

1. SOME BASIC CONCEPTS IN CHEMISTRY

1 OMQ + 2 VSAQ + 1SAQ [1 M + 2M + 2M + 4M = 9 M]

VSAQ (2 Marks)

2×2= 4 Marks

1. How many number of moles of glucose are present in 540 grams of glucose.

[MAR-26][BMP1][AP 23,25]

A: Given weight of glucose $W = 540$ g

Known GMW of glucose ($C_6H_{12}O_6$) = 180 g

$$\text{Number of moles } n = \frac{W}{\text{GMW}} = \frac{540}{180} = 3 \text{ moles.}$$

2. Calculate the weight of 0.1 mole of Sodium carbonate.

[AP 16]

A: Given no. of moles of Na_2CO_3 (n) = 0.1, Known GMW of Na_2CO_3 = 106

$$\text{Weight of } Na_2CO_3 \text{ is } W = n \times \text{GMW} = 0.1 \times 106 = 10.6 \text{ g}$$

3. How many molecules of glucose are present in 5.23 g of glucose
(Molecular weight of glucose 180 g)

A: Given weight of glucose (W) = 5.23 g, GMW of glucose = 180 g; $N_A = 6.022 \times 10^{23}$

$$\text{Number of moles } n = \frac{W}{\text{GMW}} = \frac{5.23}{180}$$

$$\text{No. of molecules} = n \times N_A = \frac{5.23}{180} \times 6.022 \times 10^{23} = 1.75 \times 10^{22} \text{ molecules.}$$

4. The empirical formula of a compound is CH_2O . Its molecular weight is 90.

Calculate the molecular formula of the compound. [MAR-26][BMP2][AP 16,24]

A: Given molecular weight = 90

$$\text{Empirical formula weight of } CH_2O = 12 + 2 + 16 = 30$$

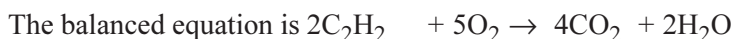
$$n = \frac{\text{Molecular weight}}{\text{Empirical formula weight}} = \frac{90}{30} = 3$$

$$\text{Molecular formula} = (\text{Empirical formula})_n = (CH_2O)_3 = C_3H_6O_3$$

5. Calculate the volume of O_2 at STP required to completely burn 100ml of acetylene.

A: Molecular formula of acetylene is C_2H_2

[BMP1]



$$2 \times 22400 \text{ ml of } C_2H_2 \text{ requires } 5 \times 22400 \text{ ml of } O_2$$

$$100 \text{ ml of } C_2H_2 \text{ requires } x \text{ ml of } O_2?$$

$$x = \frac{5 \times 22400 \times 100}{2 \times 22400} = 250 \text{ ml}$$

6. Calculate the mass percent of the different elements present in sodium sulphate (Na_2SO_4).

A: GMW of $\text{Na}_2\text{SO}_4 = 2(23) + 1(32) + 4(16) = 46(\text{Na}) + 32(\text{S}) + 64(\text{O}) = 142$

(i) 142 g of Na_2SO_4 contains 46 g of Na;

$$100 \text{ g of } \text{Na}_2\text{SO}_4 \text{ contains } x \text{ g of Na} \quad \therefore x = \frac{46 \times 100}{142} = 32.39$$

(ii) 142 g of Na_2SO_4 contains 32 g of S

$$100 \text{ g of } \text{Na}_2\text{SO}_4 \text{ contains } x \text{ g of S} \quad \therefore x = \frac{32 \times 100}{142} = 22.53$$

(iii) 142 g of Na_2SO_4 contains 64 g of O

$$100 \text{ g of } \text{Na}_2\text{SO}_4 \text{ contains } x \text{ g of O} \quad \therefore x = \frac{64 \times 100}{142} = 45.07$$

Thus, mass percents of Na, S, O are 32.39 %, 22.53%, 45.07%.

7. What do you mean by significant figures?

A: **Significant figures** are the 'meaningful digits' in an estimated value which are known to be reliable and certain plus one uncertain (estimated digit).

Ex: Volume of a liquid is 12.4 ml. This value has three significant figures. The digits 1 and 2 are reliable while the digit 4 is uncertain. The uncertainty would be ± 1 in the last digit.

8. How many significant figures are present in the following?

(i) 0.0025 (ii) 208

A: i) 0.0025 has two significant figures. [Zeros after decimal point are not significant]

ii) 208 has three significant figures. [Zeros between two non-zero digits are significant]

9. Define and explain molar mass.

A: **Molar mass:** The mass of one mole of any substance in grams is called its molar mass.

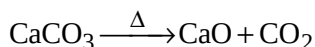
Ex: Molar mass of $\text{H}_2\text{O} = 2(1) + 1(16) = 18 \text{ g}$.

That means mass of 1 mole (6.022×10^{23}) of molecules of $\text{H}_2\text{O} = 18 \text{ g}$

Equivalent terms of molar mass are gram molar mass, gram molar weight (GMW).

10. What volume of CO_2 is obtained at STP by heating 4 g of CaCO_3 ?**[BMP2]**

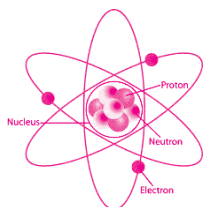
A: GMW of $\text{CaCO}_3 = 40 + 12 + 3(16) = 40(\text{Ca}) + 12(\text{C}) + 48(\text{O}) = 100 \text{ g}$



100 g of CaCO_3 liberates 22.4 L of CO_2

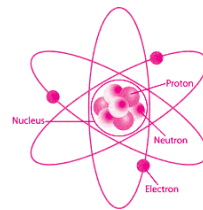
4 g of CaCO_3 liberates x L of CO_2

$$\therefore x = \frac{22.4 \times 4}{100} = 4 \times 0.224 = 0.896 \text{ L}$$



2. STRUCTURE OF ATOM

1 OMQ + 2 VSAQ + 1SAQ + LAQ [1 M + 2M + 2M + 4M + 8M = 17 M]



VSAQ (2 Marks)

2×2= 4 Marks

1. Calculate the charge of one mole of electrons.

A: Charge of one mole of electrons = Charge of one electron $\times$ Avogadro number
 $= 1.6021 \times 10^{-19} \times (6.023 \times 10^{23}) = 9.6500 \times 10^4 = 96500 \text{ C} = 1 \text{ Faraday}$

2. How many neutrons and electrons are present in the nuclei of $^{13}_6\text{C}$, $^{16}_8\text{O}$, $^{24}_{12}\text{Mg}$, $^{56}_{26}\text{Fe}$.

A:

Element	Electrons	Neutrons(A-Z)
$^{13}_6\text{C}$	6	$13 - 6 = 7$
$^{16}_8\text{O}$	8	$16 - 8 = 8$
$^{24}_{12}\text{Mg}$	12	$24 - 12 = 12$
$^{56}_{26}\text{Fe}$	26	$56 - 26 = 30$

$$^{13}_6\text{C} \quad 6 \quad 13 - 6 = 7$$

$$^{16}_8\text{O} \quad 8 \quad 16 - 8 = 8$$

$$^{24}_{12}\text{Mg} \quad 12 \quad 24 - 12 = 12$$

$$^{56}_{26}\text{Fe} \quad 26 \quad 56 - 26 = 30$$

☞ Electrons are not present in nucleus.

3. What is a black body ?

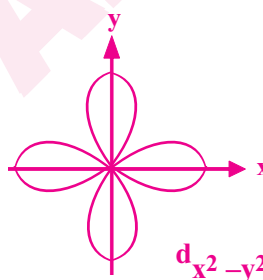
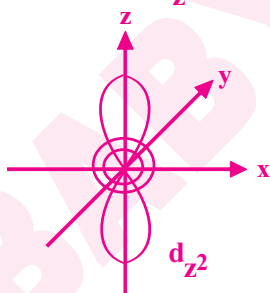
[MAR-26]

A: Black body is an ideal body which absorbs and emits all frequencies of radiation .

Ex: A hollow sphere coated inside with platinum black and having a small hole in its walls .

4. Draw the shape of d_{z^2} and $d_{x^2-y^2}$ orbital.

A:



5. What is the frequency of radiation of wavelength 600nm?

[BMP1]

A: Given that $\lambda = 600 \text{ nm} = 600 \times 10^{-9} \text{ m}$. We know $c = 3.0 \times 10^8 \text{ ms}^{-1}$

$$\text{Formula: } c = \nu\lambda \Rightarrow \nu = \frac{c}{\lambda} = \frac{3.0 \times 10^8 \text{ ms}^{-1}}{600 \times 10^{-9} \text{ m}} = 5 \times 10^{14} \text{ s}^{-1}.$$

6. How many sub-shells are associated with $n = 5$?

[BMP2]

A: 5. When $n = 5$ the possible 'l' values are $l = 0, 1, 2, 3, 4$. i.e. s, p, d, f, g (five) subshells.

7. How many electrons in an atom may have $n = 4$, and $m_s = +1/2$?

A: When $n = 4$, then number of electrons in 4th orbit $= 2n^2 = 2(4)^2 = 32$.

Out of these 32 electrons, half of the electrons, 16 have $m_s = +1/2$

8. Explain Pauli's exclusion principle.

[BMP2]

A: **Pauli's exclusion principle:** No two electrons in an atom can have the same set of all four quantum numbers. They differ atleast in one of their quantum numbers.

If 2 electrons are present in the same orbital then they must have opposite spins.

9. What is Hund's rule ?

[BMP1] [AP 19]

A: **Hund's rule:** 'In degenerate orbitals, pairing of electrons takes place only after the filling up of available orbitals with one electron each'.

E.C of O(8) is $1s^2 2s^2 2p^4$



10. What is Aufbau principle?

[MAR-26] [AP 19]

A: **Aufbau principle:** 'In the ground state of the atoms, the orbitals are filled with electrons, in their increasing order of energies'.

In other words, electrons first occupy the lowest energy orbital available to them.

The order of the orbitals : $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p \dots$

3. Classification of Elements & Periodicity in Properties

1 OMQ + 1 VSAQ + 1 SAQ + 1 LAQ [1 M + 2M + 4M + 8M = 15 M]

VSAQ (2 Marks)

1 × 2 = 2 Marks

1. An element 'X' has atomic number 34. Give its position in the periodic table. [BMP1]

A: Electronic configuration of X: $[\text{Ar}] 3d^{10}4s^24p^4$.

Valency shell configuration is $4s^24p^4$.

Period number = Valence Shell number = 4

Group number = No. of valence electrons = 6

∴ X belongs to 4th period and VIA group [or group 16.]

*2. Mg^{+2} is smaller than O^{-2} in size. why?

A: In Mg^{+2} , the number of protons = 12 and number of electrons = 10.

In O^{-2} , the number of protons = 8 and number of electrons = 10.

Thus Mg^{+2} has more number of protons. Thus, effective nuclear charge on the valence electrons increases and hence its size decreases.

Thus Mg^{+2} has small size than O^{-2} .

3. How does the nature of oxides change along third period from Na_2O to Cl_2O_7 ?

A: From Na_2O to Cl_2O_7 , basic character decreases and acidic character increases

Na	Mg	Al	Si	P	S	Cl
Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O_7
Strong Basic	Basic	Amphoteric	Weak acidic	Acidic	Strong acidic	Strong acidic

4. Consider the following species N^{-3} , O^{-2} , Na^{+} , Mg^{+2} and Al^{+3} .

(a) What is common in them?

(b) Arrange them in the increasing ionic radii.

A: Given ions: N^{-3} , O^{-2} , Na^{+} , Mg^{+2} , Al^{+3} .

(a) All the given ions have the same number of electrons (10 electrons each).

These are called iso-electronic species.

(b) The increasing order of ionic radius: $\text{Al}^{+3} < \text{Mg}^{+2} < \text{Na}^{+} < \text{O}^{-2} < \text{N}^{-3}$

Reason: In case of iso-electronic species the ionic radius decreases with the increase of the effective nuclear charge.

5. Name any two bridge elements

[MAR-26]

A: **Bridge elements**(Elements of 2nd period) **Ex:** Li, Be

6. Define metallic radius and covalent radius

A: a) Metallic radius is half of the inter nuclear distance between two adjacent metal atoms in metallic crystal.

Ex: Metallic radius of Sodium = $\frac{3.72}{2} = 1.86 \text{ \AA}$

b) Covalent radius is half of the inter-nuclear distance between two adjacent non-metal atoms of a covalent molecule .

Ex: Covalent radius of Chlorine = $\frac{1.98}{2} = 0.99 \text{ \AA}$

7. Why cation is smaller and anion is larger in radii than their parent atoms?

A: The difference in size between ions and their parent atoms is primarily due to

i) effective nuclear charge ii) changes in electron-electron repulsion

Cation has **high** effective nuclear charge and hence cation has **smaller radii**.

Anion has very **low** effective nuclear charge and hence anion has **larger radii**.

8. How are electronegativity and metallic and non-metallic characters related?

A: Electronegativity is directly related to the non-metallic character of elements.

Electronegativity is inversely related to the metallic properties of elements.

Thus the increase in Electro negativity across a period is accompanied by an increase in non-metallic properties of elements and decrease in the metallic properties of the elements.

9. Ionisation enthalpy (IE₁) of O is less than that of N. Why?

A: 'N' is more stable due to half filled electronic configuration (1s²2s²2p³).

But Oxygen is less stable as it does not contain half-filled configuration.

So IE₁ of O < IE₁ of N.

10. What are the oxidation state and covalency of Al in [AlCl(H₂O)₅]²⁺?

[BMP2]

A: The oxidation state of Al in [AlCl(H₂O)₅]²⁺ is +3 and its covalency is 6.

4. CHEMICAL BONDING AND MOLECULAR STRUCTURE

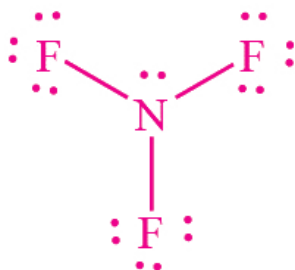
1 OMQ + 2 VSAQ + 2 SAQ [1 M + 2M + 2M + 4M + 4M = 13 M]

VSAQ (2 Marks)

2 × 2 = 4 Marks

1. Draw the Lewis structures for the NF_3 molecule.

A:



2. BF_3 is trigonal planar, but NF_3 is pyramidal. Why?

A: BF_3 is trigonal planar due to the presence of three bond pairs and no lone pairs.

NF_3 is pyramidal due to the presence of three bond pairs and one lone pair.

As per VSEPR theory, repulsions between lone pair and bond pair makes NF_3 pyramidal.

3. O_2 is paramagnetic, while O_2^{2-} is diamagnetic. Why?

A: O_2 is paramagnetic due to the presence of two unpaired electrons in its molecular orbitals.

O_2^{2-} is diamagnetic due to the presence of all paired electrons.

Here in O_2^{2-} one extra electron enters into the $2p_x$ orbital and one more electron enters into the $2p_y$ orbital. Hence, all the electrons are paired.

4. N-F bond is more polar than N-H bond, but NH_3 is more polar than NF_3 . Why?

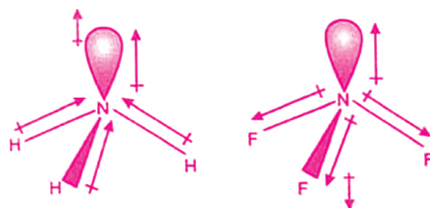
A: N-F bond is more polar than the N-H bond. This happens due to the higher electronegativity of fluorine compared to hydrogen.

NF_3 is less polar than NH_3

In NF_3 individual polarity is towards 'F' and hence, the net dipole will cancel.

But in NH_3 'N' is more electronegative than 'H'

it leads to get more dipole moment and hence more polar.



Resultant dipole moment in $\text{NH}_3 = 4.90 \times 10^{-30} \text{ Cm}$ Resultant dipole moment in $\text{NF}_3 = 0.80 \times 10^{-30} \text{ Cm}$

5. Water is a liquid at room temperature, but hydrogen sulphide is a gas. Give reason.

[BMP1]

A: Water is a liquid at room temperature due to the presence of strong hydrogen bonds in H_2O . H_2S is a gas at room temperature due to the absence of hydrogen bonds.

6. Write the bond order and magnetic behaviour of H_2 .

[MAR-26][BMP2]

A: Bond order of H_2 molecule $\frac{N_b - N_a}{2} = \frac{2 - 0}{2} = \frac{2}{2} = 1$

Hydrogen molecule is **diamagnetic** as there is no unpaired electron.

7. What is Hybridisation?

A: **Hybridisation:** The intermixing of atomic orbitals to form new hybrid orbitals of equivalent energies and shape is known as hybridisation.

The number of hybrid orbitals formed is equal to number of atomic orbitals mixed.

8. State Octet rule.

[MAR-26][BMP2]

A: **Octet rule:** To attain stability, atoms possess a tendency, to have eight electrons in their outermost energy level by losing, gaining or sharing electrons.

9. What is meant by bond order?

[BMP1][AP 19]

A: **Bond Order:** Bond order is defined as one half the difference between the number of electrons present in the bonding and the anti bonding orbitals.

Formula: Bond order = $\frac{N_b - N_a}{2}$

Ex: Bond order in H_2 is 1; Bond order in N_2 is 3

10. Give two examples of odd electron molecules.

A: NO , NO_2 , ClO_2 .

5. THERMODYNAMICS

1 OMQ + 1 VSAQ + 2 SAQ [1 M + 2M + 4M + 4M = 11 M]

V S A Q (2 Marks)

1 × 2 = 2 Marks

1. Define a system.

A: System: A small part of the universe chosen for thermodynamic study is called system.

Ex: Ice in a beaker.

2. State the first law of the thermo-dynamics.

[AP 16] [BMP2]

A: First Law of thermodynamics (Law of conservation of Energy):

- 1) "Energy can neither be created nor destroyed, but it can be converted from one form to another".
- 2) "The total energy of a system and its surroundings is constant".

3. State the second law of thermodynamics.

A: Second Law of thermodynamics:

- 1) Heat cannot flow from a colder body to a hotter body on its own.
- 2) All spontaneous processes are thermodynamically irreversible and also entropy of the system increases in all spontaneous processes.

4. State the third law of thermodynamics.

[MAR-26] [AP 19,24]

A: Third law of thermodynamics :

The entropy of a pure and perfectly crystalline substance approaches zero when the temperature approaches absolute zero. (-273°C)

Mathematically, $\lim_{T \rightarrow 0} \Delta S = 0$

5. What are intensive and extensive properties ?

[BMP1] [AP 15,19,24]

A: 1) Intensive properties are the properties which do not depend on the total amount of substance.

Ex: Temperature, pressure, density, boiling point, vapour pressure, viscosity, surface tension, specific heat...

2) Extensive properties are the properties which depend on the total amount of substance.

Ex: Mass, Volume, heat capacity, internal energy, entropy, enthalpy, Gibbs free energy...

6. Define the state function. Give two examples.

A: State function(Z): It is the property of a system which depends on the initial and the final states of the system but are independent of the path.

Ex: Volume, Pressure, Temperature, Internal Energy, Gibbs Energy.

Non Ex: Work, heat.

Real Life Ex:

You are climbing a hill.

Your height = state function

Distance walked = path function

7. The equilibrium constant for a reaction is 10. What will be value of ΔG° ?

R = 8.314 J/K.mol, T = 300 K.

A: Given $K = 10$, $R = 8.314 \text{ J/K.mole}$, $T = 300 \text{ K}$

Formula: $\Delta G^\circ = -2.303RT \log K_c = -2.303 \times 8.314 \times 300 \times \log 10 = -5744.14 \text{ J/mole}$

8. Two liters of an ideal gas at a pressure of 10 atm expands isothermally into a vacuum until its total volume is 20 litres. How much heat is absorbed and how much work is done in the expansion?

A: Given data:

Initial volume $V_1 = 2 \text{ lit}$, Final volume $V_2 = 20 \text{ lit}$,

Initial pressure $P = 10 \text{ atm}$

Since the gas expands into vacuum, external pressure $P_{\text{ext}} = 0$.

Now, heat absorbed $q = -w = P_{\text{ex}} (V_2 - V_1) = 0 (20 - 2) = 0 (18) = 0$

$\therefore$ Heat absorbed $q = 0$ and work done $w = 0$.

9. Calculate the entropy change in surroundings when 1.00 mole of $\text{H}_2\text{O}_{(l)}$ is formed under standard conditions $\Delta H_f^\circ = -286 \text{ KJmol}^{-1}$.

A: $q_{\text{rev}} = -\Delta H_f^\circ = -(286) = 286 \text{ kJmol}^{-1}$

$$\Delta S_{\text{surrounding}} = \frac{q_{\text{rev}}}{T} = \frac{286}{298} = 0.959 \text{ kJ K}^{-1} = 959.73 \text{ JK}^{-1}$$

10. Given $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$; $\Delta_r H^\circ = -92.4 \text{ kJmol}^{-1}$. What is the standard enthalpy of formation of NH_3 gas?

A: The heat of reaction $\Delta_r H^\circ$ is -92.4 kJmol^{-1} .

This is the heat of formation of 2 moles of ammonia.

The enthalpy of formation of 1 mol of $\text{NH}_3 = \frac{-92.4}{2} = -46.2 \text{ kJ}$

$\therefore$ Standard enthalpy of formation of ammonia = -46.2 kJ

6.EQUILIBRIUM

1 OMQ + 1 VSAQ + 2 SAQ [1 M + 2M + 4M + 4M = 11 M]

V S A Q (2 Marks)

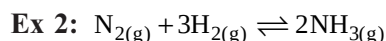
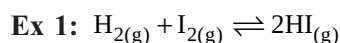
1 × 2 = 2 Marks

1. State law of chemical equilibrium.

A: Law of chemical equilibrium: In a balanced chemical equation, the **ratio** of 'the product of molar concentrations of the products' to 'the product of the molar concentrations of the reactants' is constant at a given temperature.

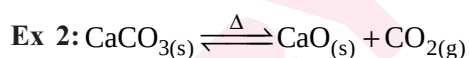
2. What is homogeneous equilibrium? Give two examples. [AP 17,18]

A: When the reactants and products are in the same physical state then the equilibrium is called homogeneous equilibrium.



3. What is heterogeneous equilibrium? Give two examples. [MAR-26][AP 17,18]

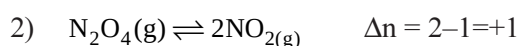
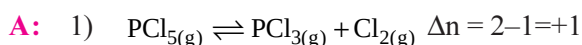
A: When the reactants and products are in different physical states then the equilibrium is said to be heterogeneous equilibrium. **Ex 1:** $\text{CO}_{2(g)} + \text{C}_{(s)} \rightleftharpoons 2\text{CO}_{(g)}$



4. What is meant by dynamic equilibrium? [BMP1]

A: The forward and backward reactions of a reversible reaction continuously takes place with equal rates simultaneously, at the equilibrium stage also. Hence the equilibrium state is a dynamic equilibrium state. Any chemical equilibrium process is a dynamic equilibrium in nature.

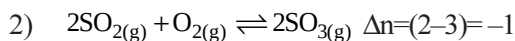
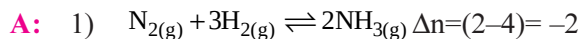
5. Give two chemical equilibrium reactions for which $K_p > K_c$ [AP 20]



$$K_p = K_c(RT)^{+1} = K_c(RT)$$

$$\therefore K_p > K_c$$

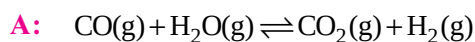
6. Give two chemical equilibrium reactions for which $K_p < K_c$



$$K_p = K_c(RT)^{-ve}$$

$$\therefore K_p < K_c$$

7. Write the equations for the conversion of K_c to K_p for the following reaction.



$$\text{Here, } \Delta n = n_p - n_R = 2 - 2 = 0.$$

$$\therefore K_p = K_c(RT)^{\Delta n} = K_c(RT)^0 = K_c(1) = K_c$$

$$\therefore K_p = K_c$$

8. What are the factors which influence the chemical equilibrium?

A: Factors influencing chemical equilibrium:

- 1) Concentration of reactants and products.
- 2) Temperature of reaction.
- 3) Pressure of reaction.
- 4) Addition of Inert gas

9. What is meant by ionic product of water?

[BMP2][AP 16,24]

A: The product of the concentrations of $[\text{H}^+]$ and $[\text{OH}^-]$ ions, in water, at a given temperature, is called ionic product of water.

$$\text{Ionic product of water, } K_w = [\text{H}^+][\text{OH}^-]$$

10. Give two examples of salts whose aqueous solutions are acidic.

A: Aqueous solutions of salts of strong acid and weak base, have acidic nature.



7. REDOX REACTIONS

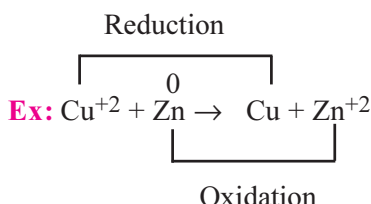
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VSAQ (2 Marks)

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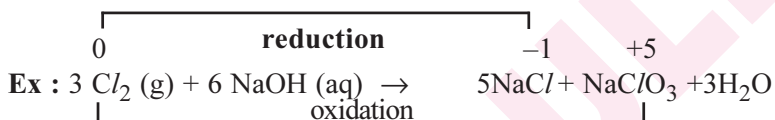
1. What is a redox reaction? Give an example. **[BMP2]**

A: Redox reactions are the reactions in which both reduction and oxidation takes place simultaneously.



2. What is disproportionation reaction? Give an example. **[BMP1]**

A: Disproportionation reactions: The redox reactions, in which the same element undergoes both oxidation & reduction are called disproportionation reactions.



Here, Cl_2 undergoes both oxidation and reduction reactions.

3. Assign Oxidation number to the underlined elements in each of the following.

a) $\text{K}_2\underline{\text{Mn}}\text{O}_4$ b) $\underline{\text{C}}_3\text{O}_2$

A: a) $\text{K}_2\underline{\text{Mn}}\text{O}_4$

↓ ↓ ↓

+1 x -2

$$2(+1) + x + 4(-2) = 0$$

$$+2 + x - 8 = 0 \therefore x = +6$$

$\therefore$ Oxidation number of 'Mn' in K_2MnO_4 is +6

b) $\underline{\text{C}}_3\text{O}_2$

↓ ↓ ↓ ↓

x -2

$$3x + 2(-2) = 0 \Rightarrow 3x = +4 \Rightarrow x = +4/3$$

$\therefore$ Oxidation number of 'C' in $\underline{\text{C}}_3\text{O}_2$ is +4/3

4. Write the formulae for the following compounds.

[MAR-26]

a) Nickel(II) sulphate b) Thallium(I) sulphate

A: a) NiSO_4 b) Tl_2SO_4

5. What are the oxidation numbers of the underlined elements in the following compounds

a) $\text{Na}\underline{\text{B}}\text{H}_4$ b) $\underline{\text{C}}_6\text{H}_{12}\underline{\text{O}}_6$

A: a) $\text{Na}\underline{\text{B}}\text{H}_4$

↓ ↓ ↓

+1 x -1

$$+1 + x + 4(-1) = 0$$

$$x - 3 = 0 \quad \therefore x = +3$$

$\therefore$ Oxidation number of 'B' in NaBH_4 is +3

b) $\underline{\text{C}}_6\text{H}_{12}\underline{\text{O}}_6$

↓ ↓ ↓

x +1 -2

$$6(x) + 12(+1) + 6(-2) = 0$$

$$6x + 12 - 12 = 0$$

$$6x = 0 \quad \therefore x = 0$$

$\therefore$ Oxidation number of 'C' in $\text{C}_6\text{H}_{12}\text{O}_6$ is 0

6. What are the oxidation numbers of the underlined elements in the following compounds

a) $\text{H}_2\underline{\text{S}}_2\underline{\text{O}}_8$ b) $\underline{\text{C}}\text{H}_3\underline{\text{C}}\underline{\text{O}}\underline{\text{O}}\text{H}$

A: a) $\text{H}_2\underline{\text{S}}_2\underline{\text{O}}_8$

↓ ↓ ↓

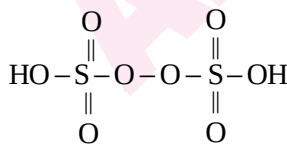
+1 x -2

$$2(+1) + 2(x) + 2(-1) + 6(-2) = 0$$

$$+2 + 2x - 2 - 12 = 0$$

$$2x = +12 \quad \therefore x = +\frac{12}{2} = +6$$

$\therefore$ Oxidation number of 'S' in $\text{H}_2\text{S}_2\text{O}_8$ is +6



d) $\underline{\text{C}} \underline{\text{H}}_3 \underline{\text{C}} \underline{\text{O}} \underline{\text{O}} \underline{\text{H}}$

↓ ↓ ↓ ↓ ↓ ↓

x +1 x -2 -2 +1

$$x + 3(+1) + x + 2(-2) + 1(+1) = 0$$

$$2x + 3 - 4 + 1 = 0$$

$$2x = 0 \quad \therefore x = 0$$

Oxidation state of carbon in CH_3 is -3

Oxidation state of carbon in COOH is +3

$\therefore$ Average oxidation number of carbon atoms in CH_3COOH is zero.

8. ORGANIC CHEMISTRY

1 OMQ + 2 VSAQ + 1 SAQ [1 M + 2M + 2M + 4M = 9 M]

VSAQ (2 Marks)

2 × 2 = 4 Marks

1. How many σ and π bonds are present in each of the following molecules?

(a) $\text{HC}\equiv\text{CCH}=\text{CHCH}_3$, (b) $\text{CH}_2=\text{C}=\text{CHCH}_3$

[MAR-26]

A: a) $\sigma_{\text{C}-\text{C}} : 4$; $\sigma_{\text{C}-\text{H}} : 6$; $\pi_{\text{C}=\text{C}} : 1$; $\pi_{\text{C}\equiv\text{C}} : 2$ (or) 10 σ bonds, 3 π bonds.

b) $\sigma_{\text{C}-\text{C}} : 3$; $\sigma_{\text{C}-\text{H}} : 6$; $\pi_{\text{C}=\text{C}} : 2$ (or) 9 σ bonds, 2 π bonds.

2. What is the type of hybridisation of each carbon in the following compound?
 $\text{CH}_3\text{CH}=\text{CHCN}$

A: sp^3 , sp^2 , sp^2 , sp

3. What is carbocation? Give example.

[MAR-26]

A: **Carbocation:** It is a species having carbon atom with positive charge and sextet of electrons.

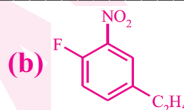
Ex: CH_3^+ (Methyl carbocation), $\text{CH}_3-\text{CH}^+-\text{CH}_3$ (Secondary carbocation)

4. What is metamerism? Give example.

A: **Metamerism** is a type of structural isomerism where compounds have the same molecular formula but differ in the arrangement of alkyl groups around a polyvalent functional group.

Ex: $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$ (Diethyl ether) & $\text{CH}_3\text{OC}_3\text{H}_7$

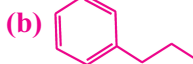
5. Write the IUPAC names of



A: a) 2-Ethyl methoxy benzene. (or) 1-ethyl anisole

b) 4-Ethyl - 1 fluoro - 2 - nitrobenzene.

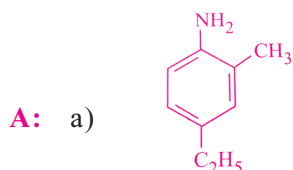
6. Write the IUPAC names of (a) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$



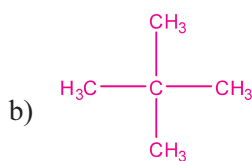
A: a) 2 Propanol

b) 1- Methyl 3- propyl benzene

7. Write the structures of (a) 4-ethyl 2-methyl aniline and (b) Neopentane.



4-ethyl 2-methyl aniline



Neopentane

8. Explain the principle of Adsorption chromatography.

A: Chromatography is a method of separation components of a mixture generally between the stationary phase and a mobile phase.

Chromatography involves the following steps:

- a) Adsorption and retention of a mixture of substances on the stationary phase and separation of adsorbed substances by the mobile phase to different distances on the stationary phase.
 - b) Recovery of the substances separated by a continuous flow of the mobile phase (elution).
-

9. Explain the term “Crystallisation”

A: Crystallisation: This technique is used for the purification of solid organic compounds.

This method is based on the difference in the solubilities of the compound and the impurities in a suitable solvent.

The impure compound is dissolved in a solvent in which it is partially soluble at room temperature and appreciably soluble at higher temperature.

The solution is heated to get a saturated solution further the solution is cooled to get pure organic compound crystals by filtration. On repeating this process finally we get very pure compound.

10. What are electrophiles and nucleophiles? Give examples.

A: Electrophiles are electron deficient species .

They are electron seeking reagents which take an electron pair from reactive site.

Ex: BF_3 , AlCl_3

Nucleophiles are electron rich species.

They are nucleus seeking reagents which bring an electron pair to the reactive site.

Ex: NH_3 , H_2O

9. HYDRO CARBONS

1 OMQ + 2 VSAQ + 1SAQ + 1LAQ [1 M + 2M + 2M + 4M + 8M = 17 M]

VSAQ (2 Marks)

2 × 2 = 4 Marks

1. What is substitution reaction? Explain with one example.

A: Substitution reaction is a chemical reaction in which one atom or group of atoms is substituted (or) replaced by another atom or group of atom.

Ex: $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$

2. What is Friedel -Crafts alkylation?

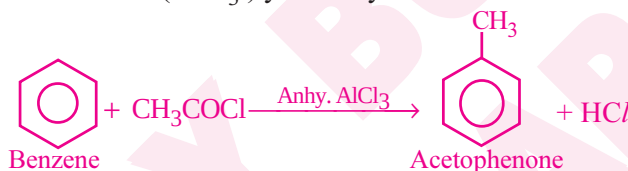
[MAR-26][BMP1][AP 18,22]

A: Friedel - Craft's alkylation : When benzene is treated with an alkyl halide in the presence of anhydrous, aluminum chloride alkyl benzene is formed



3. What is Friedel -Crafts acylation?

A: Friedel - Craft's acylation: The reaction of benzene with an acyl halide or acid anhydride in the presence of Lewis acids (AlCl_3) yields acyl benzene.



4. Explain the structural isomerism with one example.

[BMP1]

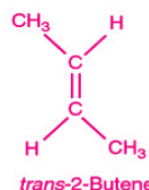
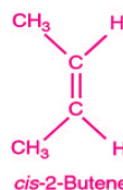
A: Structural isomerism is a type of isomerism where molecules have the same molecular formula but differ in their structural arrangements of atoms or group of atoms.

Ex: Butane and Isobutane

5. What is stereoisomerism? Give one example.

A: Stereoisomerism is a type of isomerism where compounds have same molecular formula but differ in their spatial arrangement of atoms or group of atoms.

Ex: cis-2-butene and trans-2-butene.



6. Kharash effect is not observed in the addition of HI to alkene. Why?

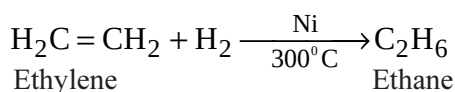
A: The H-I bond is weaker and iodine free radicals combine to form Iodine molecules instead of adding to double bond. So, Kharash effect is not observed in the addition of HI to alkene.

7. What is meant by torsional strain?

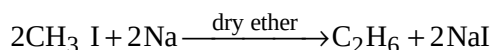
A: **Torsional strain** is a type of molecular strain in which the staggered form changes into the eclipsed form. Here, the electron clouds of the carbon-hydrogen bonds come closer to each other resulting in increase in electron cloud repulsions. This affects stability of a conformation. It results from resistance to bond twisting which is called torsional strain.

8. How ethane is prepared from ethene?

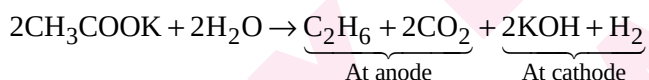
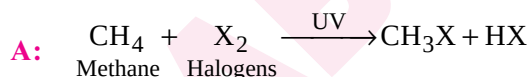
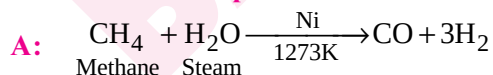
A: **Sabatier - Senderen's reduction reaction:** On a large scale, ethane is prepared by the **catalytic hydrogenation of ethylene**.

**9. What is Wurtz's reaction? Give one example.****[MAR-26][BMP2][AP 17]**

A: **Wurtz reaction:** Ethane is prepared by **heating methyl iodide** with **sodium** metal in the presence of dry ether.

**10. Explain Kolbe's electrolytic method with an example.****[BMP2]**

A: **Kolbe's electrolysis:** Ethane is obtained by the **electrolysis** of aqueous potassium acetate (or aqueous sodium acetate).

**11. Write the Halogenation of methane.****12. What is the product obtained when methane reacts with steam? Write the equation.****13. State Markovnikov rule.**

A: **Markovnikov rule** states that the addition of hydrogen halides to unsymmetrical alkenes takes place in such a manner that the positive part of the reagent attach itself to double bonded carbon atom which has more number of hydrogen atoms.

14. Write the bond enthalpy of carbon-carbon single bond, carbon-carbon double bond and carbon-carbon triple bond in kJ/mole.

A: 348 kJ/mol, 610 kJ/mol, 835 kJ/mol.

15. What is Sulphonation of benzene?

A: **Sulphonation** is the replacement of a hydrogen atom by a sulphonic acid group in a ring

It is carried out by heating benzene with fuming sulphuric acid (oleum)

