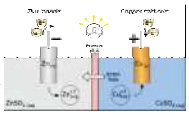


Chapter - 7

Redox Reactions

FAST TRACK : QUICK REVISION

Oxidation and Reduction :

Oxidation	Reduction
1. Addition of oxygen.	1. Removal of oxygen.
2. Removal an Hydrogen.	2. Addition of Hydrogen.
3. Addition of an electronegative element.	3. Removal of an electronegative element.
4. Removal of an electropositive element.	4. Addition of an electropositive element.
5. Loss of electron(s).	5. Gain of electron(s).
6. Increase in oxidation number.	6. Decrease in oxidation number.

- **Reducing Agent :** Reduce other substance and oxidise itself.
- **Oxidising Agent :** Oxidise other substance but reduce itself.
- **Redox Reaction :** Reactions in which oxidation and reduction takes place simultaneously.
- **Oxidation Number :** It is charge that an atom appears to have in a given species when the bonding electron are counted towards more electro-negative atom.
- **Calculation of Oxidation Number :**
  - (a) Oxidation number of all the elements in their elemental form (in standard state) is taken as zero. Oxidation number of element in a molecule Cl_2, F_2, O_2, P_4, O_3, Fe, H_2, N_2, C (graphite) is zero.
  - (b) Common Oxidation number of elements of first group is +1. Common Oxidation number of elements of second group + 2.
  - (c) For ions composed of only one atom, the oxidation number is equal to the charge on the ion.

(d) The oxidation number of oxygen in most compounds is – 2. While in peroxides (*e.g.*, H_2O_2, Na_2O_2), each oxygen atom is assigned an oxidation number of – 1, in super oxides (*e.g.*, KO_2, RbO_2) each oxygen atom is assigned an oxidation number of – (½).

(e) In oxygen difluoride (OF_2) and dioxygen difluoride (O_2F_2), the oxygen is assigned an oxidation number of + 2 and + 1, respectively.

(f) The oxidation number of hydrogen is + 1 but in metal hydride its oxidation no. is – 1.

(g) In all its compounds, fluorine has an oxidation number of – 1.

(h) The algebraic sum of the oxidation number of all the atoms in a compound must be zero.

(i) In polyatomic ion, the algebraic sum of all the oxidation numbers of atoms of the ion must equal the charge on the ion.

- **Types of Redox Reactions:**

(i) Combination Reaction : $\overset{0}{3\,Mg\,(s)} + \overset{0}{N_2\,(g)} \xrightarrow{\Delta} \overset{+2\ -3}{Mg_3N_2\,(s)}$

(ii) Decomposition Reaction : $\overset{+1\ +5\ -2}{2KClO_3(s)} \xrightarrow{\Delta} \overset{+1\ -1}{2\,KC1(s)} + \overset{0}{3O_2\,(g)}$

(iii) Metal Displacement : $\overset{+2\ +6\ -2\ \ 0}{CuSO_4\,(aq)} + \overset{0}{Zn(s)} \rightarrow \overset{+2\ +6\ -2\ \ 0}{ZnSO_4\,(aq)} + Cu\,(s)$

(iv) Non-metal displacement : $\overset{0}{Ca\,(s)} + 2\,\overset{+1\ -2}{H_2O\,(1)} \rightarrow \overset{+2\ -2\ +1}{Ca\,(OH)_2} + \overset{0}{H_2\,(g)}$

(v) Disproportionation reactions : It is a reaction in which same element is reduced and oxidized simultaneously.

$\overset{0}{C1_2\,(g)} + 2\,OH^-\,(aq) \rightarrow \overset{-1}{Cl^-\,(aq)} + \overset{+1}{C\!lO^-\,(aq)} + H_2O\,(1)$

- **Stock Notation :** Representing oxidation number of metal in Roman numerals within parenthesis after the symbol or name of metal in the molecular formula or name of a compound. For *e.g.*, Stock Notation of Ferric oxide is $Fe_2(III)O_3$ or Iron (III) oxide.

- **Fractional Oxidation Number :** When two or more atoms of an element are present in different oxidation states, then calculated oxidation number may comes out as fractional due to average of all the different oxidation states.

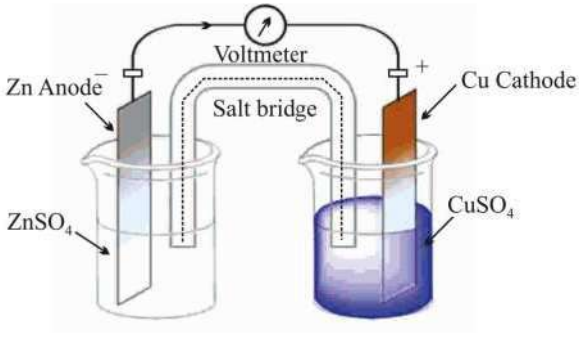
In reality no element can have a fractional oxidation state.

- **Balancing of Redox Reactions :**

  (A) Oxidation number method

  (B) Half reaction method

- **Electrode Potential (E) :** Potential difference between electrode and electrolytic solution due to charge separation.
- **Standard Electrode Potential (E^{θ})** : Electrode Potential measured at 298 K and 1M concentration of metal ions (or 1 bar pressure of gas).
- **Electrochemical Cell :** A device in which chemical energy of a spontaneous redox reaction is converted into electrical energy.



Cell diagram: Zn | Zn^{2+} || Cu^{2+} | Cu

LHS oxidation, $Zn \rightarrow Zn^{2+} + 2e^{-}$

RHS reduction $Cu^{2+} + 2e^{-} \rightarrow Cu$

Overall reaction $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

- Representation of an Electrochemical cell :

——— Flow of electrons ———→

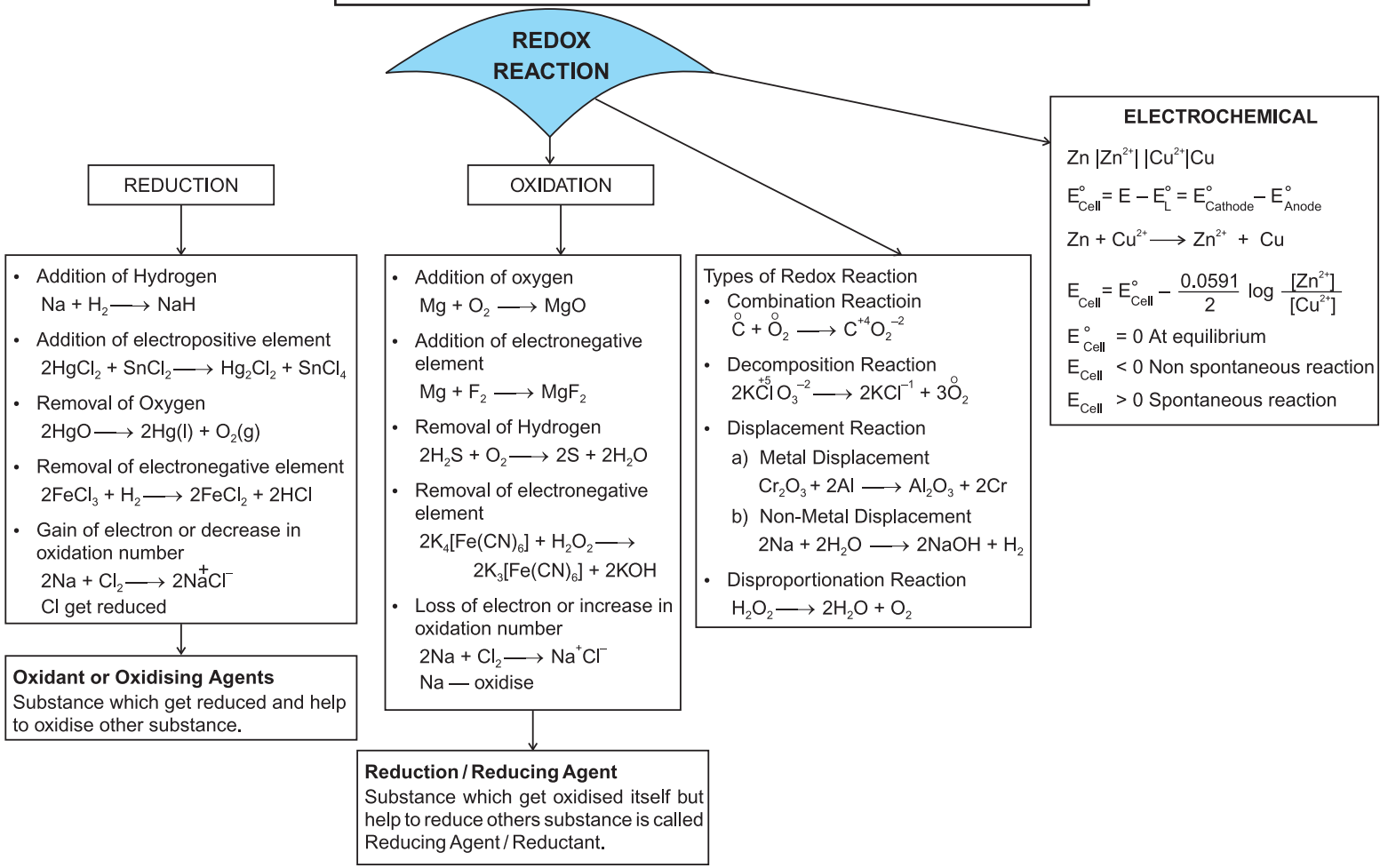
←——— Flow of current ———

$Zn(s) \mid Zn^{2+}(aq) \parallel Cu^{2+}(aq) \mid Cu(s)$

	Left Electrode	Salt Bridge	Right Electrode
LOAN	**O**xidation		**R**eduction
	Anode		**C**athode
	Negative		**P**ositive

- **Functions of Salt Bridge :** (i) To complete inner circuit. (ii) To maintain electrical neutrality around electrodes.

MIND MAP : REDOX REACTIONS



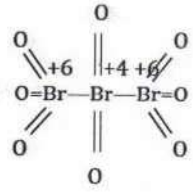
CASE BASED STUDY - QUESTIONS

1. Read the given passage and answer the questions.

Redox reactions are reactions in which oxidation and reduction takes place simultaneously. Oxidation number are assigned in accordance with the set of rules. Oxidation number and ion electron methods both are used in balancing ionic equations. Redox reactions are classified as combination, decomposition, displacement and disproportionation reactions. The concept of redox couple and electrode processes is basis of electrolysis and electrochemical cells.

(a) What are oxidation number of each individual Br in Br_3O_8

Ans. +6, +4, +6

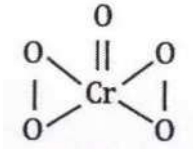


(b) If electrolysis of $CuSO_4$, solution is carried out using Cu electrodes, what will be reaction taking place at anode.

Ans. $Cu \rightarrow Cu^{2+} + 2e^-$

(c) What is oxidation number of Cr in CrO_5?

Ans. +6



$\because$ It has peroxide linkage.

(d) Give one example of disproportionation reaction.

Ans. $2Cu^+ \rightarrow Cu^{2+} + Cu$

(e) $MnO_4^{2-} + H^+ \rightarrow MnO_4^- + MnO_2 + H_2O$ [Balance this reaction]

Ans. $MnO_4^{2-} \rightarrow MnO_4^- + e^-$ ....(i)×2

$2e^- + 4H^+ + MnO_4^{2-} \rightarrow MnO_2 + 2H_2O$ ....(ii)

$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

2. Redox Reactions : Passage Based Question (Assertion and Reason)

Passage : Redox reactions are those reactions in which, there is a simultaneous oxidation and reduction taking place. There is an addition of oxygen and removal of hydrogen taking place in oxidation reactions. In Reduction, hydrogen gets added and oxygen gets removed. Redox reactions are also used to determine the strength of reductant/oxidant. In oxidation, there is a decrease in electron density while in reduction, there is an increase in electron density around the atom.

(Q1-Q4) There are assertion and reason which have been put forward. Read the given statement and choose correct alternative from the following :

(Note : A-Assertion & R-Reason)

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

Q1. **A :** Oxidation-Reduction (Redox) couple is the combination of oxidized and reduced form of a substance that is involved in Oxidation-Reduction half cell.

R: As in representation E° Fe^{3+}/Fe^{2+} and E° Cu^{2+}/Cu^{+} are two Redox couples.

Q2. **A :** In Formaldehyde (HCHO) oxidation no. of carbon is 0.

R: Formaldehyde is a covalent compound.

Q3. **A :** Oxidation state of hydrogen is water is +1 and CaH_2 is -1.

R: CaH_2 is metal hydride and for hydrogen, it assigned the oxidation state of -1.

Q4. **A :** Redox reactions are also called neutralization reactions.

R: As the number of electron gained/lost in the reaction are balanced.

Or

A : Substances which get reduced an act as reducing agent.

R: Oxidizing agent itself gets reduced.

Ans. : Q1. (c), Q2. (b), Q3. (a), Q4. (d) or (d)

MULTIPLE CHOICE QUESTIONS (MCQ)

1. The oxidation state of Fe in Fe_3O_4 is

   (a) +2 (b) + 3

   (c) $\frac{8}{3}$ (d) + 2, + 3

2. The oxidation state of 'S' in $KAl(SO_4)_2 .12H_2O$ is

   (a) –2 (b) – 1

   (c) 2 (d) + 6

3. Oxidation state carbon in C_3O_2 is

   (a) $\frac{4}{3}$ (b) 0

   (c) 2 (d) 0, 2

4. The reaction $S_8 + 12OH^- \longrightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$ is

   (a) Combination reaction (b) Decomposition reaction

   (c) Non-metal displacement (d) Disproportionation reaction

5. E^0 for H^+/H_2 is

   (a) 0 (b) +1V

   (c) –1.0V (d) –2.0V

6. Which one act as strong oxidising agent

   $K^+/K = –2.9$ 3V, $Ag^+/Ag = 0.80$, $Hg^{2+}/Hg = 0.79V$

   (a) K^+ (b) K

   (c) Hg^{2+} (d) Ag^+

7. The coefficient of HCl in balance reaction is

   $Pb_3O_4 + HCl \longrightarrow PbCl_2 + Cl_2 + H_2O$

   (a) 1 (b) 8

   (c) 3 (d) 4

8. Sum of oxidation numbers of all Bromine atoms in Br_3O_8 is

   (a) 6 (b) 4

   (c) 16 (d) 20

9. In the reaction $6ClO_2^- \longrightarrow 4ClO_3^- + 2Cl^-$, Cl^- ion is

   (a) Oxidised Reduced (b) Reduced

   (c) Odixised and (d) Neither Oxidised nor reduced

10. 'I' can not act as reducing agent in following state

(a) –1 (b) +1

(c) +7 (d) +5

Ans: 1. (d) 2. (d) 3. (d) 4. (d) 5. (a) 6. (d) 7. (b) 8. (c) 9. (c) 10. (d)

FILL IN THE BLANKS

(i) Oxidation is _____ of electrons.

(ii) S.H.E. stands for _____.

(iii) Oxidation state of Oxygen in O_2F_2 is _____.

(iv) Disproportionation is a type of _____ reaction.

(v) Oxidant is one which _____ electron..

(vi) $Cl_2 + 2OH^- \longrightarrow ClO^- + C1^-$ is a _____ type of reaction.

(vii) Oxidation state of F is always either _____ or _____ .

(viii) Oxidation state of Oxygen in O_3 is _____ .

(ix) Reducing agent are also called _____.

(x) Hydrogen economy is use of Hydrogen as _____.

Ans: (i) loss, (ii) standard hydrogen electrode, (iii) +1, (iv) redox, (v) gain, (vi) disproportionation, (vii) 0, –1, (viii) zero, (ix) reductant, (x) fuel

TRUE AND FALSE TYPE QUESTIONS

(i) In Redox reaction first oxidation take place.

(ii) Oxidising agents are also called reductant.

(iii) Fluorine cannot have +1 oxidation state.

(iv) O_2^+ has oxidation state of oxygen as +½.

(v) If for the reaction $Ca^{2+} + 2e^- \longrightarrow Ca(s)$; $E^\Theta = -2.87$

Then for the reaction $2Ca^{2+} + 4e^- \longrightarrow 2Ca(s)$; $E^\Theta = 2(-2.87)V$

(vi) Salt bridge is used for enhancing E° values of individual half reaction.

(vii) Anode is –ve charged in Galvanic cell.

(viii) KCl can be use in salt bridge.

(ix) Current flows in galvanic cell from Anode to cathode.

(x) MnO_4^- is colourless in basic medium.

Ans: (i) False (ii) False (iii) True (iv) True (v) False
(vi) False (vii) True (viii) True (ix) False (x) False

MATCH THE COLUMNS

1.

Column-I	Column-II
(a) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$	(p) Disproportionation
(b) $Cr_2O_3 + 2A1 \longrightarrow Al_2O_3 + 2Cr$	(q) Non-metal displacement
(c) $Fe + 2HCl \longrightarrow FeCl_2 + H_2$	(r) Metal displacement
(d) $P_4 + 3OH^- + 3H_2O \rightarrow PH_3 + 3H_2PO_2^-$	(s) Metal displacement

Ans. (a) – (s) (b) – (r) (c) – (q) (d) – (p)

2.

Column-I	Column-II (Oxidation sate of N)
(a) NO	(p) + 5
(b) NO_2	(q) + 3
(c) NO_2^-	(r) + 4
(d) NO_3^-	(s) + 2

Ans. (a) – (s) (b) – (r) (c) – (q) (d) – (p)

3.

Column-I	Column-II
(A) Increase in oxidation number	(a) Loss of electron
(B) Reducing agent	(b) Oxidation
(C) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + H_2O$	(c) Natural redox reaction
(D) Photosynthesis	(d) Redox reaction

Ans. (A) – (b) (B) – (a) (C) – (d) (D) – (c)

4.

Column-I	Column-II
(A) Decrease in oxidation number	(a) Disproportionation
(B) Oxidizing agent	(b) Fractional oxidation number
(C) $2Cu^+ \rightarrow Cu^{2+} + Cu$	(c) Reduction
(D) Mn_3O_4	(d) Gain of electron

Ans. (A) – (c) (B) – (d) (C) – (a) (D) – (b)

5.

Column-I	Column-II
(A) H_2O_2	(a) –1
(B) $MnSO_4$	(b) +3
(C) $AlCl_3$	(c) +5
(D) P_2O_5	(d) +6

Ans. (A) – (a) (B) – (d) (C) – (b) (D) – (c)

ASSERTION AND REASON TYPE QUESTIONS

Each question contain statement-1 (Assertion) and statement-2 (Reason)

Examine the statements carefully and work the correct answer according to the instruction given below :

(a) If both the statements are True and Statement-2 is the correct explanation of the statement-1

(b) If both the statements are True and statement-2 is not the correct explanation of statement-1

(c) If statement-1 is true and statement-2 is False.

(d) If statement-1 is false and statement-2 is True.

1. Statement - 1 : In HF, the oxidation state of 'F' is –1
   Statement - 2 : 'F' being most electronegative, will have -1 oxidation in its compound.

2. Statement - 1 : Oxygen has zero oxidation state in O_2.
   Statement - 2 : Element in their elemental form have zero oxidation state.

3. Statement - 1 : Oxidation state of Oxygen in H_2O_2 is –1.
   Statement - 2 : H_2O_2 has peroxide linkage.

4. Statement - 1 : For the reaction $Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$; E_{cell} is +ve.
   Statement - 2 : For standard Hydrogen electrode $E° = 0$

5. Statement - 1 : $2H_2O_2 \longrightarrow 2H_2O + O_2$ is Decomposition reaction (Redox).
   Statement - 2 : Oxygen has -2 oxidation state in H_2O.

6. Statement - 1 : $C + O_2 \longrightarrow CO_2$; carbon get oxidised.
   Statement - 2 : Gain of Hydrogen is reduction.

7. Statement - 1 : $CaCO_3 \longrightarrow CaO + CO_2$ is not redox reaction.
   Statement - 2 : C, Ca, O do not change their oxidation number in the reaction.

8. Statement - 1 : Oxidation also occurs when decrease in electron density is observed.
   Statement - 2 : Oxidation is gain of electro-positive element.

9. Statement - 1 : $Cr_2O_7^{2-}$ is a self indicator.
   Statement - 2 : MnO_4^- acts as a self indicator.

10. Statement - 1 : Equivalence point comes first before end point.
Statement - 2 : Equivalence point cannot be obtained even by graphical method.

Ans: 1. (a) 2. (a) 3. (a) 4. (b) 5. (d) 6. (b) 7. (a) 8. (c) 9. (d) 10. (d)

ONE WORD ANSWER TYPE QUESTIONS

1. What is the oxidation number of S in S_8.
2. What is the oxidation state of Oxygen in H_2O_2.
3. Name the substance used in salt-bridge.
4. Name an indicator which can act as self-indicator.
5. When a substance gains electron, it is called :
6. Name the ion which is used for balancing the hydrogen atom in acidic medium.
7. In the reaction $3Mg + N_2 \longrightarrow Mg_3N_2$, Nitrogen is oxidised or reduced.

Ans: 1. zero 2. 1 3. NH_4Cl or KCl 4. $KMnO_4$
5. Reduction 6. H^+ 7. Reduced

1-MARK QUESTIONS

1. Define oxidation and reduction according to electronic concept.
2. Define oxidation and reduction according to oxidation number.
3. A freshly cut apple is almost white but it turns reddish brown after sometime. Give reason.
4. Define oxidation number.
5. Write oxidation number of Mn in $KMnO_4$.
6. Write oxidation number of Cr in $Cr_2O_7^{2-}$.
7. Write Stock notation of MnO_2 and $AuCl_3$.
8. Define redox reaction with example.
9. Define disproportionation reaction. Give one example.
10. Define the term redox titration.

11. Name the indicator used in redox titration involving $K_2Cr_2O_7$ as an oxidizing agent.

12. At what concentration of Cu^{2+} (aq.) will electrode potential become equal to its standard electrode potential ? [**Ans.** 1 M]

13. The standard reduction potentials of three metals cations X, Y and Z are + 0.52, – 3.03 and – 1.18 V respectively. Arrange X, Y and Z in order of increasing reducing power. [**Ans.** X < Z < Y]

14. An electrochemical cell consists of two electrodes *i.e.*, Anode and Cathode. What is the direction of flow of electrons in this cell ?

15. Why anode is negatively charged in an electrochemical cell?

16. Out of Zn and Cu vessel one will be more suitable to store 1 M HCl? [**Ans.** Cu]

Given $E^{\theta}_{Zn^{2+}/Zn} = -0.76$ V, $E^{\theta}_{Cu^{2+}/Cu} = +0.34$ V.

15. Is it safe to stir 1 M $AgNO_3$ solution with copper spoon ?

Given $E^{\theta}_{Ag^{+}/Ag} = +0.80$ V, $E^{\theta}_{Cu^{2+}/Cu} = +0.34$ V. [**Ans.** No]

2-MARKS QUESTIONS

1. Identify oxidant and reductant in the reaction :

$$I_2\,(aq) + 2S_2O_3^{2-}\,(aq) \longrightarrow 2\,I^-\,(aq) + S_4O_6^{2-}(aq).$$

2. Calculate oxidation number of Fe in Fe_3O_4 and write a suitable justification of your answer.

3. Oxidation-reduction reactions are complementary. Explain.

4. Write formula for the following compounds :

(i) Mercury (II) chloride

(ii) Nickel (II) sulphate

(iii) Iron (III) sulphate

(iv) Chromium (III) oxide

5. Justify that the reaction : $H_2O(s) + F_2 \longrightarrow HF + HOF$ is a redox reaction.

6. A decomposition reaction may or may not be a redox reaction. Write two decomposition reactions in support of the statement.

7. Split the reaction 2 K (s) + $C1_2$ (g) $\longrightarrow$ 2 KC1 (s) into oxidation and reduction half reactions.

8. Calculate the oxidation number of underlined elements in following compounds :

   (i) $Ca\underline{O}_2$ (ii) $H_2\underline{S}_2O_7$ (iii) $K_2\underline{Mn}O_4$ (iv) $K\underline{I}_3$

9. Write the functions of salt bridge in an electrochemical cell.

10. Define the term redox couple. Write the practical application of redox couple.

11. The standard reduction potentials of two metals A and B are – 0.76 V and + 0.34 V respectively. An electrochemical cell is formed using electrodes of these metals.

    (i) Identify the cathode and anode.

    (ii) Write the direction of flow of electron.

3-MARKS QUESTIONS

1. Calculate oxidation number of :

   (i) Cr in $Cr_2O_4^{2-}$

   (ii) O in KO_2

   (iii) Na in Na_2O_2.

2. Account for the following :

   (i) HNO_3 acts as oxidizing agent while HNO_2 can act both as reducing and oxidizing agent.

   (ii) AgF_2 is unstable compound and act as a strong oxidizing agent.

   (iii) Ozone acts as an oxidising agent.

3. Permanent ion (MnO_4^-) reacts with sulfur dioxide gas in acidic medium to produce Mn^{2+} ion and hydrogen sulphate ion. Write ionic equation and balance by ion electron method.

4. Balance the following equation by oxidation number method :

   $P_4(s) + OH^-(aq) \longrightarrow PH_3 + H_2PO_2^-(aq)$ [*Basic Medium*]

5. Balance the following equation by ion electron method :

   $C1_2O_7(g) + H_2O_2(1) \longrightarrow ClO_2^-(aq) + O_2(g)$ [*Basic medium*]

6. Depict the galvanic cell in which the reaction

   $Zn(s) + 2\,Ag^+(aq) \longrightarrow Zn^{2+}(aq) + 2\,Ag(s)$ takes place. Further show :

   (i) Which electrode is negatively charged ?

   (ii) The carriers of the current in the cell

   (iii) Individual reaction at each electrode.

7. Explain with suitable reasons :

   (i) Reaction $FeSO_4(aq) + Cu(s) \longrightarrow CuSO_4(aq) + Fe$ does not occur.

   (ii) Zinc can displace copper from aqueous $CuSO_4$ solution but Ag cannot.

   (iii) Solution of $AgNO_3$ turns blue when copper rod is immersed in it.

5-MARKS QUESTIONS

1. (i) MnO_4^{2-} undergoes disproportionation reaction in acidic medium but MnO_4^- does not. Give reason.

   (ii) Give one example each of the following redox reactions:

   (a) Combination reaction

   (b) Decomposition reaction

   (c) Metal displacement reaction

2. Consider the cell reaction of an electrochemical cell : $Ni(s) + 2\,Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2\,Ag(s)$ and answer the following questions :

   (i) Write anode and cathode half reactions.

   (ii) Mention the direction of flow of electrons.

(iii) How is the electrical neutrality maintained in the solutions of the two half cells ?

(iv) Write the formula for calculating standard emf of this cell.

(v) How does the emf change when the concentration of silver ions is decreased ?

3. Justify the reason that following reactions are redox reactions.

(a) $CuO\ (s) + H_2\ (g) \longrightarrow Cu\ (s) + H_2O\ (g)$

(b) $Fe_2O_3 + 3CO\ (g) \longrightarrow 2\ Fe\ (g) + 3CO_2\ (g)$

(c) $NH_3\ (g)\ 5O_2\ (g) \longrightarrow 4NO\ (g) + 5H_2O\ (g)$

(d) $BCl_3\ (g) + 3\ LiAlH_4 \longrightarrow B_2H_6 + LiCl + AlCl_3$

(e) $2K + F_2 \longrightarrow 2KF$

[**Hints:–** CuO is oxidizing agent, H_2 is acting as reducing agent because Cu (II) is changing to Cu (0) by gain of e^- H_2 is getting oxidised to H_2O (g), its oxidations sate is changing from 0 to +1, by loss of electrons.

(ii) It is redox reaction: Fe_2O_3 is getting reduced to fe. CO is getting oxidised to CO_2.]

4. Using standard electrode : Predict if the reaction between as the following is feasible.

(i) Fe^{3+} (aq) and I^- (aq)

(ii) Ag^+ and Cu

(iii) Fe^{3+} and Br^- (aq)

(iv) Ag and Fe^{3+} (aq)

(iv) Br_2 (aq) and Fe^{2+} (aq)

Hint:– $E^\theta_{I_2/I^-} = 0.541$ V, $E^\theta_{Cu^{2+}/Cu}$, = 0.34V, $E^\theta_{Br_2/Br^-} = 1.09$V, $E^\theta_{Ag^+/Ag} = 0.80$V, $E^\theta_{Fe^{3+}/Fe^{2+}} = 0.77$V.

5. Draw the diagram for the galvanic cell which would have overall chemical reaction as

$$Zn + 2Ag^+ \longrightarrow Zn^{2+} + 2Ag.$$

Answer the following :

(i) Write the reactions occurring at each electrode.

(ii) In which directions do the electrons flow in the external circuit?

(iii)Name the salt to be taken in salt bridge.

(iv)Label the anode and cathode.

(v) How does the EMF change when the concentration of solvers ions is decreased?

HOTS QUESTIONS

1. 6×10^{-3} mole $K_2Cr_2O_7$ reacts completely with 9×10^{-3} mole X^{n+} to give XO_3^- and Cr^{3+}. Find the value of X.

   Ans. $K_2Cr_2O_7 + X^{n+} \longrightarrow \overset{+5}{X}O_3^- + Cr^{3+}$

   $6\times10^{-3} \times 6 = (5\text{-}n) \times 9 \times 10^{-3} \longrightarrow n = 1$

2. For the redox reaction

   $K_2Cr_2O_7 + X\ H_2SO_4 + Y\ SO_2 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + ZH_2O$

   What is the sum of $x + y + z$

   Ans. $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

   $\therefore x = 1 \quad y = 3 \quad z = 1 \quad \therefore x + y + z = 5$

3. An aqueous solution containing 1M each of Au^{+3}, Cu^{+2}, Ag^+, Li^+ is being electrolysed using inert electrodes the value of standard potentials are

   $E^\theta_{Ag^+/Ag} = 0.80\ V,\ E^\theta_{Cu^2+Cu} = 0.34\ V,\ E^\theta_{Au^{3+}/Au} = 1.50\ V,\ E^\theta_{Li^+/Li} = -3.03V$

   With increasing voltage, find the sequence of deposition of metals on the cathode.

   Ans. Only Au^{3+}, Ag^+ and Cu^{2+} will deposit at cathode.

   Li^+ will not deposit at cathode be cause SRP of water is -0.8274V

   So after Cu^{2+} ; H_2 will evolve at cathode.

4. E^θ for $Cl_2\ (g) + 2l^- \longrightarrow 2Cl^-\ (aq.)$ is 1.36 V, then calculate.

   E^θ for $4C1^-\ (aq.) \longrightarrow\ 2Cl_2(g) + 4e^-$

   Ans. $E^\theta_{Cl^-/Cl_2} = -1.36$ E^θ is independent of amount of substance

5. Why salt bridge is made up of saturated solution of KNO_3 in agar–agar.

   Ans. Velocities of both K^+ and NO_3^- are nearly the same.

UNIT TEST-I

Time Allowed: 1 hr **Maximum Marks : 20**

General Instructions:

(i) All questions are compulsory.

(ii) Maximum marks carried by each question are indicated against it.

---

1. Identify the oxidised and Reduced species in the following reaction [1]

   $H_2S + Cl_2 \longrightarrow 2HCl + S$

   (a) H_2S (b) Cl_2 (c) Both H_2, Cl_2 (d) None of these

2. What is the oxidation state of Br in BrO_3^-? [1]

   (a) +1 (b) +3 (c) +4 (d) +5

3. Classify the type of reaction in Redox Reaction form : [1]

   $3H_2O + P_4 + 3OH^- \longrightarrow PH_3 + 3H_2PO_2^-$

4. What is a redox couple? Give one example.

5. Identify oxidant in reaction given below : [1]

   $CuO(s) + H_2(g) \longrightarrow Cu(s) + H_2O(g)$

6. Assign oxidation number to the underlined elements [2]

   (a) $NaH_2\underline{P}O_4$ (b) $H_4\underline{P_2}O_7$ (c) $K_2\underline{Mn}O_4$ (d) $H_2\underline{S_2}O_7$

7. Predict product of electrolysis in following case [2]

   - An aqueous solution of $CuCl_2$ with platinum electrodes.

8. Consider the reaction $Zn(s) + 2Ag^+(aq.) \longrightarrow Zn^{2+}(aq.) + 2Ag(s)$

   Answer following : [3]

   (i) Which electrode is negatively charged ?

   (ii) What are carrier of current in the cell ?

   (iii) Individual reaction at each electrode.

9. E^θ values are given : $K^+/K = -2.93V$, $Ag^+/Ag = 0.80V$ [3]

   $Hg^{2+}/Hg = 0.79V$ $Mg^{2+}/Mg = -2.37V$, $Cr^{3+}/Cr = -0.74V$

   (i) Which one is strong reducing agent ?

   (ii) Which one is strong oxidising agent ?

   (iii) Which redox couple is a stronger reducing agent than H^+/H_2 ?

10. Balance the reaction (ion-electron or oxidation number) [5]

    $P_4(s) + OH^-(aq.) \longrightarrow PH_3(g) + H_2PO_2^-(aq.)$ [Basic medium]

UNIT TEST-II

Time Allowed: 1 Hr. **(REDOX REACTIONS)** **Maximum Marks : 20**

General Instructions:

(i) All questions are compulsory.

(ii) Maximum marks carried by each question are indicated against it.

---

1. The average oxidation No. of Iodine is I_3^- ion is. [1]

2. What is oxidation state of Cr in $K_2Cr_2O_7$? [1]

3. Write the name of cell in which chemical energy is converted into Electrical energy. [1]

4. Why is anode negatively charged in an electrochemical cell? [1]

5. Identify the oxidised and Reduced species in the following reaction

   $$H_2S + Cl_2 \longrightarrow 2HCl + S$$ [1]

6. A decomposition reaction may or may not be a redox Reaction. Write two decomposition reactions in support of the statement. [2]

7. Write the functions of salt bridge in a electrochemical cell. [2]

8. Account for the following : [3]

   (i) HNO_3 acts as oxidizing agent while HNO_2 can act both as Reducing and oxidizing agent.

   (ii) AgF_2 is unstable compound and act as a strong oxidizing agent.

   (iii) Ozone acts as an oxidizing agent.

9. Explain with suitable reasons : [3]

   (i) Reaction $FeSO_4$ (aq) + Cu(s) $\rightarrow$ $CuSO_4$ (aq) + Fe does not occur.

   (ii) Zinc can displace copper from aqueous $CuSO_4$ solution but Ag cannot.

   (iii) Solution of $AgNO_3$ turns blue when copper rod is immersed in it.

10. (i) Give one example each of the following redox reactions : [3]

    (a) Combination Reaction

(b) Decomposition Reaction

(c) Metal displacement Reaction

(ii) Remaining two are Assertion and Reason. Read the statement carefully and choose the correct alternative : [2]

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Both Assertion and Reason are false.

(I) **Assertion :** Redox couple is the combination of oxidised and Reduced from of a substance involved in an oxidation or reduction half cell.

Reason : In the Representation E^{θ} Fe^{3+}/Fe^{2+} and E^{θ} Cu^{2+}/Cu, Fe^{3+}/Fe^{2+} and Cu^{2+}/Cu are Redox couples.

(II) **Assertion :** Oxidation no. of C in HCHO is zero.

Reason : Formaldehyde is covalent compound.

*****