

D and F Block Elements :V

EXEMPLAR PROBLEMS:

5. On addition of small amount of KMnO_4 to concentrated H_2SO_4 , a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following.

- (i) Mn_2O_7
- (ii) MnO_2
- (iii) MnSO_4
- (iv) Mn_2O_3

Ans. (i)

8. Which of the following reactions are disproportionation reactions?

- (a) $\text{Cu}^+ \longrightarrow \text{Cu}^{2+} + \text{Cu}$
- (b) $3\text{MnO}_4^- + 4\text{H}^+ \longrightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$
- (c) $2\text{KMnO}_4 \longrightarrow \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
- (d) $2\text{MnO}_4^- + 3\text{Mn}^{2+} + 2\text{H}_2\text{O} \longrightarrow 5\text{MnO}_2 + 4\text{H}^+$

- (i) a, b
- (ii) a, b, c
- (iii) b, c, d
- (iv) a, d

8. (i)

11. KMnO_4 acts as an oxidising agent in acidic medium. The number of moles of KMnO_4 that will be needed to react with one mole of sulphide ions in acidic solution is

- (i) $\frac{2}{5}$
- (ii) $\frac{3}{5}$
- (iii) $\frac{4}{5}$
- (iv) $\frac{1}{5}$

11. (i)

16. KMnO_4 acts as an oxidising agent in alkaline medium. When alkaline KMnO_4 is treated with KI, iodide ion is oxidised to _____.

- (i) I_2
- (ii) IO^-
- (iii) IO_3^-
- (iv) IO_4^-

16. (iii)

18. When acidified $\text{K}_2\text{Cr}_2\text{O}_7$ solution is added to Sn^{2+} salts then Sn^{2+} changes to

- (i) Sn
- (ii) Sn^{3+}
- (iii) Sn^{4+}
- (iv) Sn^+

18. (iii)

21. Why is HCl not used to make the medium acidic in oxidation reactions of KMnO_4 in acidic medium?

- (i) Both HCl and KMnO_4 act as oxidising agents.
- (ii) KMnO_4 oxidises HCl into Cl_2 which is also an oxidising agent.
- (iii) KMnO_4 is a weaker oxidising agent than HCl.
- (iv) KMnO_4 acts as a reducing agent in the presence of HCl.

21. (ii)

32. Why does copper not replace hydrogen from acids?

32. Cu shows positive E value.

38. When a brown compound of manganese (A) is treated with HCl it gives a gas (B). The gas taken in excess, reacts with NH_3 to give an explosive compound (C). Identify compounds A, B and C.

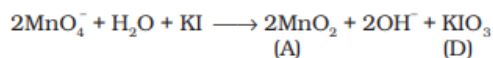
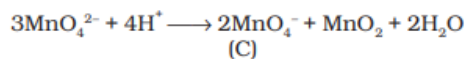
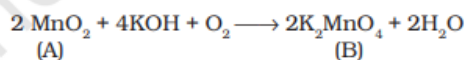
38. A = MnO_2 B = Cl_2 C = NCl_3

$\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + 2\text{H}_2\text{O}$ (A) (B)

$\text{NH}_3 + 3\text{Cl}_2 \rightarrow \text{NCl}_3 + 3\text{HCl}$ (excess) (C)

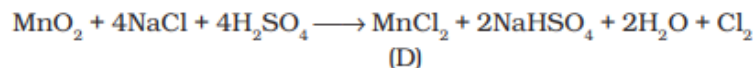
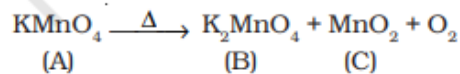
45. When orange solution containing $\text{Cr}_2\text{O}_7^{2-}$ ion is treated with an alkali, a yellow solution is formed and when H^+ ions are added to yellow solution, an orange solution is obtained. Explain why does this happen?

66. A = MnO_2 (B) K_2MnO_4 (C) KMnO_4 (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



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 (FeCr_2O_4) in the following steps.

Step (1): Preparation of sodium chromate



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

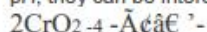


Step(3): Conversion of sodium dichromate to potassium dichromate



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 ($\text{Cr}_2\text{O}_7^{2-}$) exists in equilibrium with chromate (CrO_4^{2-}) ion at pH 4. However, by changing the pH, they can be interconverted.



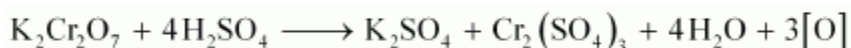
Q15 :

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

(i) iodide (ii) iron(II) solution and (iii) H₂S

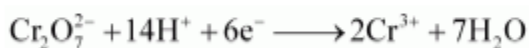
Answer :

$\text{K}_2\text{Cr}_2\text{O}_7$ acts as a very strong oxidising agent in the acidic medium.

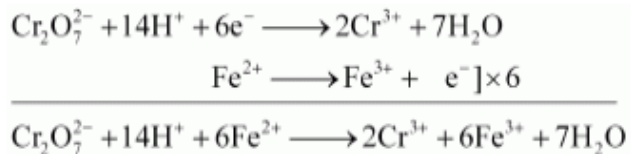


$\text{K}_2\text{Cr}_2\text{O}_7$ takes up electrons to get reduced and acts as an oxidising agent. The reaction of $\text{K}_2\text{Cr}_2\text{O}_7$ with other iodide, iron (II) solution, and H_2S are given below.

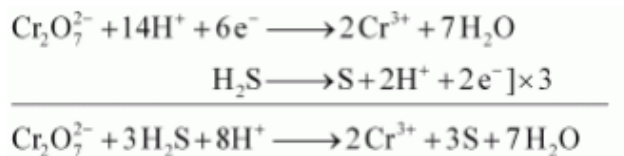
(i) $\text{K}_2\text{Cr}_2\text{O}_7$ oxidizes iodide to iodine.



(ii) $\text{K}_2\text{Cr}_2\text{O}_7$ oxidizes iron (II) solution to iron (III) solution i.e., ferrous ions to ferric ions.



(iii) $\text{K}_2\text{Cr}_2\text{O}_7$ oxidizes H_2S to sulphur.



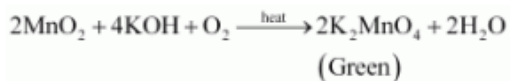
Q16 :

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

Write the ionic equations for the reactions.

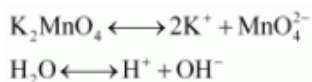
Answer :

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_3 or KClO_4 , to give K_2MnO_4 .

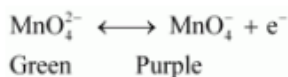


The green mass can be extracted with water and then oxidized either electrolytically or by passing chlorine/ozone into the solution.

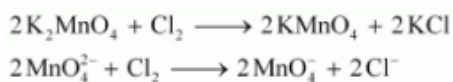
Electrolytic oxidation



At anode, manganate ions are oxidized to permanganate ions.

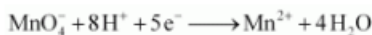


Oxidation by chlorine





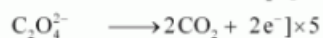
(i) Acidified KMnO_4 solution oxidizes Fe (II) ions to Fe (III) ions i.e., ferrous ions to ferric ions.



(ii) Acidified potassium permanganate oxidizes SO_2 to sulphuric acid.



(iii) Acidified potassium permanganate oxidizes oxalic acid to carbon dioxide.



Q26 :

Indicate the steps in the preparation of:

(i) $\text{K}_2\text{Cr}_2\text{O}_7$ from chromite ore.

(ii) KMnO_4 from pyrolusite ore.

Answer :

(i)

Potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) is prepared from chromite ore (FeCr_2O_4) in the following steps.

Step (1):Preparation of sodium chromate



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

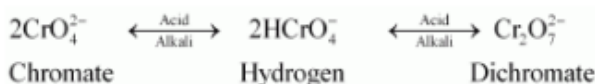


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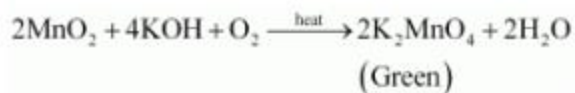
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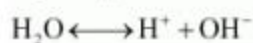
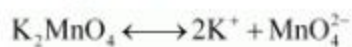
(ii)

Potassium permanganate (KMnO_4) 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_3 or KClO_4 , to give K_2MnO_4 .

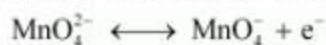


The green mass can be extracted with water and then oxidized either electrolytically or by passing chlorine/ozone into the solution.

Electrolytic oxidation



At anode, manganate ions are oxidized to permanganate ions.



Green Purple

Oxidation by chlorine



Oxidation by ozone

