HIGHER SECONDARY FIRST YEAR PUBLIC EXAMINATION – MARCH - 2025

CHEMISTRY – ANSWER KEY

PART-I

Note : i)Answer all the questions. **[15x1=15]**

ii) Choose the most appropriate answer from the given four alternatives and write the option code and the corresponding answer

	TYPE-A		TYPE-B	
1.	c)	NH_4Cl	b)	Both assertion and reason are true and the reason is the correct explanation of assertion
2.	b)	Acetaldehyde	b)	Propene
3.	a)	P	d)	-3227 kJ mol^{-1}
4.	a)	Staggered>skew > Eclipsed	a)	Bio-magnification
5.	c)	3	a)	Staggered>skew > Eclipsed
6.	d)	-3227 kJ mol^{-1}	d)	17
7.	b)	kerosene	c)	NH_4Cl
8.	c)	glucose	a)	P
9.	a)	argon	c)	$(RT)^2$
10.	d)	17	a)	argon
11.	c)	$C_6H_5\overset{+}{N}H_3$	b)	Acetaldehyde
12.	b)	Propene	b)	kerosene
13.	a)	Bio-magnification	c)	3
14.	c)	$(RT)^2$	c)	glucose
15.	b)	Both assertion and reason are true and the reason is the correct explanation of assertion	c)	$C_6H_5\overset{+}{N}H_3$

PART-II

Answer any six of the following questions. Question no.24 is compulsory. [6 x 2 = 12]

16. Define relative atomic mass.

- The relative atomic mass is defined as the ratio of the average atomic mass to the unified atomic mass unit.

$$\text{Relative atomic mass } (A_r) = \frac{\text{Average mass of the atom}}{\text{unified atomic mass}}$$

- Relative atomic mass of hydrogen $(A_r)_H = 1.008u$

17. Define Heisenberg's uncertainty principle.

'It is impossible to accurately determine both the position and the momentum of a microscopic particle simultaneously'.

$$\Delta x . \Delta p \geq \frac{h}{4\pi}$$

where, Δx and Δp are uncertainties in determining the position and momentum, respectively.

18. Discuss the three types of Covalent hydrides.

- Electron precise
- Electron deficient
- Electron-rich hydrides

19. Give the mathematical expression that relates gas volume and moles.

- Equal volume of all gases under same temperature and pressure contains equal number of molecules

$$\boxed{V \propto n}$$

20. State the third law of thermodynamics.

- "the entropy of pure crystalline substance at absolute zero is zero"

$$\boxed{\lim_{T \longrightarrow 0} S = 0}$$

21. What is sublimation?

Few substances like benzoic acid, naphthalene and camphor when heated pass directly from solid to vapor without melting. On cooling the vapours will give back solids. Such phenomenon is called sublimation.

22. Explain inductive effect with suitable example.

- Inductive effect is defined as the change in the polarisation of a covalent bond due to the presence of adjacent bonds, atoms or groups in the molecule.
- This is a permanent phenomenon.
- Example : $\overset{\delta\delta+}{CH_3} \rightarrow \overset{\delta+}{CH_2} \rightarrow \overset{\delta-}{Cl}$

23. Define Smog.

- Smog is a combination of <u>smoke and fog</u> which forms droplets that remain suspended in the air.
- Smog mainly consists of ground level ozone, oxides of nitrogen, volatile organic compounds,SO_2, acidic aerosols and gases, and particulate matter.
  Smog is a chemical mixture of gases that forms a brownish yellow haze over urban cities.

24. The equilibrium concentrations of NH_3, N_2 and H_2 are 1.8×10^{-2} M, 1.2×10^{-2} M and 3×10^{-2} M respectively. Calculate the equilibrium constant for the formation of NH_3 from N_2 and H_2. [Hint: M= mol lit^{-1}]

<u>Given</u>

$NH_3 = 1.8 \times 10^{-2}$ M,
$N_2 = 1.2 \times 10^{-2}$ M and
$H_2 = 3 \times 10^{-2}$ M

$$\mathbf{N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}}$$

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_c = \frac{1.8 \times 10^{-2} \times 1.8 \times 10^{-2}}{1.2 \times 10^{-2} \times 3 \times 10^{-2} \times 3 \times 10^{-2} \times 3 \times 10^{-2}}$$

$$\boxed{K_c = 1 \times 10^3 L^2\ mol^{-2}}$$

PART-III

Answer any six of the following questions. Question no.33 is compulsory. [6 x 3 = 18]

25. Calculate the relative molecular mass of the following

i) Ethanol(C_2H_5OH) $= (2 \times 12) + (6 \times 1.008) + (1 \times 16)$

$= 24 + 6.048 + 16$

$= 46.048$ u

ii) Glucose ($C_6H_{12}O_6$) $= (6 \times 12) + (12 \times 1.008) + (6 \times 16)$

$= 72 + 12.096 + 96$

$= 180.096$ u

26. Briefly give the basis for Pauling's scale of electronegativity

$$(\chi_A - \chi_B) = 0.182\sqrt{E_{A-B} - (E_{A-A} \times E_{B-B})^{1/2}}$$

$\Rightarrow E_{A-B}$ Bond energy of AB molecules.

$\Rightarrow E_{A-A}$ and E_{B-B} are the bond energy of A_2 and B_2 molecules.

27. How do you convert para hydrogen into ortho hydrogen ?

- By using catalyst like Iron
- By passing electric discharge
- By heating at 800°C
- By mixing with paramagnetic molecules like oxygen
- By mixing with atomic hydrogen

28. Can a Van der Waals gas with a=0 be liquefied? Explain.

- If the Vander waals constant a = 0 for a gas, then it behaves ideally. i.e, there are no intermolecular forces of attraction. So it cannot be liquefied.

$$P_c = \frac{a}{27b^2}$$

- If a = 0, then p and 27 b =0, which means that either p = 0 or b = 0 which is not possible. Therefore the gas cannot be liquefied.

29. What are the limitations of Henry's law?

- Henry's law is applicable at moderate temperature and pressure only.
- Only the less soluble gases obeys Henry's law
- The gases reacting with the solvent do not obey Henry's law. For example, ammonia or HCl reacts with water and hence does not obey this law. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$
- The gases obeying Henry's law should not associate or dissociate while dissolving in the solvent.

30. Explain the covalent character in ionic bond.

- The partial covalent character in ionic compounds can be explained on the basis of a phenomenon called polarization.

- An ionic compound, there is an electrostatic attractive force between the cation and anion.
- The positively charged cation attracts the valence electrons of anion while repelling the nucleus.
- This causes a distortion in the electron cloud of the anion and its electron density drifts towards the cation, which results in some sharing of the valence electrons between these ions.
- Thus, a partial covalent character is developed between them. This phenomenon is called polarization.

31. What is isomerism ? Give its types.

Two or more compounds with the same molecular formula but different structure and properties (physical, chemical, or both). Compounds exhibiting this isomerism are called isomers.

Types i. Constitutional isomerism, ii. stereoisomerism.

32. What are uses of Chlorobenzene?

- Chloro benzene is used in the manufacture of pesticides like DDT
- It is used as high boiling solvent in organic synthesis.
- It is used as fibre - swelling agent in textile processing.

33. Write the equation for the chain reaction between methane and chlorine in the presence of light.

$$\underset{\text{Methane}}{CH_4} + Cl_2 \xrightarrow{\text{light / } h\nu} \underset{\text{Methyl chloride}}{CH_3Cl} + HCl$$

$$\underset{\text{Methyl chloride}}{CH_3Cl} + Cl_2 \xrightarrow{\text{light / } h\nu} \underset{\text{Methylene chloride}}{CH_2Cl_2} + HCl$$

$$\underset{\text{Methylene chloride}}{CH_2Cl_2} + Cl_2 \xrightarrow{\text{light / } h\nu} \underset{\text{Chloroform}}{CHCl_3} + HCl$$

$$\underset{\text{Chloroform}}{CHCl_3} + Cl_2 \xrightarrow{\text{light / } h\nu} \underset{\text{Carbon tetrachloride}}{CCl_4} + HCl$$

PART-IV

Answer all the questions. **[5 x 5 = 25]**

34. a) (i) Define Molar volume

➢ The volume occupied by one mole of any substance in the gaseous state at a given temperature and pressure is called molar volume.

(ii) What are the limitations of Bohr's atom model?

- The Bohr's atom model is applicable only to species having one electron.
- It was unable to explain the splitting of spectral lines in the presence of **magnetic field (Zeeman's effect)** or an **electrical field (Stark effect)**.

- Bohr's theory was unable to explain why the electron is restricted to revolve around the nucleus in a fixed orbit in which the angular momentum of the electron is equal to $\frac{nh}{2\pi}$.

(OR)

b) (i) Why halogens act as oxidising agents?

- Halogens are strong oxidizing agents because their tendency of accepting electrons are high.
- Halogens have high electron negativity and electron affinity values.
- Halogens have a unstable np^5 electronic configuration.
- By gaining one electron it becomes a Stable Fully filled np^6 electronic configuration

(ii) State the trends in the variation of electronegativity in group and periods

Along the Group: It decreases along the group.

- As we move down the group the nuclear charge decreases
- The atomic size increases.

Along the period : It increases along the period Reason

- As we move along the period the nuclear charge increases
- The atomic size decreases.
- The attraction between the valence electron and the nucleus increases

35. a) (i) Describe briefly the biological importance of Calcium and magnesium

Importance of magnesium

- Magnesium plays a important role in Bio-chemical reactions catalyzed by enzymes
- Magnesium is the co-factor of all enzymes that utilize ATP in phosphate transfer and energy release.
- Mg is essential for DNA synthesis, stability & Proper functioning of the DNA.
- Magnesium is used for balancing the electrolyte in the body
- Magnesium is present in Chlorophyll and play a main role in Photosynthesis
- Deficiency of Mg caused Neuro -Muscular irritation.

Importance of Calcium

- Calcium is a major component of bones and teeth.
- Calcium is present in blood and its concentration is maintained by hormones.
- Calcium is also important for muscle contraction.

(OR)

b) (i) Suggest and explain an indirect method to calculate lattice enthalpy of sodium chloride crystal.

ΔH_f = heat of formation of sodium chloride

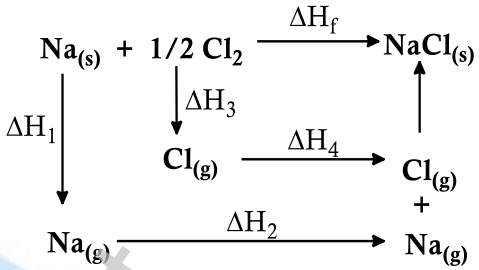
ΔH_1 = heat of sublimation of $Na_{(S)}$

ΔH_2 = ionisation energy of $Na_{(S)}$

ΔH_3 = dissociation energy of $Cl_{2(g)}$

ΔH_4 = Electron affinity of Cl_g

U = lattice energy of NaCl



$$\Delta H_f = \Delta H_1 + \Delta H_2 + \frac{1}{2}\Delta H_3 + \Delta H_4 + U$$

$$U = (\Delta H_f) - \left(\Delta H_1 + \Delta H_2 + \frac{1}{2}\Delta H_3 + \Delta H_4\right)$$

36. a) (i) Using Le-Chatlier's principle explain the effect of the following factors on Equilibrium.

Condition	**Stress**	**Direction**
Concentration	Addition of reactants (increase in reactant concentration) Removal of products (decrease in product concentration)	Forward reaction
	Addition of products (increase in product concentration) Removal of reactants (decrease in reactant concentration)	Reverse reaction
Pressure	Increase of pressure (Decrease in volume)	Reaction that favours fewer moles of the gaseous molecules
	Decrease of pressure (Increase in volume)	Reaction that favours more moles of the gaseous molecules
Temperature	Increase (High T)	Towards endothermic reaction
	decrease (Low T)	Towards exothermic reaction
Catalyst	Addition of catalyst	No effect
Inert gas	Addition of inert gas at constant volume	No effect

(OR)

b) (i) Derive the expression for vapour pressure of binary solution of liquid in liquid using Raoult's law

According to Raoult's law,

$p_A \alpha\ x_A$ ----------(1)

$p_A = k\ x_A$

when $x_A = 1$, $k = p°_A$

where $p°_A$ is the vapour pressure of pure component 'A' at the same temperature.

Therefore,

$p_A = p°_A\ x_A$ ---------- (2)

Similarly, for component 'B'

$p_B = p°_B\ x_B$ ----------(3)

xA and xB are the mole fraction of the components A and B respectively.

According to Dalton's law of partial pressure the total pressure in a closed vessel will be

equal to the sum of the partial pressures of the individual components.

Hence,

$P_{total} = p_A + p_B$ ----------(4)

Substituting the values of pA and pB from equations (9.4) and (9.5) in the above equation,

$P_{total} = x_A p°_A + x_B p°_B$ (5)

We know that $x_A + x_B = 1$ or $x_A = 1 - x_B$

Therefore,

$P_{total} = (1 - x_B)\ p°_A + x_B\ p°_B$ ----------(6)

$P_{total} = p°_A + x_B(\ p°_B - p°_A)$ ---------(7)

37. a) (i) Draw the M.O diagram for oxygen molecule calculate its bond order and show that O_2 is paramagnetic.

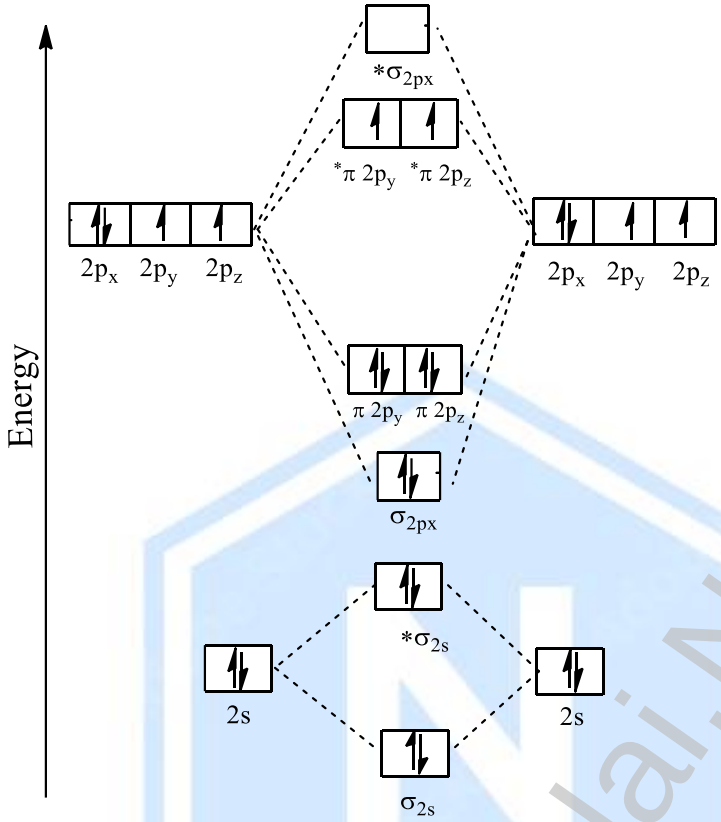
Molecular orbital diagram of Oxygen molecule O_2

- Electronic configuration of Nitrogen : $1s^2\ 2s^2\ 2p^4$
- Electronic configuration of Nitrogen molecule :

$$(\sigma_{1s})^2\ \ (\sigma^*_{1s})^2\ \ (\sigma_{2s})^2\ \ (\sigma^*_{2s})^2 (\pi_{2p_z})^2 \left(\pi_{2p_y}\right)^2 (\sigma_{2p_x})^2 (\pi^*_{2p_x})^1 \left(\pi^*_{2p_y}\right)^1$$

$$\textbf{Bond order} = \frac{N_b - N_a}{2} = \frac{10 - 6}{2} = 2$$

- Molecule has two unpaired electrons.Hence it is paramagnetic.



(OR)

b) (i)

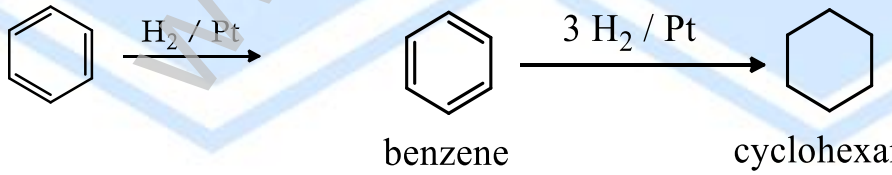
$CH_3-C\equiv C-CH(Cl)-CH_3$

4 – chloropent – 2 – yne

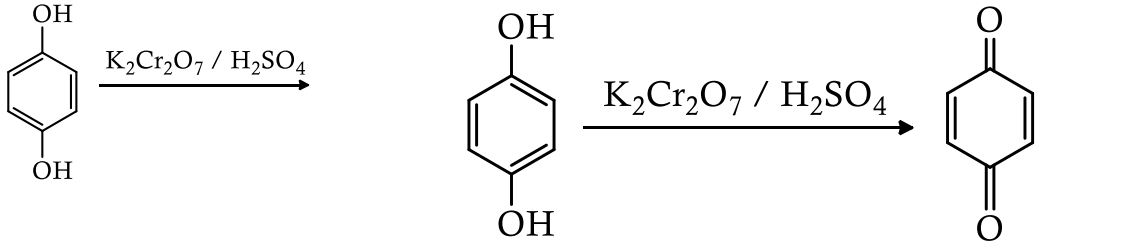
$CH_3-CH(OH)-CH-CHO$

2 – hydroxybutanal

(ii) Identify A and B



benzene cyclohexane



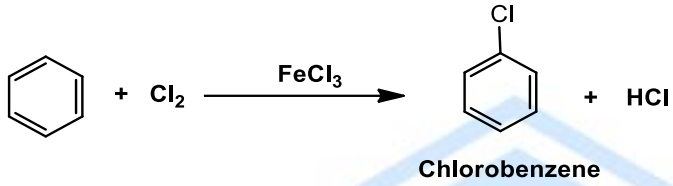
4-Hydroxy Phenol *p*-benzoquinone

38. a) How will you convert benzene to following compounds

(i) Benzene to chlorobenzene

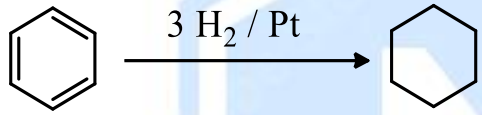
$$\underset{\text{Benzene}}{C_6H_5-H} + HCl + \frac{1}{2}O_2 \xrightarrow{CuCl_2\ /\ 525\ K} \underset{\text{Chlorobenzene}}{C_6H_5-Cl} + H_2O$$

(or)



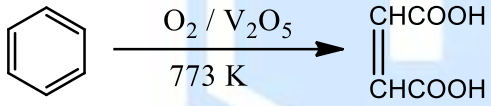
Chlorobenzene

(ii) Benzene to cyclohexane



benzene cyclohexane

(iii) Benzene to maleic acid



benzene Maleic acid

(OR)

b) Write short notes on the the following

(i) <u>Raschig process</u>

$$\underset{\text{Benzene}}{C_6H_5-H} + HCl + \frac{1}{2}O_2 \xrightarrow{CuCl_2\ /\ 525\ K} \underset{\text{Chlorobenzene}}{C_6H_5-Cl} + H_2O$$

(ii) <u>Dows Process</u>

$$\underset{\text{Chlorobenzene}}{C_6H_5-Cl} + NaOH \xrightarrow{300\ atm\ /\ 350\ ^\circ C} \underset{\text{Phenol}}{C_6H_5-OH} + NaCl$$

(iii) <u>Williamson ether synthesis</u>

$$CH_3CH_2Br + NaOCH_2CH_3 \xrightarrow{\Delta} CH_3CH_2OCH_2CH_3 + NaBr$$

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