REDOX REACTIONS

1. (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

Choose the correct option.

(1) H_2O_2 acts as reducing and oxidising agent respectively in equation (A) and (B)

(2) H_2O_2 acts as oxidising agent in equation (A) and (B)

(3) H_2O_2 acts as reducing agent in equation (A) and (B)

(4) H_2O_2 act as oxidizing and reducing agent respectively in equation (A) and (B)

(A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

2. The reaction of sulphur in alkaline medium is the below:

$$S_{8(s)} + a\,OH^-_{(aq)} \rightarrow b\,S^{2-}_{(aq)} + c\,S_2O_3^{2-}{}_{(aq)} + d\,H_2O_{(\ell)}$$

The values of 'a' is _______. (Integer answer)

3. Which of the following equation depicts the oxidizing nature of H_2O_2?

(1) $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$

(2) $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$

(3) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

(4) $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$

4. In basic medium CrO_4^{2-} oxidises $S_2O_3^{2-}$ to form SO_4^{2-} and itself changes into $Cr(OH)_4^-$. The volume of 0.154 M CrO_4^{2-} required to react with 40 mL of 0.25 M $S_2O_3^{2-}$ is _______ mL. (Rounded-off to the nearest integer)

5. In mildly alkaline medium, thiosulphate ion is oxidized by MnO_4^- to "A". The oxidation state of sulphur in "A" is ______.

6. $2\,MnO_4^- + b\,C_2O_4^{2-} + c\,H^+ \rightarrow x\,Mn^{2+} + y\,CO_2 + z\,H_2O$

If the above equation is balanced with integer coefficients, the value of c is _______. (Round off to the Nearest Integer).

$2\,MnO_4^- + b\,C_2O_4^{2-} + c\,H^+ \rightarrow x\,Mn^{2+} + y\,CO_2 + z\,H_2O$

7. The exact volumes of 1 M NaOH solution required to neutralise 50 mL of 1 M H_3PO_3 solution and 100 mL of 2 M H_3PO_2 solution, respectively, are :

(1) 100 mL and 100 mL

(2) 100 mL and 50 mL

(3) 100 mL and 200 mL

(4) 50 mL and 50 mL

8. 15 mL of aqueous solution of Fe^{2+} in acidic medium completely reacted with 20 mL of 0.03 M aqueous $Cr_2O_7^{2-}$. The molarity of the Fe^{2+} solution is _______ $\times 10^{-2}$ M (Round off to the Nearest Integer).

9. The oxidation states of nitrogen in NO, NO_2, N_2O and NO_3^- are in the order of :

(1) $NO_3^- > NO_2 > NO > N_2O$

(2) $NO_2 > NO_3^- > NO > N_2O$

(3) $N_2O > NO_2 > NO > NO_3^-$

(4) $NO > NO_2 > N_2O > NO_3^-$

10. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing Fe^{2+} ions is $x \times 10^{-2}$ M. The value of x is ________. (Nearest integer)

11. Identify the process in which change in the oxidation state is five :

(1) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

(2) $MnO_4^- \rightarrow Mn^{2+}$

(3) $CrO_4^{2-} \rightarrow Cr^{3+}$

(4) $C_2O_4^{2-} \rightarrow 2CO_2$

12. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is .... $\times 10^{-2}$ g/L. (Round off to the nearest integer)

13. The species given below that does NOT show disproportionation reaction is :

(1) BrO_4^- (2) BrO^- (3) BrO_2^- (4) BrO_3^-

14. When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is _______ $\times 10^{-2}$. (Nearest integer)

[Atomic mass of K = 39, Mn = 55, O = 16]

15. Match **List – I** with **List - II**.

	List -I (Colloid Preparation Method)		**List -II (Chemical Reaction)**
(a)	Hydrolysis	(i)	$2AuCl_3 + 3HCHO + 3H_2O \rightarrow 2Au(sol) + 3HCOOH + 6HC1$
(b)	Reduction	(ii)	$As_2O_3 + 3H_2S \rightarrow As_2S_3(sol) + 3H_2O$
(c)	Oxidation	(iii)	$SO_2 + 2H_2S \rightarrow 3S(sol) + 2H_2O$
(d)	Double Decomposition	(iv)	$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3(sol) + 3HCl$

Choose the most appropriate answer from the options given below.

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

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

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

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

SOLUTION

1. Official Ans. by NTA (3)

(A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

In this equation, H_2O_2 is reducing chlorine from +1 to –1.

(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$ In this equation, H_2O_2 is reducing iodine from 0 to –1.

Sol. In (A) reduction of HOCl occurs so it will be a oxidising agent hence H_2O_2 will be a reducing agent.

In(B) reduction of I_2 occurs so it will be a oxidising agent and H_2O_2 will be a reducing agent.

2. Official Ans. by NTA (12)

Sol.

$$16e^{\ominus} + S_8 \longrightarrow 8S^{2-}$$
$$12H_2O + S_8 \longrightarrow 4S_2O_3^{2-} + 24H^+ + 16e^{\ominus}$$
$$2S_8 + 12\,H_2O \longrightarrow 8S^{2-} + 4S_2O_3^{2-} + 24\,H^+$$

for balancing in basic medium add equal number of $OH^{\ominus}$ that of H^+

$$2S_8 + 12H_2O + 24OH^{\ominus} \longrightarrow 8S^{2-} + 4\,S_2O_8^{2-} + 24H_2O$$

$$2S_8 + 24OH^{\ominus} \rightarrow 8S^{2-} + 4S_2O_8^{2-} + 12\,H_2O$$

$$S_8 + 12\,OH^{\ominus} \rightarrow 4S^{2-} + 2S_2O_8^{2-} + 6\,H_2O$$

a = 12

3. Official Ans. by NTA (70)

Sol. $P \propto T$

$$\frac{P_2}{P_1} = \frac{T_2}{T_1} \Rightarrow \frac{40}{35} = \frac{T_2}{300}$$

$T_2 = 342.854$ K

$= 69.70°C \simeq 70°C$

Hence answer is (70)

4. Official Ans. by NTA (173)

Sol. $\overset{+6}{Cr}O_4^{2-} + \overset{+2}{S_2}O_3^{2-} \rightarrow \overset{+6}{S}O_4^{2-} + \overset{+3}{Cr}(OH)_4^-$

gm equi. of $CrO_4^{2-} = S_2O_3^{2-}$

$0.154 \times 3 \times v = 0.25 \times 40 \times 8$

$v = 173.16 = 173$ ml

Hence answer is (173)

5. Official Ans by NTA (6)

Sol. $MnO_4^- + S_2O_3^{2-} \rightarrow \overset{+4}{Mn}O_2 + \underset{(A)}{SO_4^{2-}}$

Oxidation state of 'S' in SO_4^{2-}

= + 6

6. Official Ans. by NTA (16)

Sol. Writting the half reaction

oxidation half reaction

$MnO_4^- \rightarrow Mn^{2+}$

balancing oxygen

$MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

balancing Hydrogen

$8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

balancing charge

$5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

Reduction half

$C_2O_4^{2-} \rightarrow CO_2$

Balancing carbon

$C_2O_4^{2-} \rightarrow 2CO_2$

Balancing charge

$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$

Net equation

$$16H^+ + 2MnO_4^- + 5C_2O_4^{2-} \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$$

So c = 16

7. Official Ans. by NTA (3)

Sol. $H_3PO_3 + 2NaOH \rightarrow Na_2HPO_3 + 2H_2O$

50 ml 1M

1M V = ?

$$\Rightarrow \frac{n_{NaOH}}{n_{H_3PO_3}} = \frac{2}{1}$$

$$\Rightarrow \frac{1 \times V}{50 \times 1} = \frac{2}{1} \Rightarrow \boxed{V_{NaOH} = 100\,ml}$$

$H_3PO_2 + 2NaOH \rightarrow NaH_2PO_3 + H_2O$

100 ml 1M

2M V = ?

$$\Rightarrow \frac{n_{NaOH}}{n_{H_3PO_3}} = \frac{1}{1}$$

$$\Rightarrow \frac{1 \times V}{2 \times 100} = \frac{1}{1} \Rightarrow \boxed{V_{NaOH} = 200\,ml}$$

8. Official Ans. by NTA (24)

Sol. $n_{eq}\ Fe^{2+} = n_{eq}\ Cr_2O_7^{2-}$

or, $\left(\dfrac{15 \times M_{Fe^{2+}}}{1000}\right) \times 1 = \left(\dfrac{20 \times 0.03}{1000}\right) \times 6$

$\therefore\ M_{Fe^{2+}} = 0.24\ M = 24 \times 10^{-2}\ M$

9. Official Ans. by NTA (1)

Sol. The oxidation states of Nitrogen in following molecules are as follows

$NO_3^- \rightarrow +5$

$NO_2 \rightarrow +4$

$NO \rightarrow +2$

$N_2O \rightarrow +1$

10. Official Ans. by NTA (18)

Sol. milli-equivalents of Fe^{2+} = milli-equivalents of $K_2Cr_2O_7$

$M \times 10 \times 1 = 0.02 \times 15 \times 6$

$M = 0.18 = 18 \times 10^{-2}\ M$

11. Official Ans. by NTA (2)

Sol. $MnO_4^- + 5e \rightarrow Mn^{+2}$

12. Official Ans. by NTA (1575)

Sol. $n_{eq}\ KMnO_4 = n_{eq}\ H_2C_2O_4 . 2H_2O$

or , $\dfrac{10 \times 0.05}{1000} \times 5 = \dfrac{10 \times M}{1000} \times 2$

$\therefore$ Conc. of oxalic acid solution = 0.125 M

= 0.125 × 126 g /L = 15.75 g/L

= 1575×10^{-2} g/L

13. Official Ans. by NTA (1)

Sol. In $BrO_4^{\ominus}$, Br is in highest oxidation state (+7), So it cannot oxidise further hence it cannot show disproportionation reaction.

14. Official Ans. by NTA (316)

Sol. Let molarity of $KMnO_4$ = x

$KMnO_4 + FeSO_4 \rightarrow Fe_2(SO_4)_3 + Mn^{2+}$

n = 5 n = 1

(Equivalents of $KMnO_4$ reacted)

= (Equivalents of $FeSO_4$ reacted)

$\Rightarrow$ (5 × x × 10 ml) = 1 × 0.1 × 10 ml

$\Rightarrow$ x = 0.02 M

Molar mass of $KMnO_4$ = 158 gm/mol

$\Rightarrow$ Strength = (x × 158) = 3.16 g/ℓ

15. Official Ans. by NTA (2)

Sol. According to type of reactions for preparation, colloids have been classified