}{NaHSO_3} + H_2O$$

$$NaHSO_3 + NaOH \longrightarrow \underset{\text{Sodium sulphite}}{Na_2SO_3} + H_2O$$

10. The names of the salts formed by some dibasic acids are given below :

Dibasic acids	*Salts*
(*i*) Sulphuric acid	Bisulphate & Sulphate
(*ii*) Sulphurous acid	Bisulphite & Sulphite
(*iii*) Carbonic acid	Bicarbonate & Carbonate
(*iv*) Hydrogen sulphide	Bisulphide & Sulphide

11. Tribasic acids : The acids which ionize on dissolving in water to produce **three replaceable Hydrogen ions per molecule** of an acid are called **tribasic acids,** *e.g.*, H_3PO_4.

Ionization of Phosphoric acid

$$H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$$

$$H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}$$

$$HPO_4^{2-} \rightleftharpoons H^+ + PO_4^{3-}$$

$$H_3PO_4 \rightleftharpoons 3H^+ + PO_4^{3-}$$

Tribasic acids form **two different acid salts** and **one normal salt.**

$$NaOH + H_3PO_4 \longrightarrow \underset{\text{(Acid salt)}}{NaH_2PO_4} + H_2O$$

$$NaH_2PO_4 + NaOH \longrightarrow \underset{\text{(Acid salt)}}{Na_2HPO_4} + H_2O$$

$$Na_2HPO_4 + NaOH \longrightarrow \underset{\text{(Normal salt)}}{Na_3PO_4} + H_2O$$

12. **Concentration** of an acid is the measure of the amount of water present in the acid.
13. **Concentrated acid** contains **negligible quantities of water**.
14. **Dilute acid** contains **more quantity of water** and **less quantity of acid**.
15. **Strong acid** will **remains strong** even if the **solution** is diluted and **weak acid** will **remains weak** even if the **solution** is **concentrated.**
16. **Methods of preparation of acids :** Acids are generally prepared by the following methods :

(*a*) By synthesis or **direct combination :**

$$\underset{\text{Hydrogen}}{H_2} + \underset{\text{Chlorine}}{Cl_2} \longrightarrow \underset{\text{Hydrochloric acid}}{2HCl}$$

$$\underset{\text{Hydrogen}}{H_2} + \underset{\text{Bromine}}{Br_2} \longrightarrow \underset{\text{Hydrobromic acid}}{2HBr}$$

$$\underset{\text{Hydrogen}}{H_2} + \underset{\text{Boiling sulphur}}{S} \longrightarrow \underset{\text{Hydrogen sulphide}}{H_2S}$$

(*b*) By dissolving acidic oxide or **acid anhydride in water:**

Acidic oxides are also called as acid anhydrides. Acidic oxides on dissolving in water produces acids.

$$\underset{\text{Carbon dioxide}}{CO_2} + H_2O \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3}$$

$$\underset{\text{Sulphur dioxide}}{SO_2} + H_2O \longrightarrow \underset{\text{Sulphurous acid}}{H_2SO_3}$$

$$\underset{\text{Phosphorus pentaoxide}}{P_2O_5} + 3H_2O \longrightarrow \underset{\text{Phosphoric acid}}{2H_3PO_4}$$

$$\underset{\text{Nitrogen dioxide (Mixed anhydride)}}{2NO_2} + H_2O \longrightarrow \underset{\text{Nitrous acid}}{HNO_2} + \underset{\text{Nitric acid}}{HNO_3}$$

(*c*) By the reaction of non-volatile acid with the salts of more volatile acids :

Concentrated sulphuric acid is the non-volatile or least volatile acid which reacts with metallic nitrates and metallic chlorides to form Nitric acid and Hydrochloric acid respectively.

$$\underset{\text{Rock salt}}{NaCl} + H_2SO_4(\text{conc.}) \xrightarrow[200°C]{\text{below}} NaHSO_4 + \underset{\text{Hydrochloric acid}}{HCl}$$

$$\underset{\text{Nitre}}{KNO_3} + H_2SO_4(\text{conc.}) \xrightarrow[200°C]{\text{below}} KHSO_4 + \underset{\text{Nitric acid}}{HNO_3}$$

(*d*) **By the oxidation of non-metals :** Non-metals on reaction with concentrated acids get oxidized to respective oxyacids.

$$C + 2H_2SO_4(\text{conc.}) \longrightarrow CO_2 + 2H_2O + \underset{\text{dioxide}}{\overset{\text{Sulphur}}{2SO_2}}$$

$$C + 4HNO_3(\text{conc.}) \longrightarrow CO_2 + 2H_2O + \underset{\text{dioxide}}{\overset{\text{Nitrogen}}{4NO_2}}$$

$$S + 6HNO_3(\text{conc.}) \longrightarrow \underset{\text{acid}}{\overset{\text{Sulphuric}}{H_2SO_4}} + 2H_2O + 6NO_2$$

$$P + 5HNO_3(\text{conc.}) \longrightarrow \underset{\text{acid}}{\overset{\text{Phosphoric}}{H_3PO_4}} + 5NO_2 + H_2O$$

17. The **physical properties** of an **acid** are

(*i*) They are **sour** in taste.

(*ii*) They are **corrosive** in nature.

(*iii*) They show characteristic colour change with indicators.

Acids show characteristic colour change with indicators.

Name of Indicator	*Colour change*
1. Blue litmus	Red
2. Phenolphthalein	Colourless
3. Methyl orange	Red or Pink

18. The typical chemical properties of a dilute acid are :

(*a*) **Reaction with active metals :** Dilute acids (except dilute nitric acid) on reaction with active metals produce a colourless and odourless gas which burns with a popping sound.

$$Fe + 2HCl(\text{dil.}) \longrightarrow FeCl_2 + H_2\uparrow$$

$$Mg + 2HCl(\text{dil.}) \longrightarrow MgCl_2 + H_2\uparrow$$

$$Zn + 2HCl\ (\text{dil.}) \longrightarrow ZnCl_2 + H_2\uparrow$$

$$Fe + H_2SO_4(\text{dil.}) \longrightarrow FeSO_4 + H_2\uparrow$$

$$Mg + H_2SO_4(\text{dil.}) \longrightarrow MgSO_4 + H_2\uparrow$$

$$Zn + H_2SO_4(\text{dil.}) \longrightarrow ZnSO_4 + H_2\uparrow$$

Nitric acid on reaction with metals produce oxides of nitrogen and water as it is a strong oxidizing agent. Only Magnesium and Manganese react with very dilute nitric acid to liberate hydrogen.

$$Mg + 2HNO_3\ (\text{v dil.}) \longrightarrow Mg(NO_3)_2 + H_2\uparrow$$

$$Mn + 2HNO_3\ (\text{v dil.}) \longrightarrow Mn(NO_3)_2 + H_2\uparrow$$

(*b*) **Reaction with bases :** Dilute acids react with bases to form salt and water as the only products and the reaction is called as **neutralization reaction.**

$$NaOH + HCl\ (\text{dil.}) \longrightarrow NaCl + H_2O$$

$$KOH + HCl\ (\text{dil.}) \longrightarrow KCl + H_2O$$

$$NH_4OH + HCl\ (\text{dil.}) \longrightarrow NH_4Cl + H_2O$$

$$NaOH + HNO_3\ (\text{dil.}) \longrightarrow NaNO_3 + H_2O$$

$$KOH + HNO_3\,(dil.) \longrightarrow KNO_3 + H_2O$$
$$NH_4OH + HNO_3\,(dil.) \longrightarrow NH_4NO_3 + H_2O$$
$$2NaOH + H_2SO_4\,(dil.) \longrightarrow Na_2SO_4 + 2H_2O$$

Ionic equation

$$Na^+ OH^- + H^+ Cl^- \longrightarrow Na^+ Cl^- + H_2O$$

Deleting the spectator ions

$$OH^- + H^+ \longrightarrow H_2O$$

In neutralization reaction, Hydroxyl ion derived from base and Hydrogen ion derived from an acid combine to form unionized water molecule.

(*c*) **Reaction with metallic oxides :** Metallic oxides react with acids to form salt and water.

$$CuO + H_2SO_4\,(dil.) \longrightarrow CuSO_4 + H_2O$$
$$ZnO + 2HCl\,(dil.) \longrightarrow ZnCl_2 + H_2O$$
$$MgO + H_2SO_4\,(dil.) \longrightarrow MgSO_4 + H_2O$$
$$CuO + 2HNO_3\,(dil.) \longrightarrow Cu(NO_3)_2 + H_2O$$

(*d*) **Reaction with metallic carbonates and bicarbonates :** Dilute acids react with metallic carbonates and bicarbonates to liberate a colourless, odourless gas with brisk effervescence which turns lime water milky.

$$CaCO_3 + 2HCl(dil.) \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$$
$$Na_2CO_3 + H_2SO_4\,(dil.) \longrightarrow Na_2SO_4 + H_2O + CO_2$$
$$CuCO_3 + 2HCl\,(dil.) \longrightarrow CuCl_2 + H_2O + CO_2$$
$$CaCO_3 + 2HCl\,(dil.) \longrightarrow CaCl_2 + H_2O + CO_2$$
$$KHCO_3 + H_2SO_4\,(dil.) \longrightarrow KHSO_4 + H_2O + CO_2$$
$$NaHCO_3 + HCl\,(dil.) \longrightarrow NaCl + H_2O + CO_2$$
$$CO_2\uparrow + \underset{\text{Lime water}}{Ca(OH)_2} \longrightarrow \underset{\substack{\text{(White ppt.)}\\ \text{milkiness}}}{CaCO_3} + H_2O$$

(*e*) **Reaction with metallic sulphites and bisulphites :** Dilute acids react with metallic sulphites and bisulphites to liberate a colourless gas having burnt Sulphur smell which turns acidified Potassium dichromate from orange to green and Potassium permanganate solution from purple to colourless, *i.e.*, it decolourizes.

$$\underset{\substack{\text{Sodium}\\ \text{sulphite}}}{Na_2SO_3} + H_2SO_4(dil.) \longrightarrow \underset{\substack{\text{Sodium}\\ \text{sulphate}}}{Na_2SO_4} + H_2O + \underset{\substack{\text{Sulphur}\\ \text{dioxide}}}{SO_2}$$
$$\underset{\substack{\text{Potassium}\\ \text{sulphite}}}{K_2SO_3} + 2HCl\,(dil.) \longrightarrow \underset{\substack{\text{Potassium}\\ \text{chloride}}}{2KCl} + H_2O + SO_2$$
$$\underset{\substack{\text{Potassium}\\ \text{bisulphite}}}{2KHSO_3} + H_2SO_4\,(dil.) \longrightarrow \underset{\substack{\text{Potassium}\\ \text{sulphate}}}{K_2SO_4} + 2H_2O + 2SO_2$$
$$\underset{\substack{\text{Sodium}\\ \text{bisulphite}}}{NaHSO_3} + HCl\,(dil.) \longrightarrow \underset{\substack{\text{Sodium}\\ \text{chloride}}}{NaCl} + H_2O + SO_2$$
$$\underset{\substack{\text{Potassium}\\ \text{dichromate}\\ \text{(Orange)}}}{K_2Cr_2O_7} + 3SO_2 + H_2SO_4 \longrightarrow K_2SO_4 + \underset{\substack{\text{Chromium}\\ \text{sulphate}\\ \text{(Green)}}}{Cr_2(SO_4)_3} + H_2O$$
$$\underset{\substack{\text{Potassium}\\ \text{permanganate}\\ \text{(Purple)}}}{2KMnO_4} + 2H_2O + 5SO_2 \longrightarrow \underset{\substack{\text{Potassium}\\ \text{sulphate}}}{K_2SO_4} + \underset{\substack{\text{Manganese}\\ \text{sulphate}\\ \text{(Colourless)}}}{2MnSO_4} + 2H_2SO_4$$

(f) Reaction with metallic sulphides and bisulphides : Dilute acids combine with metallic sulphides and bisulphides to form a colourless gas having rotten egg smell which turns lead acetate solution black.

$$FeS + 2HCl\,(dil.) \longrightarrow \underset{\text{Ferrous chloride}}{FeCl_2} + \underset{\text{Hydrogen sulphide}}{H_2S}$$

$$\underset{\text{Sodium bisulphide}}{NaHS} + HCl\,(dil.) \longrightarrow \underset{\text{Sodium chloride}}{NaCl} + \underset{\text{Hydrogen sulphide}}{H_2S}$$

$$\underset{\text{Potassium bisulphide}}{2KHS} + H_2SO_4\,(dil.) \longrightarrow \underset{\text{Potassium sulphate}}{K_2SO_4} + \underset{\text{Hydrogen sulphide}}{2H_2S}$$

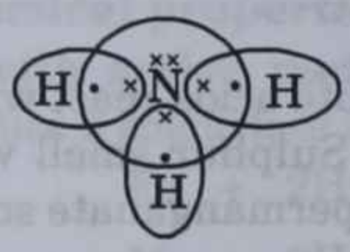
$$H_2S + \underset{\substack{\text{Lead acetate}\\\text{(Colourless)}}}{(CH_3COO)_2Pb} \longrightarrow \underset{\text{Acetic acid}}{2CH_3COOH} + \underset{\substack{\text{Lead sulphide}\\\text{(Black)}}}{PbS}$$

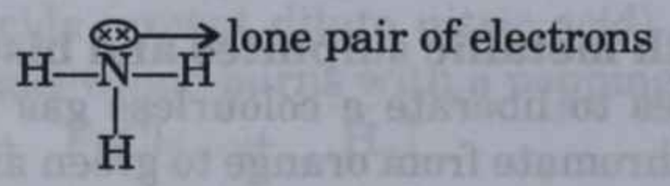
19. The **metallic hydroxides** and **metallic oxides** are called **bases**. The general formula of metallic hydroxide is $M(OH)_x$, where x is the valency of metal.
20. **Soluble bases** are called **alkalies**, *e.g.*, NaOH, KOH, NH_4OH and $Ca(OH)_2$. $Ca(OH)_2$ is sparingly soluble.
21. **Alkalies :** These are the **soluble bases**. The compounds which on dissolving in water produce **hydroxyl ions** as the only negatively charged particles.

$$NaOH \longrightarrow Na^+ + OH^-$$
$$KOH \longrightarrow K^+ + OH^-$$
$$NH_4OH \longrightarrow NH_4^+ + OH^-$$

22. **Ammonium ion :** The ammonium ion is formed between ammonia molecule and hydrogen ion. In ammonia there are three single covalent bonds between nitrogen and hydrogen and one lone pair of electrons on nitrogen atom. The hydrogen ion shares lone pair of electrons from nitrogen atom to complete its dublet by a **coordinate bond formation** thereby leading to the formation of an ammonium ion.

(i) Formation of Ammonia molecule

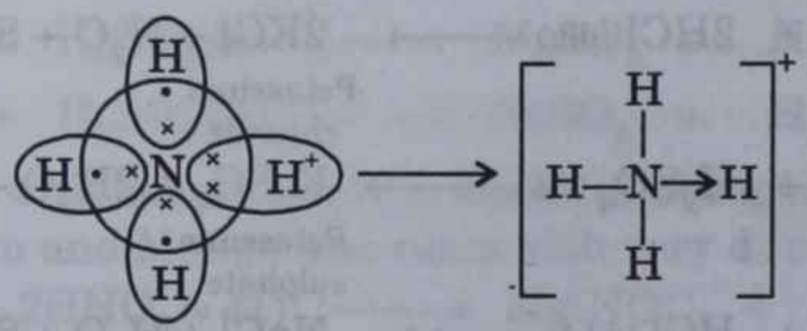




(ii) Formation of Hydrogen ion

$$H + e^- \longrightarrow H^+$$

(iii) Formation of Ammonium ion



23. Bases are classified on the basis of their **strength, acidity and concentration**.
24. **Strong bases :** The bases which almost **completely ionized** in their aqueous solutions are called **strong bases**. The solution of strong base contains **mostly ions**, *e.g.*, NaOH, KOH.
25. **Weak bases :** The bases which **incompletely** or **partially ionized** in their aqueous solutions are called **weak bases**. The solution of weak base contains **ions as well as molecules**, *e.g.*, NH_4OH, $Cu(OH)_2$.
26. **Acidity of a base :** The **number of replaceable Hydroxyl ions present per molecule** of a base in its aqueous solution is called **acidity of a base**. In case of **water insoluble bases**, the **acidity is equal to the number of Hydroxyl ions present per molecule** of a base.

27. Monoacidic bases : The bases which contain only one hydroxyl ion in per molecule of a base.

$$NaOH \longrightarrow Na^+ + OH^-$$

$$KOH \longrightarrow K^+ + \underset{\text{Hydroxyl ion}}{OH^-}$$

28. Diacidic bases : The bases which contain two hydroxyl ions in per molecule of a base.

$$Ca(OH)_2 \longrightarrow Ca^{2+} + 2OH^-$$

$$Mg(OH)_2 \longrightarrow Mg^{2+} + 2OH^-$$

29. Triacidic bases : The bases which contain three hydroxyl ions in per molecule of a base.

$$\underset{\text{Ferric hydroxide}}{Fe(OH)_3} \longrightarrow Fe^{3+} + 3OH^-$$

$$\underset{\text{Aluminium hydroxide}}{Al(OH)_3} \longrightarrow Al^{3+} + 3OH^-$$

30. Methods of preparation of bases : Bases are generally prepared by the following methods:

(*a*) Reaction of metals with oxygen : Metals like sodium, potassium and calcium burn in oxygen to form their respective oxides.

$$4K + O_2 \longrightarrow 2K_2O$$

$$2Ca + O_2 \longrightarrow 2CaO$$

(*b*) By the reaction of water with soluble metallic oxides and ammonia : Soluble basic oxides and ammonia on dissolving in water produces soluble bases.

$$Na_2O + H_2O \longrightarrow 2NaOH$$

$$K_2O + H_2O \longrightarrow 2KOH$$

$$NH_3 + H_2O \longrightarrow NH_4OH$$

(*c*) By the reaction of water on metals : Active metals react with water to displace hydrogen and form metallic hydroxide or metallic oxide depending on the nature of metal and the conditions of temperature.

$$2Na + \underset{\text{(cold)}}{2H_2O} \longrightarrow 2NaOH + H_2\uparrow$$

$$2K + \underset{\text{(cold)}}{2H_2O} \longrightarrow 2KOH + H_2\uparrow$$

$$Ca + \underset{\text{(cold)}}{2H_2O} \longrightarrow Ca(OH)_2 + H_2\uparrow$$

$$Zn + \underset{\text{(steam)}}{H_2O} \longrightarrow \underset{\text{Zinc oxide}}{ZnO} + H_2\uparrow$$

$$\underset{\text{heated}}{3Fe} + \underset{\text{(steam)}}{4H_2O} \rightleftharpoons \underset{\text{Triferric tetraoxide}}{Fe_3O_4} + 4H_2\uparrow$$

(*d*) By the precipitation of metallic hydroxides from their soluble salts : In this case, **interchange** of **radicals** in solution takes place, *i.e.*, **double decomposition** reaction takes place.

$$\underset{\text{Cupric nitrate}}{Cu(NO_3)_2} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Cupric hydroxide}}{Cu(OH)_2\downarrow} + \underset{\text{Sodium nitrate}}{2NaNO_3}$$

$$\underset{\text{Ferric chloride}}{FeCl_3} + \underset{\text{Ammonium hydroxide}}{3NH_4OH} \longrightarrow \underset{\text{Ferric hydroxide (Reddish brown)}}{Fe(OH)_3\downarrow} + \underset{\text{Ammonium chloride}}{3NH_4Cl}$$

$$\underset{\text{Magnesium sulphate}}{MgSO_4} + \underset{\text{Potassium hydroxide}}{2KOH} \longrightarrow \underset{\text{Magnesium hydroxide}}{Mg(OH)_2\downarrow} + \underset{\text{Potassium sulphate}}{K_2SO_4}$$

$$\underset{\text{Ferrous chloride}}{FeCl_2} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Ferrous hydroxide}}{Fe(OH)_2\downarrow} + \underset{\text{Sodium chloride}}{2NaCl}$$

(e) Thermal decomposition of metallic carbonates : Metallic carbonates on heating give their respective metallic oxides and carbon-dioxide gas is evolved.

$$\underset{\substack{\text{Zinc carbonate}\\\text{(White)}}}{ZnCO_3} \xrightarrow{\Delta} \underset{\substack{\text{Zinc oxide}\\\text{(Yellow-hot White-cold)}}}{ZnO} + CO_2\uparrow$$

$$\underset{\substack{\text{Lead carbonate}\\\text{(White)}}}{PbCO_3} \xrightarrow{\Delta} \underset{\substack{\text{Lead oxide}\\\text{(Reddish brown-hot Light yellow-cold)}}}{PbO} + CO_2\uparrow$$

$$\underset{\substack{\text{Copper carbonate}\\\text{(Green)}}}{CuCO_3} \xrightarrow{\Delta} \underset{\substack{\text{Copper oxide}\\\text{(Black-hot Black-cold.)}}}{CuO} + CO_2\uparrow$$

Carbon dioxide is a colourless and odourless gas which turns lime water milky.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

Sodium carbonate and **potassium carbonate** are **stable towards heat.**

(f) Thermal decomposition of metallic nitrates : Lead nitrate on heating **decripitates**, melts to give off reddish brown coloured gas having pungent suffocating smell. A residue is left behind which sticks to the glass tube. The residue is reddish brown or reddish yellow when hot, and light yellow when cold.

$$2Pb(NO_3)_2 \xrightarrow{\Delta} \underset{\substack{\text{(Reddish yellow-hot}\\\text{Light yellow-cold)}}}{2PbO} + 4NO_2 + O_2$$

Similarly,

$$2Zn(NO_3)_2 \xrightarrow{\Delta} \underset{\substack{\text{(Yellow - hot}\\\text{White - cold)}}}{2ZnO} + 4NO_2 + O_2$$

$$2Cu(NO_3)_2 \xrightarrow{\Delta} \underset{\substack{\text{(Black - hot}\\\text{Black - cold)}}}{2CuO} + 4NO_2 + O_2$$

The colour of the residues are summarized in the table given below :

Colour of the residue		
Name of the residue	*Hot*	*Cold*
1. Lead monoxide	Reddish brown/ Reddish yellow	Light yellow
2. Zinc oxide	Yellow	White
3. Copper oxide	Black	Black

Nitrogen dioxide turns freshly prepared acidified ferrous sulphate solution brown black.

$$FeSO_4 + NO_2 \longrightarrow \underset{\substack{\text{Nitroso ferrous sulphate}\\\text{(Brown black)}}}{FeSO_4.NO}$$

Sodium nitrate and potassium nitrate on heating forms their respective nitrite with the liberation of oxygen.

$$2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$$

$$2KNO_3 \xrightarrow{\Delta} 2KNO_2 + O_2$$

Silver nitrate and mercury nitrate on heating give their respective metal, nitrogen dioxide and oxygen.

$$2AgNO_3 \xrightarrow{\Delta} 2Ag + 2NO_2 + O_2$$

$$Hg(NO_3)_2 \xrightarrow{\Delta} Hg + 2NO_2 + O_2$$

31. The **physical properties** of bases are

(*i*) **bitter** to taste (*ii*) **slippery** to touch.

(*iii*) Soluble bases show characteristic colour change with indicators.

Name of Indicator	*Colour change*
1. Red litmus	Blue
2. Phenolphthalein	Pink
3. Methyl orange	Yellow

32. The chemical properties of bases are :

(*a*) Alkalies react with ammonium salts to liberate a colourless gas having pungent, irritating smell which turns **Nessler's reagent brown** and give **dense white fumes** with **concentrated HCl**.

$$\underset{\text{Salammoniac or Ammonium chloride}}{2NH_4Cl} + \underset{\text{Slaked lime}}{Ca(OH)_2} \xrightarrow{\Delta} \underset{\text{Calcium chloride}}{CaCl_2} + 2NH_3 + 2H_2O$$

$$\underset{\text{Ammonium chloride}}{NH_4Cl} + \underset{\text{Sodium hydroxide}}{NaOH} \xrightarrow{\Delta} \underset{\text{Sodium chloride}}{NaCl} + \underset{\text{Ammonia}}{NH_3} + H_2O$$

(*b*) Alkalies readily absorb carbon dioxide from atmosphere.

$$\underset{\text{Potassium hydroxide}}{2KOH} + CO_2 \longrightarrow \underset{\text{Potassium carbonate}}{K_2CO_3} + H_2O$$

$$\underset{\text{Sodium hydroxide}}{2NaOH} + CO_2 \longrightarrow \underset{\text{Sodium carbonate}}{Na_2CO_3} + H_2O$$

(*c*) Bases react with acids to form salt and water.

$$\underset{\text{Sodium hydroxide}}{2NaOH} + H_2SO_4 \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4} + 2H_2O$$

$$\underset{\text{Potassium hydroxide}}{KOH} + HNO_3 \longrightarrow \underset{\text{Potassium nitrate}}{KNO_3} + H_2O$$

$$\underset{\text{Zinc hydroxide}}{Zn(OH)_2} + H_2SO_4 \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + 2H_2O$$

$$\underset{\text{Copper hydroxide}}{Cu(OH)_2} + 2HNO_3 \longrightarrow \underset{\text{Copper nitrate}}{Cu(NO_3)_2} + 2H_2O$$

(*d*) Alkalies, *i.e.*, soluble bases precipitate different coloured insoluble bases from their soluble salts.

$$\underset{\text{Zinc chloride}}{ZnCl_2} + \underset{\text{Potassium hydroxide}}{2KOH} \longrightarrow \underset{\text{Zinc hydroxide (White ppt.)}}{Zn(OH)_2\downarrow} + 2KCl$$

$$\underset{\text{Iron (II) chloride}}{FeCl_2} + \underset{\text{Ammonium hydroxide}}{2NH_4OH} \longrightarrow \underset{\text{Ferrous hydroxide (Dirty green ppt.)}}{Fe(OH)_2\downarrow} + 2NH_4Cl$$

$$\underset{\text{Ferric chloride}}{FeCl_3} + \underset{\text{Sodium hydroxide}}{3NaOH} \longrightarrow \underset{\text{Ferric hydroxide (Reddish brown ppt.)}}{Fe(OH)_3\downarrow} + 3NaCl$$

$$\underset{\text{Copper sulphate}}{CuSO_4} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Copper hydroxide (Pale blue ppt.)}}{Cu(OH)_2\downarrow} + Na_2SO_4$$

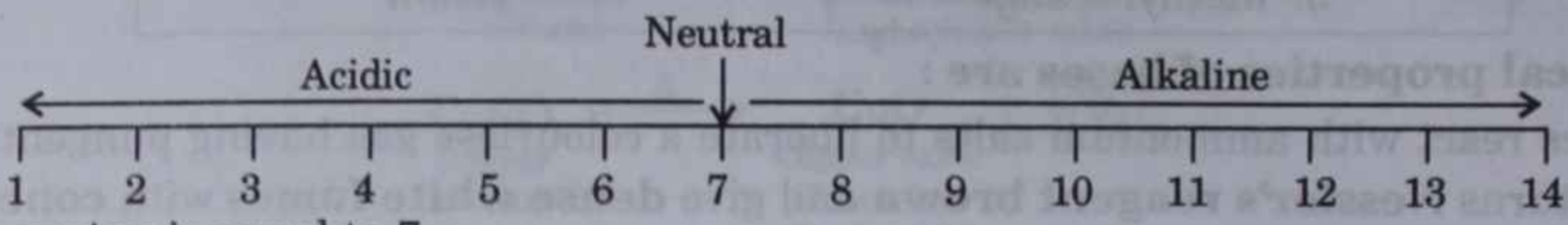
(*e*) Insoluble bases decompose on heating to form their respective metallic oxides and water.

$$\underset{\text{Zinc hydroxide}}{Zn(OH)_2} \xrightarrow{\Delta} \underset{\text{Zinc oxide}}{ZnO} + H_2O$$

$$\underset{\text{Copper hydroxide}}{Cu(OH)_2} \xrightarrow{\Delta} \underset{\text{Copper oxide}}{CuO} + H_2O$$

$$\underset{\text{Lead hydroxide}}{Pb(OH)_2} \xrightarrow{\Delta} \underset{\text{Lead oxide}}{PbO} + H_2O$$

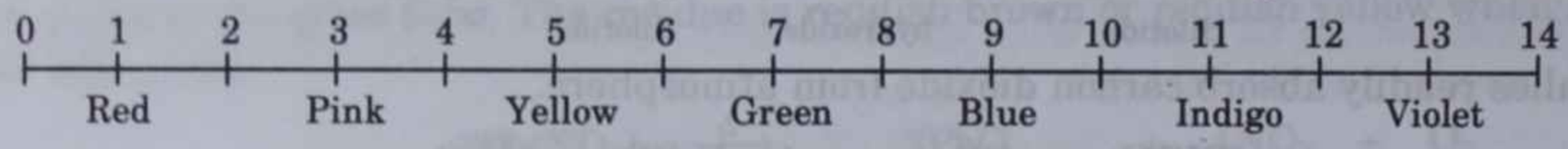
33. pH scale tells us whether the given solution is **acidic, alkaline** or **neutral**.



34. pH of pure water is equal to 7.

35. At pH = 7, solution is neutral.
pH > 7, solution is alkaline.
pH < 7, solution is acidic.

36. Universal indicator is a **mixture of several organic dyes**. It not only tells whether **the given solution** is **acidic** or **alkaline** but it also predicts **the strength of the given solution**.



Colour changes in the universal indicator (For different pH values)

37. Salts : These are the chemical compounds which on dissolving in water produce positively charged particles **other than Hydrogen ions** and negatively charged particles **other than Hydroxyl ions**.

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$KCl \rightleftharpoons K^+ + Cl^-$$

38. Salts can be **classified as**

(*a*) **Normal salt** (*b*) **Acid salt** (*c*) **Basic salt** (*d*) **Double salt**
(*e*) **Mixed salt** (*f*) **Complex salt**

(*a*) Normal salt : The salt formed by complete replacement of replaceable Hydrogen ions of an acid by a basic radical, or metallic ion. Some examples of normal salts are Sodium chloride (NaCl), Potassium nitrate (KNO_3), Copper sulphate ($CuSO_4$), Sodium acetate (CH_3COONa), Ammonium chloride (NH_4Cl), Sodium phosphate (Na_3PO_4).

The formation of the above named salts are shown below :

$$\text{Acid} + \text{Base} \longrightarrow \text{Salt} + \text{Water}$$

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

$$HNO_3 + KOH \longrightarrow KNO_3 + H_2O$$

$$H_2SO_4 + Cu(OH)_2 \longrightarrow CuSO_4 + 2H_2O$$

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

$$HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$$

$$H_3PO_4 + 3NaOH \longrightarrow Na_3PO_4 + 3H_2O$$

These salts are dissolving in water dissociate into their constituent ions.

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$KCl \rightleftharpoons K^+ + Cl^-$$

(*b*) Acid salt : A salt formed by incomplete or partial replacement of replaceable Hydrogen ions of an acid by a basic radical or metallic ion. Some examples of acid salt are Sodium hydrogen sulphate

($NaHSO_4$), Potassium bisulphate ($KHSO_4$), Sodium dihydrogen phosphate (NaH_2PO_4), Sodium hydrogen sulphite ($NaHSO_3$). The formation of the above named salts can be shown below.

Acid	+	Alkali	⟶	Salt	+	Water
H_2SO_4	+	NaOH	⟶	$NaHSO_4$	+	H_2O
H_2SO_4	+	KOH	⟶	$KHSO_4$	+	H_2O
H_3PO_4	+	NaOH	⟶	NaH_2PO_4	+	H_2O
H_2SO_3	+	NaOH	⟶	$NaHSO_3$	+	H_2O

Acid salts are formed when the basicity of the acid taken is more than the acidity of a base. In aqueous solutions, acid salts furnish hydrogen ion or hydronium ion (H_3O^+). Hence, the aqueous solution of acid salt exhibits all the properties of an acid. The acid salt contains a cation obtained from the base and one or more hydrogn atoms of the acid attached to the anion obtained from the acid.

(*c*) **Basic salt** : The salt formed by the partial or incomplete replacement of replaceable Hydroxyl ions of diacidic or triacidic base by an acid radical. Some examples of basic salts are basic lead chloride (Pb(OH)Cl), basic copper chloride (Cu(OH)Cl), Basic magnesium chloride (Mg(OH)Cl), basic lead nitrate ($Pb(OH)NO_3$), basic copper nitrate (Cu(OH)NO). The formation of the above named salts are shown below :

Base	+	Acid	⟶	Salt	+	Water
$Pb(OH)_2$	+	HCl	⟶	Pb(OH)Cl Lead hydroxy chloride or Basic lead chloride	+	H_2O
$Cu(OH)_2$	+	HCl	⟶	Cu(OH)Cl Basic copper chloride or Copper hydroxy chloride	+	H_2O
$Mg(OH)_2$	+	HCl	⟶	Mg(OH)Cl Basic magnesium chloride or Magnesium hydroxy chloride	+	H_2O
$Pb(OH)_2$	+	HNO_3	⟶	$Pb(OH)NO_3$ Basic lead nitrate or Lead hydroxy nitrate	+	H_2O
$Cu(OH)_2$	+	HNO_3	⟶	$Cu(OH)NO_3$ Basic copper nitrate or Copper hydroxy nitrate	+	H_2O

It is to be noted the basic salts are only formed when the acidity of the base taken is more than the basicity of an acid. The basic salts contain a metallic cation, a hydroxyl ion from the base and an anion obtained from the acid.

(*d*) **Double salts** : Double salts are formed from two simple salts when they crystallize out from their saturated solutions.

e.g.,

$K_2SO_4.Al_2(SO_4)_3.24H_2O$	–	Potash alum
$FeSO_4.(NH_4)_2.SO_4.6H_2O$	–	Mohr's salt
$K_2SO_4.Cr_2(SO_4)_3.24H_2O$	–	Chrome alum
$(NH_4)_2.SO_4.Fe_2(SO_4)_3.24H_2O$	–	Ferric alum

The aqueous solution of double salts furnish the ions of their constituent ions.

(*e*) **Mixed salts** : They contain more than one acid or basic radicals.

e.g., $CaOCl_2$ – Bleaching powder

$$CaOCl_2 \rightleftharpoons Ca^{2+} + Cl^- + ClO^-$$

$NaKCO_3$ – Sodium potassium carbonate

(*f*) **Complex salt** : They form one complex ion and one simple ion on dissolving in water.

e.g.,
$$K_3[Fe(CN)_6] \rightleftharpoons \underset{\text{Potassium ion}}{3K^+} + \underset{\text{Ferricyanide ion}}{[Fe(CN)_6]^{3-}}$$

$$Na[Ag(CN)_2] \rightleftharpoons \underset{\text{Sodium ion}}{Na^+} + \underset{\text{Silver cyanide ion}}{(Ag(CN)_2)^-}$$

39. Soluble salts are generally prepared by the following methods :

(*a*) **By synthesis :** Several soluble salts are prepared by heating the constituent elements together.

$$\underset{\text{Heated}}{2Fe} + \underset{\text{dry}}{3Cl_2} \longrightarrow \underset{\substack{\text{Anhydrous}\\ \text{Iron (III) Chloride}}}{2FeCl_3}$$

$$2Na + Cl_2 \longrightarrow 2NaCl$$

(*b*) **Simple displacement :** Soluble salts of active metals like Mg, Zn, Fe etc. can be prepared by the simple displacement reactions involving active metal and dilute acid.

$$Mg + 2HCl\ (dil.) \longrightarrow \underset{\substack{\text{Magnesium}\\ \text{chloride}}}{MgCl_2} + H_2\uparrow$$

$$Zn + H_2SO_4\ (dil.) \longrightarrow \underset{\substack{\text{Zinc}\\ \text{sulphate}}}{ZnSO_4} + H_2\uparrow$$

$$Fe + H_2SO_4\ (dil.) \longrightarrow \underset{\substack{\text{Ferrous}\\ \text{sulphate}}}{FeSO_4} + H_2\uparrow$$

(*c*) **Double decomposition - neutralization reaction :**

Insoluble or soluble bases react with acids to form salt and water. By this reaction only soluble salts are prepared.

$$NH_4OH + HCl\ (dil.) \longrightarrow \underset{\substack{\text{Ammonium}\\ \text{chloride}}}{NH_4Cl} + H_2O$$

$$2KOH + H_2SO_4\ (dil.) \longrightarrow \underset{\substack{\text{Potassium}\\ \text{sulphate}}}{K_2SO_4} + 2H_2O$$

$$Cu(OH)_2 + 2HNO_3 \longrightarrow \underset{\text{Copper nitrate}}{Cu(NO_3)_2} + H_2O$$

$$2NaOH + H_2SO_4 \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4} + 2H_2O$$

(*d*) **By the reaction of metallic carbonates, bicarbonates, sulphites, bisulphites, sulphides and bisulphides with dilute acids :**

$$\underset{\substack{\text{Calcium}\\ \text{carbonate}}}{CaCO_3} + 2HCl\ (dil.) \longrightarrow \underset{\substack{\text{Calcium}\\ \text{chloride}}}{CaCl_2} + H_2O + CO_2$$

$$\underset{\text{Zinc Sulphite}}{ZnSO_3} + H_2SO_4\ (dil.) \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + H_2O + SO_2$$

$$\underset{\text{Zinc sulphide}}{ZnS} + 2HCl\ (dil.) \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2} + H_2S$$

$$\underset{\substack{\text{Sodium}\\ \text{bicarbonate}}}{NaHCO_3} + HCl\ (dil.) \longrightarrow \underset{\substack{\text{Sodium}\\ \text{chloride}}}{NaCl} + H_2O + CO_2$$

$$KHSO_3 + HNO_3\ (dil.) \longrightarrow KNO_3 + H_2O + SO_2$$

Potassium bisulphite — Potassium nitrate

$$KHS + HCl\ (dil.) \longrightarrow KCl + H_2S$$

Potassium bisulphide — Potassium chloride

(e) By the reaction of chlorides and nitrates with concentrated sulphuric acid :

$$NaCl + H_2SO_4\ (conc.) \xrightarrow{\text{Below } 200^\circ C} NaHSO_4 + HCl$$

$$2NaCl + H_2SO_4\ (conc.) \xrightarrow{\text{Above } 200^\circ C} Na_2SO_4 + 2HCl$$

$$KNO_3 + H_2SO_4\ (conc.) \xrightarrow{\text{Below } 200^\circ C} KHSO_4 + HNO_3$$

$$2KNO_3 + H_2SO_4\ (conc.) \xrightarrow{\text{Above } 200^\circ C} K_2SO_4 + 2HNO_3$$

(f) By the reaction of metals with alkali :

$$Zn + 2NaOH \xrightarrow{\text{Boiling}} Na_2ZnO_2 + H_2$$

Powder — Sodium zincate

$$Pb + 2KOH \xrightarrow{\text{Boiling}} K_2PbO_2 + H_2$$

Powder — Potassium plumbate

$$2Al + 2NaOH + 2H_2O \xrightarrow{\text{Boiling}} 2NaAlO_2 + 3H_2$$

Powder — Sodium aluminate

40. Insoluble salts are prepared by the following methods :

(a) Synthesis : Several insoluble salts are prepared by the constituent elements together.

$$Fe + S \xrightarrow{\Delta} FeS$$

Iron (II) sulphide

$$Zn + S \xrightarrow{\Delta} ZnS$$

Zinc sulphide

$$Pb + S \xrightarrow{\Delta} PbS$$

Lead sulphide

(b) Double decomposition – precipitation reaction.

$$Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2\downarrow + 2NaNO_3$$

Lead nitrate — Lead chloride (White ppt.) — Sodium nitrate

$$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3\downarrow + 2NaCl$$

Calcium chloride — Sodium carbonate — Calcium carbonate (White ppt.) — Sodium chloride

$$Pb(NO_3)_2 + Na_2SO_4 \longrightarrow PbSO_4\downarrow + 2NaNO_3$$

Lead nitrate — Sodium sulphate — Lead sulphate (White precipitate insoluble in all mineral acids) — Sodium nitrate

$$BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4\downarrow + 2NaCl$$

Barium chloride — Sodium sulphate — Barium sulphate (White precipitate insoluble in all mineral acids) — Sodium chloride

(c) Insoluble salts cannot be directly prepared from another insoluble salt.
These salts are prepared by two steps.

For example conversion of lead carbonate to lead sulphate :

Step I : Conversion of insoluble salt to a soluble salt : By the reaction of insoluble salt with dilute nitric acid.

$$\underset{\text{Insoluble salt}}{PbCO_3} + 2HNO_3\,(dil.) \longrightarrow \underset{\text{Soluble salt}}{Pb(NO_3)_2} + H_2O + CO_2$$

Step-II : Soluble salt undergoes reaction with either dilute acid or another soluble salt (precipitation).

$$\underset{\text{Soluble salt}}{Pb(NO_3)_2} + H_2SO_4\,(dil.) \longrightarrow PbSO_4\downarrow + 2HNO_3$$

or

$$Pb(NO_3)_2 + Na_2SO_4 \longrightarrow PbSO_4\downarrow + 2NaNO_3$$

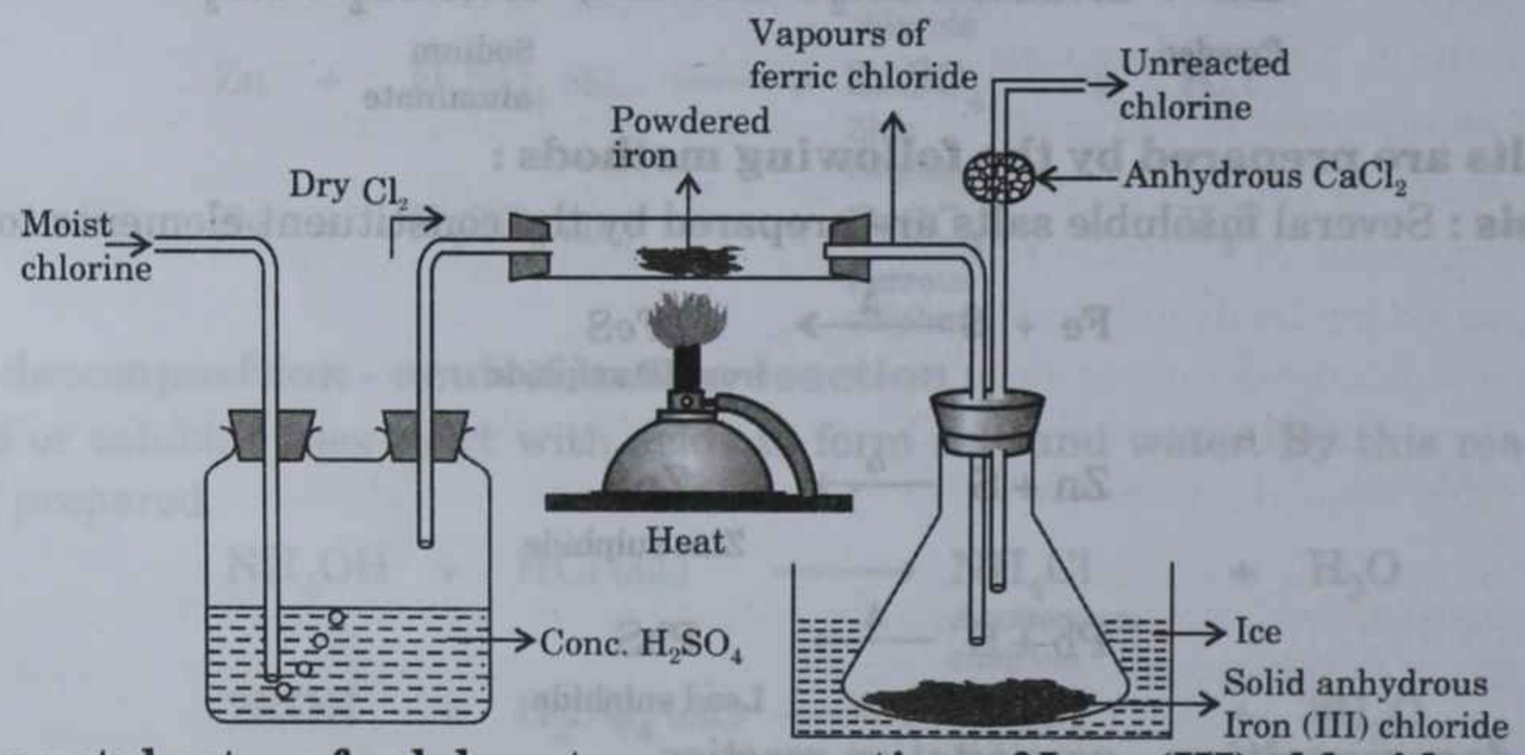
or

$$Pb(NO_3)_2 + K_2SO_4 \longrightarrow PbSO_4\downarrow + 2KNO_3$$

41. The laboratory preparation of some normal and acid salts are briefly given below :

(*i*) Iron (III) chloride or anhydrous ferric chloride (By synthesis)

During the laboratory preparation of anhydrous ferric chloride dry chlorine is passed over heated iron. The iron (III) chloride formed volatizes as its formation is exothermic and it condenses in the receiver as brown scales. As iron (III) chloride is highly deliquescent in nature, therefore it is kept dry in the receiver with the help of anhydrous calcium chloride which does not allow the moisture to enter into the receiver.



Experimental set-up for laboratory preparation of Iron (III) chloride anhydrous

(*ii*) Copper (II) sulphate (By decomposition)

Copper sulphate can be prepared by the reacion of copper oxide, copper hydroxide or copper carbonate with dilute sulphuric acid.

$$CuO + H_2SO_4\,(dil.) \longrightarrow CuSO_4 + H_2O$$
$$Cu(OH)_2 + H_2SO_4\,(dil.) \longrightarrow CuSO_4 + 2H_2O$$
$$CuCO_3 + H_2SO_4\,(dil.) \longrightarrow CuSO_4 + H_2O + CO_2$$

Add copper oxide or copper hydroxide or copper carbonate to heated dilute sulphuric acid in small quantities with constant strining till no more compound gets dissolved in the acid and the unreacted compound gets settled to the bottom. Filter the hot solution and the filtrate is collected in the China dish. Evaporate the filterate slowly by heating to the point of crystallization and then allow it to cool. Bright blue crystals of $CuSO_4.5H_2O$ are formed which are further dried.

The other salts prepared by this method are lead nitrate, copper nitrate, calcium chloride etc.

(*iii*) Zinc sulphate (By displacement)

Salts like zinc sulphate, iron (II) sulphate can be prepared by the reaction of metals with dilute sulphuric acid. Metals like iron and zinc can displace hydrogen from dilute acids as they are lying above hydrogen in the metal activity series.

$$Zn + H_2SO_4\,(dil.) \longrightarrow ZnSO_4 + H_2O$$

$$Fe + H_2SO_4\,(dil.) \longrightarrow FeSO_4 + H_2$$

The following steps are involved in the preparation of above named salt

(*i*) Dilute sulphuric acid is taken in a beaker and zinc pieces in little quantity are added to it with constant stirring till no further reaction takes place.

(*ii*) Effervescence is observed during the liberation of hydrogen. When effervescence stops it indicates the completion of reaction, *i.e.*, all the acid has been used up.

(*iii*) The above hot solution is filtered and the excess of zinc (unreacted) is removed.

(*iv*) The filtrate is collected in the China dish and allowed to evaporate to get the crystals.

(*v*) The crystals obtained are filtered, washed and dried between the folds of filter paper.

(*iv*) Sodium sulphate (By neutralization)

Sodium sulphate can be prepared by the reaction of sodium hydroxide or sodium carbonate with dilute sulphuric acid.

$$2NaOH + H_2SO_4\,(dil.) \longrightarrow Na_2SO_4 + 2H_2O$$

$$Na_2CO_3 + H_2SO_4\,(dil.) \longrightarrow Na_2SO_4 + H_2O + CO_2$$

For the preparation of sodium sulphate initially the process of titration is conducted so as to know the volumes of alkali and acid used up for the completion of reaction. As both the reactants and the products are soluble in water. The following steps are involved in the process of titration.

(*i*) 5 cm^3 of sodium hydroxide solution is measured and transfered in the conical flask. A drop of phenolpthalein is added. The solution turns pink. If Na_2CO_3 solution is taken then methyl orange is added.

(*ii*) Now, rinse and fill the burette with dilute sulphuric acid. Note the initial reading of the burette. Now add acid drop by drop into the conical flask containing sodium hydroxide by constant stirring till the last drop decolourizes the solution (end point-completion of reaction). Now note the final reading of the burette and calculate the difference. The difference will give the volume of dilute sulphuric acid required to neutralize 25 cm^3 of sodium hydroxide.

(*iii*) The acid and alkali are mixed in the same ratio by volume (as determined by titration) in the evaporating dish. The solution contains sodium sulphate and water.

(*iv*) On evaporating the solution the crystals of $Na_2SO_4.10H_2O$ are obtained.

42. The properties of salts are :

(*a*) Efflorescence : Certain hydrated salts, when left exposed to atmosphere, lose their water of crystallization and crumble into powder. Such salts are called **efflorescent salts** and the property as **efflorescence**.

e.g., – $Na_2CO_3.10H_2O$, $Na_2SO_4.10H_2O$, $MgSO_4.7H_2O$

(*b*) Deliquescence : Certain salts, when left exposed to atmosphere, absorb moisture and get converted into their saturated solution. Such salts are called **deliquescent salts** and the property as **deliquescence**.

e.g., – Ferric chloride, Magnesium chloride

(*c*) Hygroscopy : Certain substances, when left exposed to atmosphere, absorb moisture and become wet. Such substances are called **hygroscopic substances** and the property as **hygroscopy**. Hygroscopic substances are called as **drying agents**.

e.g., – Anhydrous calcium chloride, Calcium oxide, Concentrated sulphuric acid.

(*d*) Hydrolysis : The phenomenon due to which salt of strong acid and weak base, or weak acid and strong base on dissolving in water reacts with it to form parent acid and alkali thereby rendering the solution either **acidic** or **alkaline** in nature.

(*i*) **Ammonium chloride** – It is a salt of strong acid and weak base.

Strong acid	*Weak base*
Hydrochloric acid (HCl)	Ammonium hydroxide (NH_4OH)

$$\underset{\text{Highly ionized}}{NH_4Cl} + H_2O \longrightarrow \underset{\text{Feebly ionized}}{NH_4OH} + \underset{\text{Highly ionized}}{HCl}$$

$$NH_4^+Cl^- + H_2O \longrightarrow NH_4OH + H^+Cl^-$$

Deleting the spectator ions

$$NH_4^+ + H_2O \longrightarrow NH_4OH + H^+$$

The presence of **Hydrogen ions** renders the solution **acidic**.

In general, the salt solution of strong acid and weak base is acidic in nature.

Other examples are Ferric chloride, Copper sulphate, Ammonium sulphate, Ammonium nitrate, Aluminium chloride.

(*ii*) **Sodium acetate** – CH_3COONa is a salt of strong base, *i.e.*, NaOH and weak acid, *i.e.*, CH_3COOH.

Strong base	*Weak acid*
Sodium hydroxide (NaOH)	Acetic acid (CH_3COOH)

$$\underset{\text{Highly ionized}}{CH_3COONa} + H_2O \longrightarrow \underset{\text{Weakly ionized}}{CH_3COOH} + \underset{\text{Highly ionized}}{NaOH}$$

$$CH_3COO^-Na^+ + H_2O \longrightarrow CH_3COOH + Na^+OH^-$$

Deleting the spectator ions,

$$CH_3COO^- + H_2O \longrightarrow CH_3COOH + OH^-$$

The presence of **Hydroxyl ion** renders the solution **alkaline**.

In general, the salt solution of weak acid and strong base is alkaline in nature. Other example, potassium acetate, sodium sulphide, sodium sulphite.

43. The **salts of strong acid** and **strong base do not hydrolyse** as the solution formed is **neutral .**
44. **Water of crystallization :** The definite number of water molecules which enters into loose chemical combination when the salt crystallizes out of its saturated solution.
45. **Hydrated salts on heating** lose their water of crystallization *i.e.,* lose their **crystalline** shape and the **colour fades**., *e.g.*, if hydrated copper sulphate is heated, its colour changes from blue to white and crystalline shape becomes amorphous.

$$\underset{\text{Blue, crystalline}}{CuSO_4 . 5H_2O} \xrightarrow{\Delta} \underset{\text{White, amorphous}}{CuSO_4} + 5H_2O$$

46. **Hydrated salts on heating** become **anhydrous**.
47. Zinc and Aluminium displace hydrogen from the acids as well as alkalies, therefore, they are **amphoteric** in nature.

$$Zn + H_2SO_4\,(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$$

$$Zn + 2HCl\,(dil.) \longrightarrow ZnCl_2 + H_2\uparrow$$

$$\underset{\text{Powder}}{Zn} + 2NaOH \xrightarrow{\text{heat}} \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$$

$$2Al + 3H_2SO_4\,(dil.) \longrightarrow Al_2(SO_4)_3 + 3H_2\uparrow$$

$$2Al + 6HCl(dil.) \longrightarrow 2AlCl_3 + 3H_2\uparrow$$

$$\underset{\text{Powder}}{2Al} + 2NaOH + 2H_2O \xrightarrow{\text{heat}} \underset{\text{Sodium aluminate}}{2NaAlO_2} + 3H_2\uparrow$$

48. The oxides of Zinc and Aluminium react with acids as well as alkalies to form salt and water as the only products, therefore, they are **amphoteric** in nature.

$$ZnO + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2O$$

$$ZnO + 2HCl(dil.) \longrightarrow ZnCl_2 + H_2O$$

$$ZnO + 2NaOH(dil.) \xrightarrow{\Delta} Na_2ZnO_2 + H_2O$$

$$Al_2O_3 + 3H_2SO_4(dil.) \longrightarrow Al_2(SO_4)_3 + 3H_2O$$

$$Al_2O_3 + 6HCl(dil.) \longrightarrow 2AlCl_3 + 3H_2O$$

$$Al_2O_3 + 2NaOH\ (dil.) \xrightarrow{\Delta} 2NaAlO_2 + H_2O$$

49. The hydroxides of Zinc and Aluminium react with acids as well as alkalies to form salt and water as the only products, therefore, they are **amphoteric** in nature.

$$Zn(OH)_2 + H_2SO_4(dil.) \longrightarrow ZnSO_4 + 2H_2O$$

$$Zn(OH)_2 + 2NaOH\ (dil.) \xrightarrow{\Delta} Na_2ZnO_2 + 2H_2O$$

$$2Al(OH)_3 + 3H_2SO_4(dil.) \longrightarrow Al_2(SO_4)_3 + 6H_2O$$

$$Al(OH)_3 + NaOH(dil.) \xrightarrow{\Delta} NaAlO_2 + 2H_2O$$

50. Solubility Table of Salts

(*i*) All salts of Sodium, Potassium and Ammonium are soluble in water.

(*ii*) All nitrates and nitrites are soluble in water.

(*iii*) All sulphates are soluble in water.

Except : $CaSO_4$, $PbSO_4$, $BaSO_4$

(*iv*) All chlorides are soluble in water.

Except : Hg_2Cl_2, AgCl and $PbCl_2$ (soluble in hot water)

(*v*) All sulphites are insoluble in water.

Except : Na_2SO_3, K_2SO_3 and $(NH_4)_2SO_3$

(*vi*) All sulphides are insoluble in water

Except : Na_2S, K_2S and $(NH_4)_2S$.

(*vii*) All carbonates are insoluble in water.

Except : Na_2CO_3, K_2CO_3 and $(NH_4)_2CO_3$

51. Equation for the acid rain : The oxides of sulphur (released from oil refineries) and the oxides of nitrogen (released by automobiles exhaust) produces acid rain.

Sulphurdioxide combines with oxygen and water to form sulphuric acid.

$$2SO_2 + 2H_2O + O_2 \longrightarrow 2H_2SO_4$$

Nitrogen dioxide form nitric acid.

$$N_2 + O_2 \xrightarrow[Lightning]{Thunder\ and} 2NO$$

$$2NO + O_2 \longrightarrow 2NO_2$$

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

PREVIOUS YEARS' QUESTIONS

2012

Q1. The gas produced on reaction of dilute sulphuric acid with a metallic sulphide. [1]

Ans. Hydrogen sulphide.

Q2. Magnesium reacts with nitric acid to liberate hydrogen gas. [1]

Ans. Magnesium reacts with very dilute nitric acid to liberate hydrogen gas.

Q3. Give balanced equations for the following reactions :

(*i*) Dilute nitric acid and Copper carbonate.

(*ii*) Silver nitrate solution and Sodium chloride solution.

(*iii*) Zinc sulphide and Dilute sulphuric acid. [3]

Ans. (*i*) $CuCO_3 + 2HNO_3 \longrightarrow Cu(NO_3)_2 + CO_2 + H_2O$

(*ii*) $AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$

(*iii*) $ZnS + H_2SO_4 \longrightarrow ZnSO_4 + H_2S$

2011

Q1. Name the aqueous salt solution used for testing sulphate radical. [1]

Ans. Barium chloride solution.

Q2. Choose the correct answer from the options given below

(*i*) Hydroxide of this metal is soluble in sodium hydroxide solution

(A) Magnesium (B) Lead

(C) Silver (D) Copper [1]

Ans. (B) Lead

(*ii*) When dilute sulphuric acid reacts with iron sulphide, the gas evolved is.

(A) Hydrogen sulphide

(B) Sulphur dioxide

(C) Sulphur trioxide

(D) Vapours of sulphuric acid [1]

Ans. (A) Hydrogen sulphide

Q3. Write balanced chemical equation for each of the following reactions :

(*i*) Sodium thiosulphate is reacted with dilute hydrochloric acid.

(*ii*) Calcium bicarbonate reacts with dilute hydrochloric acid.

(*iii*) Dilute sulphuric acid is poured over sodium sulphite.

(*iv*) Lead nitrate solution is added to sodium chloride solution.

(*v*) Zinc is heated with sodium hydroxide solution. [5]

Ans. (*i*) $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2 + S$

(*ii*) $Ca(HCO_3)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O + 2CO_2$

(*iii*) $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$

(*iv*) $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

(*v*) $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

Q4. What happens to the crystals of washing soda when exposed to air ? Name the phenomenon exhibited. [2]

Ans. Washing soda crystals loose water of crystallization when exposed to air and crumble down to form powder.

The phenomenon exhibited is efflorescence.

Q5. Name the method used for preparation of the following salts from the list given below :

(*i*) Sodium nitrate

(*ii*) Iron (III) chloride

(*iii*) Lead chloride

(*iv*) Zinc sulphate

(*v*) Sodium hydrogen sulphate

List

(A) Simple displacement

(B) Neutralization

(C) Decomposition by an acid

(D) Double decomposition

(E) Direct synthesis [5]

Ans. (*i*) (B) Neutralization

(*ii*) (E) direct synthesis

(*iii*) (D) double decomposition

(*iv*) (A) simple displacement

(*v*) (C) decomposition by acid

2010

Q1. Select from the list given below (A to D), one substance in each case which matches the description given in parts (*i*) to (*iv*). (Note : Each substance is used only once in the answer.)

(A) Iron(III) chloride

(B) Chromium sulphate

(C) Lead(II) chloride

(D) Sodium chloride.

(*i*) A compound which is deliquescent.

(*ii*) A compound which is insoluble in cold water, but soluble in hot water.

(*iii*) A compound whose aqueous solution is neutral in nature.

(*iv*) The compound which is responsible for the green colouration when sulphur dioxide is passed through acidified potassium dichromate solution. [5]

Ans. (*i*) A (*ii*) C (*iii*) D (*iv*) B

Q2. Select the correct answer from the choices A, B, C and D which are given. Write only the letter corresponding to the correct answer.

(*i*) An organic weak acid is :

(A) Formic acid
(B) Sulphuric acid
(C) Nitric acid
(D) Hydrochloric acid [1]

Ans. A

(*ii*) An example of a complex salt is :

(A) Zinc sulphate
(B) Sodium hydrogen sulphate
(C) Iron(II) ammonium sulphate
(D) Tetraammine copper(II) sulphate. [1]

Ans. D

Q3. State your observation for the following cases:

Paper soaked in potassium permanganate solution is introduced into a gas jar of sulphur dioxide. [1]

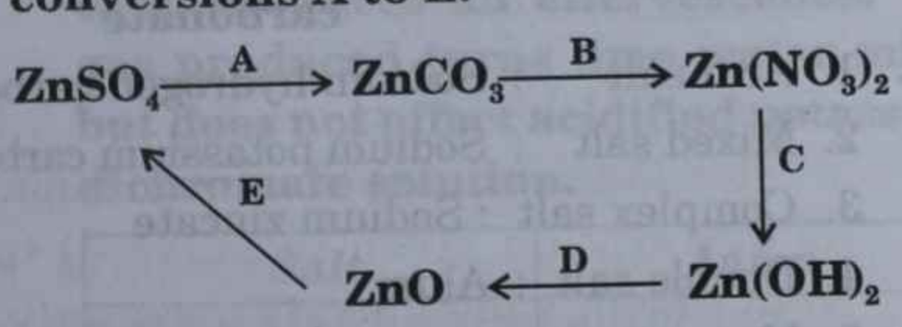
Ans. It decolourizes purple colour of $KMnO_4$.

Q4. Write the equation for the reactions:

Zinc oxide is treated with sodium hydroxide solution. [1]

Ans. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$

Q5. Give the equations for the following conversions A to E.



[5]

Ans. A : $ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$.

B : $ZnCO_3 + 2HNO_3 \longrightarrow Zn(NO_3)_2 + H_2O + CO_2$.

C : $Zn(NO_3)_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaNO_3$.

D : $Zn(OH)_2 \xrightarrow{\Delta} ZnO + H_2O$.

E : $ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$

Q6. Solution A is a sodium hydroxide solution. Solution B is a weak acid. Solution C is dilute sulphuric acid. Which solution will

(*i*) liberate sulphur dioxide from sodium sulphite.

(*ii*) give a white precipitate with zinc sulphate solution.

(*iii*) contain solute molecules and ions ? [3]

Ans. (*i*) C (*ii*) A (*iii*) B

Q7. Give the equation for the preparation of each of the following salts from the starting material given.

(*i*) Copper sulphate from copper(II) oxide.

(*ii*) Iron(III) chloride from Iron.

(*iii*) Potassium sulphate from potassium hydroxide solution.

(*iv*) Lead chloride from lead carbonate (two equations). [5]

Ans. (*i*) $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$.

(*ii*) $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$.

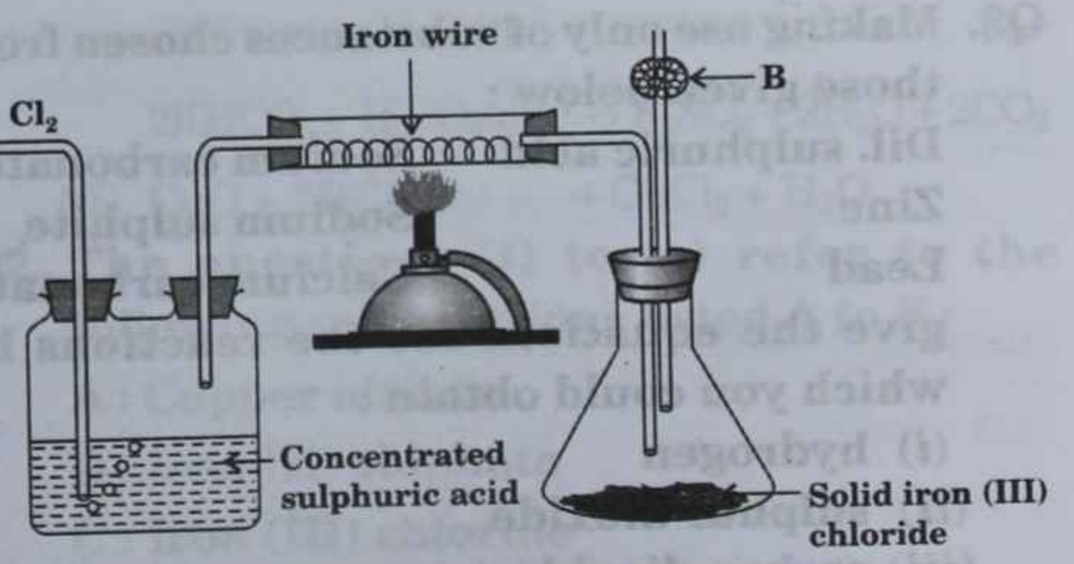
(*iii*) $2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$

(*iv*) $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

$Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$.

2009

Q1. (*a*) The diagram given below is to prepare Iron(III) chloride in the laboratory:



(*i*) What is substance B?

(*ii*) What is the purpose of B?

(*iii*) Why is iron(III) chloride to be stored in a closed container?

(iv) Write the equation for the reaction between iron and chlorine. [4]

(b) Write the equation(s) for the reaction(s) to prepare lead sulphate from lead carbonate. [2]

Ans. (a) (i) Anhydrous calcium chloride

(ii) Drying agent

(iii) As it is highly deliquescent.

(iv) $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$

(b) $PbCO_3 + 2HNO_3$ (dil.) $\longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

$Pb(NO_3)_2 + H_2SO_4$ (dil.) $\longrightarrow PbSO_4 + 2HNO_3$

Q.2 Define the term: Neutralisation. [1]

Ans. When H^+ ions derived from an acid combine with hydroxyl ions of a base to form unionized water molecule is called as neutralisation.

2008

Q1. Select the correct answer from the choices A, B, C, D which are given.

Dilute sulphuric acid will produce a white precipitate when added to a solution of

A. Copper nitrate

B. Zinc nitrate

C. Lead nitrate

D. Sodium nitrate [1]

Ans. C

Q2. What are the terms defined in the following ?

(i) A salt containing a metal ion surrounded by other ions or molecules.

(ii) A base which is soluble in water. [2]

Ans. (i) Complex salt

(ii) Alkali

Q3. Making use only of substances chosen from those given below :

Dil. sulphuric acid	**Sodium carbonate**
Zinc	**Sodium sulphite**
Lead	**Calcium carbonate**

give the equations for the reactions by which you could obtain :

(i) hydrogen

(ii) sulphur dioxide

(iii) carbon dioxide

(iv) zinc carbonate (two steps required) [5]

Ans. (i) $Zn + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$

(ii) $Na_2SO_3 + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$

(iii) $Na_2CO_3 + H_2SO_4(dil.) \rightarrow Na_2SO_4 + H_2O + CO_2\uparrow$

(iv) $Zn + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$

$ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

2007

Q1. From the list given below, select the word(s) required to correctly complete blanks (i) to (v) in the following passage :

ammonia, ammonium, carbonate, carbon dioxide, hydrogen, hydronium, hydroxide, precipitate, salt, water.

A solution X turns blue litmus red, so it must contain (i) _____ ions; another solution Y turns red litmus blue and therefore, must contain (ii) _____ ions. When solutions X and Y are mixed together, the products will be a (iii) _____. and (iv) _____. If a piece of magnesium were put into solution X, (v) _____ gas would be evolved. [5]

(Note: Words chosen from the list are to be used only once. Write the answers as (i), (ii), (iii) and so on. Do not copy the passage.)

Ans. (i) Hydronium (ii) Hydroxide

(iii) Salt (iv) Water

(v) Hydrogen

Q2. Match the following :-

Column A	**Column B**
1. Acid salt	**A. Sodium potassium carbonate**
2. Mixed salt	**B. Alum**
3. Complex salt	**C. Sodium carbonate**
4. Double salt	**D. Sodium zincate**
5. Normal salt	**E. Sodium hydrogen carbonate** [5]

Ans. 1. Acid salt : Sodium hydrogen carbonate

2. Mixed salt : Sodium potassium carbonate

3. Complex salt : Sodium zincate

4. Double salt : Alum

5. Normal salt : Sodium carbonate

Q3. Write balanced equations for the following reactions :

(i) Lead sulphate from lead nitrate solution and dilute sulphuric acid.

(ii) Copper sulphate from copper and concentrated sulphuric acid.

(iii) Lead chloride from lead nitrate solution and sodium chloride solution.

(iv) Ammonium sulphate from ammonia and dilute sulphuric acid.

(v) Sodium chloride from sodium carbonate solution and dilute hydrochloric acid. [5]

Ans. (i) $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$

(ii) $Cu + 2H_2SO_4(conc.) \longrightarrow CuSO_4 + 2H_2O + SO_2$

(iii) $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

(iv) $2NH_3 + H_2SO_4(dil.) \longrightarrow (NH_4)_2SO_4$

(v) $Na_2CO_3 + 2HCl(dil.) \longrightarrow 2NaCl + H_2O + CO_2$

Q4. Salts A, B, C, D and E undergo reactions (i) to (v) respectively. Identify the anion present in these salts on the basis of these reactions. Tabulate your answers in the format given below :

(i) When silver nitrate solution is added to a solution of A, a white precipitate, insoluble in dilute nitric acid, is formed.

(ii) Addition of dilute hydrochloric acid to B produces a gas which turns lead acetate paper black.

(iii) When a freshly prepared solution of ferrous sulphate is added to a solution of C and concentrated sulphuric acid is gently poured from the side of the test tube, a brown ring is formed.

(iv) When dilute sulphuric acid is added to D a gas is produced which turns acidified potassium dichromate solution from orange to green.

(v) Addition of dilute hydrochloric acid to E produces an effervescence. The gas produced turns lime water milky but does not affect acidified potassium dichromate solution.

Salt	*Anion*
A	
B	
C	
D	
E	

[5]

Ans. (i) A – Chloride or Cl^-

(ii) B – Sulphide or S^{2-}

(iii) C – Nitrate or NO_3^-

(iv) D – Sulphite or SO_3^{2-}

(v) E – Carbonate or CO_3^{2-}

2006

Q1. Mention the colour changes observed when the following indicators are added to acids :

(i) Alkaline phenolphthalein solution

(ii) Methyl orange solution

(iii) Neutral litmus solution [3]

Ans. (i) It gets decolourised

(ii) It turns red or pink

(iii) It turns red.

Q2. Choose the correct answers from the choices A, B, C and D.
Which of the following hydroxides is not an alkali.
A : Ammonium hydroxide
B : Calcium hydroxide
C : Copper hydroxide
D : Sodium hydroxide [3]

Ans. C : Copper hydroxide

2005

Q1. Write balanced chemical equations for the following :

(i) Potassium hydrogen carbonate and dilute sulphuric acid

(ii) Copper oxide and dilute hydrochloric acid [2]

Ans. (i) $KHCO_3 + H_2SO_4(dil.) \longrightarrow KHSO_4 + H_2O + CO_2$

Or

$2KHCO_3 + H_2SO_4(dil.) \rightarrow K_2SO_4 + 2H_2O + 2CO_2$

(ii) $CuO + 2HCl(dil.) \longrightarrow CuCl_2 + H_2O$

Q2. The questions (i) to (v) refer to the following salt solutions listed A to F :
A : Copper nitrate
B : Iron (II) sulphate
C : Iron (III) chloride
D : Lead nitrate
E : Magnesium sulphate
F : Zinc chloride

(*i*) Which two solutions will give a white precipitate when treated with dilute hydrochloric acid followed by barium chloride solution ?

(*ii*) Which two solutions will give a white precipitate when treated with dilute nitric acid followed by silver nitrate solution ?

(*iii*) Which solution will give a white precipitate when either dilute hydrochloric acid or dilute sulphuric acid is added to it ?

(*iv*) Which solution becomes deep / inky blue colour when excess ammonium hydroxide is added to it ?

(*v*) Which solution gives a white precipitate with excess ammonium hydroxide solution ? [5]

Ans. (*i*) Iron (II) sulphate, Magnesium sulphate

(*ii*) Iron (III) chloride, Zinc chloride

(*iii*) Lead nitrate

(*iv*) Copper nitrate

(*v*) Lead nitrate

Q3. Match the description given below :

A : Acidic oxide	**F : Efflorescence**
B : Alkali	**G : Electrolysis**
C : Amphoteric oxide	**H : Electrolyte**
D : Basic oxide	**I : Homologous series**
E : Deliquescence	**J : Hydrocarbons**

(*i*) The property of spontaneously giving up water of crystallization to the atmosphere.

(*ii*) A compound, which is soluble in water and the only negative ions in the solution are hydroxide ions.

(*iii*) An oxide, which forms salts when it reacts with both acids and alkalies. [3]

Ans. (*i*) Efflorescence (*ii*) Alkali

(*iii*) Amphoteric oxide

Q4. What do you observe when

(*i*) Hydrogen sulphide gas is passed through Lead acetate solution ?

(*ii*) Neutral litmus solution is added to Sodium hydrogen carbonate solution ? [2]

Ans. (*i*) A black precipitate appears

(*ii*) It turns Red

Q5. Fill in the blanks with suitable words.

An acid is a compound which when dissolved in water forms hydronium ions as the only (1) _ _ _ _ _ ions. A base is a compound which if soluble in water contains (2) _ _ _ _ _ ions. A base reacts with an acid to form a (3) _ _ _ _ _ and water only. The type of reaction is known as (4) _ _ _ _ _. [4]

Ans. 1. Positive 2. Hydroxyl

3. Salt 4. Neutralisation

Q6. The preparation of lead sulphate from lead carbonate is a two step process (Lead sulphate cannot be prepared by adding dilute sulphuric acid to lead carbonate).

(*i*) What is the first step that is required to prepare lead sulphate from lead carbonate ?

(*ii*) Write the equation for the reaction that will take place when this first step is carried out ?

(*iii*) Why is the direct addition of dilute sulphuric acid to lead carbonate an impractical method of preparing lead sulphate ? [3]

Ans. (*i*) The first step is to convert lead carbonate to lead nitrate by reacting it with dilute Nitric acid.

(*ii*) $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

(*iii*) The insoluble lead sulphate formed does not allow the reaction between acid and the salt.

IMPORTANT QUESTIONS

Q1. (*a*) (*i*) What is the purpose of pH scale ?

(*ii*) What is the pH of pure water ?

(*iii*) 'A' is a soluble acidic oxide, 'B' is a soluble base. Compared to the pH of pure water, what will be the pH of (1) a solution of 'A' (2) a solution of 'B'

(*b*) Taking Sodium carbonate as an example, give the meaning of the following terms :

(*i*) Water of Crystallization

(*ii*) Anhydrous

(*iii*) Efflorescence

(c) Barium chloride solution can be used to distinguish between a Sodium sulphate solution and a Sodium nitrate solution. How is this done ?

(d) Name two gases which are responsible for acid rain.

Ans. (a) (i) pH scale is used to determine the alkalinity and acidic nature of the solution.

(ii) Seven

(iii) (1) Less than seven (2) More than seven

(b) (i) Water of Crystallization : The definite number of water molecules which enter into loose chemical combination when he salt crystallizes out from its saturated solution.

Sodium carbonate ($Na_2CO_3.10H_2O$) has ten water molecules of crystallization.

(ii) Anhydrous : Hydrated salts on heating lose their water of crystallization and are rendered anhydrous.

$$Na_2CO_3.10H_2O \xrightarrow{\Delta} \underset{\text{anhydrous}}{Na_2CO_3} + 10H_2O$$

(iii) Efflorescence : Hydrated salts, when left exposed to atmosphere, lose their water of Crystallization and crumble down to form a powder. Such salts are called as efflorescent salts and the property as efflorescence.

$Na_2CO_3.10H_2O$, on exposure to atmosphere, loses its water of Crystallization and crumbles to form a powder.

(c) Barium chloride solution, when reacts with Sodium sulphate solution, a white precipitate is formed which is insoluble in all the mineral acids, whereas when Barium chloride solution reacts with Sodium nitrate, no visible reaction takes place.

$$BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaCl$$

$$BaCl_2 + 2NaNO_3 \longrightarrow Ba(NO_3)_2 + 2NaCl$$

(d) Nitrogen dioxide and Sulphur dioxide.

Q2. (a) Outline the steps required to convert Hydrogen chloride to anhydrous Iron (III) chloride. Write the equations for the reactions which take place.

(b) (i) What are the two steps to change Lead carbonate to Lead chloride ?

(ii) Give the name of a soluble salt of lead and write the equation for the action of heat on this salt.

Ans. (a) $MnO_2 + 4HCl(conc.) \longrightarrow MnCl_2 + Cl_2 + 2H_2O$

Chlorine is dried by passing through concentrated H_2SO_4. Then dried Chlorine is passed over heated Iron to get anhydrous Iron (III) chloride.

$$\underset{\text{heated}}{2Fe} + \underset{\text{dry}}{3Cl_2} \longrightarrow 2FeCl_3$$

(b) (i) $PbCO_3 + 2HNO_3(dil.) \rightarrow Pb(NO_3)_2 + H_2O + CO_2$

$$Pb(NO_3)_2 + 2HCl(dil.) \rightarrow PbCl_2 + 2HNO_3$$

(ii) Lead nitrate

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_3 + O_2$$

Q3. From the following list of substances, choose those which meet the description given below :

Ammonium chloride, Ammonium nitrate, Chlorine, dilute Hydrochloric acid, Iron, Lead nitrate, Manganese (IV) oxide, Silver nitrate, Sodium nitrate, Sulphur.

Two compounds whose aqueous solution gives white precipitate with dilute Hydrochloric acid.

Ans. Silver nitrate solution and Lead nitrate solution.

Q4. What do you see when Barium chloride solution is added to dilute Sulphuric acid ?

Ans. A white precipitate is formed which is insoluble in all mineral acids.

Q5. (a) A solution has a pH of 7. Explain how you would

(i) increase its pH.

(ii) decrease its pH.

(b) If a solution changes the colour of litmus from red to blue, what can you say about its pH ?

(c) What can you say about the pH of a solution that liberates Carbon dioxide from Sodium carbonate ?

Ans. (a) (i) By adding alkali

(ii) By adding an acid.

(b) More than seven.

(c) Less than seven.

Q6. Write equations for each of the following reactions:

(a) Chlorine is passed over heated iron.

(b) Copper sulphate solution is added to Sodium hydroxide solution.

Ans. (*a*) $2Fe + 3Cl_2 \xrightarrow[\text{dry}]{\text{heated}} 2FeCl_3$

(*b*) $CuSO_4 + 2NaOH \longrightarrow Cu(OH)_2 + Na_2SO_4$

Q7. Name from the list of substances given below, the substances which you would use to prepare each of the following salts named in parts (*a*) to (*d*) :

Copper, Lead, Sodium, Zinc, Copper oxide, Lead carbonate, Sodium carbonate solution, dilute Hydrochloric acid, dilute Nitric acid and dilute Sulphuric acid.

(*a*) Zinc sulphate

(*b*) Copper sulphate

(*c*) Sodium sulphate

(*d*) Lead sulphate

Ans. (*a*) $Zn + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$

(*b*) $CuO + H_2SO_4(dil.) \longrightarrow CuSO_4 + H_2O$

(*c*) $Na_2CO_3 + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + H_2O + CO_2$

(*d*) $PbCO_3 + 2HNO_3(dil.) \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

$Pb(NO_3)_2 + H_2SO_4(dil.) \longrightarrow PbSO_4 + 2HNO_3$

Q8. For each of the salts A, B, C and D, suggest a suitable method of preparation which relates to its description given below :

(*a*) 'A' is Sodium salt.

(*b*) 'B' is an insoluble salt.

(*c*) 'C' is a soluble salt of Copper.

(*d*) 'D' is a soluble salt of Zinc.

(Do not describe the procedure for the preparation. Refer only to the appropriate method)

Ans. (*a*) By neutralization

e.g., $NaOH + HCl \longrightarrow NaCl + H_2O$

(*b*) By precipitation

e.g., $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2\downarrow + 2NaNO_3$

(*c*) $CuCO_3 + H_2SO_4(dil.) \longrightarrow CuSO_4 + H_2O + CO_2$

(*d*) Simple displacement

e.g., $Zn + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$

Q9. Define or explain the meaning of the following terms :

(*a*) Acid (*b*) pH scale.

Ans. (*a*) Acid : Acid is the chemical compound which, on dissolving in water, produces Hydronium ions as the only positively charged particles.

(*b*) pH scale : The scale used for determining the acidic or alkaline character of the solution.

Q10. Sulphuric acid can be used to prepare a number of gases in the laboratory. Write balanced equations for reactions in which the following gases are obtained using dilute Sulphuric acid as one of the reactants.

(*a*) Hydrogen

(*b*) Carbon dioxide

(*c*) Sulphur dioxide

Ans. (*a*) $Zn + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$ or any other active metal except Na, K, Ca, Sn, Pb.

(*b*) $Na_2CO_3 + H_2SO_4(dil.) \rightarrow Na_2SO_4 + H_2O + CO_2\uparrow$ any other metallic Carbonate or Bicarbonate except of Calcium and Lead.

(*c*) $Na_2SO_3 + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$ Any other metallic Sulphite or Bisulphite.

Q11. (*a*) The pH value of pure water is 7. Compare the pH values of Sulphur dioxide solution and Ammonia solution with that of pure water.

(*b*) Name :

(*i*) two bases which are not alkalies.

(*ii*) a normal salt and acid salt of same acid.

(*iii*) a salt insoluble in cold water but soluble in hot water.

Ans. (*a*) pH of Sulphur dioxide solution is less than seven.

pH of Ammonia solution is more than seven.

(*b*) (*i*) Magnesium hydroxide, Copper hydroxide.

(*ii*) Sodium sulphate and Sodium bisulphate.

(*iii*) Lead chloride.

Q12. Answer the following questions relating to salts and their preparation :

(*a*) What is salt ?

(*b*) What kind of salt is prepared by precipitation ?

(*c*) Name a salt prepared by direct combination. Write the equation for the reaction that takes place when preparing the salt you have named.

(*d*) What procedure would be used to prepare Sodium salt such as Sodium sulphate. (Give the name of the procedure only)

Ans. (*a*) Salts are the chemical compounds which, on dissolving in water, produce positively charged particles other than Hydronium ions and negatively charged particles other than Hydroxyl ion.

(*b*) Insoluble salts are prepared by precipitation.

(*c*) Iron (III) chloride or Ferric chloride

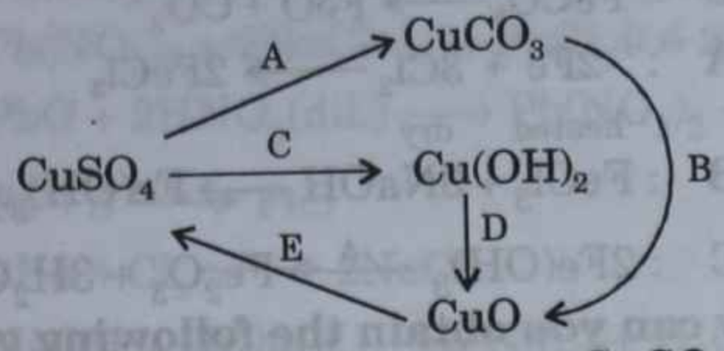
$$\underset{\text{heated}}{2Fe} + \underset{\text{dry}}{3Cl_2} \longrightarrow 2FeCl_3$$

(*d*) By reacting Sodium carbonate or Sodium hydroxide with dilute Sulphuric acid. It is prepared by the reaction of neutralization.

$$Na_2CO_3 + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + H_2O + CO_2$$

$$2NaOH + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + 2H_2O$$

Q13. For each of the conversions A, B, C, D and E in the scheme below, state briefly in words how the conversions can be carried out :



Ans. A. $CuSO_4 + Na_2CO_3 \longrightarrow CuCO_3 + Na_2SO_4$

B. $CuCO_3 \xrightarrow{\Delta} CuO + CO_2 \uparrow$

C. $CuSO_4 + 2NaOH \longrightarrow Cu(OH)_2 + Na_2SO_4$

D. $Cu(OH)_2 \longrightarrow CuO + H_2O$

E. $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$

Q14. (*i*) What is an alkali ?

(*ii*) Explain the meaning of the term acid salt.

Ans. (*i*) Water soluble bases are called as alkalies.

(*ii*) The salt formed by the incomplete replacement of replaceable Hydrogen ions of an acid by a basic radical or metallic ion.

Q15. State what would you observe when :

(*a*) Hydrated Copper sulphate is heated.

(*b*) Sodium carbonate solution is mixed with Calcium chloride solution.

(*c*) Lead nitrate solution is mixed with dilute Hydrochloric acid.

(*d*) Lead nitrate is heated.

(*e*) Ferric chloride is exposed to atmosphere.

(*f*) Blue litmus is dipped in the solution of dilute acid.

(*g*) Dilute acid is added to Sodium carbonate.

(*h*) Sodium hydroxide solution is slowly added to Copper sulphate solution.

(*i*) Copper hydroxide is heated.

(*j*) Sodium hydroxide is added to Ammonium chloride.

(*k*) Copper nitrate is heated.

(*l*) Copper carbonate is heated.

(*m*) Barium chloride solution is slowly added to Sodium sulphate solution.

(*n*) Carbon dioxide is passed through lime water.

(*o*) Washing soda crystals are exposed to atmosphere.

Ans. (*a*) Hydrated Copper sulphate, on heating, changes from blue to white and the crystalline form changes to amorphous (powder).

(*b*) A white precipitate is observed.

(*c*) A white precipitate is formed which is soluble in hot water but insoluble in cold water.

(*d*) Lead nitrate, on heating, decripitates, melts to give a reddish brown coloured gas which turns freshly prepared acidified Ferrous sulphate solution brown black. A residue is left behind which is reddish brown when hot and light yellow when cold.

(*e*) It absorbs moisture from the atmosphere and gets converted into its solution.

(*f*) It changes to red.

(*g*) A colourless and odourless gas with brisk effervescence is evolved which turns lime water milky.

(*h*) A bluish white precipitate is formed which is insoluble in excess of Sodium hydroxide.

(*i*) Bluish white precipitate slowly changes to black colour.

(*j*) A colourless gas with pungent irritating smell evolves which turns Nessler's reagent brown and gives dense white fumes with concentrated Hydrochloric acid.

(*k*) Copper nitrate, on heating, melts to give a reddish brown coloured gas which turns freshly prepared acidified Ferrous sulphate solution brown black. A residue is left behind which is black when hot and black when cold.

(*l*) Copper carbonate, on heating, gives a colourless and odourless gas which turns lime water milky. A residue is left behind which is black when hot and black when cold.

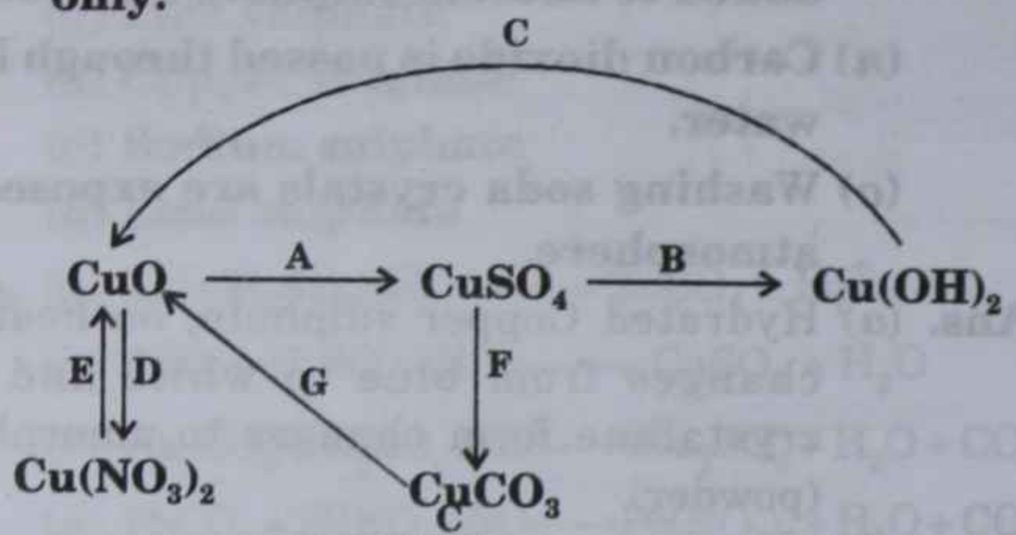
(*m*) A white precipitate is formed which is insoluble in all mineral acids.

(*n*) It turns milky.

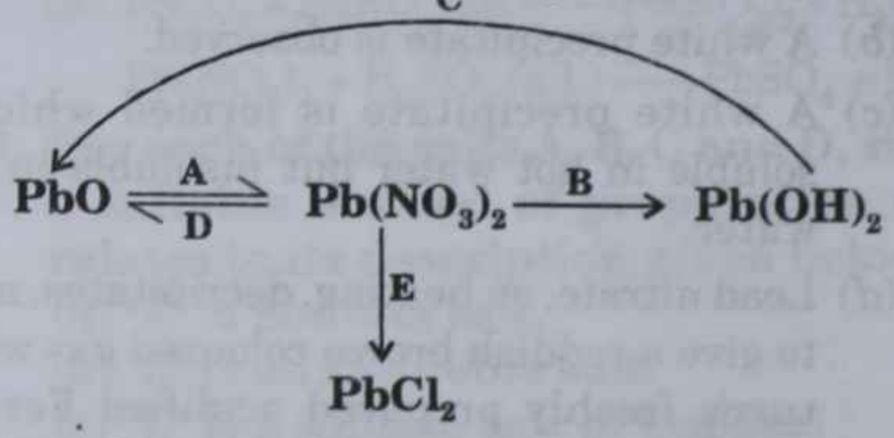
(*o*) It crumbles to form a powder.

Q16. How are the following conversions carried out ? Give balanced chemical equations only.

(*a*)



(*b*)



(*c*) $Zn \xrightarrow{A} ZnS \xrightarrow{B} ZnSO_4 \xrightarrow{C} Zn(OH)_2 \xrightarrow{D} ZnO$

$ZnS \xrightarrow{E} H_2S$, $ZnSO_4 \xrightarrow{F} ZnCO_3 \xrightarrow{G} ZnO$

(*d*) $Fe \xrightarrow{A} FeS \xrightarrow{B} FeCl_2 \xrightarrow{C} Fe(OH)_2 \xrightarrow{D} FeO$

$FeS \xrightarrow{E} H_2S$, $FeCl_2 \xrightarrow{F} FeCO_3 \xrightarrow{G} FeO$

(*e*) $Fe \xrightarrow{A} FeCl_3 \xrightarrow{B} Fe(OH)_3 \xrightarrow{C} Fe_2O_3$

Ans. (*a*) A : $CuO + H_2SO_4(dil.) \longrightarrow CuSO_4 + H_2O$

B : $CuSO_4 + 2NaOH \longrightarrow Cu(OH)_2 + Na_2SO_4$

C : $Cu(OH)_2 \xrightarrow{\Delta} CuO + H_2O$

D : $CuO + 2HNO_3(dil.) \longrightarrow Cu(NO_3)_2 + H_2O$

E : $2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4HNO_2 + O_2\uparrow$

F : $CuSO_4 + Na_2CO_3 \longrightarrow CuCO_3 + Na_2SO_4$

G : $CuCO_3 \xrightarrow{\Delta} CuO + CO_2$

(*b*) A : $PbO + 2HNO_3(dil.) \longrightarrow Pb(NO_3)_2 + H_2O$

B : $Pb(NO_3)_2 + 2NaOH \rightarrow Pb(OH)_2 + 2NaNO_3$

C : $Pb(OH)_2 \xrightarrow{\Delta} PbO + H_2O$

D : $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2\uparrow$

E : $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

(*c*) A : $Zn + S \xrightarrow{\Delta} ZnS$

B : $ZnS + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2S$

C : $ZnSO_4 + 2NaOH \longrightarrow Zn(OH)_2 + Na_2SO_4$

D : $Zn(OH)_2 \xrightarrow{\Delta} ZnO + H_2O$

E : $ZnS + 2HCl(dil.) \longrightarrow ZnCl_2 + H_2S$

F : $ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

G : $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$

(*d*) A : $Fe + S \xrightarrow{\Delta} FeS$

B : $FeS + 2HCl(dil.) \longrightarrow FeCl_2 + H_2S$

C : $FeCl_2 + 2NaOH \longrightarrow Fe(OH)_2 + 2NaCl$

D : $Fe(OH)_2 \xrightarrow{\Delta} FeO + H_2O$

E : $FeS + 2HCl \longrightarrow FeCl_2 + H_2S$

F : $FeCl_2 + Na_2CO_3 \longrightarrow FeCO_3 + 2NaCl$

G : $FeCO_3 \xrightarrow{\Delta} FeO + CO_2$

(*e*) A : $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$

B : $FeCl_3 + 3NaOH \xrightarrow[\text{dry}]{\text{heated}} Fe(OH)_3 + 3NaCl$

C : $2Fe(OH)_3 \xrightarrow{\Delta} Fe_2O_3 + 3H_2O$

Q17. How can you obtain the following gases by using dilute acid and one another substance ?

(*a*) Hydrogen

(*b*) Carbon dioxide

(*c*) Sulphur dioxide

(*d*) Hydrogen sulphide

Ans. (*a*) $Fe + H_2SO_4(dil.) \longrightarrow FeSO_4 + H_2\uparrow$

$Mg + 2HCl(dil.) \longrightarrow MgCl_2 + H_2\uparrow$

(*b*) $Na_2CO_3 + 2HCl(dil.) \longrightarrow 2NaCl + H_2O + CO_2\uparrow$

$NaHCO_3 + HCl(dil.) \longrightarrow NaCl + H_2O + CO_2\uparrow$

(*c*) $Na_2SO_3 + 2HCl(dil.) \longrightarrow 2NaCl + H_2O + SO_2\uparrow$

$Na_2SO_3 + 2H_2SO_4(dil.) \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$

(*d*) $FeS + 2HCl(dil.) \longrightarrow FeCl_2 + H_2S\uparrow$

$Na_2S + 2HCl(dil.) \longrightarrow 2NaCl + H_2S\uparrow$

$ZnS + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2S\uparrow$

Q18. How are the following named salts prepared in laboratory ? Give balanced chemical equations only.

(*a*) Iron (III) chloride

(*b*) Magnesium sulphate

(*c*) Sodium sulphate

(*d*) Lead chloride

(*e*) **Lead nitrate**
(*f*) **Iron (II) sulphide**
(*g*) **Sodium chloride**
(*h*) **Iron (II) chloride**
(*i*) **Zinc sulphate**
(*j*) **Lead sulphide**
(*k*) **Lead carbonate**
(*l*) **Lead sulphate**
(*m*) **Copper sulphate**
(*n*) **Magnesium chloride**
(*o*) **Silver chloride**

Ans. (*a*) $\underset{\text{heated}}{2Fe} + \underset{\text{dry}}{3Cl_2} \longrightarrow 2FeCl_3$

(*b*) $Mg + H_2SO_4(dil.) \longrightarrow MgSO_4 + H_2\uparrow$

(*c*) $Na_2CO_3 + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + H_2O + CO_2\uparrow$

$2NaOH + H_2SO_4(dil.) \longrightarrow Na_2SO_4 + 2H_2O$

(*d*) $Pb(NO_3)_2 + 2HCl(dil.) \longrightarrow PbCl_2\downarrow + 2HNO_3$

$Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2\downarrow + 2NaNO_3$

(*e*) $PbO + 2HNO_3(dil.) \longrightarrow Pb(NO_3)_2 + H_2O$

(*f*) $Fe + S \xrightarrow{\Delta} FeS$

(*g*) $2Na + Cl_2 \longrightarrow 2NaCl$

$NaOH + HCl(dil.) \longrightarrow NaCl + H_2O$

(*h*) $Fe + 2HCl(dil.) \longrightarrow FeCl_2 + H_2\uparrow$

(*i*) $Zn + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2\uparrow$

$ZnO + H_2SO_4(dil.) \longrightarrow ZnSO_4 + H_2O$

(*j*) $Pb(NO_3)_2 + H_2S \longrightarrow PbS + 2HNO_3$

$Pb(NO_3)_2 + Na_2S \longrightarrow PbS + 2NaNO_3$

(*k*) $Pb(NO_3)_2 + Na_2CO_3 \longrightarrow PbCO_3 + 2NaNO_3$

$Pb(NO_3)_2 + K_2CO_3 \longrightarrow PbCO_3 + 2KNO_3$

(*l*) $Pb(NO_3)_2 + Na_2SO_4 \longrightarrow PbSO_4 + 2NaNO_3$

$Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$

(*m*) $CuO + H_2SO_4(dil.) \longrightarrow CuSO_4 + H_2O$

$CuCO_3 + H_2SO_4(dil.) \longrightarrow CuSO_4 + H_2O + CO_2\uparrow$

(*n*) $Mg + 2HCl(dil.) \longrightarrow MgCl_2 + H_2\uparrow$

$MgO + 2HCl(dil.) \longrightarrow MgCl_2 + H_2O$

$MgCO_3 + 2HCl(dil.) \longrightarrow MgCl_2 + H_2O + CO_2\uparrow$

(*o*) $AgNO_3 + HCl(dil.) \longrightarrow AgCl + HNO_3$

Q19. Choosing only substances from the list given below in the box, write equations for the preparation of:

(*i*) Iron (II) sulphate
(*ii*) Iron (II) chloride
(*iii*) Iron (III) chloride
(*iv*) Iron (II) sulphide
(*v*) Zinc sulphate
(*vi*) Copper sulphate
(*vii*) Sodium chloride
(*viii*) Copper carbonate

Iron, Copper, Sulphur, Chlorine, Sodium, Zinc	**dilute Sulphuric acid** **dilute Hydrochloric acid** **dilute Nitric acid**	**Copper oxide** **Sodium carbonate** **Sodium hydroxide**

Ans. (*i*) $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$

(*ii*) $Fe + 2HCl \longrightarrow FeCl_2 + H_2\uparrow$

(*iii*) $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$

(*iv*) $Fe + S \xrightarrow{\Delta} FeS$

(*v*) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$

(*vi*) $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$

(*vii*) $NaOH + HCl \longrightarrow NaCl + H_2O$

(*viii*) $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$

$CuSO_4 + Na_2CO_3 \longrightarrow CuCO_3 + Na_2SO_4$

Q20. Starting from Lead nitrate how will you prepare the following named salts in laboratory. Write only the balanced chemical equations in support of your answer.

(*i*) Lead chloride
(*ii*) Lead sulphate
(*iii*) Lead carbonate
(*iv*) Lead sulphide

Ans. (*i*) $Pb(NO_3)_2 + 2HCl(dil.) \longrightarrow PbCl_2 + 2HNO_3$

(*ii*) $Pb(NO_3)_2 + Na_2SO_4 \longrightarrow PbSO_4 + 2NaNO_3$

(*iii*) $Pb(NO_3)_2 + Na_2CO_3 \longrightarrow PbCO_3 + 2NaNO_3$

(*iv*) $Pb(NO_3)_2 + Na_2S \longrightarrow PbS + 2NaNO_3$

Q21. What is the expected pH of the following solution

(*i*) which liberates carbon dioxide from metallic carbonates ?
(*ii*) which liberates ammonia on heating with ammonium salts ?
(*iii*) of pure water ?

Ans. (*i*) Less than seven

(*ii*) More than seven

(*iii*) Equal to seven.

Q22. Solutions A, B, C and D are having pH 1, 5, 8 and 14 respectively. In this context answer the following questions.

(*i*) Choose the solutions which are acidic in nature.

(*ii*) Choose the solutions which are basic in nature.

(*iii*) Choose the solutions which are highly acidic and highly alkaline.

(*iv*) Choose the solutions which contain both ions and molecules.

Ans. (*i*) A and B

(*ii*) C and D

(*iii*) Highly acidic – A

Highly alkaline – D

(*iv*) B and C

Q23. Give one example each of the sodium salts as

(*i*) acid salt

(*ii*) normal salt

(*iii*) mixed salt

(*iv*) complex salt.

Ans. (*i*) Sodium bisulphate or Sodium bicarbonate.

(*ii*) Sodium sulphate or Sodium carbonate.

(*iii*) Sodium potassium sulphate.

(*iv*) Sodium argentocyanide.

Q24. What is the pH of the following solutions ?

(*i*) Ferric chloride

(*ii*) Sodium acetate

(*iii*) Sodium chloride

Ans. (*i*) Less than 7

(*ii*) More than 7

(*iii*) Equal to 7

Q25. On adding pure water to acidic oxide and soluble basic oxide separately. How does the pH of pure water change ?

Ans. On adding pure water to acidic oxide the pH decreases. On adding pure water to soluble basic oxide the pH increases.

Q26. Give only equations for the conversion of insoluble lead carbonate to lead chloride.

Ans. $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

$Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

Or

$Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

Q27. Write balanced chemical equation to support each of the statement given below (use only dilute sulphuric acid).

(*i*) Basic oxide + Acid ⟶ Salt + Water

(*ii*) Amphoteric oxide + Acid ⟶ Salt + Water

(*iii*) Alkali + Acid ⟶ Salt + Water

(*iv*) Base + Acid ⟶ Salt + Water

(*v*) Active metal + Acid ⟶ Salt + Hydrogen

(*vi*) Metallic carbonate + Acid ⟶ salt + Water + Carbon dioxide

Ans. (*i*) $MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$

(*ii*) $ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$

(*iii*) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(*iv*) $Cu(OH)_2 + H_2SO_4 \longrightarrow CuSO_4 + 2H_2O$

(*v*) $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$

(*vi*) $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

Q28. Name two salts each which an dissolving in water produces

(*i*) Acidic (*ii*) Basic

(*iii*) Neutral solution

Ans. (*i*) Copper sulphate and Ammonium chloride

(*ii*) Potassium acetate and Sodium sulphide

(*iii*) Sodium chloride and Potassium sulphate

❑❑

Let's Recall

Fill Your Answer in the Space Given for Each Question.

Q1. Match the following :

A.

Column -I	Column-II
(*i*) Acid	(*a*) Washing soda
(*ii*) Base	(*b*) Ferric chloride
(*iii*) Efflorescent	(*c*) Hydroxyl ion
(*iv*) Deliquescent	(*d*) Concentrated sulphuric acid
(*v*) Hygroscopic	(*e*) Hydrogen ion

Ans. (*i*) ☐ (*ii*) ☐ (*iii*) ☐ (*iv*) ☐ (*v*) ☐

B.

Column -I	Column-II
(*i*) Ferric chloride	(*a*) Precipitation
(*ii*) Sodium chloride	(*b*) Simple displacement
(*iii*) Magnesium sulphate	(*c*) Metal oxide and dilute acid
(*iv*) Lead chloride	(*d*) Synthesis
(*v*) Copper sulphate	(*e*) Neutralization

Ans. (*i*) ☐ (*ii*) ☐ (*iii*) ☐ (*iv*) ☐ (*v*) ☐

C.

Column -I	Column-II
(*i*) Potash alum	(*a*) Acid salt
(*ii*) Sodium sulphate	(*b*) Double salt
(*iii*) Potassium bisulphate	(*c*) Basic salt
(*iv*) Copper hydroxychloride	(*d*) Normal salt

Ans. (*i*) ☐ (*ii*) ☐ (*iii*) ☐ (*iv*) ☐

Q2. Fill in the blanks.

(*i*) Element 'A' is a non-metal and it burns in oxygen to form _____ which on dissolving in water produces _____ which turns blue litmus to _____.

(*ii*) _____ metals react with dilute acids to liberate _____.

(*iii*) Sulphur dioxide is having _____ smell.

(*iv*) Ammonium hydroxide is a _____ base.

(*v*) Soluble salts are prepared by _____ whereas insoluble salts are generally prepared by _____.

(*vi*) Hygroscopic substances are also called as _____.

(*vii*) _____ is a green coloured insoluble salt.

(*viii*) _____ has a smell of rotten eggs.

(*ix*) Both _____ and _____ turn lime water milky.

(*x*) On adding acid to methyl orange it changes to _____.

Q3. State whether the following statements are True or False.

(*i*) Carbon dioxide is a neutral oxide. ☐

(*ii*) Acetic acid is a tribasic acid. ☐

(*iii*) pH of pure water is 7. ☐

(*iv*) Anhydrous sodium carbonate is efflorescent. ☐

(*v*) Bleaching powder is a mixed salt. ☐

(*vi*) Sodium chloride is double salt.

(*vii*) Ferro cyanide ion is a complex ion.

(*viii*) Soluble bases are called Alkalies.

(*ix*) Phosphoric acid is a weak dibasic acid.

(*x*) Non-metals react both with dilute as well as concentrated acids.

Q4. Complete and balance the following chemical equations (all reactants are given).

(*i*) $C + HNO_3(conc.) \longrightarrow$ _____ + _____ + _____

(*ii*) $NaCl + H_2SO_4 \xrightarrow{\text{Room temperature}}$ _____ + _____

(*iii*) $NH_4Cl + NaOH \xrightarrow{\Delta}$ _____ + _____ + _____

(*iv*) $Pb(NO_3)_2 \xrightarrow{\Delta}$ _____ + _____ + _____

(*v*) $Fe + Cl_2 \longrightarrow$ _____

(*vi*) $S + HNO_3 \longrightarrow$ _____ + _____ + _____

(*vii*) $FeCl_3 + NH_4OH \longrightarrow$ _____ + _____

(*viii*) $Fe + H_2O \longrightarrow$ _____ + _____

(*ix*) $Na_2S + H_2SO_4 \longrightarrow$ _____ + _____

(*x*) $Na_2SO_3 + HCl \longrightarrow$ _____ + _____ + _____

(*xi*) $Na_2CO_3 + H_2SO_4 \longrightarrow$ _____ + _____ + _____

(*xii*) $Pb(NO_3)_2 + HCl \longrightarrow$ _____ + _____

(*xiii*) $Al + NaOH + H_2O \longrightarrow$ _____ + _____

(*xiv*) $Al_2O_3 + HCl \longrightarrow$ _____ + _____

(*xv*) $KOH + H_2SO_4 \longrightarrow$ _____ + _____

Q5. Each question has four options, out of which only one option is correct. Dark the bubble for correct answer.

(*i*) Phosphorous acid is

(*a*) weak tribasic acid (*b*) strong dibasic acid

(*c*) weak dibasic acid (*d*) strong tribasic acid.

Ans. (*a*) (*b*) (*c*) (*d*)

(*ii*) Ammonium salts on heating with alkali produces

(*a*) hydrogen (*b*) ammonia (*c*) nitrogen (*d*) None of these.

Ans. (*a*) (*b*) (*c*) (*d*)

(*iii*) The aqueous solution of potassium chloride is

(*a*) alkaline (*b*) neutral (c) acidic (*d*) amphoteric.

Ans. (*a*) (*b*) (*c*) (*d*)

(*iv*) All acids essentially contain

(*a*) oxygen (*b*) nitrogen (*c*) carbon (*d*) hydrogen.

Ans. (*a*) (*b*) (*c*) (*d*)

(*v*) Choose hydro-acid from the following acids.

(*a*) Acetic acid (*b*) Carbonic acid (*c*) Hydrochloric acid (*d*) Sulphuric acid.

Ans. (a) (b) (c) (d)

(*vi*) Choose oxy-acid from the following acids.

(*a*) Hydrochloric acid (*b*) Hydroiodic acid (*c*) Nitric acid (*d*) Hydrofluoric acid.

Ans. (a) (b) (c) (d)

(*vii*) Hydrated copper sulphate on heating changes to

(*a*) blue and crystalline (*b*) white and crystalline

(*c*) blue and amorphous (*d*) white and amorphous.

Ans. (a) (b) (c) (d)

(*viii*) Iron (II) sulphide is prepared in laboratory by

(*a*) neutralization (*b*) precipitation (*c*) synthesis (*d*) None of these.

Ans. (a) (b) (c) (d)

(*ix*) The acid anhydride of sulphuric acid is

(*a*) sulphur dioxide (*b*) sulphur trioxide

(*c*) sulphur monochloride (*d*) None of these.

Ans. (a) (b) (c) (d)

(*x*) Nitrogen oxide is a

(*a*) greenish yellow coloured gas (*b*) colourless and odourless gas

(*c*) reddish brown coloured gas (*d*) None of these.

Ans. (a) (b) (c) (d)

(*xi*) Solution 'A' has pH-1 whereas solution 'B' has pH-4. In this context choose the correct statement

(*a*) 'A' is a weak acid in comparison to B (*b*) 'A' and 'B' both are weak bases

(*c*) 'A' is a strong acid in comparison B (*d*) 'A' is strong base in comparison to 'B'.

Ans. (a) (b) (c) (d)

(*xii*) The pH of copper chloride solution is

(*a*) mole than 7 (*b*) Less than 7 (*c*) Equal to 7 (*d*) None of these

Ans. (a) (b) (c) (d)

(*xiii*) In laboratory, copper sulphate is prepared by

(*a*) displacement (*b*) Synthesis (*c*) Direct combination (*d*) Decomposition by acid

Ans. (a) (b) (c) (d)

(*xiv*) The acid which directly converts phosphorus to phosphoric acid

(*a*) Dilute sulphuric acid (*b*) Dilute acetic acid

(*c*) Dilute nitric acid (*d*) Concentrated nitric acid

Ans. (a) (b) (c) (d)

(*xv*) Soluble salt like sodium sulphate can be prepared in laboratory by the process of

(*a*) Titration (*b*) Synthesis (*c*) Displacement (*d*) Decomposition

Ans. (a) (b) (c) (d)

ANSWERS

1. A. (*i*) *e* (*ii*) *c* (*iii*) *a* (*iv*) *b* (*v*) *d**

B. (*i*) *d* (*ii*) *e* (*iii*) *b* (*iv*) *a* (*v*) *c*

C. (*i*) *b* (*ii*) *d* (*iii*) *a* (*iv*) *c*

2. (*i*) acidic oxides, acids, red (*ii*) reactive, hydrogen

(*iii*) burning sulphur (*iv*) weak

(*v*) neutralization reactions, precipitation reactions

(*vi*) drying agents (*vii*) copper carbonate

(*viii*) Hydrogen sulphide (*ix*) Carbon dioxide and Sulphur dioxide

(*x*) Red or Pink

3. (*i*) False (*ii*) False (*iii*) True (*iv*) False (*v*) True

(*vi*) False (*vii*) True (*viii*) True (*ix*) True (*x*) False

4. (*i*) $C + 4HNO_3 \longrightarrow CO_2 + 2H_2O + 4NO_2$

(*ii*) $NaCl + H_2SO_4 \xrightarrow{\text{Room temperature}} NaHSO_4 + HCl$

(*iii*) $NH_4Cl + NaOH \xrightarrow{\Delta} NaCl + NH_3 + H_2O$

(*iv*) $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

(*v*) $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$

(*vi*) $S + 6HNO_3 \longrightarrow H_2SO_4 + 2H_2O + 6NO_2$

(*vii*) $FeCl_3 + 3NH_4OH \longrightarrow Fe(OH)_3 + 3NH_4Cl$

(*viii*) $3Fe + 4H_2O \rightleftharpoons Fe_3O_4 + 4H_2$

(*ix*) $Na_2S + H_2SO_4 \longrightarrow Na_2SO_4 + H_2S$

(*x*) $Na_2SO_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2$

(*xi*) $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

(*xii*) $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

(*xiii*) $2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2$

(*xiv*) $Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$ (*xv*) $2KOH + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O$

5. (*i*) *c* (*ii*) *b* (*iii*) *b* (*iv*) *d* (*v*) *c* (*vi*) *c* (*vii*) *d*

(*viii*) *c* (*ix*) *b* (*x*) *c* (*xi*) *c* (*xii*) *b* (*xiii*) *d* (*xiv*) *d* (*xv*) *a*

SELF EVALUATION Test

Time : 30 minutes ***Marks : 25***

Q1. Name (*i*) A green coloured carbonate which on heating changes to black.

(*ii*) A carbonate which does not decompose on heating. **1**

Q2. Give reasons why **2**

(*i*) anhydrous ferric chloride is stored in air tight containers.

(*ii*) sodium chloride is neither hygroscopic nor deliquescent yet common salt becomes wet during rainy season.

Q3. Write balanced chemical equations for the following reactions. **2**

(*i*) $KHCO_3 + HCl \longrightarrow$ (*ii*) $ZnO + NaOH \longrightarrow$

(*iii*) $Al + NaOH + H_2O \longrightarrow$ (*iv*) $FeCl_2 + NH_4OH \longrightarrow$

Q4. Write only balanced chemical equations only for the laboratory preparation of the following named salts. **3**

(*i*) Zinc sulphate (*ii*) Lead nitrate (*iii*) Lead sulphate

Q5. Distinguish between the following pairs as directed **3**

(*i*) Sodium nitrate and sodium chloride (using silver nitrate solution)

(*ii*) Sodium sulphite and sodium sulphate (Barium chloride solution)

(*iii*) Sodium carbonate and sodium sulphate (using dilute Hydrochloric acid)

Q6. Name the gas evolved and give one confirmatory test of each gas. **4**

(*i*) Marble chips are added to dilute hydrochloric acid.

(*ii*) Dilute sulphuric acid is added to iron (II) sulphide.

(*iii*) Ammonium chloride is heated with alkali.

(*iv*) Dilute sulphuric acid is added to sodium sulphite.

Q7. Choosing only from the list of substances given below. How will you prepare the following named salts in laboratory ? Write only balanced chemical equation in support of your answer. **10**

List : Fe, Cu, Na, Pb, CuO, PbO, Cl_2, S, dilute H_2SO_4, dilute HCl, dilute HNO_3, Zn, Na_2CO_3, NaOH.

(*i*) Ferric chloride (*ii*) Ferrous sulphate

(*iii*) Ferrous chloride (*iv*) Copper sulphate

(*v*) Sodium sulphate (*vi*) Zinc chloride

(*vii*) Lead nitrate (*viii*) Lead carbonate

(*ix*) Copper carbonate (*x*) Zinc sulphide