66. A = MnO_2 (B) K_2MnO_4 (C) $KMnO_4$ (D) KIO_3

$$\underset{(A)}{2\,MnO_2} + 4KOH + O_2 \longrightarrow \underset{(B)}{2K_2MnO_4} + 2H_2O$$

$$3MnO_4^{2-} + 4H^+ \longrightarrow \underset{(C)}{2MnO_4^-} + MnO_2 + 2H_2O$$

$$2MnO_4^- + H_2O + KI \longrightarrow \underset{(A)}{2MnO_2} + 2OH^- + \underset{(D)}{KIO_3}$$

71. A violet compound of manganese (A) decomposes on heating to liberate oxygen and compounds (B) and (C) of manganese are formed. Compound (C) reacts with KOH in the presence of potassium nitrate to give compound (B). On heating compound (C) with conc. H_2SO_4 and NaCl, chlorine gas is liberated and a compound (D) of manganese along with other products is formed. Identify compounds A to D and also explain the reactions involved.

71. A = $KMnO_4$ B = K_2MnO_4 C = MnO_2 D = $MnCl_2$

$$\underset{(A)}{KMnO_4} \xrightarrow{\Delta} \underset{(B)}{K_2MnO_4} + \underset{(C)}{MnO_2} + O_2$$

$$MnO_2 + KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

$$MnO_2 + 4NaCl + 4H_2SO_4 \longrightarrow \underset{(D)}{MnCl_2} + 2NaHSO_4 + 2H_2O + Cl_2$$

NCERT PROBLEMS

(iii) The transition metals generally form coloured compounds.

Most of the complexes of transition metals are colored. This is because of the absorption of radiation from visible light region to promote an electron from one of the d-orbitals to another. In the presence of ligands , the d orbitals split up into two sets of orbitals having different energies. Therefore, the transition of electrons can take place from one set to another. The energy required for these transitions is quite small and falls in the visible region of radiation. The ions of transition metals absorb the radiation of a particular wavelength and the rest is reflected, imparting color to the solution.

Q14 :

Describe the preparation of potassium dichromate from iron chromite ore.

What is the effect of increasing pH on a solution of potassium dichromate?

Answer :

Potassium dichromate is prepared from chromite ore $\left(FeCr_2O_4\right)$ in the following steps.

Step (1): Preparation of sodium chromate

$$4FeCr_2O_4 + 16NaOH + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8H_2O$$

Step (2): Conversion of sodium chromate into sodium dichromate

$$2Na_2CrO_4 + conc.H_2SO_4 \longrightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$$

Step(3): Conversion of sodium dichromate to potassium dichromate

$$Na_2Cr_2O_7 + 2KCl \longrightarrow K_2Cr_2O_7 + 2NaCl$$

Potassium dichromate being less soluble than sodium chloride is obtained in the form of orange coloured crystals and can be removed by filtration.

The dichromate ion $\left(Cr_2O_7^{2-}\right)$ exists in equilibrium with chromate $\left(CrO_4^{2-}\right)$ ion at pH 4. However, by changing the pH, they can be interconverted.

$2CrO_{2\text{-}4}$ -Ã¢â€ '-

Q15 :

Describe the oxidising action of potassium dichromate and write the ionicequations for its reaction with:

(i) iodide (ii) iron(II) solution and (iii) H_2S

Answer :

$K_2Cr_2O_7$ acts as a very strong oxidising agent in the acidic medium.

$$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2\left(SO_4\right)_3 + 4H_2O + 3[O]$$

$K_2Cr_2O_7$ takes up electrons to get reduced and acts as an oxidising agent. The reaction of $K_2Cr_2O_7$ with other iodide, iron (II) solution, and H_2S are given below.

(i) $K_2Cr_2O_7$ oxidizes iodide to iodine.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$
$$2I^- \longrightarrow I_2 + 2e^-]\times 3$$
$$Cr_2O_7^{2-} + 6I^- + 14H^+ \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$$

(ii) $K_2Cr_2O_7$ oxidizes iron (II) solution to iron (III) solution i.e., ferrous ions to ferric ions.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$

$$Fe^{2+} \longrightarrow Fe^{3+} + e^-]\times 6$$

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

(iii) $K_2Cr_2O_7$ oxidizes H_2S to sulphur.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$

$$H_2S \longrightarrow S + 2H^+ + 2e^-]\times 3$$

$$Cr_2O_7^{2-} + 3H_2S + 8H^+ \longrightarrow 2Cr^{3+} + 3S + 7H_2O$$

Q16 :

Describe the preparation of potassium permanganate. How does the acidifiedpermanganate solution react with (i) iron(II) ions (ii) $SO_2$and (iii) oxalic acid?

Write the ionic equations for the reactions.

Answer :

Potassium permanganate can be prepared from pyrolusite (MnO_2). The ore is fused with KOH in the presence of either atmospheric oxygen or an oxidising agent, such as KNO_3or $KClO_4$, to give K_2MnO_4.

$$2MnO_2 + 4KOH + O_2 \xrightarrow{\text{heat}} \underset{(\text{Green})}{2K_2MnO_4} + 2H_2O$$

The green mass can be extracted with water and then oxidized either electrolytically or by passing chlorine/ozone into the solution.

Electrolytic oxidation

$$K_2MnO_4 \longleftrightarrow 2K^+ + MnO_4^{2-}$$

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

At anode, manganate ions are oxidized to permanganate ions.

$$\underset{\text{Green}}{MnO_4^{2-}} \longleftrightarrow \underset{\text{Purple}}{MnO_4^-} + e^-$$

Oxidation by chlorine

$$2K_2MnO_4 + Cl_2 \longrightarrow 2KMnO_4 + 2KCl$$

$$2MnO_4^{2-} + Cl_2 \longrightarrow 2MnO_4^- + 2Cl^-$$