CHAPTER 06

REDOX REACTION

The meeting of two personalities is like the contact of two chemical substances; if there is any reaction, both are transformed

"CARL JUNG"

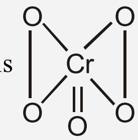
INTRODUCTION

A number of phenomena, both phtysical as well as biological, are concerned with redox reaction. These reactions find extensive use in pharmaceutical, biological, industrial, metallurgical and agricultural areas. The importance of these reactions is apparent from the fact that burning of different types of fuels for obtaining energy for domestic, transport and other commercial purposes, electrochemical processes for extraction of highly reactive metals and non-metals, manufacturing of chemical compounds like caustic soda, operation of dry and wet batteries and corrosion of metals fall within the purview of redox processes. Of late, environmental issues like Hydrogen Economy (use of liquid hydrogen as fuel) and development of 'Ozone Hole' have started figuring under redox phenomenon.

ETOOS KEY POINTS

Miscellaneous Examples

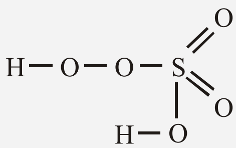
In order to determine the exact or individual oxidation number we need to take help from the structures of the molecules. Some special cases are discussed as follows:

(I) The structure of CrO_5 is 

From the structure, it is evident that in CrO_5 there are two peroxide linkages and one double bond. The contribution of each peroxide linkage is –2. Let the oxidation number of Cr is x.

$\therefore$ x + (–2)2 + (–2) = 0 or x = 6

$\therefore$ Oxidation number of Cr = + 6.

(II) The structure of H_2SO_5 is 

From the structure, it is evident that in H_2SO_5, there is one peroxide linkage, two sulphur-oxygen double bonds and one OH group. Let the oxidation number of S = x.

$\therefore$ (+ 1) + (– 2) + x + (–2) 2+ (–2) + 1 = 0

or x + 2 – 8 = 0 or x – 6 = 0 or x = 6

$\therefore$ Oxidation number of S in H_2SO_5 is + 6 .

Oxidation State as a periodic property :

Oxidation state of an atom depends upon the electronic configuration of an atom i.e. why it is periodic properties.

(a) I A group of alkali metals show +1 oxidation state.

(b) II A group or alkaline earth metals show +2 oxidation state

(c) The maximum normal oxidation state, show by III A group elements is +3. These elements also show +2 to +1 oxidation states also.

(d) Elements of IV A group show their maximum and minimum oxidation states +4 and –4 respectively.

(e) Non metals shows number of oxidation states, the relation between maximum and minimum oxidation states for non metals is equal to (maximum oxidation state – minimum oxidation state = 8).

For example sulphur has maximum oxidation number +6 as being in VI A group element.

Paradox of fractional oxidation number :

Fractional oxidation number is the average of oxidation state of all atoms of element under examination and the structural parameters reveal that the atoms of element for whom fractional oxidation state is realised a actually present in different oxidation states. Structure of the species C_3O_2, Br_3O_8 and $S_4O_6^{2-}$ reveal the following bonding situations :

The element marked with asterisk (*) in each species is exhibiting different oxidation number from rest of the atoms of the same element in each of the species. This reveals that in C_3O_2, two carbon atoms are present in +2 oxidation state each whereas the third one is present in zero oxidation state and the average is + 4/3. However, the realistic picture is +2 for two terminal carbons and zero for the middle carbon.

$$O = \overset{+2}{C} = \overset{0}{C}^{*} = \overset{+2}{C} = O$$

Structure of C_3O_2
(Carbon suboxide)

Etoos Tips & Formulas

Oxidation :

(i) Addition of Oxygen
(ii) Removal of Hydrogen
(iii) Addition of Electronegative element
(iv) Removal of Electropositive element
(v) Increment in oxidation state of Electropositive element
(vi) increase in (+) ve valency or decrease in (–) ve valency of a substance takes place called oxidation.

Reduction :

(i) Removal of Oxygen :
(ii) Addition of Hydrogen
(iii) Removal of Electronegative element
(iv) Addition of Electropositive element
(v) Decrement in oxidation state of Electropositive element
(vi) decrease in (+) ve valency or increase in (–) ve valency of a substance is called reduction.

Oxidising agent (oxidant) and reducing agent (Reductant)

Oxidising agent or Oxidant

Oxidising agents are those compounds which can oxidise others and reduce itself during the chemical reaction. Those reagents in which for an element, oxidation number decreases or which undergoes gain of electrons in a redox reaction are termed as oxidants.

Reducing agent or Reductant

Reducing agents are those compounds which can reduce other and oxidise itself during the chemical reaction. Those reagents in which for an element, oxidation number increases or which undergoes loss of electrons in a redox reaction are termed as reductants.

Ex. KI , $Na_2S_2O_3$ etc are the powerful reducing agents.

Oxidation number change method :-(method of balancing redox equation)

This method was given by Jonson. In a balanced redox reaction, total increase in oxidation number must be equal to total decreases in oxidation number. This equivalence provides the basis for balancing redox reactions.

The general procedure involves the following steps :-

(i) Select the atom in oxidising agent whose oxidation number decreases and indicate the gain of electrons.
(ii) Select the atom in reducing agent whose oxidation number increases and write the loss of electrons.
(iii) Now cross multiply i.e.multiply oxidising agent by the number of loss of electrons and reducing agent by number of gain of electrons.
(iv) Balance the number of atoms on both sides whose oxidation numbers change in the reaction.
(v) In order to balance oxygen atoms, add H_2O molecules to the side deficient in oxygen. Then balance the number of H atoms by adding H^+ ions in the hydrogen.

SOLVED EXAMPLE

Ex. 1 The weight of sodium bromate required to prepare 55.5 mL of 0.672 N solution for cell reaction,
$BrO_3^- + 6H^+ + 6e^- \longrightarrow Br^- + 3H_2O$, is
(A) 1.56 g (B) 0.9386 g
(C) 1.23 g (D) 1.32 g

Sol. Meq. of $NaBrO_3 = 55.5 \times 0.672 = 37.296$
Let weight of $NaBrO_3 = W$

$\therefore \frac{W}{M_{NaBrO_3}} \times 6 \times 1000 = 37.296$ (equivalent weight = M/6) of n-factor = 6

$\therefore \frac{M}{151} \times 6 \times 1000 = 37.296$

$\therefore W = 0.9386$ g
Hence, (B) is the correct answer.

Ex. 2 $NaIO_3$ reacts with $NaHSO_3$ according to equation
$IO_3^- + 3HSO_3^- \longrightarrow I^- + 3H^+ + 3SO_4^{2-}$
The weight of $NaHSO_3$ required to react with 100 mL of solution containing 0.68 g of $NaIO_3$ is
(A) 5.2 g (B) 0.2143 g
(C) 2.3 g (D) none of the above

Sol. Meq. of $NaHSO_3$ = Meq. of $NaIO_3 = N \times V = \frac{0.68}{198} \times 6 \times 1000$ $(I^{5+} + 6e^- \rightarrow I^-)$

$\therefore \frac{W_{NaHSO_3}}{M_{NaHSO_3}} \times 2 \times 1000 = \frac{0.68}{198} \times 6 \times 100$

$W_{NaHSO_3} = \frac{0.68 \times 6 \times 100 \times 104}{198 \times 1000} = 0.2143$

Hence (B) is the correct answer.

Ex. 3 If 0.5 moles of $BaCl_2$ is mixed with 0.1 moles of Na_3PO_4, the maximum amount of $Ba_3(PO_4)_2$ that can be formed is
(A) 0.7 mol (B) 0.5 mol
(C) 0.2 mol (D) 0.05 mol

Sol. Let us first solve this problem by writing the complete balanced reaction.
$3BaCl_2 + 2Na_3PO_4 \longrightarrow Ba_3(PO_4)_2 \downarrow + 6NaCl$

We can see that the moles of $BaCl_2$ used are $\frac{3}{2}$ times the moles of Na_3PO_4. Therefore, to react with 0.1 mol of Na_3PO_4, the moles of $BaCl_2$ required would be $0.1 \times \frac{3}{2} = 0.15$. Since $BaCl_2$ is 0.5 mol, we can conclude that Na_3PO_4 is the limiting reagent.

Therefore, moles of $Ba_3(PO_4)_2$ formed is $0.1 \times \frac{3}{2}$ = 0.05 mol.
Hence, (D) is the correct answer.

Ex. 4 A 0.1097 g sample of As_2O_3 required 36.10 mL of $KMnO_4$ solution for its titration. The molarity of $KMnO_4$ solution is.
(A) 0.02 (B) 0.04
(C) 0.0122 (D) 0.3

Sol.
n-factor = 5 (between MnO_4^- and Mn^{2+})

$As_2O_3 + MnO_4^- \quad 2AsO_4^{3-} + Mn^{2+}$

n-factor = 4 (between As_2O_3 and AsO_4^{3-})

Let, molarity of $KMnO_4$ solution be M
$\therefore$ Eq. of As_2O_3 = Eq. of $KMnO_4$ solution

$\frac{0.1097}{198} \times 4 = \frac{36.10 \times M \times 5}{1000}$ (Equivalent weight $As_2O_3 = \frac{198}{4}$)

Molarity = 0.0122 M
Hence, (C) is the correct answer.

Ex. 5 In basic medium, CrO_4^{2-} oxidize $S_2O_3^{2-}$ to form SO_4^{2-} and itself changes to $Cr(OH)_4^-$. How many mL of 0.154 M CrO_4^{2-} are required to react with 40 mL of 0.246 M $S_2O_3^{2-}$?
(A) 200 mL (B) 156.4 mL
(C) 170.4 mL (D) 190.4 mL

Sol. $40 \times 0.246 \times 8 = V \times 0.154 \times 3$ (Meq. of $S_2O_3^{2-}$ = Meq. of CrO_4^{2-})
$\therefore V = 170.4$ mL
Hence, (C) is the correct answer.

Ex. 6 10 mL of 0.4 M $Al_2(SO_4)_3$ is mixed with 20 mL of 0.6 M $BaCl_2$. Concentration of Al^{3+} ion in the solution will be.
(A) 0.266 M (B) 10.3 M
(C) 0.1 M (D) 0.25 M

Sol.

	$Al_2(SO_4)_3$ +	$BaCl_2$ $\longrightarrow$	$BaSO_4 \downarrow$ +	$AlCl_3$
Initial Meq.	$10 \times 0.4 \times 6$ = 24	$20 \times 0.6 \times 2$ = 24	0	0
Final Meq.	0	0	24	24

$[Al^{3+}] = \frac{24}{30 \times 3} = 0.266$ M
Hence (A) is the correct answer.

Ex. 7 0.52 g of a dibasic acid required 100 mL of 0.2 N NaOH for complete neutralization.
The equivalent weight of acid is
(A) 26 (B) 52
(C) 104 (D) 156

Sol. Meq. of Acid = Meq. of NaOH

$\frac{0.52}{E} \times 1000 = 100 \times 0.2$

$\therefore E = 26$
Hence (A) is the correct answer.

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. H_2O_2 reduces MnO_4^- ion to
(A) Mn^+ (B) Mn^{2+}
(C) Mn^{3+} (D) Mn^-

2. When a sulphur atom becomes a sulphide ion
(A) There is no change in the composition of atom
(B) It gains two electrons
(C) The mass number changes
(D) None of these

3. The ultimate products of oxidation of most of hydrogen and carbon in food stuffs are
(A) H_2O alone (B) CO_2 alone
(C) H_2O and CO_2 (D) None of these

4. When P reacts with caustic soda, the products are PH_3 and NaH_2PO_2. This reaction is an example of
(A) Oxidation
(B) Reduction
(C) Oxidation and reduction (Redox)
(D) Neutralization

5. Which one of the following does not get oxidised by bromine water
(A) Fe^{2+} to Fe^{3+} (B) Cu^+ to Cu^{2+}
(C) Mn^{2+} to MnO_4^- (D) Sn^{3+} to Sn^{+4}

6. In the reaction $H_2S + NO_2 \rightarrow H_2O + NO + S$. H_2S is
(A) Oxidised (B) Reduced
(C) Precipitated (D) None of these

7. The conversion of PbO_2 to $Pb(NO_3)_2$ is
(A) Oxidation
(B) Reduction
(C) Neither oxidation nor reduction
(D) Both oxidation and reduction

8. In the course of a chemical reaction an oxidant
(A) Loses electrons
(B) Gains electrons
(C) Both loses and gains electron
(D) Electron change takes place

9. $2CuI \rightarrow Cu + CuI_2$, the reaction is
(A) Redox (B) Neutralisation
(C) Oxidation (D) Reduction

10. H_2S reacts with halogens, the halogens
(A) Form sulphur halides (B) Are oxidised
(C) Are reduced (D) None of these

11. Equation $H_2S + H_2O_2 \rightarrow S + 2H_2O$ represents
(A) Acidic nature of H_2O_2
(B) Basic nature of H_2O_2
(C) Oxidising nature of H_2O_2
(D) Reducing nature of H_2O_2

12. In the reaction
$C_2O_4^{2-} + MnO_4^- + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$
the reductant is
(A) $C_2O_4^{2-}$ (B) MnO_4^-
(C) Mn^{2+} (D) H^+

13. A reducing agent is a substance which can
(A) Accept electron (B) Donate electrons
(C) Accept protons (D) Donate protons

14. Which of the following is the most powerful oxidizing agent
(A) F_2 (B) Cl_2
(C) Br_2 (D) I_2

15. Of the four oxyacids of chlorine the strongest oxidising agent in dilute aqueous solution is
(A) $HClO_4$ (B) $HClO_3$
(C) $HClO_2$ (D) $HOCl$

16. Identify the correct statement about H_2O_2
(A) It acts as reducing agent only
(B) It acts as both oxidising and reducing agent
(C) It is neither an oxidiser nor reducer
(D) It acts as oxidising agent only

17. Several blocks of magnesium are fixed to the bottom of a ship to
(A) Keep away the sharks
(B) Make the ship lighter
(C) Prevent action of water and salt
(D) Prevent puncturing by under-sea rocks

18. Which of the following behaves as both oxidising and reducing agents
(A) H_2SO_4 (B) SO_2
(C) H_2S (D) HNO_3

Exercise # 2

SINGLE OBJECTIVE | AIIMS LEVEL

1. In which of the following acid, which acid has oxidation reduction and complex formation properties
(A) HNO_3 (B) H_2SO_4
(C) HCl (D) HNO_2

2. The compound which could not act both as oxidising as well as reducing agent is
(A) SO_2 (B) MnO_2
(C) Al_2O_3 (D) CrO

3. Of all the three common mineral acids, only sulphuric acid is found to be suitable for making the solution acidic because
(A) It does not react with $KMnO_4$ or the reducing agent
(B) Hydrochloric acid reacts with $KMnO_4$
(C) Nitric acid is an oxidising agent which reacts with reducing agent
(D) All of the above are correct

4. For H_3PO_3 and H_3PO_4 the correct choice is
(A) H_3PO_3 is dibasic and reducing
(B) H_3PO_3 is dibasic and non-reducing
(C) H_3PO_4 is tribasic and reducing
(D) H_3PO_3 is tribasic and non-reducing

5. Match List I with List II and select the correct answer using the codes given below the lists

List I (Compound)	List II (Oxidation state of N)
(A) NO_2	(1) + 5
(B) HNO	(2) - 3
(C) NH_3	(3) + 4
(D) N_2O_5	(4) + 1

Codes :

	A	B	C	D
(A)	2	3	4	1
(B)	3	1	2	4
(C)	3	4	2	1
(D)	2	3	1	4

6. M^{3+} ion loses $3e^-$. Its oxidation number will be
(A) 0 (B) + 3
(C) + 6 (D) - 3

7. Oxidation number of oxygen in potassium super oxide (KO_2) is
(A) - 2 (B) - 1
(C) - 1/2 (D) - 1/4

8. One mole of N_2H_4 loses 10 mol of electrons to form a new compound Y. Assuming that all nitrogen appear in the new compound, what is the oxidation state of N_2 in Y ? (There is no change in the oxidation state of hydrogen)
(A) + 3 (B) - 3
(C) - 1 (D) + 5

9. An element A in a compound ABD has oxidation number A^{n-}. It is oxidised by $Cr_2O_7^{2-}$ in acid medium. In the experiment 1.68×10^{-3} moles of $K_2Cr_2O_7$ were used for 3.26×10^{-3} moles of ABD. The new oxidation number of A after oxidation is
(A) 3 (B) 3 – n
(C) n – 3 (D) +n

10. The incorrect order of decreasing oxidation number of S in compounds is :-
(A) $H_2S_2O_7 > Na_2S_4O_6 > Na_2S_2O_3 > S_8$
(B) $H_2SO_5 > H_2SO_3 > SCl_2 > H_2S$
(C) $SO_3 > SO_2 > H_2S > S_8$
(D) $H_2SO_4 > SO_2 > H_2S > H_2S_2O_8$

11. In which of the following reaction is there a change in the oxidation number of nitrogen atoms :-
(A) $2NO_2 \rightarrow N_2O_4$
(B) $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$
(C) $N_2O_5 + H_2O \rightarrow 2HNO_3$
(D) none

12. For the redox reaction :
$MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O$
the correct stoichiometric coefficients of MnO_4^-, $C_2O_4^{2-}$ and H^+ are respectively
(A) 2,5,16 (B) 16,5,2
(C) 5,16,2 (D) 2,16,5

13. A certain weight of pure $CaCO_3$ is made to react completely with 200 mL of an HCl solution to give 224 mL of CO_2 gas at STP. The normality of the HCl is :-
(A) 0.05 N (B) 0.1 N
(C) 1.0 N (D) 0.2 N

14. The volume of 1.5 M H_3PO_4 solution required to neutralize exactly 90 mL of a 0.5 M $Ba(OH)_2$ solution is :-
(A) 10 mL (B) 30 mL
(C) 20 mL (D) 60 mL

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. **Column-I** | **Column-II**

Column-I	Column-II
(A) Molarity	(p) Dependent on temperature
(B) Molality	(q) $\dfrac{M_A \times n_A}{n_A M_A + n_B M_B}$ x 100
(C) Mole fraction	(r) Independent of temperature
(D) Mass %	(s) $\dfrac{X_A}{X_B M_B} \times 1000$

Where M_A , M_B are molar masses, n_A , n_B are no of moles & X_A , X_B are mole fractions of solute and solvent respectively.

2.

Column-I	Column-II
(A) 100 ml of 0.2 M $AlCl_3$ solution + 400 ml	(p) Total concentration of cation**(s)** = 0.12 M of 0.1 M HCl solution
(B) 50 ml of 0.4 M KCl + 50 ml H_2O	(q) $[SO_4^{2-}] = 0.06$ M
(C) 30 ml of 0.2 M K_2SO_4 + 70 ml H_2O	(r) $[SO_4^{2-}] = 2.5$ M
(D) 200 ml 24.5% (w/v) H_2SO_4	(s) $[Cl^-] = 0.2$ M

3.

Column-I	Column-II
(A) 4.1 g H_2SO_3	(p) 200 mL of 0.5 N base is used for complete neutralization
(B) 4.9 g H_3PO_4	(q) 200 millimoles of oxygen atoms
(C) 4.5 g oxalic acid ($H_2C_2O_4$)	(r) Central atom is in its highest oxidation number
(D) 5.3 g Na_2CO_3	(s) May react with an oxidising agent

4.

Column-I	Column-II
(A) Sn^{+2} + MnO_4^- (acidic) 3.5 mole 1.2 mole	(p) Amount of oxidant available decides the number of electrons transfer
(B) $H_2C_2O_4$ + MnO_4^- (acidic) 8.4 mole 3.6 mole	(q) Amount of reductant available decides the number of electrons transfer
(C) $S_2O_3^{-2}$ + I_2 7.2 mole 3.6 mole	(r) Number of electrons involved per mole of oxidant > Number of electrons involved per mole of reductant
(D) Fe^{+2} + $Cr_2O_7^{-2}$ (acidic) 9.2 mole 1.6 mole	(s) Number of electrons involved per mole of oxidant < Number of electrons involved per mole of reductant.

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic solution [AIPMT (Prelims)–2007]

(A) 1 (B) $\frac{3}{5}$

(C) $\frac{4}{5}$ (D) $\frac{2}{5}$

2. Oxidations numbers of P in PO_4^{3-}, of S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$, are respectively [AIPMT (Prelims)–2009]

(A) +3 , +6 and +5 (B) +5 , +3 and +6

(C) –3 , +6 and +6 (D) +5 , +6 and +6

3. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$ are respectively [AIPMT (Prelims)–2010]

(A) +3 , +5 ,+4 (B) +5 , +3, +4

(C) +5, +4, +3 (D) +3 , +4 ,+5

4. How much amount of $CuSO_4.5H_2O$ required for liberation of 2.54 g I_2 when titrated with KI [AIIMS-2011]

(A) 2.5 gm (B) 4.99 gm

(C) 2.4 gm (D) 1.2 gm

5. A solution contains Fe^{2+}, Fe^{3+} and I^- ions. This solution was treated with iodine at 35°C. E° for Fe^{3+}/Fe^{2+} is 0.77 V and E° for $I_2/2I^-$ = 0.536 V. The favourable redox reaction is [AIPMT (Mains)–2011]

(A) I^- will be oxidised to I_2

(B) Fe^{2+} will be oxidised to Fe^{3+}

(C) I_2 will be reduced to I^-

(D) There will be no redox reaction

6. In which of the following compounds, nitrogen exhibits highest oxidation state ? [AIPMT (Prelims) –2012]

(A) N_3H (B) NH_2OH

(C) N_2H_4 (D) NH_3

7. (a) $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$ [AIPMT - 2014]

(b) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$

Role of hydrogen peroxide in the above reactions is respectively

(A) Oxidizing in (a) and reducing in (b)

(B) Reducing in (a) and oxidising in (b)

(C) Reducing in (a) and (b)

(D) Oxidising in (a) and (b)

8. Which of the following processes does not involve oxidation of iron ? [AIPMT - 2015]

(A) Liberation of H_2 from steam by iron at high temperature

(B) Rusting of iron sheets

(C) Decolourization of blue $CuSO_4$ solution by iron

(D) Formation of $Fe(CO)_5$ from Fe

9. Assuming complete ionization, same moles of which of the following compounds will require the least amount of acidified $KMnO_4$ for complete oxidation ? [Re -AIPMT - 2015]

(A) FeC_2O_4 (B) $Fe(NO_2)_2$

(C) $FeSO_4$ (D) $FeSO_3$

MOCK TEST

1. Amongst the following identify the species with an atom in + 6 oxidation state

(A) MnO_4^- (B) $Cr(CN)_6^{3-}$ (C) NiF_6^{2-} (D) CrO_2Cl_2

2. In which of the following compounds, is the oxidation number of iodine is fractional

(A) IF_3 (B) IF_2 (C) I_3^- (D) IF_7

3. The compound $YBa_2Cu_3O_7$ which shows superconductivity has copper in oxidation state .... Assume that the rare earth element Yttrium is in its usual +3 oxidation state

(A) 3/7 (B) 7/3 (C) 3 (D) 7

4. The oxidation number of sulphur in S_8, S_2F_2, H_2S respectively, are

(A) 0, +1 and - 2 (B) + 2, +1 and - 2 (C) 0, + 1 and + 2 (D) - 2, + 1 and - 2

5. Which one of the following reactions is not an example of redox reaction

(A) $Cl_2 + 2H_2O + SO_2 \rightarrow 4H^+ + SO^{4-} + 2Cl^-$ (B) $Cu^{++} + Zn \rightarrow Zn^{++} + Cu$

(C) $2H_2 + O_2 \rightarrow 2H_2O$ (D) $HCl + H_2O \rightarrow H_3O^- + Cl^-$

6. For the reactions, $C + O_2 \rightarrow CO_2; \Delta H = -393J$

$2\ Zn + O_2 \rightarrow 2\ ZnO; \Delta H = -412J$

(A) Carbon can oxidise Zn (B) Oxidation of carbon is not feasible

(C) Oxidation of Zn is not feasible (D) Zn can oxidise carbon

7. In the reaction $B_2H_6 + 2KOH + 2X \rightarrow 2Y + 6H_2$, X and Y are respectively

(A) H_2, H_3BO_3 (B) HCl, KBO_3 (C) H_2O, KBO_3 (D) H_2O, KBO_2

8. In a balanced equation $H_2SO_4 + x\,HI \rightarrow H_2S + y\,I_2 + z\,H_2O$, the values of x, y, z are

(A) $x = 3, y = 5, z = 2$ (B) $x = 4, y = 8, z = 5$ (C) $x = 8, y = 4, z = 4$ (D) $x = 5, y = 3, z = 4$

9. Which of the following can act as an acid and as a base

(A) $HClO_3^-$ (B) $H_2PO_4^-$ (C) HS^- (D) All of these

10. MnO_4^{2-} (1 mole) in neutral aqueous medium is disproportionate to

(A) 2/3 mole of MnO_4^- and 1/3 mole of MnO_2 (B) 1/3 mole of MnO_4^- and 2/3 mole of MnO_2

(C) 1/3 mole of Mn_2O_7 and 1/3 mole of MnO_2 (D) 2/3 mole of Mn_2O_7 and 1/3 mole of MnO_2

11. The conductivity of a saturated solution of $BaSO_4$ is $3.06 \times 10^{-6}\ ohm^{-1}\ cm^{-1}$ and its equivalent conductance is $1.53\,ohm^{-1}\ cm^{-1}\ equivalent^{-1}$. The K_{sp} of the $BaSO_4$ will be

(A) 4×10^{-12} (B) 2.5×10^{-9} (C) 2.5×10^{-13} (D) 4×10^{-6}

12. When MnO_2 is fused with KOH, a coloured compound is formed, the product and its colour is

(A) K_2MnO_4, purple green (B) $KMnO_4$, purple

(C) Mn_2O_3, brown (D) Mn_3O_4 black

13. In the following reaction,

$3Br_2 + 6CO_3^{2-} + 3H_2O = 5Br^- + BrO_3^- + 6HCO_3$

(A) Bromine is oxidised and carbonate is reduced (B) Bromine is reduced and water is oxidised

(C) Bromine is neither reduced nor oxidised (D) Bromine is both reduced and oxidised

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1
1. Electrostatics
2. Capacitance

Module-2
1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3
1. Electromagnetic Induction
2. Alternating Current

Module-4
1. Geometrical Optics
2. Wave Optics

Module-5
1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)
1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)
1. Electrochemistry
2. Surface Chemistry

Module-3(IC)
1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)
1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)
1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1
1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2
1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3
1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4
1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5
1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues