

Chapter 8

Redox Reactions

Solutions

SECTION - A

Objective Type Questions

(2)

(4)

3–

+5, +6

+5, +5

(Oxidation Number, Oxidation, Reduction, Oxidising agent and Reducing agent)

- 1. Oxidation number of Cr atom in CrO₅ and K₃CrO₈ respectively
 - (1) +6, +6
 - (3) +6, +5
- Sol. Answer (3)



- 2. Find the incorrect statement
 - (1) Higher reduction potential of non-metal means stronger reducing agent
 - (2) Lower oxidation potential of a metal means strong oxidising agent
 - (3) Oxidation state of oxygen in O_3 is -1
 - (4) All of these

Sol. Answer (4)

Higher reduction potential means higher tendency to get reduced *i.e.* better oxidizing agent. Lower oxidation potential means higher reduction potential means

- \Rightarrow High tendency to get reduced
- \Rightarrow High tendency to oxidize others
- Oxidation state of oxygen in O_3 is 0.

122 Redox Reactions



Sol. Answer (2)



... Oxidation number changes from +1 to +3.

(Types of Redox reactions, Balancing of Redox reactions)

- 7. When an alkali metal is reacted with hydrogen then metallic hydride is formed. In this reaction
 - (1) Hydrogen is oxidised
 - (3) Hydrogen is neither oxidised nor reduced
- Sol. Answer (2)

$$2M + H_2^0 \longrightarrow 2M^{+1}H^{-1}$$

- \therefore H⁰₂ \longrightarrow H⁻¹ (Reduction)
- 8. $\operatorname{Cl}_{2}(g) + X\overline{O}H \rightarrow \operatorname{YClO}_{3}^{-} + ZH_{2}O + 10e^{-}$
 - The coefficient X, Y and Z are
 - (1) 6, 2, 2
 - (2) 5, 1, 3
 - (3) 12, 2, 6
 - (4) 12, 1, 6
- Sol. Answer (3)

 $\overset{0}{\text{Cl}_2} \longrightarrow \overset{+5}{2\text{ClO}_3^-} + 10\text{e}^-$

To balance O and H, we first find out side deficient in 'O' atoms.

 $Cl_2 + 6H_2O \longrightarrow 2ClO_3 + 10e^-$

Then find out side deficient in H and add H_2O , then add equal number of OH^- on opposite side.

$$Cl_2 + 6H_2O \longrightarrow 2ClO_3 + 12H_2O$$

Adding OH-,

 $Cl_2 + 12OH^- \longrightarrow 2ClO_3 + 6H_2O + 10e^-$

(Law of equivalence and Titrations, Electrochemical cell)

9. The ratio of number of moles of $KMnO_4$ and $K_2Cr_2O_7$ required to oxidise 0.1 mol Sn^{2+} to Sn^{+4} in acidic medium

 (1) 6:5
 (2) 5:6
 (3) 1:2
 (4) 2:1

Sol. Answer (1)

$$\Delta O.N. = 5$$

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

$$\Delta O.N. = 2$$

2 mole of Sn²⁺ \longrightarrow 5 mole of MnO₄⁻

Then, 0.1
$$\longrightarrow \frac{5 \times 0.1}{2}$$

- (2) Hydrogen is reduced
- (4) Hydrogen is oxidised as well as reduced

Since,

$$Cr_{2}O_{7}^{2} \longrightarrow 2Cr^{3+}$$

$$\sum_{\Delta O N = 6}^{\Delta O N = 6} 4$$

$$Sr^{2+} \longrightarrow Sr^{4+}$$

$$\sum_{\Delta O N = 2}^{\Delta O N = 2} 4$$
2 mole of $Sr^{2+} \longrightarrow 6$ mole of $Cr_{2}O_{7}^{2-}$
Then, $0.1 \longrightarrow \frac{6 \times 0.1}{2}$
Then, $ratio = \frac{MnO_{x}}{Cr_{2}O_{x}^{2-}} = \frac{\frac{5 \times 0.1}{2}}{\frac{6 \times 0.1}{2}} = 5 : 6$
10. $Cl_{2} \longrightarrow NaCl + NaClO_{3} + H_{2}O$
The equivalent mass of Cl_{2} in the above reaction is
(1) M
(2) $\frac{M}{3}$
(3) $\frac{M}{2}$
(4) $\frac{3M}{5}$
Sol. Answer (4)
$$\left(Cl_{2} \longrightarrow 2ClO_{3}^{-} + 10e^{-} \dots (1)\right)$$
Adding (1) and (2), we get
 $6Cl_{2} \longrightarrow 10C\Gamma + 2ClO_{3}$
 \therefore 6 moles of Cl_{2} require 10 moles of electrons
 \therefore 1 mole of Cl_{2} require 10 moles of electrons
 \therefore n factor $= \frac{5}{3}$
 \therefore Equivalent mass $= \frac{Molar mass}{\frac{5}{3}} = \frac{3}{5} \times Molar mass$

- 11. KCl is used as an electrolyte in salt bridge because
 - (1) K⁺ and Cl⁻ are isoelectronic
 - (2) Monovalent ions are required
 - (3) Both the ions have almost same velocity
 - (4) They are having similar size

Sol. Answer (3)

KCI is used in salt bridge since K⁺ and CI⁻ have almost the same ionic velocity.

12. EMF of the given cell

	$A_{(s)} A_{(aq)}^{2+} B_{(aq)}^{2+} B_{(s)}$										
	Given $E^{\circ}_{A/A^{2+}}$:+1.4 V and	I E _B	_{B²⁺} ∶−1.4 V								
	(1) 2.8 V	(2)	1.8 V	(3)	0 V	(4)	–1.8 V				
Sol.	Answer (1)					/					
	$E_{cell}^{0} = \left(E_{cathode}^{0}\right)_{SRP} - \left(E_{a}^{0}\right)_{SRP} = \left(E_{a}^{0}\right)_{SRP} + \left(E_{a}^{0}\right)_{SRP} +$	node)	SRP			JUS.					
	$= \left(E_{anode}^{0}\right)_{SOP} - \left(E_{cath}^{0}\right)$	$_{ode})_{s}$	OP		C dain	1000					
	Where SRP is standard re-	ductio	on potential		HILL III						
	and SOP is standard oxida	ation	ootential		conice						
	:. $E_{Cell} = [1.4 - (-1.4)]V$				the inoral						
	= +2.8 V			$\langle \cdot \rangle$	F. ducar						
13.	Electrode potential depende	s upo	n	· Fo	ANT						
	(1) Size of electrode		i Ca	(2)	Surface area of electro	ode					
	(3) Temperature		Le Divisio	(4)	Shape of electrode						
Sol.	Answer (3)										
Electrode potential depends upon temperature											
	$\Delta G = - nFE^{\circ}$										
	and ΔG depends upon tem	perat	ure								
14.	Number of electrons involve	ed in	the reaction when 0.1	mol N	${\rm IH}_{\rm 3}$ dissolved in water						
	(1) 2	(2)	0.4	(3)	0.9	(4)	Zero				
Sol.	Answer (4)										
	$NH_3 + H_2O \longrightarrow NH_4OH$; not a redox reaction.										

 $F_2 + 2e^- \longrightarrow 2F^-$

15.
$$\frac{1}{2}F_2 + e^- \longrightarrow F^ E^\circ = +3.02 \text{ V}$$

Electrode potential for given reaction

Sol. Answer (1)

E° is an intensive property, so it does not change with the amount of substance.

$$\therefore \quad \frac{1}{2}F_2 + e^- \longrightarrow F^-; E^\circ = +3.02 \text{ V}$$

$$F_2 + 2e^- \longrightarrow 2F; E^\circ = +3.02 \text{ V}$$

$$1000F_2 + 2000e^- \longrightarrow 2000F^-; E^\circ = +3.02 \text{ V}$$

- , otential, ł (4) A = B = C 16. Three metals A, B and C are arranged in increasing order of standard reduction electrode potential, hence their chemical reactivity order will be
 - A > B > CB > C > A(1) A < B < C(2) (3)

Sol. Answer (2)

Increasing order of standard reduction potential

Increasing order of standard oxidation potential

Metals have tendency to get oxidized

- Higher the tendency to get oxidized, higher the reactivity *.*..
- Reactivity order: ...

17. How many moles of KMnO₄ are required to oxidise one mole of SnCl₂ in acidic medium?

(1)
$$\frac{1}{5}$$
 (2) $\frac{2}{5}$ (3) $\frac{3}{5}$ (4) $\frac{4}{5}$

Sol. Answer (2)

$$(\Delta O.N. = +2) \times 5$$

$$+7$$

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

$$(\Delta O.N. = -5) \times 2$$

where $\Delta O.N.$ = change in oxidation number

... The reaction becomes

 $2MnO_4^- + 5SnCl_2 \longrightarrow 2Mn^{2+} + 5Sn^{4+}$

5 moles SnCl₂ require 2 moles of KMnO₄

1 mole $SnCl_2$ requires $\frac{2}{5}$ moles of KMnO₄

- 18. Which of the following is incorrect regarding salt bridge solution?
 - (1) Solution must be a strong electrolyte
 - (2) Solution should be inert towards both electrodes
 - (3) Size of cations and anions of salt should be much different
 - (4) Salt bridge solution is prepared in gelatin or agar-agar to make it semi-solid

Sol. Answer (3)

In salt bridge, size of cations and anions should not be much different, they should be similar.

- Standard electrode potentials of redox couples A²⁺/A, B²⁺/B, C/C²⁺ and D²⁺/D are 0.3 V, -0.5 V, -0.75 V and 0.9 V respectively. Which of these is best oxidising agent and reducing agent respectively?
 - (1) D^{2+}/D and B^{2+}/B (2) B^{2+}/B and D^{2+}/D (3) D^{2+}/D and C^{2+}/C (4) C^{2+}/C and D^{2+}/D

Sol. Answer (1)

Out of the given couples, highest reduction potential means highest tendency to get reduced \Rightarrow Best oxidizing agent (D²⁺/D)

Similarly lowest reduction potential

 \Rightarrow Best reducing agent $(B^{2+} / B \longrightarrow -0.5V)$

Because $C \longrightarrow C^{2+}$; $E^{\circ} = -0.75 V$

 \therefore C²⁻¹ \longrightarrow C; E° = +0.75 V

20. The number of moles of H_2O_2 required to completely react with 400 ml of 0.5 N KMnO₄ in acidic medium are

Sol. Answer (1)

where,

 Δ O.N. = Change in oxidation number

:. Reaction becomes

 $2MnO_4^- + 5H_2O_2 \longrightarrow 2Mn^{2+} + 5O_2$

In the reaction, for 1 mole of KMnO₄,

 $\Delta O.N. = 5$

 \therefore n factor of KMnO₄ = 5

Given, normality of $KMnO_4 = 0.5 N$

We know, normality = Molarity × n-factor

- \therefore Molarity = 0.1 M.
- :. Number of moles of $KMnO_4$ in 400 ml = 0.4 × 0.1 = 0.04 moles

From the reaction,

2 moles of $KMnO_4$ react with 5 moles of H_2O_2

(2)

$$\therefore$$
 0.04 moles of KMnO₄ react with $\frac{5}{2} \times 0.04$ moles of H₂O₂ = 0.1

--6

SECTION - B

Previous Years Questions

1. The oxidation state of Cr in CrO_6 is

[NEET-2019 (Odisha)]

[NEET-2019]

[NEET-2019]

+6

(1) +4 **Sol.** Answer (4*)

The most appropriate oxidation state of Cr in CrO₆ is +6 although CrO₆ has doubtful existence.

2. The correct structure of tribromooctaoxide is

$$(1) \begin{array}{c} O \\ O \\ O \\ O'' \\ O$$

(3)

+12

Sol. Answer (1)

The correct structure of tribromooctaoxide is

- 3. Which of the following reactions are disproportionation reaction?
 - (a) $2Cu^+ \longrightarrow Cu^{2+} + Cu^0$
 - (b) $3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$
 - (c) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$
 - (d) $2MnO_4^- + 3Mn^{2+} + 2H_2O \longrightarrow 5MnO_2 + 4H^+$

Select the correct option from the following

(1) (a) and (b) only (2) (a), (b) and (c) (3) (a), (c) and (d) (4) (a) and (d) only

Sol. Answer (1) (a) $2Cu^{+1}$ \longrightarrow $Cu^{2(+)} + Cu^{0}$ Disproportionation (b) $3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^{+7} + MnO_2 + 2H_2O$ Disproportionation (c) $2KMnO_4 \xrightarrow{+7} K_2MnO_4 + MnO_2 + O_2^0$ \therefore Not a disproportionation (d) $2\overset{+7}{M}nO_4^- + 3\overset{+2}{M}n^{2+} + 2H_2O \longrightarrow 5\overset{+4}{M}nO_2 + 4H^+$ Comproportionation The correct order of N-compounds in its decreasing order of oxidation states is 4. [NEET-2018] (2) HNO_3 , NO, NH_4CI , N_2 (1) HNO_3 , NO, N₂, NH₄Cl (3) NH_4CI , N₂, NO, HNO₃ (4) HNO_3 , NH_4CI , NO, N_2 **Sol.** Answer (1) $\overset{+5}{H\,N\,O_{3}}\,,\,\overset{+2}{N\,O},\,\overset{0}{N_{2}},\,\overset{-3}{N\,H_{4}CI}$ Hence, the correct option is (1). FFIFOUTINGS Integ For the redox reaction, $MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O_4^{2-}$ 5. The correct coefficients of the reactants for the balanced equation are [NEET-2018] $C_2 O_4^{2-}$ MnO₄ H⁺ (1) 16 5 2 5 16 (2) 2 16 2 (3) 5 (4) 2 16 5 **Sol.** Answer (2) Reduction ${}^{+7}MnO_4^- + {}^{+3}C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + {}^{+4}C_2O_2 + H_2O_2$ n-factor of $MnO_4^- \Rightarrow 5$ n-factor of $C_2O_4^{2-} \Rightarrow 2$ Ratio of n-factors of MnO_4^- and $C_2O_4^{2-}$ is 5 : 2 So, molar ratio in balanced reaction is 2 : 5 The balanced equation is $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O_2$... Assuming complete ionization, same moles of which of the following compounds will require the least amount 6. of acidified KMnO₄ for complete oxidation? [Re-AIPMT-2015] (2) $Fe(NO_2)_2$ (1) FeC_2O_4 (3) FeSO₄ (4) FeSO₂

Sol. Answer (3)

 $MnO_4^- \longrightarrow Mn^{2+}$; Change in O.N. = 5 In option, (1) $Fe^{2+} \longrightarrow Fe^{3+}$; Change in O.N. = 1 $C_2O_4^{2-} \longrightarrow 2CO_2$; Change in O.N. = 2 3 (2) $Fe^{2+} \longrightarrow Fe^{3+}$; Change in O.N. = 1 $\}_5$ $2NO_2^- \longrightarrow 2NO_3^-$; Change in O.N. = 4 (3) $Fe^{2+} \longrightarrow Fe^{3+}$; Change in O.N. = 1 $\{1, \dots, N\}$ (4) $Fe^{2+} \longrightarrow Fe^{3+}$; Change in O.N. = 1 $SO_3^{2-} \longrightarrow SO_4^{2-}$; Change in O.N. = 2 3Which of the following processes does not involve oxidation of iron? [AIPMT-2015] 7. (1) Liberation of H₂ from steam by iron at high temperature (2) Rusting of iron sheets (3) Decolourization of blue CuSO₄ solution by iron (4) Formation of Fe(CO)₅ from Fe Sol. Answer (4) (a) $H_2O_2+O_3 \rightarrow H_2O+2O_2$ 8. (b) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$ Role of hydrogen peroxide in the above reactions is respectively [AIPMT-2014] Reducing in (a) and oxidizing in (b) (1) Oxidizing in (a) and reducing in (b) (2)Oxidizing in (a) and (b) (3) Reducing in (a) and (b) (4)Sol. Answer (3) In which of the following compounds, nitrogen exhibits highest oxidation state? 9. [AIPMT (Prelims)-2012] (3) N₂H₄ (1) N₂H (2) NH₂OH (4) NH₂ Sol. Answer (1) 10. A solution contains Fe²⁺, Fe³⁺ and I⁻ ions. This solution was treated with iodine at 35°C. E° for Fe³⁺/Fe²⁺ is +0.77 V and E° for $I_2/2I^- = 0.536$ V. The favourable redox reaction is [AIPMT (Mains)-2011] (1) I^- will be oxidised to I_2 (2) Fe²⁺ will be oxidised to Fe³⁺ (3) I₂ will be reduced to I^- (4) There will be no redox reaction Sol. Answer (1) Favourable redox reaction is one for which E° = +ve because only then ΔG would be -ve. $\Delta G^{\circ} = - nFE^{\circ}$ $\mathsf{E}^{\circ}_{\mathsf{cell}} = \mathsf{E}^{\circ}_{\mathsf{F}\mathsf{e}^{3+}/\mathsf{F}\mathsf{e}^{2+}} - \mathsf{E}^{\circ}_{|_{2}/2|^{-}}[\mathsf{E}_{\mathsf{cell}} = \mathsf{E}_{\mathsf{cathode}} - \mathsf{E}_{\mathsf{anode}}] = + 0.234 \text{ V}$ \therefore Cathode (reduction) \longrightarrow Fe³⁺ \longrightarrow Fe²⁺ Anode (oxidation) $\longrightarrow 2l^- \longrightarrow l_2$

Solutions of Assignment (Level-II)					Re	Redox Reactions 131			
11.	Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$ are respectively						[AIPMT (Prelims)-2010]		
Sol.	(1) +3, +5, +4 Answer (4)	(2)	+5, +3, +4	(3)	+5, +4, +3	(4)	+3, +4, +5		
12.	12. Oxidation numbers of P in PO ₄ ³⁻ , of S in SO ₄ ²⁻ and that of Cr in Cr ₂ O ₇ ²⁻ , are respectively								
						[AI	PMT (Prelims)-2009]		
Sol.	(1) + 3, + 6 and + 5 Answer (4)	(2)	+ 5, + 3 and + 6	(3)	- 3, + 6 and + 6	(4)	+ 5, + 6 and + 6		
13.	The number of moles of KMnO ₄ that will be needed to react with one mole of sulphite ion in acidic solution is [AIPMT (Prelims)-2007]								
	(1) 1	(2)	$\frac{3}{5}$	(3)	<u>4</u> 5	(4)	$\frac{2}{5}$		
Sol.	Answer (4)								
14.	Standard reduction potentials of the half reactions are given below $F_{2(g)} + 2e^- \rightarrow 2F_{(aq)}^-$; $E^o = +2.85 \text{ V}$ $Cl_{2(g)} + 2e^- \rightarrow 2Cl_{(aq)}^-$; $E^o = +1.36 \text{ V}$ $Br_{2(l)} + 2e^- \rightarrow 2Br_{(aq)}^-$; $E^o = +1.06 \text{ V}$ $l_{2(s)} + 2e^- \rightarrow 2l_{(aq)}^-$; $E^o = +0.53 \text{ V}$ The strongest oxidising and reducing agents respectively are								
	(1) F_2 and I^-	(2)	Br ₂ and Cl⁻	(3)	Cl ₂ and Br	(4)	Cl_2 and I_2		
Sol. Answer (1)									
	Highest reduction potenti	al ⇒ s	trongest oxidizing ag	jent	<i>i.e.</i> , F ₂ (+2.85 V)	2.14			
	Lowest reduction potentia	$al \Rightarrow st$	rongest reducing age	ent	<i>i.e.</i> , I^- ($E^\circ = -0.5$)	3 V)			
15.	Standard electrode potential for Sn^{4+}/Sn^{2+} couple is +0.15 V and that for the Cr^{3+}/Cr couple is -0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be								
	(1) +1.83 V	(2)	+1.19 V	(3)	+0.89 V	(4)	+0.18 V		
Sol.	I. Answer (3) $E^{\circ}_{Cell} = E^{\circ}_{cathode} - E^{\circ}_{anode} = E^{\circ}_{reduction} - E^{\circ}_{oxidation}$ For the cell to be functional, E ^o must be positive								
	\therefore E° in the formula is a	lways	taken in terms (E°) _{si}	_{RP} i.e. s	tandard reduction p	ootential.			
Here E° would be positive when $Sn^{4+} \longrightarrow Sn^{2+}$; $E^{\circ} = + 0.15 \text{ V}$									
								And $Cr \longrightarrow Cr^{3+}$; $E^{\circ} = -(-0.74 \text{ V}) = +0.74 \text{ V}$ Oxidation potential	
	$\therefore E^{\circ} = E^{\circ}_{Sn^{4+}/Sn^{2+}} - E^{\circ}_{C}$	= r ³⁺ /Cr	0.15 V – (– 0.74 V) = +0.8	39 V				

132 Redox Reactions

16.	Standard reduction electrode potential of three metals X, Y and Z are –1.2 V, +0.5 V and –3.0 V respectively. The reducing power of these metals will be								
	(1) $X > Y > Z$ (2) $Y = 1$	> Z > X	(3)	Y > X > Z	(4)	Z > X > Y			
Sol.	Answer (4)								
Higher reduction potential \Rightarrow stronger oxidizing power									
	\Rightarrow Weaker reducing power								
	\therefore Reducing power : Y < X < Z								
17.	In the reaction								
	$2H_2O_2 \rightarrow 2H_2O + O_2$								
	(1) Oxygen is oxidised only		(2)	Oxygen is reduced onl	у				
	(3) Oxygen is neither oxidised nor	reduced	(4)	Oxygen is both oxidise	d and	d reduced			
Sol.	Answer (4)								
	$H_2O_2^{-1} \longrightarrow H_2O^{-2} + O_2^0$								
	Oxygen is both oxidised and reduce	ed.							
	<i>i.e.</i> this is a disproportion reaction.				5				
18.	Which change requires an oxidising	agent?							
	(1) $2S_2O_3^{2-} S_4O_6^{2-}$ (2) Zr	n²+ <u></u> Zn	(3)		(4)	$SO_3 \Longrightarrow SO_4^{2-}$			
Sol.	Answer (1)			JH Stime					
	$2S_2\Omega_2^{2-} \longrightarrow S_2\Omega_2^{2-}$			Conices					
	$20_20_3 (3 \times 2) = -2$	$4x + (-2 \times 6) = -$	2	C.C. Malso					
	$ \Rightarrow \mathbf{x} = (3 \div 2)^{-1} = 2 $	$\Rightarrow x = \pm 25$	20	Lucatio.					
	\rightarrow γ γ γ γ	\rightarrow x + 2.0	hence	e requires an oxidizing a	agent				
19	Given the following reactions involving	A B C and D	- Pat		gont				
10.	(i) $C + B^+ \rightarrow C^+ + B$		o` (ii)	$A^+ + D \rightarrow No$ reaction					
	(iii) $C^+ + A \rightarrow No$ reaction	1euronisio	(iv)	$D + B^+ \rightarrow D^+ + B$					
	The correct arrangement of A. B. C.	a aae	ent						
	(1) $D > B > C > A$ (2) A	> C > D > B	(3)	C > A > B > D	(4)	C > A > D > B			
Sol.	Answer (4)		(-)		()				
	From the data, it is concluded that								
	D cannot reduce A⁺								
	A cannot reduce C ⁺								
	\Rightarrow Reducing power \longrightarrow C > A >	> D							
	Also, It is seen that D reduces B⁺								
	\therefore Reducing power \longrightarrow C > A >	> D > B							

-	÷ .	,							
20.	Which element undergoes disproportionation in water?								
	(1) Cl ₂	(2)	F ₂	(3)	К		(4)	Cs	
Sol.	Answer (1)								
	Cl ₂ in water disprope	Cl ₂ in water disproportionates to give HCI and HOCI							
	$Cl_2 + H_2O \longrightarrow H_2O$	CI+HOCI							
21.	Standard reduction -2.37 volt respective	ootentials at ely. Which or	25°C of Li ⁺ / ne of the follo	Li, Ba ²⁺ / Ba, N wing is the stro	la⁺ / Na a ngest oxi	ind Mg ²⁺ / Mg a idizing agent?	are –3	.05, –2.90, –2.71 and	
	(1) Ba ²⁺	(2)	Mg ²⁺	(3)	Na ⁺		(4)	Li ⁺	
Sol.	Answer (2)								
	Strongest oxidizing	agent							
	\Rightarrow Highest reduction potential								
Out of the given values, Mg ²⁺ has the highest reduction potential.									
22.	Which substance is	serving as	a reducing ag	gent in the follo	wing rea	ction?			
	$14H^{+} + Cr_2O_7^{2-} + 3Ni \rightarrow 7H_2O + 3Ni^{2+} + Cr^{3+}$								
	(1) H ⁺	(2)	Cr ₂ O ₇ ²⁻	(3)	H ₂ O		(4)	Ni	
Sol.	Answer (4)				(~				
	$^{+6}$ Cr \longrightarrow Cr $^{+3}$ (Oxidizing agent)								
	$Ni \longrightarrow Ni^{2+}$ (Red	ucing agent)				Orices			
	<i>i.e.</i> Ni acts as reduc	cing agent s	ince if reduce	es Cr ⁺⁶ to Cr ³⁺	$\langle \cdot \rangle$	a So.			
23.	The oxide, which cannot act as a reducing agent, is								
	(1) CO ₂	(2)	CIO ₂	(3)	NO ₂		(4)	SO ₂	
Sol.	Answer (1)				L'an				
	CO ₂ cannot act as a because carbon is a	a reducing as already in its	gent because s highest pos	to reduce othe sible oxidation	ers, it itse state.	If has to get o	xidizec	I. This is not possible	
24.	Oxidation state of F	e in Fe ₃ O ₄ i	s H	6.					

(1) $\frac{5}{4}$ (2) $\frac{4}{5}$ (3) $\frac{3}{2}$ (4) $\frac{8}{3}$

Sol. Answer (4)

 $Fe_{3}O_{4} \qquad 3x + (-2 \times 4) = 0$ $\Rightarrow x = \frac{+8}{3}$

25. Oxidation numbers of A, B, C are +2, +5 and -2 respectively. Possible formula of compound is

- (1) $A_2(BC_2)_2$ (2) $A_3(BC_4)_2$ (2) $A_3(BC_4)_2$
- (3) $A_2(BC_3)_2$ (4) $A_3(B_2C)_2$

Sol. Answer (2)

Possible formula for the compound would be A3(BC4)2

$$A_3 \longrightarrow 3 \times +2 = +6$$
$$BC_4 \longrightarrow +5 + (-2 \times 4) = -3$$
$$2(BC_4) \longrightarrow -3 \times 2 = -6$$

Combining A_3 and $2BC_4$, we get net charge of 0 *i.e.* Electrical neutrality of compound is maintained. In the other options, electrical neutrality is not maintained.

- 26. The oxidation states of sulphur in the anions SO_3^{2-} , $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order
 - (1) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$ (2) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$ (3) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$ (4) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$
- Sol. Answer (1)

 $SO_3^{2-} \longrightarrow x + (-2 \times 3) = -2 \Rightarrow x = +4$ $S_2O_4^{2-} \longrightarrow 2x + (-2 \times 4) = -2 \Rightarrow x = +3$ $S_2O_6^{2-} \longrightarrow 2x + (-2 \times 6) = -2 \Rightarrow x = +5$

- :. Oxidation state follows the order, $S_2O_6^{2-} > SO_3^{2-} > S_2O_4^{2-}$
- 27. Electrode potential for the following half-cell reactions are
 - $Zn \rightarrow Zn^{2+}$ + 2e⁻; E^o = + 0.76 V;

 $Fe \rightarrow Fe^{2+} + 2e^{-}; E^{\circ} = + 0.44 V$

The EMF for the cell reaction $Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ will be

(1)
$$-0.32$$
 V (2) $+1.20$ V (3) -1.20 V (4) $+0.32$ V

Sol. Answer (4)

$$\mathbf{E}_{cell}^{\circ} = \left(\mathbf{E}_{reduction}^{\circ}\right)_{SRP} - \left(\mathbf{E}_{oxidation}^{\circ}\right)_{SRP}$$
$$= -\left(\mathbf{E}_{reduction}^{\circ}\right)_{SOP} + \left(\mathbf{E}_{oxidation}^{\circ}\right)_{SOP}$$
$$= \mathbf{E}_{Zn/Zn^{2+}}^{\circ} - \mathbf{E}_{Fe/Fe^{2+}}^{\circ}$$
$$= (0.76 - 0.44) V = + 0.32 V$$

(1) +5 (2) +3 (3) +6 (4) -10 Sol. Answer (3)

SECTION - C

Assertion - Reason Type Questions

- 1. A: Fluorine acts as a stronger oxidising agent than chlorine.
 - R: Standard reduction potential of fluorine is higher than Cl_{2.}
- Sol. Answer (1)

Standard reduction potential of F₂ is higher than that of Cl₂

- ... Fluorine is a stronger oxidizing agent than Cl₂
- 2. A: Oxidation number of carbon in HCN is +4.
 - R : Oxidation state and valency is same for carbon.
- Sol. Answer (4)

Valency of carbon is 4 while oxidation state of carbon varies from compound to compound.

In HCN, $\overset{+1}{H} \overset{+2}{C} \overset{-3}{\cong} N$

 $C \longrightarrow +2$ state

- 3. A : Equivalent weight of KMnO₄ in acidic medium is $\frac{M}{5}$
 - R : In acidic medium 1 mol of MnO_4^- gains 5 electron.
- Sol. Answer (1)

In acidic medium, $\stackrel{+7}{MnO_4^-} \xrightarrow{+5e^-} Mn^{2+}$ *i.e.* 1 mole of KMnO₄ accepts 5 electrons

- \therefore n factor of KMnO₄ = 5
- 4. A: Electrons flow in external circuit of galvanic cell while ions flow in internal circuit.
 - R : Direction of current flow is reverse that of electron flow.
- Sol. Answer (2)

Direction of conventional current is opposite to flow of electrons.

Also, electrons flow in the external circuit while ions flow in the internal circuit.

- 5. A: Sn²⁺ and Fe³⁺ can't remain together in a solution.
 - R: Sn²⁺ and Fe³⁺ will react mutually to form Sn⁴⁺ and Fe²⁺.
- Sol. Answer (1)

Sn²⁺ and Fe³⁺ will react to give Sn⁴⁺ and Fe²⁺ because $E_{Fe^{3+}/Fe^{2+}}^{\circ} > E_{Sn^{4+}/Sn^{2+}}^{\circ}$

- So, they cannot remain mutually in a solution.
- 6. A : The oxidation number of S is +6 in H_2SO_4 .
 - R : H_2SO_4 has one peroxide linkage.

Sol. Answer (3)

 $\ln H_2 SO_4, +2 + x + (-2 \times 4) = 0$

 \Rightarrow x = +6

Oxidation state of sulphure = + 6

Structure of H₂SO₄ is

If does not have any peroxide linkage.

7. A: HNO₂ acts as reducing agent only.

R: HNO₂ oxidises to HNO₃ only but not reduce by any reducing agent.

Sol. Answer (4)

In HNO₂, oxidation state is +3 for nitrogen.

Hence it can be oxidized to +5 or be reduced upto -3.

:. If can act as both reducing as well as oxidizing agent.

- 8. A : In alkaline medium, KMnO₄ acts as powerful oxidising agent.
 - R: KMnO₄ reduces to give Mn²⁺ in alkaline medium.

Sol. Answer (3)

KMnO₄ acts as a powerful oxidizing agent in both acidic and alkaline medium.

KMnO₄ reduces to Mn⁺⁶ in alkaline medium.

9. A: When Cu_2S is converted into $Cu^+ \& SO_2$, then equivalent weight of Cu_2S will be M/8 (M = Mol. wt. of Cu_2S)

но – 🖁 – Он

R: Cu⁺ is converted Cu⁺⁺, during this one electrons is lost.

Sol. Answer (2)

- :. For 1 mole Cu_2S , net change in oxidation number = 2 + 6 = 8
- :. n-factor = 8
- \therefore Equivalent weight = $\frac{M}{8}$

Also, $Cu^+ \longrightarrow Cu^{2+} + e^{-1}$

- :. 1 electron is lost.
- 10. A : I₂ is a mild oxidising agent.
 - R : I_2 can be used for titrating sodium thiosulphate.

Sol. Answer (2)

 $\rm I_{\rm 2}$ is indeed a mild oxidizing agent. It has positive (low) value of E° = 0.54 V

It is used for titrating sodium thiosulphate

 $l_2^{} + S_4^{}O_6^{2-} \xrightarrow{} 2l^- + 4SO_4^{2-}$



 $\Delta O.N. = +2 \times 2 - 2 = 2$