CHAPTER

8

Redox Reactions

8.1 Classical Idea of Redox Reactions - Oxidation and Reduction Reactions

1. Which of the following is redox reaction?
(a) Evaporation of H_2O
(b) Both oxidation and reduction
(c) H_2SO_4 with NaOH
(d) In atmosphere O_3 from O_2 by lightning
(1997)

8.2 Redox Reactions in Terms of Electron Transfer Reactions

2. Without losing its concentration, $ZnCl_2$ solution cannot be kept in contact with
(a) Al (b) Pt
(c) Au (d) Ag *(1998)*

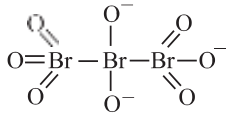
8.3 Oxidation Number

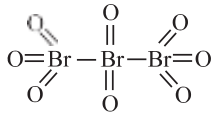
3. What is the change in oxidation number of carbon in the following reaction?

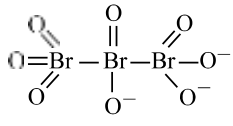
$$CH_{4(g)} + 4Cl_{2(g)} \rightarrow CCl_{4(l)} + 4HCl_{(g)}$$

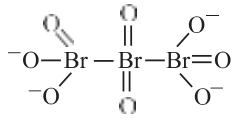
(a) + 4 to + 4 (b) 0 to + 4
(c) – 4 to + 4 (d) 0 to – 4 *(NEET 2020)*

4. The correct structure of tribromooctaoxide is

(a) 

(b) 

(c) 

(d) 

(NEET 2019)

5. Which of the following reactions are disproportionation reactions?

(i) $2Cu^{+} \longrightarrow Cu^{2+} + Cu^{0}$
(ii) $3MnO_4^{2-} + 4H^{+} \xrightarrow{\Delta} 2MnO_4^{-} + MnO_2 + 2H_2O$
(iii) $2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$
(iv) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \longrightarrow 5MnO_2 + 4H^{+}$

Select the correct option from the following.
(a) (i) and (iv) only (b) (i) and (ii) only
(c) (i), (ii) and (iii) (d) (i), (iii) and (iv)
(NEET 2019)

6. The oxidation state of Cr in CrO_5 is
(a) –6 (b) +12
(c) +6 (d) +4
(Odisha NEET 2019, 2014)

7. The correct order of N-compounds in its decreasing order of oxidation states is
(a) HNO_3, NO, N_2, NH_4Cl
(b) HNO_3, NO, NH_4Cl, N_2
(c) HNO_3, NH_4Cl, NO, N_2
(d) NH_4Cl, N_2, NO, HNO_3 *(NEET 2018)*

8. For the redox reaction,

$$MnO_4^{-} + C_2O_4^{2-} + H^{+} \rightarrow Mn^{2+} + CO_2 + H_2O$$

The correct coefficients of the reactants for the balanced equation are

	MnO_4^-	$C_2O_4^{2-}$	H^+
(a)	16	5	2
(b)	2	5	16
(c)	2	16	5
(d)	5	16	2

(NEET 2018)

9. Hot concentrated sulphuric acid is a moderately strong oxidizing agent. Which of the following reactions does not show oxidizing behaviour?
(a) $Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$
(b) $S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$
(c) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$
(d) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$ *(NEET-II 2016)*

10. (I) $H_2O_2 + O_3 \longrightarrow H_2O + 2O_2$
(II) $H_2O_2 + Ag_2O \longrightarrow 2Ag + H_2O + O_2$

Role of hydrogen peroxide in the above reactions is respectively

(a) oxidizing in (I) and reducing in (II)
(b) reducing in (I) and oxidizing in (II)
(c) reducing in (I) and (II)
(d) oxidizing in (I) and (II) *(2014)*

11. The pair of compounds that can exist together is
(a) $FeCl_3$, $SnCl_2$ (b) $HgCl_2$, $SnCl_2$
(c) $FeCl_2$, $SnCl_2$ (d) $FeCl_3$, KI *(2014)*

12. A mixture of potassium chlorate, oxalic acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number?
(a) S (b) H
(c) Cl (d) C *(2012)*

13. Oxidation numbers of P in PO_4^{3-}, of S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$ are respectively
(a) +3, +6 and +5
(b) +5, +3 and +6
(c) –3, +6 and +6
(d) +5, +6 and +6 *(2009)*

14. Number of moles of MnO_4^- required to oxidize one mole of ferrous oxalate completely in acidic medium will be
(a) 7.5 moles (b) 0.2 moles
(c) 0.6 moles (d) 0.4 moles. *(2008)*

15. Which is the best description of the behaviour of bromine in the reaction given below?

$H_2O + Br_2 \rightarrow HOBr + HBr$

(a) Proton acceptor only
(b) Both oxidised and reduced
(c) Oxidised only
(d) Reduced only *(2004)*

16. The oxidation states of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order
(a) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
(b) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$
(c) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
(d) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$ *(2003)*

17. Oxidation state of Fe in Fe_3O_4 is
(a) $\frac{5}{4}$ (b) $\frac{4}{5}$
(c) $\frac{3}{2}$ (d) $\frac{8}{3}$ *(1999)*

18. Reaction of sodium thiosulphate with iodine gives
(a) tetrathionate ion (b) sulphide ion
(c) sulphate ion (d) sulphite ion. *(1996)*

19. The oxide, which cannot act as a reducing agent is
(a) CO_2 (b) ClO_2
(c) NO_2 (d) SO_2 *(1995)*

20. Which substance is serving as a reducing agent in the following reaction?

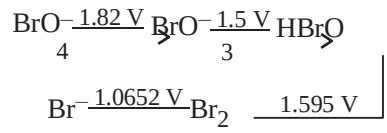
$14H^+ + Cr_2O_7^{2-} + 3Ni \rightarrow 7H_2O + 2Cr^{3+} + 3Ni^{2+}$

(a) H^+ (b) $Cr_2O_7^{2-}$
(c) H_2O (d) Ni *(1994)*

21. The oxidation state of I in $H_4IO_6^-$ is
(a) + 1 (b) – 1
(c) + 7 (d) + 5 *(1994)*

8.4 Redox Reactions and Electrode Processes

22. Consider the change in oxidation state of bromine corresponding to different emf values as shown in the given diagram :



Then the species undergoing disproportionation is
(a) BrO_3^- (b) BrO_4^-
(c) Br_2 (d) HBrO *(NEET 2018)*

ANSWER KEY

1.	(b)	**2.**	(b)	**3.**	(c)	**4.**	(b)	**5.**	(b)	**6.**	(c)	**7.**	(a)	**8.**	(b)	**9.**	(d)	**10.**	(c)
11.	(c)	**12.**	(c)	**13.**	(d)	**14.**	(d)	**15.**	(b)	**16.**	(a)	**17.**	(d)	**18.**	(a)	**19.**	(a)	**20.**	(d)
21.	(c)	**22.**	(d)																

Hints & Explanations

1. (b) : Redox reactions are those chemical reactions which involve both oxidation and reduction simultaneously.

2. (b) : Only 'Al' lies above 'Zn' in electrochemical series, which can displace Zn from $ZnCl_2$ solution. Therefore, conc. of $ZnCl_2$ will decrease when kept in 'Al' container.

$2Al + 3ZnCl_2 \rightarrow 2AlCl_3 + 3Zn$

3. (c) : In CH_4, oxidation number of carbon is –4 while in CCl_4, oxidation number of carbon is +4. Thus, the change in oxidation number of carbon in the given reaction is from –4 to +4.

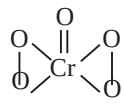
4. (b)

5. (b) : Disproportionation reactions are those in which the same element/compound gets oxidised and reduced simultaneously.

$2Cu^+ \rightarrow Cu^{2+} + Cu^0$

$3\overset{+6}{Mn}O_4^{2-} + 4H^+ \longrightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$

6. (c) : CrO_5 has butterfly structure having two peroxo bonds.



Peroxo oxygen has –1 oxidation state.

Let oxidation state of Cr be 'x'

CrO_5 : $x + 4(-1) + 1(-2) = 0 \Rightarrow x = +6$

7. (a) : $\overset{+5}{H}N\overset{+2}{O}_3$, $\overset{0}{N_2}$, $\overset{-3}{N}H_4Cl$

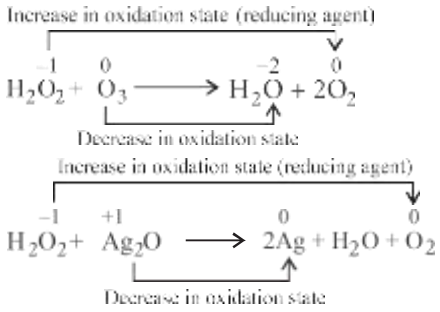
8. (b) : The correct balanced equation is

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

9. (d) : $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

Here, the oxidation state of every atom remains the same so, it is not a redox reaction.

10. (c) :



H_2O_2 acts as reducing agent in both the reactions in which O_2 is evolved.

11. (c) : Both $FeCl_2$ and $SnCl_2$ are reducing agents with low oxidation numbers.

12. (c) : $\overset{+1\ +5\ -2}{KClO_3} + (COOH)_2 + \overset{+6}{H_2SO_4} \longrightarrow$

$\overset{+6}{K_2SO_4} + \overset{-1}{KCl} + CO_2 + H_2O$

Maximum change in oxidation number occurs in case of chlorine, *i.e.*, from +5 to –1.

13. (d) : Let oxidation number of P in PO_4^{3-} be x.

$\therefore \quad x + 4(-2) = -3 \Rightarrow x = +5$

Let oxidation number of S in SO_4^{2-} be y.

$\therefore \quad y + 4(-2) = -2 \quad \Rightarrow \quad y = +6$

Let oxidation number of Cr in $Cr_2O_7^{2-}$ be z.

$\therefore \quad 2z + 7(-2) = -2 \Rightarrow z = +6$

14. (d) : $[5e^- + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$ ..(i)] × 2

$[C_2O_4^{2-} \rightarrow 2e^- + 2CO_2$ .....(ii)] × 5

On addition, we get

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

2 moles of MnO_4^- required to oxidise 5 moles of oxalate.

$\therefore$ Number of moles of MnO_4^- required to oxidise 1 mole of oxalate = 2/5 = 0.4

15. (b) : $H_2O + \overset{0}{Br_2} \rightarrow \overset{+1}{HOBr} + \overset{-1}{HBr}$

In the above reaction, the oxidation number of Br_2 increases from zero (in Br_2) to +1 (in HOBr) and decreases from zero (in Br_2) to –1 (in HBr). Thus, Br_2 is oxidised as well as reduced and hence, it is a redox reaction.

16. (a) : SO_3^{2-} : $x + (-2)3 = -2$ or $x - 6 = -2$ or $x = +4$

$S_2O_4^{2-}$: $2x + (-2)4 = -2$

or $2x - 8 = -2$ or $2x = +6$ $\therefore$ $x = +3$

$S_2O_6^{2-}$: $2x + (-2)6 = -2$

or $2x - 12 = -2$ or $2x = +10$ $\therefore$ $x = +5$

Oxidation states follow the order : $SO_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$

17. (d) : Fe_3O_4 : $3x + 4(-2) = 0 \Rightarrow x = +\frac{8}{3}$

18. (a) : $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2\,NaI$

(Sodium tetrathionate)

19. (a) : Since carbon is in its maximum oxidation state of +4, therefore, carbon dioxide (CO_2) cannot act as a reducing agent.

20. (d) : Since the oxidation number of Ni increases from 0 to 2, therefore it acts as a reducing agent.

21. (c) : Let x = Oxidation state of I. Since oxidation state of H = + 1 and oxidation state of O = – 2, therefore for $H_4IO_6^-$, we get

$(4 \times 1) + x + (6 \times -2) = -1$ or $x = +7$

22. (d) : For a reaction to be spontaneous, E°_{cell} should be positive as $\Delta G^\circ = -nFE^\circ_{cell}$

$HBrO \longrightarrow Br_2$; $E^\circ = 1.595$ V, SRP (cathode)

$HBrO \longrightarrow BrO_3^-$; $E^\circ = -1.5$ V, SOP (anode)

$2HBrO \longrightarrow Br_2 + BrO_3^-$

E°_{cell} = SRP (cathode) – SRP (anode)

= 1.595 – 1.5 = 0.095 V

$E^\circ_{cell} > 0 \Rightarrow \Delta G^\circ < 0$ (spontaneous)