**Exercise-1** 

Marked Questions may have for Revision Questions.

## **OBJECTIVE QUESTIONS**

# Section (A) : Classical Concept of Equivalent weight/Mass, Equivalent weight, n-factor and Normality for Acid, Base and Precipitate

 $N_2 \longrightarrow NH_3$ 0 -3 28 Eq.wt = mol.wt./ n factor = 6 = 4.67 $n=3\!\times\!2=6$ A-1. Sol. BrO<sub>3</sub>- $\rightarrow Br_2$ A-2. Sol. +5 ∴ (V.f.) BrO<sub>3</sub><sup>-</sup> = 5  $\therefore$  Eq wt = M/5 A-3. Sol. In acidic medium KMnO4 shows following reaction - $\dot{\mathrm{Mn}}\,\mathrm{O}_4^- + 8\mathrm{H}^+ + \mathrm{e}^- \rightarrow \mathrm{Mn}^{2+} + 4\mathrm{H}_2\mathrm{O}$ V.f. = +5 molecular wt. M v.f. = 5 Equivalent weight = molecular wt. Equivalent wt of acid =  $No.of H^+$  replaced per acid molecule A-4. Sol. 98 Equivalent wt. = 1 = 98Sol. Valency factor = 1 A-5. Μ Equivalent weight = 1 A-6. Sol. Normality = Molarity  $\times$  v.f.  $\therefore$  1M H<sub>3</sub>PO<sub>4</sub> = 3N H<sub>3</sub> PO<sub>4</sub> A-7. V.F. of As<sub>2</sub>S<sub>3</sub> is 28. Sol. Reason of this is change in oxidation state of both As and S. V.F. = 2(5-3) + 3[6 - (-2)] = 4 + 24 = 28.:. Eq. wt = M/28Section (B) : Titration

**B-1.** Sol. m. eq. of  $H_2SO_4 = m. eq. of Na_2CO_3$ 

 $\frac{V}{0.1 \times 1000} = \frac{0.125}{106} \times 2$ V = 23.6 mL

**B-2.** Sol. Eq. of Na<sub>2</sub>CO<sub>3</sub> = Eq. of H<sub>2</sub>SO<sub>4</sub>

 $\frac{1.06}{106}$  × 2 =  $\frac{25}{1000}$  × N N = 0.8 NB-3. 22400 mL volume contains = 1 mole gas Sol.  $\therefore 224 \text{ mL volume contains} = \frac{1}{22400} \times 224$  $=\overline{100}$  mole CO<sub>2</sub> Eq of  $CO_2 = Eq$  of HCI 1 200  $\overline{100}_{\times 2} = \overline{1000}_{\times N}$ N = 0.1 N $E_{MCl_2} = E_{M^+2} + E_{Cl^-}$ B-4. Sol. = 32.7 + 35.5 = 68.2Molecular mass =  $2 \times 68.2 = 136.4$ :. B-5. (1) Explanation : No. of meg of  $H^+ = 10 \times 1 + 20 \times 2 = 50$ [ $:: H_2SO_4$ , N = 2 M] Sol. No. of meg of  $OH^- = 30 \times 1 = 30$ No. of meq of H<sup>+</sup> left unreacted = 50 - 30 = 20 meq Hence, (1) is correct, (2), (3) and (4) are ruled out.

# Section (C) : Equivalent Concept for Redox reactions, KMnO<sub>4</sub> / K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> v/s Reducing Agents & their Redox Titration

- **C-1.** Sol. m eq of KMnO4 =  $0.1 \times 5 \times V = 0.5 V$ & m eq K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> =  $0.1 \times 6 \times V = 0.6 V$ So, K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> will oxidise more Fe<sup>2+</sup>
- **C-2.** Sol. Milli equivalents of  $FeC_2O_4 = 0.1 \times 3 \times 25 = 7.5$ From choice (4), milli equivalents of KMnO<sub>4</sub> = 0.1 × 5 × 15 = 7.5  $\therefore$  m. eq. of FeC<sub>2</sub>O<sub>4</sub> = m. eq. of KMnO<sub>4</sub>
- **C-3.** Sol.  $1.68 \times 10^{-3} \times 6 = 3.36 \times 10^{-3} \times X$ 
  - x = 3

- So, oxidation number of A increases by 3.
- $\therefore$  New oxidation number of A = -n + 3 = 3 n.
- C-4. Sol. (1) Formula of silver chromate (VI) will be Ag<sub>2</sub>CrO<sub>4</sub>

(2) Minimum mass of zinc required for reduction of 0.1 mole of  $Cr^{3+}$  to  $Cr^{2+} = \frac{0.1}{2}$  moles of Zn (v.f. of Zn = 2 & v.f. of  $Cr^{3+} = 1$ ) (3)  $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$ 

in both ions, chromium is in +6 oxidation state.

(4) Given reaction is correct.

### Section (D) : Hydrogen peroxide, Hardness of water, Available chlorine

D-1. Sol. 1.5 N H<sub>2</sub>O<sub>2</sub> VS = ?VS = Normality × 5.6 = 1.5 × 5.6 = 8.4 V  $N_1V_1 + N_2V_2 - 3 \times 250 + 1 \times 750$  $V_1 + V_2 = 1000$ Nf = D-2. Sol. = 1.5 N So, volume strength =  $N_f \times 5.6 = 1.5 \times 5.6 = 8.4 V$ D-3. Sol. mole of  $CaCO_3 = 2/100 = 0.02$ 1 so mole of CaO =  $2 \times 0.02 = 0.01$ so mass of CaO = 0.01 × 56 = 0.56 g NaOH D-4. Sol.  $H_2C_2O_4$ 63× 1000 40× 1000  $M = 126 \times 100$ 40× 100 M = M = 5M = 10N = 10 N = 10 V = 125 mL  $V = 125 \, mL$  $N_1V_1 = 1250$  milli equivalent N<sub>2</sub>V<sub>2</sub> = 1250 milli equivalent so, resulting solution will be neutral.

# Exercise-2

Marked Questions may have for Revision Questions.

## **PART - I : OBJECTIVE QUESTIONS**

- 1. Sol. Equivalent of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> = equivalent of N<sub>2</sub>H<sub>4</sub> also equivalent of KMnO<sub>4</sub> = equivalent of N<sub>2</sub>H<sub>4</sub> So, equivalent of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> = equivalent of KMnO<sub>4</sub>  $0.1 \times 6 \times V_1 = 0.3 \times 5 \times V_2$ so V<sub>2</sub> = 2/5 V<sub>1</sub>
- **2. Sol.** In 1<sup>st</sup> reaction, oxisdation number of N is + 4, in 2<sup>nd</sup> reaction it is –3 & in 3<sup>rd</sup> reaction it is +5, none of which changes during reaction.
- **3. Sol.** Valency factor ratio is inversely related to molar ratio. (V.f.)HI : (V.f.)HNO<sub>3</sub> = 1 : 3 = 2 : 6 ∴ Molar ratio = 6 : 2
- 4. Sol.  $2Li + \overset{\circ}{H_2} \longrightarrow 2LiH$

H itself is reduced, so it act as oxidizing agent.

Reduction  
Na + H<sub>2</sub>O 
$$\longrightarrow$$
 NaOH +  $\frac{1}{2}$  H<sub>2</sub>  
Oxidation

5. Sol.

6. Sol. 
$$Cr_2O_7^{2-} + \begin{array}{c} (+4) \\ SO_2 \rightarrow Cr^{3+} + \\ SO_3 \end{array}$$

For a completely balanced equation, net charge on reactant side & product side must be equal.
-1 + 4 + x (-1) = 0
x = +3

8. Sol. 
$$\overset{(+2)}{\operatorname{CaCO}_3} \longrightarrow \overset{(+2)}{\operatorname{CaO}_4} \overset{(+4)}{\operatorname{CaO}_2}$$

9.

15.

Sol.

(+4) (+4) ΝÔ<sub>2</sub>  $N_2O_4$ & difference = 0Sol.  $P_{2}^{+5}O_{5}$  $^{+5}P_4O_{10}$ & difference = 0+2 NO +1 N₂O & difference = 1+6 SO<sub>2</sub>  $SO_3$ 8 difference = 2

- **10. Sol.** Here Ni is oxidised to Ni<sup>2+</sup> So it acts as reducing agent
- **11. Sol.** +7 +6

 $KMnO_4 \longrightarrow K_2MnO_4$ v.f. = 1 M

equivalent wt. =  $\overline{1}$  = M.

- **12.** Sol.  $2H_2S + SO_2 \longrightarrow 3S + 2H_2O$ S in SO<sub>2</sub> is reduced from +4 to 0 state. Therefore it act as oxidising agent.
- **13.** Sol.  $2^{NO} + 3l_2 + 4H_2O \longrightarrow 2^{NO_3^-} + 6l^- + 8H^+$ N is oxidised so it acts a reducing agent.

14. Sol.  
Reduction  
(oxidising agent)  

$$+3$$
  $-2$   $+2$   $0$   
 $2FeCI_3$   $+$   $H_2S \rightarrow 2FeCI_2 + 2HCI + S$   
Oxidation (reducing agent)  
Oxidation

$$Fe^{2^{*}} + MnO_{4}^{-} \longrightarrow Mn^{2^{*}} + Fe^{3^{*}}$$

$$Reduction$$

16. Sol. In formation of nitrogen oxides from  $N_2 \& O_2$ N is oxidised & O is reduced.

 $\stackrel{+2}{\text{NO}} \stackrel{-2}{\text{NO}} \stackrel{(+4)}{\text{NO}} \stackrel{(-2)}{\text{NO}} \stackrel{(+1)}{\text{NO}} \stackrel{(-2)}{\text{NO}} \stackrel{(+2)}{\text{etc.}}$  $Fe_2O_3$ Ni(CN)<sub>4</sub> 17. Sol. Ni(CO)<sub>4</sub>  ${}^{+6}_{SF_6}$  $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O_4^{2-}$ 18. Sol. V.f. = 5 V.f. = 2Balanced equation :  $2MnO_{4^-} + 5C_2O_{4^2^-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O_2$ *.*..  $M^{3+} - 3e^- \longrightarrow M^{6+}$ Sol. 19. 20.  $[Fe(CO)_5]$ : x + 5(0) = 0Sol. x = 0  $\Rightarrow$ 21. SRP values for KMnO<sub>4</sub> & K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> are 1.57 V & 1.33 V respectively so greater the SRP better Sol. oxidising agent. 22. Sol.  $CI^- + MnO_4^- \longrightarrow Mn^{+2} + CI_2$ Eq of  $Cl_2 = Eq$  of  $KMnO_4$ 10 158 2 [mole of  $Cl_2$ ] = 5 50 mole of  $CI_2 = \frac{2 \times 158}{2 \times 158} = 0.15823$  mole volume of Cl<sub>2</sub> at STP = 0.15823 × 22.4 = 3.54 L 23.  $MnO_4^-$  + 5e<sup>-</sup> + 8 H<sup>+</sup>  $\longrightarrow$   $Mn^{2+}$  + 4 H<sub>2</sub>O Sol. 1 mole of MnO<sub>4</sub><sup>-</sup> accepts 5 mole of e<sup>-</sup>  $\Rightarrow$ 1/5 mole of MnO4- accepts 1 mole of e-0.2 mole of MnO4- accepts 1 mole of e-⇒ 0.6 mole of MnO4- accepts 3 mole of e-⇒  $Fe^{2+} \longrightarrow Fe^{3+} + e^{-}$ 1 mole of Fe<sup>2+</sup> will liberate 1 mole of e<sup>-</sup> ⇒  $Cr_2O_7^{2-} + 6e^- + 14 H^+ \longrightarrow 2 Cr^{+3} + 7 H_2O$ 1 mole of Cr<sub>2</sub>O<sub>7</sub><sup>2-</sup> will accept 6 moles of e<sup>-</sup> ⇒ 1 mole of  $FeC_2O_4 \longrightarrow Fe^{3+} + CO_2 + 3e^{-}$ 1 moles of ferrous oxalate gives 3 moles of e- $\Rightarrow$ 0.2 moles of KMnO<sub>4</sub> = 1/5 moles of KMnO<sub>4</sub> oxidises 1 mole of Fe<sup>2+</sup> ion. (Tallies with statement  $\Rightarrow$ A) 0.6 moles of  $KMnO_4 = 3/5$  moles of  $KMnO_4$  will oxidise 1 mole of ferrous oxalate (Tallies with statement C) 1 mole of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> will oxidise 2 moles of ferrous oxalate. (Tallies with statement D) Hence ,(1) , (3) , (4) are correct while (2) is incorrect.

**24. Ans.** (2)

Sol. When O. No. decreases i.e. reduced or oxidizing agent.

**25. Ans.** (2)

- **26. Ans.** (2)
- Sol.

 $MnO_{4^-} \longrightarrow Mn^{2+}$ 

(+7) (+2)

 $\therefore$  MnO<sub>4</sub><sup>-</sup> acts as oxidising agent.

**Exercise-3** 

# PART - I : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS) OFFLINE JEE-MAIN

2.

**Sol.** Dilute nitric acid converts chromate into dichromate and H<sub>2</sub>O.

 $2K_{2}CrO_{4} + 2HNO_{3} \longrightarrow K_{2}Cr_{2}O_{7} + 2KNO_{3} + H_{2}O.$   $\stackrel{+3}{Mn_{2}O_{3}} \xleftarrow{+4e^{-}} [KMnO_{4}] \xrightarrow{+e^{-}} [MnO_{4}]^{2-}$   $\xrightarrow{+3e^{-}} + 4e^{-} + 4e^{-}$ 

3.

**Sol.** 
$$C_{r_2O_7^{-2-}}^{+6} + 14H^{+} + 6I^{-} \longrightarrow C_r^{+3} + 7H_2O + 3I_2$$

- 4. Sol. HCl reduces  $MnO_{4^{-}}$  to  $Mn^{2+}$  and itself oxidises to Cl<sub>2</sub>.
- 5. Sol. Weight of organic compound = 29.5 mg

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NH<sub>3</sub> + HCI → NH<sub>4</sub>CI

HCI (remaining) + NaOH → NaCI + H<sub>2</sub>O

(1.5 m mole)

Total milimole of HCI = 2

mili mole of HCI used by NH<sub>3</sub> = 2 - 1.5 = 0.5

mili mole of NH<sub>3</sub> = 0.5

weight of NH<sub>3</sub> = 0.5 × 17 mg = 8.5 mg

\frac{14}{17} × 8.5 mg = 7 mg

\frac{7}{29.5} × 100 = 23.7 %.
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6. Sol. 
$$MnO_{4^-} + C_2O_{4^{2-}} + H^+ \longrightarrow Mn^2 + CO_2 + H_2O$$
  
vf = 1(7 -2) vf = 2(3-2)

= 2 = 5 **Balanced Equation :**  $2MnO_4^- + 5C_2O_4^{2-} + 16 H^+ \longrightarrow 2Mn^{2+} + 10 CO_2 + 8H_2O_2$ So, x = 2, y = 5 & z = 16. 7. Sol. Mass of organic compound = 1.4 glet it contain x mmole of N atom. organic compound  $\longrightarrow NH_3$ x m mole 2NH<sub>3</sub> + H<sub>2</sub>SO<sub>4</sub> - $\rightarrow$  (NH<sub>4</sub>)<sub>2</sub> SO<sub>4</sub>. (1st) 6 mmole initially taken.  $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$  (2nd) 2 mmole reacted Hence m moles of  $H_2SO_4$  reacted in 2nd equation = 1  $\Rightarrow$  m moles of H<sub>2</sub>SO<sub>4</sub> reacted from 1st equation = 6 - 1 = 5 m moles  $\Rightarrow$  m moles of NH<sub>3</sub> in 1st equation = 2 x 5 = 10 m moles  $\Rightarrow$  m moles of N atom in the organic compound = 10 m moles  $\Rightarrow$  mass of N = 10 x 10<sup>-3</sup> x 14 = 0.14 g 0.14 × 100  $\Rightarrow$  % of N = 1.4 = 10 %

#### **ONLINE JEE-MAIN**

#### 3.

Sol. Organic compound  $\longrightarrow$  NH<sub>3</sub> (1.4g)  $2NH_3 + H_2SO_4 \longrightarrow (NH_4)2SO_4$  $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$ 1 1 1 1  $n_{NH_3} + 20 \times \overline{10} \times \overline{1000} = 60 \times \overline{10} \times 2 \times \overline{1000}$ 12 2  $n_{\rm NH_3} = \frac{12}{1000} = \frac{10}{1000} = \frac{10}{100}$  $\frac{0.14}{\times}\!\times\!100$ % of N = 1.4 $n_{N} = {n_{NH_3}} = 0.01 \implies m_{N} = 0.01 \times 14 = 0.14 \text{ g}$ = 10%. ⇒ PART - II : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

## \* Marked Questions may have more than one correct option.

			Mo	ecular we	eight			Mol.	wt.	Mol	wt
1.	Sol.	Eq. mass = <sup>Change</sup>	in	oxidation	No.	of	Mn _	_ 4 -	2	_	2
	(O.N. of Mn in $MnSO_4 = +2$ ; O.N. of Mn in $MnO_2 = +4$ ).										

#### **2. Sol.** (A) Equilivalents of $H_2C_2O_{4.}2H_2O$ in 10 mL = Equivalents of NaOH

 $\left(\frac{6.3}{126/2} \times \frac{1000}{250}\right)_{x} \frac{10}{1000} = 0.1 \times V \text{ (in litre)}$  $\therefore \qquad V = 0.04 \text{ L} = 40 \text{ mL}.$ 

- **3. Sol.**  $2MnO_4^- + I^- + H_2O \longrightarrow 2MnO_2 + IO_3^- + 2OH^-$ .
- 4. Sol.  $Cr_2O_7^{2-}$  +  $Fe^{2+} \longrightarrow 2Cr^{3+}$  +  $Fe^{3+}$  +  $7H_2O$  n = 6 n=11 mole of  $Cr_2O_7^{2-}$  will require six moles of  $Fe^{2+}$  ions.
- 5. Sol. milli mole of Hypo =  $0.25 \times 48$ =  $2 \times$  milli mole of Cl<sub>2</sub> milli mole of Cl<sub>2</sub> =  $\frac{0.25 \times 48}{2}$  = 6 milli mole = milli mole of Cl<sub>2</sub> = milli mole of CaOCl<sub>2</sub> So, molarity =  $\frac{6}{25}$  M = 0.24 M
- Sol. CaOCl₂ = Ca(OCl)Cl
   OCl⁻ Hypochlorite ion
   which is anion of HOCl
   Anhydride of HOCl = Cl₂O.

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#### **APSP Solutions** PART-I $\underset{Na_{2}}{\overset{+2}{\operatorname{S}_{2}}} \underset{O_{3}}{\overset{----}{\longrightarrow}} Na_{2} \overset{+6}{\operatorname{S}} O_{4}$ 1. $\mathsf{E}_{\mathsf{Na}_2\mathsf{S}_2\mathsf{O}_3} = \frac{\mathsf{mol. wt.}}{\mathsf{V.f}} = \frac{\mathsf{M}}{\mathsf{8}}$ the total change in oxidation number = $4 \times 2 = 8$ ÷ $2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + I_2 + 2K_2SO_4$ . 2. $Cu^{2+} + 1e^{-} \longrightarrow Cu^{+}$ . $E_{Cu} = ?. V.F. = 1.$ 159.5 $E_{CuSO4} = 1 = 159.5$ 3. $eq_{acid} = eq_{base}$ (VF = 1 for both) $CHCl_2COOH + NH_3 \longrightarrow CHCl_2COONH_4$ From reaction, m.moles of NH<sub>3</sub> = m.moles of dichloroacetic acid = 100 100 Moles of $NH_3 = 1000 = 0.1$ :. 4. Equivalents of $FeC_2O_4$ = equivalents of KMnO<sub>4</sub> 5 x = 3 mole x (mole) $\times 3 = 1 \times 5$ Equivalent of KMnO<sub>4</sub> = equivalent of FeSO<sub>4</sub> + equivalent of FeC<sub>2</sub>O<sub>4</sub> 5. 4 x = 5 mole $x \times 5 = 1 \times 1 + 1 \times 3$ 6. meg of $Na_2CO_3 = meg of H_2SO_4$ $10 \times 22.7 = N \times 10.2$ Normality = 0.2225 N $0.2225 \times 400 = 10 \times V_{\rm f}$ $V_f = 890.2 \text{ mL}$ or Volume of H<sub>2</sub>O mixed = 890.2 - 400 = 490.2 mL *.*.. 7. $HNO_3 + NH_4^+ \longrightarrow N_2 + NO_2$ V.F. of $HNO_3 = (5 - 4) = 1$ V.F. of $NH_4^+ = [0 - (-3)] = 3$ so molar ratio of HNO3 and NH4<sup>+</sup> is 3 : 1. 1 mole (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> is found to contain 2 mole of NH<sub>4</sub><sup>+</sup> So, required moles of HNO<sub>3</sub> is $3 \times 2 = 6$ mole. 126 2 $H_2C_2O_4$ . $2H_2O = 2 + 24 + 64 + 36 = 126$ and Equivalent wt. = 8. $W \times 1000$

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 $\rightarrow NH_3 :: V.f. of HNO_3 = 8$ HNO<sub>3</sub> — 9. Eq. wt. = M/8.  $\begin{array}{c} NH_2OH \longrightarrow N_2O \\ -1 & +1 \end{array}$ 10.  $\therefore$  V.f. of NH<sub>2</sub>OH = 2  $\therefore$  Eq wt = M/2 11.  $Ca(HCO_3)_2 + CaO \rightarrow 2CaCO_3 \downarrow + H_2O$ 324  $162 = n_{CaO} = 2$ 12. meg H<sub>2</sub>O<sub>2</sub> = meg I<sub>2</sub> 0.508×2 ×1000  $N \times 5 = 254$ or Normality = 0.8 N Volume strength =  $5.6 \times N = 5.6 \times .8 = 4.48 V.$ 13.  $8KMnO_4 + 3Na_2S_2O_3 + H_2O \rightarrow 2KOH + 8MnO_2 + 3Na_2SO_4 + 3K_2SO_4$ Reduction  $BiO_3^- + Mn^{2+} \longrightarrow Bi^{3+} + MnO_4^-$ 14. Oxidation (i)  $2e + 6H^+ + BiO_3^- Bi^{3+} + 3H_2O$ (ii) 4H<sub>2</sub>O + Mn<sup>2+</sup> MnO<sub>4</sub><sup>-</sup> + 8H<sup>+</sup> + 5e (i)  $\times 5 + (ii) \times 2$ , we get 14 H<sup>+</sup> + 5 BiO<sub>3</sub><sup>-</sup> + 5Mn<sup>2+</sup> 5Bi<sup>3+</sup> + 2MnO<sub>4</sub><sup>-</sup> + 7 H<sub>2</sub>O Hence, (2) is the correct balanced reaction. 15. m.eq. of  $H_2SO_4 = m.eq.$  of NaOH  $98 \times 1.84 \times 10$ 98  $x 2 x 10 = 2 x V_1$  $V_1 = 184 \text{ mL}$ Molecular weight Mol. wt. Mol. wt. Eq. mass = Change in oxidation No. of Mn = 4-2 = 2 16.  $(O.N. of Mn in MnSO_4 = +2; O.N. of Mn in MnO_2 = +4).$ 17. (1) Equilivalents of H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.2H<sub>2</sub>O in 10 mL = Equivalents of NaOH 6.3 1000 10  $\left(\frac{126/2}{250}\right)_{\times} \frac{1000}{1000} = 0.1 \times V$  (in litre) V = 0.04 L = 40 mL.*:*.. 18. O<sub>3</sub> will oxidise H<sub>2</sub>O<sub>2</sub> into oxygen, hence radioacitve oxygen of H<sub>2</sub>O<sub>2</sub> will go only in oxygen, not in water. Half reactions :  $O_3 + 2H^+ + 2e^- \longrightarrow O_2 + H_2O$ ;  $H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^-$ 19. (HCI, HNO3, H3PO2, H3BO3) H2SO4, H2SO3, H3PO3, H4P2O5 are diprotic. HCI, HNO3, H3PO2, H3BO3 are monoprotic.  $^{+7}$  KMnO<sub>4</sub> +  $^{+2}$  FeC<sub>2</sub>O<sub>4</sub>  $\longrightarrow$   $^{+3}$  Fe<sup>3+</sup> +  $^{+2}$  Mn<sup>2+</sup> +  $^{+4}$  CO<sub>2</sub>

 $3KMnO_4 + 5FeC_2O_4 \rightarrow Products$  by mole-mole analysis.

21.

 $\frac{{}^{n}KMnO_{4}}{3} = \frac{{}^{n}FeC_{2}O_{4}}{5}$  ${}^{n}KMnO_{4} = \frac{3}{5} \times 1 \text{ moles.}$ 

wt of metal = 0.28 - 0.14 gm. = 0.14 gm
 wt.of substance = wt. of oxygen
 equivalent of substance = equivalent of oxygen

$$\frac{w_{(sub.)}}{E_A} = \frac{w_{(oxygen)}}{E_O} \qquad E_A = E_O = \frac{32}{4}$$
For SO<sub>2</sub> 
$$E_{Sulphur} = \frac{32}{4}$$

25.

i.e.

26. 70% by weight means 70 g of orthophosphoric acid is present in 100 g acid  $N = \frac{w}{Eq. wt.} \times \frac{1000}{V_{(cc)}}$ w = 70 qmol. mass 98 Eq. wt. = no. replacable H - atoms = 3 $70 \ \times \ 3 \ \times \ 1000 \ \times \ 1.54$ mass 100 98 × 100 V = density = 1.54N = = 33 N  $N_1V_1 \hspace{0.1 cm} + \hspace{0.1 cm} N_2V_2$  $V_1 + V_2$ 27. Normality of a mixture (N) = Normality(N<sub>1</sub>) of H<sub>2</sub>SO<sub>4</sub> = molarity × basicity =  $0.2 \times 2 = 0.4$  N  $N_2 = 0.2 \times 1 = 0.2 N$ V<sub>1</sub> = 100mL, V<sub>2</sub> = 200 mL  $0.4 \hspace{0.1in} \times \hspace{0.1in} 100 \hspace{0.1in} + \hspace{0.1in} 0.2 \hspace{0.1in} \times \hspace{0.1in} 200$ 40 + 40 80 100 +200  $=\overline{300} = 0.2670$  N 300 N = \_ Normality of mixture of acid and base(N')  $N_1V_1 \sim N_2V_2$ 

$$(N') = \frac{V_1 + V_2}{V_1 + V_2}$$

28. The hardness of water is estimated by simple titration of ethylene diamine tetra acetate (EDTA) solution.EDTA forms stable complexes with the metal ions present in the hard water since stability consatants of calcium and magnesium complexes of EDTA are different, even the selective estimation of these ions is possible.

= 8

= 8

29. In presence of phenoplhthalein

 $\frac{1}{2} \text{ meq. of Na}_2\text{CO}_3 = \text{meq. of HCI}$   $\frac{1}{2} \times 40 \times 0.05 \times \frac{1}{2} = x \times 0.05$   $\therefore x = 40 \text{ mI}$ with M.O. Meq. of Na}2\text{CO}\_3 + Meq. of NaHCO}\_3 = Meq. of HCI 2 \times 40 \times 0.05 + 40 \times 0.05 = y \times 0.05

y = 120 ml  $\therefore (y - x) = 80 \text{ ml}$ 

**30.** During oxidation of H<sub>2</sub>O<sub>2</sub>, O–O bond is not broken.

#### PART - II

- 1. Let oxidation number of Os = xOxidation number of oxygen = -2x + 4 (-2) = 0x = + 8

$$\therefore 2 \times 1 + 2x + 7 \times -2 = 0$$
  
x = + 6  
Oxidation number of S = +6

H<sub>2</sub>S<sub>2</sub>O<sub>7</sub> is oleum.

 $\begin{array}{cccc} H_2SO_4 \ + \ SO_3 & \longrightarrow & H_2S_2O_7 & \longrightarrow & 2H_2SO_4 \\ Sulphuric & Oleum & Sulphuric \\ acid & & acid \end{array}$ 

- I<sup>-</sup> can be oxidised to I₂
   Na can be oxidised to Na<sup>+</sup>
   Fe<sup>2+</sup> can be oxidised to Fe<sup>3+</sup>
   So, all are reducing agent.
- 4. Both oxidation and reduction are taking place in : Oxidised (Reducing agent)



- 5. The reaction of  $MnO^{2-4}$  in aqueous medium takes place as below  $3MnO^{2-4} + 2H_2O \rightarrow MnO_2$
- 6. KCN + Fe  $(CN)_2 \longrightarrow K_4 [Fe(CN)_6]$ This is not redox reaction.
- 7. The balanced chemical equationis :

 $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$ 

- 8.  $As_2S_5 + 40 HNO_3 \longrightarrow 5 H_2SO_4 + 40 NO_2 + 2 H_3AsO_4 + 12 H_2O$
- 9. 70% by weight means70 g of orthophosphoric acid is present in 100 g acid

$$V = \frac{\frac{W}{Eq. wt.} \times \frac{1000}{V_{(cc)}}}{\frac{W}{Eq. wt.} \times \frac{1000}{V_{(cc)}}}$$
  
w = 70 g  
mol. mass  
Eq. wt. =  $\frac{100}{1.54}$   
Eq. wt. =  $\frac{\frac{Mass}{density}}{\frac{100}{1.54}}$ 

$$N = \frac{\frac{70 \times 3 \times 1000 \times 1.54}{98 \times 100}}{= 33 \text{ N}}$$

- 10. Normality = molarity  $\times x$ 
  - x = number of replacable H atom or OH groups in a molecule In  $H_3PO_4$  (orthophosphoric acid) x = 3

11. Suppose the molecules of Na<sub>2</sub>CO<sub>3</sub> and NaHCO<sub>3</sub> in a mixture are 'a' . milli-equivalent of HCI

 $N_1V_1 + N_2V_2 = NV$ a × 2 ×1000 + a × 1× 1000 = 0.1 V 3a = 10–4 V .....(i) [::  $N = basicity/acidity \times M$ ]

wt. of  $Na_2CO_3$  + wt. of  $NaHCO_3$  = 1 g ( $\therefore$  wt. of mixture = 1 g)

 $\Rightarrow$  a × 106 + a × 84 = 1

 $a = 5.26 \times 10^{-3}$  ....(ii) Fr

rom Eqs. (i) and (ii) we have 
$$3 \times 5.26 \times 10^{-3} = 10^{-4}$$
V

12. S undergoes increase in oxidation number from +2 to +2.5, while I undergoes decrease in oxidation number from 0 to -1.

(-)

**13.** Cl<sub>2</sub> + OH<sup>-</sup> → Cl<sup>-</sup> + ClO<sub>3</sub><sup>-</sup> + H<sub>2</sub>O; v.f. of Cl<sub>2</sub> = 
$$\frac{2 \times 10}{2 + 10} = \left(\frac{5}{3}\right)$$
  
∴ Eq. wt. of Cl<sub>2</sub> =  $\frac{71}{5/3} = 42.6$ 

14. Valency factor of  $Cr_2O_7^{2-} = 6$ molecular weight molecular weight 6

v.f Equivalent weight = \_

 $Cr_2O_7^{2-} + 14H^+ + 6I^-$ 15. 3I<sub>2</sub> + 2Cr<sup>3+</sup> + 7H<sub>2</sub>O  $\rightarrow$ (v.f.=6) (v.f.=2) Equivalents of  $K_2Cr_2O_7$  = equivalents of  $I_2$  $1 \times 6 = \text{moles of } I_2 \times 2$ Moles of  $I_2 = 3$ 

Moles of  $K_2Cr_2O_7 \times v.f. = moles of Sn^{2+} \times v.f.$ 

1×2 1 Moles of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> = 6 = 3

17. Hypo (Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>) decolouriese iodine solution.

16.

 $2Na_2S_2O_3 + I_2 \longrightarrow 2NaI + Na_2S_4O_6$ Sodium tetra thionate

The neutralization of NaOH by H<sub>2</sub>SO<sub>4</sub> takes place as follows 18.  $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + H_2O$ For complete neutralization Equilvalents of acid = equivalents of base

Equilvalents of NaOH = moles × Acidity = 1 × 1 = 1 Equilvalents of H<sub>2</sub>SO<sub>4</sub> =  $\frac{\chi}{98} \times 2 = \frac{\chi}{49}$  (Mol. mass of H<sub>2</sub>SO<sub>4</sub> = 98 Putting the values 1 × 1 =  $\frac{\chi}{49} \Rightarrow \chi = 49$  g but H<sub>2</sub>SO<sub>4</sub> is 70% let y 70% H<sub>2</sub>SO<sub>4</sub> is required  $\frac{70}{100} \times y = 49 \Rightarrow y = 70$  g

**19.**  $2Fe^{3+}(aq) + Sn^{2+}(aq) \longrightarrow 2Fe^{2+}(aq) + Sn^{4+}(aq)$ 

**20.** When a compound is simultaneously get reduced as well as oxidised in a reaction, then this type of reaction is called disproportionation reaction. Following reaction is an example of it.

 $4 P + 3NaOH \longrightarrow 3H_2O + PH_3 + 3NaH_2PO_2$ 

**21.**  $MnO_4^- \longrightarrow MnO_2$ 

 $Mn^{+7} \longrightarrow Mn^{+4}$ 

In this reaction Mn<sup>+7</sup> reductive by Mn<sup>+4</sup>

- **22.** In Acid Base neutralisation 1 H<sup>+</sup> combines with 1 OH<sup>-</sup> to produce 1 H<sub>2</sub>O therefore its equivalent mass = molecular mass.
- **23.**  $8KMnO_4 + 3Na_2S_2O_3 + H_2O \rightarrow 2KOH + 8MnO_2 + 3Na_2SO_4 + 3K_2SO_4$

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	Ans	swers	;  =						
				EXER	CISE - 1				
A-1.	(4)	A-2.	(1)	A-3.	(3)	A-4.	(4)	A-5.	(1)
A-6.	(3)	A-7.	(4)	B-1.	(1)	B-2.	(4)	B-3.	(2)
B-4.	(3)	B-5.	(1)	C-1.	(2)	C-2.	(4)	C-3.	(2)
C-4.	(2)	D-1.	(2)	D-2.	(2)	D-3.	(2)	D-4.	(1)
				EXER	CISE - 2				
1.	(1)	2.	(4)	3.	(3)	4.	(2)	5.	(3)
6.	(3)	7.	(3)	8.	(1)	9.	(4)	10.	(2)
11.	(1)	12.	(2)	13.	(2)	14.	(1)	15.	(3)
16.	(3)	17.	(2)	18.	(1)	19.	(2)	20.	(1)
21.	(2)	22.	(1)	23.	(2)	24.	(2)	25.	(2)
26.	(2)								
				EXER	CISE - 3				
				PA	RT - I				
				OFFLINE	JEE-MA	IN			
1.	(3)	2.	(4)	3.	(4)	4.	(2)	5.	(3)
6.	(3)	7.	(2)						
				ONLINE	JEE-MAI	N			
1.	()	2.	(2)	3.	(3)	4.	(3)		
				PA	RT - II				
1.	(B)	2.	(A)	3.	(A)	4.	(D)	5.	(C)
6.	(A)								