REDOX REACTIONS

1. Oxidation number of potassium in K_2O, K_2O_2 and KO_2 , respectively, is :

(1) +1, +4 and +2 (2) +1, +2 and +4

(3) +1, +1 and +1 (4) +2 , +1 and $+\frac{1}{2}$

2. The strength of an aqueous NaOH solution is most accurately determined by titrating :

(Note : consider that an appropriate indicator is used)

(1) Aq. NaOH in a volumetric flask and concentrated H_2SO_4 in a conical flask

(2) Aq. NaOH in a pipette and aqueous oxalic acid in a burette

(3) Aq. NaOH in a burette and concentrated H_2SO_4 in a conical flask

(4) Aq. NaOH in a burette and aqueous oxalic acid in a conical flask

3. The compound that cannot act both as oxidising and reducing agent is :

(1) H_2O_2

(2) H_2SO_3

(3) HNO_2

(4) H_3PO_4

4. The hardness of a water sample containing 10^{-3} M $MgSO_4$ expressed as $CaCO_3$ equivalents (in ppm) is ______.

(molar mass of $MgSO_4$ is 120.37 g/mol)

5. Consider the following equations :

$2\,Fe^{2+} + H_2O_2 \rightarrow x\,A + y\,B$

(in basic medium)

$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'\,C + y'\,D + z'\,E$

(in acidic medium)

The sum of the stoichiometric coefficients x, y, x', y' and z' for products A, B, C, D and E, respectively, is ___________.

6. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3 \cdot xH_2O$. The normality of the solution is 0.1 N. The value of x is _______.

(The atomic mass of Na is 23g/mol) :-

7. A 20.0 mL solution containing 0.2 g impure H_2O_2 reacts completely with 0.316 g of $KMnO_4$ in acid solution. The purity of H_2O_2 (in %) is ______ (mol. wt. of H_2O_2 = 34; mol. wt. of $KMnO_4$ = 158)

8. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is ________ .

9. The volume, in mL, of 0.02 M $K_2Cr_2O_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is_______.

(Molar mass of Fe = 56 g mol^{-1})

10. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4, respectively, are x, y and z. The sum of x, y and z is ____.

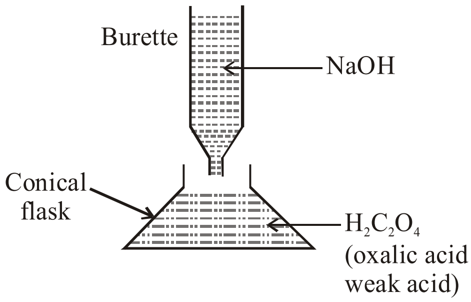
SOLUTION

1. NTA Ans. (3)

Sol. Potasisum has an oxidation of +1 (only) in combined state.

2. NTA Ans. (4)

Sol.



3. NTA Ans. (4)

Sol. (i) H_2O_2 act as oxidising agent as well as reducing agent depending on condition.

(ii) H_2SO_3 act as oxidising agent as well as reducing agent depending on condition.

(iii) HNO_2 act as oxidising agent as well as reducing agent depending on condition.

(iv) H_3PO_4 can not act both as oxidising and reducing agent.

H_3PO_4 can act as only oxidising agent.

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

4. NTA Ans. (100)

Sol. 1 Litre has 10^{-3} moles $MgSO_4$

So , 1000 litre has 1 mole $MgSO_4$

= 1 mole $CaCO_3$

= 100 ppm

5. Official Ans. by NTA (19)

Sol. $\left[Fe^{2+} \rightarrow Fe^{3+} + e^-\right] \times 2$

$$\frac{H_2O_2 + 2e^- \rightarrow 2HO^{\ominus}}{2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2HO^{\ominus}_{(q\omega)}}$$

x = 2 y = 2

$\left[8H^+ + MnO_4^- + 5e^- \rightarrow Mn^{2+} + 4H_2O\right] \times 2$

$\left[H_2O_2 \rightarrow O_{2(g)} + 2H^+ + 2e^-\right] \times 5$

$\Rightarrow 16H^+ + 2MnO_4^- + 5H_2O_2$

$\rightarrow 2Mn^{2+} + 8H_2O + 5O_{2(g)} + 10H^+$

$\Rightarrow 6H^+ + 2MnO_4^- + 5H_2O_2$

$\rightarrow 2Mn^{2+} + 8H_2O + 5O_{2(g)}$

So x' = 2 y' = 8 z' = 5

so x + y + x' + y' + z'

$\Rightarrow$ 2 + 2 + 2 + 8 + 5

$\Rightarrow$ 19

6. Official Ans. by NTA (10)

Sol. Molar mass of $Na_2CO_3 \cdot xH_2O$

$\Rightarrow 23 \times 2 + 12 + 48 + 18x$

$\Rightarrow 46 + 12 + 48 + 18x$

$\Rightarrow (106 + 18x)$

$$Eqwt = \frac{M}{2} = (53 + 9x)$$

As n_{factor} in dissolution will be determined from net cationic or anionic charge; which is 2 so

$$Eqwt = \frac{M}{2} = 53 + 9x$$

$$Gmeq = \frac{wt}{Eqwt} = \frac{1.43}{53 + 9x}$$

$$Normality = \frac{Gmeq}{V_{litre}}$$

$$Normality = 0.1 = \frac{\frac{1.43}{53 + 9x}}{0.1}$$

As volume = 100 ml

= 0.1 Litre

$$So \quad 10^{-2} = \frac{1.43}{53 + 9x}$$

53 + 9x = 143

9x = 90

x = 10.00

7. Official Ans. by NTA (85)

Sol. Eq of H_2O_2 = Eq of $KMnO_4$

$$x \times 2 = \frac{0.316}{158} \times 5$$

$x = 5 \times 10^{-3}$ mol

$$m_{H_2O_2} = 5 \times 10^{-3} \times 34 = 0.17 gm$$

$$\%H_2O_2 = \frac{0.17}{0.2} \times 100 = 85$$

8. Official Ans. by NTA (10)

Sol. $H_3PO_2 + NaOH \rightarrow NaH_2PO_2 + H_2O$

$$\frac{n_{H_3PO_2} \text{reacted}}{1} = \frac{n_{NaOH} \text{reacted}}{1}$$

$$\Rightarrow \frac{0.1 \times 10}{1} = 0.1 \times V_{NaOH}$$

$\Rightarrow V_{NaOH} = 10$ ml.

9. Official Ans. by NTA (50.00)

Sol. $K_2Cr_2O_7 + FeC_2O_4 \longrightarrow Cr^{+3} + Fe^{+3} + CO_2$

$n = 6$ $\quad$ $n = 3$

$$\frac{0.02 \times 6 \times V(mL)}{1000} = \frac{0.288}{144} \times 3$$

$$\Rightarrow \boxed{V = 50 mL}$$

10. Official Ans. by NTA (19.00)

Sol. $K_2Cr_2O_7$

$2(+1) + 2x + 7(-2) = 0$

$x = +6$

In $K_2Cr_2O_7$, Transition metal (Cr) present in +6 oxidation state.

$KMnO_4$

$(+1) + y + 4(-2) = 0$

$x = +7$

In $KMnO_4$, transition metal (Mn) present in +7 oxidation state

K_2FeO_4

$2(+1) + z + 4(-2) = 0$

$x = +6$

In K_2FeO_4 , transition metal (Fe) present in +6 oxidation state

So, $x = +6$

$y = +7$

$z = +6$

$x + y + z = 19$