HIGHER SECONDARY FIRST YEAR PUBLIC EXAMINATION

MARCH - 2024

CHEMISTRY – ANSWER KEY

PART-I

	TYPE-A		TYPE-B	
1.	B	$-NO_2$	A	rich in dissolved oxygen
2.	C	Free radical	A	6.022×10^{20}
3.	A	4l+2	D	$Fe_4[Fe(CN)_6]_3$
4.	C	=0	A	Square Pyramidal
5.	A	rich in dissolved oxygen	A	31.1°C
6.	A	6.022×10^{20}	B	Castner's Process
7.	A	31.1°C	B	$-NO_2$
8.	C	Freon-113	D	-1
9.	D	$Fe_4[Fe(CN)_6]_3$	C	Ethanol+water
10.	C	Ethanol+water	A	4l+2
11.	A	Assertion is true & the reason is false	C	Free radical
12.	B	Castner's Process	C	Freon-113
13.	D	-1	C	=0
14.	A	Square Pyramidal	A	$CO + H_2$
15.	A	$CO + H_2$	A	Assertion is true and the reason is false

PART-II

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

16. Define electronegativity.

- Electronegativity is a relative tendency of an element present in covalent molecule to attract the shared pair of electrons towards itself.

17. Define equivalent mass.

- Equivalent mass of an element, compound or ion is the mass that combines or displaces 1.008 g hydrogen or 8 g oxygen or 35.5 g Chlorine.

$$\text{equivalent mass} = \frac{\text{molar mass}}{\text{Equivalence factor}}$$

18. Write balanced chemical equation for action of heat on calcium carbonate

$$\underset{\text{Calcium Carbonate}}{CaCO_3} \xrightarrow{\Delta} \underset{\text{Quick lime}}{CaO_{(S)}} + CO_2 \uparrow$$

19. State Dalton law of Partial pressure

- The total pressure of a non-reacting gases is equal to the sum of the partial pressure of the gases present in the mixture

$$\mathbf{P_{Tot} = p_1 + p_2 + p_3 \ldots}$$

20. What type of hybridisations are possible in the following geometries?

a)BF_3 b)CH_4 c)PCl_5 d) SF_6

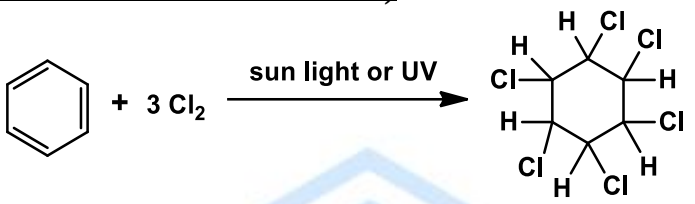
a)BF_3 -sp^2 b) CH_4 -sp^3 c)PCl_5 -sp^3 d d) SF_6 - $sp^3 d^2$

21. What is greenhouse effect?

It is defined as the heating up the earth surface due to trapping of infrared radiations reflected by earth's surface by certain gases in the atmosphere.

22. How will you convert Benzene to BHC ?

Benzene → BHC (Benzene Hexa Chloride)



BHC (Benzene HexaChloride)
Gammaxane (or) Lindane

23. Write a note on homologous series.

- A series of organic compounds each containing a characterised functional group and the successive members differ from each other in molecular formula by a $-CH_2$ group is called homologous series.

Eg. **Alkanes:** Methane (CH_4), Ethane (C_2H_6), etc.

24. Calculate the molality of the solution containing 90 g of glucose dissolved in 2 kg of water.

$$\text{Molality} = \frac{\text{Number of moles of solute}}{\text{Mass of the solvent (Kg)}}$$

$$\text{Molality} = \frac{\frac{90}{180}}{2} = 0.25\ m$$

PART-III

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

25. Define orbital? What are the n and ℓ values for $3p_x$ and $4d_{x^2-y^2}$ electron?

- Orbital is a three dimensional space which the probability of finding the electron is maximum.

Orbital	n	ℓ
3 p_x	3	1
4 $d_{x^2-y^2}$	4	2

26. Give the uses of Hydrogen

- Liquid hydrogen is used as Rocket Fuel
- Hydrogen is used for preparing Fertilizer and explosives
- It is used as catalyst for the preparation of Vanaspati.
- It is used for the preparation of Methanol and industrial solvent.

27. Explain the periodic trend of ionisation potential.

Along the Group: It decreases along the group.

- As we move down the group the valence electrons are added into new shells.
- As a result the distance between the nucleus and the valence electrons increases.
- Hence the nuclear charge decreases and the ionization also decreases.

Along the period : It increases along the period

- As we move along the period the valence electrons are added to the same shell.

- So the Nuclear charge increases, And the attraction between the valence electron and the nucleus increases
- Hence more energy is required to remove the valence electron, so Ionization energy increases.

28. Derive the K_p and K_c for the following equilibrium reaction.

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

	$H_{2(g)}$	$I_{2(g)}$	$HI_{(g)}$
Initial number of moles	a	b	-
number of moles reacted	x	x	-
Number of moles at equilibrium	a-x	b-x	2x
molar concentration at equilibrium	$\frac{a-x}{V}$	$\frac{b-x}{V}$	$\frac{2x}{V}$

$$K_c = \frac{[HI]^2}{[H_2]^1\,[I_2]^1}$$

$$K_C = \frac{\left(\frac{2x}{V}\right)^2}{\frac{a-x}{V} \times \frac{b-x}{V}} = \frac{\frac{4x^2}{V^2}}{\frac{(a-x)(b-x)}{V^2}}$$

$$\boxed{K_C = \frac{4x^2}{(a-x)(b-x)}}$$

$$\Delta n_g = 2 - 2 = 0 \Rightarrow$$

$$K_p = K_C (RT)^0 = K_C$$

$$\boxed{K_P = \frac{4x^2}{(a-x)(b-x)}}$$

29. What is a pi (π) bond?

❖ When two atomic orbitals overlaps sideways, the resultant covalent bond is called a pi (π)bond

30. Define Hess's law of constant heat summation.

- The enthalpy change of a reaction either at constant volume or constant pressure is the same whether it takes place in a single or multiple steps provided the initial and final states are same.

$$\boxed{\Delta H_r = \Delta H_1 + \Delta H_2 + \Delta H_3}$$

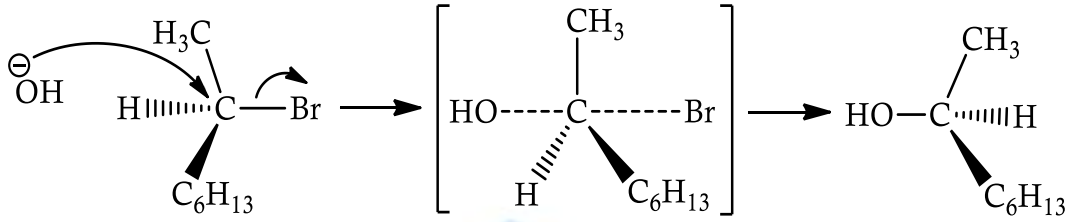
31. Differentiate electrophiles and nucleophiles.

Electrophiles	Nucleophiles
• Electron deficiency species • Positive changed ions • All Lewis acids act as electrophiles • Ex. NO_2^+, $AlCl_3$, BF_3	• Electron rich species having a lone pair of electron • Negatively charged ions • All Lewis bases act as nucleophiles • Ex. Cl^-, CN^-, Br^-, I^-, NH_3

32. Explain S_N2 reaction mechanism.

- It is a bimolecular reaction
- It follows the second order kinetic mechanism
- It is a single step process
- Rate = k_2 [alkylhalide] [nucleophile]

- Dose not form carbon cation intermediate.
- Inversion in configuration.
- Example :- (-)2 – Bromooctane is heated with sodium hydroxide

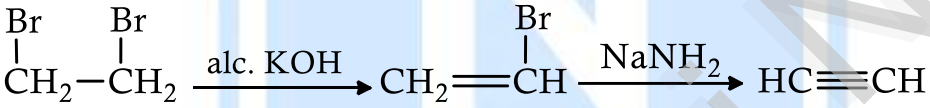


(-)-2-Bromo octane Transition State (+)-2-Octanol

- (–) 2 – Bromo octane is heated with sodium hydroxide (+) – 2 – Octanol is formed with invesion of configuration.
- The carbon at which substitution occurs has inverted configuration during the course of reaction. This inversion of configuration is called Walden inversion.

33. Find the A,B and C

$$CH_2{=}CH_2 + Br_2 \longrightarrow A \xrightarrow{\text{alc. KOH}} B \xrightarrow{NaNH_2} C$$



A **B** **C**

(A)	$Br-CH_2-CH_2Br$	Ethylene Bromide (or) 1,2 dibromoethane
(B)	$CH_2=CH-Br$	bromoethene
(C)	$CH \equiv CH$	Acetylene

PART-IV

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

34. a) (i) An organic compound present in vinegar has 40% carbon, 6.6 % hydrogen, and 53.4 % oxygen, Find the empirical formula and molecular formula of the compound. (Given, Molar mass: 60 g mol^{-1}).

Element	Percentage	Atomic mass	Relative number of atoms	Simple ratio	Whole number
C	40	12	$\frac{40}{12} = 3.3$	$\frac{3.3}{3.3} = 1$	1
H	6.6	1	$\frac{6.6}{1} = 6.6$	$\frac{6.6}{3.3} = 2$	2
O	53.4	16	$\frac{53.4}{16} = 3.3$	$\frac{3.3}{3.3} = 1$	1

- The ratio of C: H : O is 1 : 2 : 1 and hence, the empirical formula of the compound is CH_2O.
- Empirical Formula mass = (1 × 12 + 1 × 2 + 1 × 16)
- = 12 + 2 + 16 = 30.

  Whole number n $= \frac{\text{Molar mass}}{\text{Empirical formula mass}} = \frac{60}{30} = 2$
- Therefore, Molecular formula = $(CH_2O)_2 = C_2H_4O_2$

(ii) Write a notes on Spin quantum number

- It is denoted by the symbol 's'
- The electron in an atom revolves around the nucleus and also spins in a clockwise direction or in anti-clockwise direction.

Spin direction	clockwise	anti-clockwise
's' value	+½	-½

(OR)

b) Discuss briefly the similarities between beryllium and aluminium.

- Beryllium chlorides form a dimeric structure like aluminium chloride with chloride bridges.
- As in excess of alkali aluminium hydroxide gives aluminate ion, Beryllium hydroxide gives beryllate ion.
- Both beryllium and aluminium hydroxides are amphoteric in nature.
- On hydrolysis of their carbides gives methane.
- Both are rendered passive by nitric acid.

35. a) What are Interstitial hydrides? Give an example.

- Metallic hydrides are usually obtained by hydrogenation of metals and alloys in which hydrogen occupies the interstitial sites (voids). Hence, they are called interstitial hydrides.
- Example: $TiH_{1.5-1.8}$ and $PdH_{0.6-0.8}$

(ii) Give the general electronic configuration of lanthanides and actinides?

- Lanthanides = $4f^{1-14}\ 5d^{0-1}\ 6s^2$
- Actinides = $5f^{0-14}\ 6d^{0-2}\ 7s^2$

(OR)

b) List the characteristics of internal energy.

- The internal energy of a system is an extensive property.
- If the amount is doubled, the internal energy is also doubled.
- The internal energy of a system is a state function.
- The change in internal energy does not depend on the path by which the final state is reached.
- The change in internal energy of a system is expressed as $\mathbf{\Delta U = U_f - U_i}$
- In a cyclic process, there is no internal energy change. $\mathbf{\Delta U_{(cyclic)} = 0}$
- $\Delta U = U_f - U_i = -ve \quad if(U_f < U_i)$
- $\Delta U = U_f - U_i = +ve \quad if(U_f > U_i)$

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36. a) (i) State Raoult's law

"A solution of volatile liquids the partial vapour pressure of each component (A & B) of the solution is directly proportional to its mole fraction.

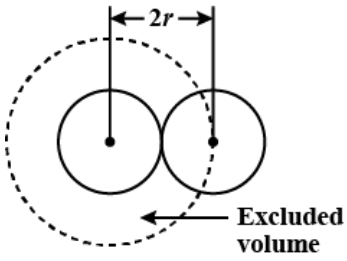
$$\boxed{P_A \propto x_A} \quad \Rightarrow \quad P_A = k\ X_A$$

(ii) Explain the correction terms for volume in the van der Waals equation.

Volume correction

- ❖ Every individual molecule of a gas occupies a certain volume, the actual volume is less than the volume of the container V.
- ❖ Correction factor V'

- V = excluded volume
- Consider gas molecules as spheres,
- Excluded volume for two molecules $= \frac{4}{3}\pi(2r)^3 = 8\left(\frac{4}{3}\pi r^3\right) = 8\,V_m$
  - V_m= volume of a single molecule
  - b = Van der Waals constant $b = 4V_m$
- Excluded volume for single molecule $= \frac{8V_m}{2} = 4V_m$
- Excluded volume for n molecule $= n(4V_m) = nb$
- $V' = nb$
- $V_{ideal} = V - nb$ ––––––––②



(OR)

b) (i) Derive the Van't Hoff equation

- The relation between standard free energy change (ΔG°) and equilibrium constant (K)

$$\Delta G^o = -RT\ln K \quad ––––––\ ①$$
$$\Delta G^o = \Delta H^o - T\Delta S^o \quad ––––––\ ②$$

From ① & ② we get

$$-RT\ln K = \Delta H^o - T\Delta S^o$$
$$\ln K = \frac{\Delta H^o}{-RT} - \frac{T\Delta S^o}{-RT}$$
$$\ln K = -\frac{\Delta H^o}{RT} + \frac{T\Delta S^o}{RT}$$
$$\ln K = -\frac{\Delta H^o}{R}(T^{-1}) + \frac{T\Delta S^o}{RT} \quad ––––––\ ③$$

Equ ③ diff. w. r t. "T"

$$\frac{d(\ln K)}{dT} = -\frac{\Delta H^o}{R}(-T^{-2}) + 0$$

Differential form of van't Hoff equation

$$\Rightarrow \boxed{\frac{d(\ln K)}{dT} = \frac{\Delta H^o}{RT^2}} \quad ––– \quad ④$$

$$\int_{K_1}^{K_2} d(\ln K) = \frac{\Delta H^o}{R}\int_{T_1}^{T_2} T^{-2}dT$$
$$[\ln K]_{K_1}^{K_2} = \frac{\Delta H^o}{R}\left[\frac{T^{-1}}{-1}\right]_{T_1}^{T_2}$$
$$[\ln K]_{K_1}^{K_2} = \frac{\Delta H^o}{R}\left[-\frac{1}{T}\right]_{T_1}^{T_2}$$

$$d(\ln K) = \frac{\Delta H^o}{R}T^{-2}dT$$

$$\ln K_2 - \ln K_1 = \frac{\Delta H^o}{R}\left[-\frac{1}{T_2} + \frac{1}{T_1}\right]$$

$$\ln\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\ln\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

$$2.303 \times \log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

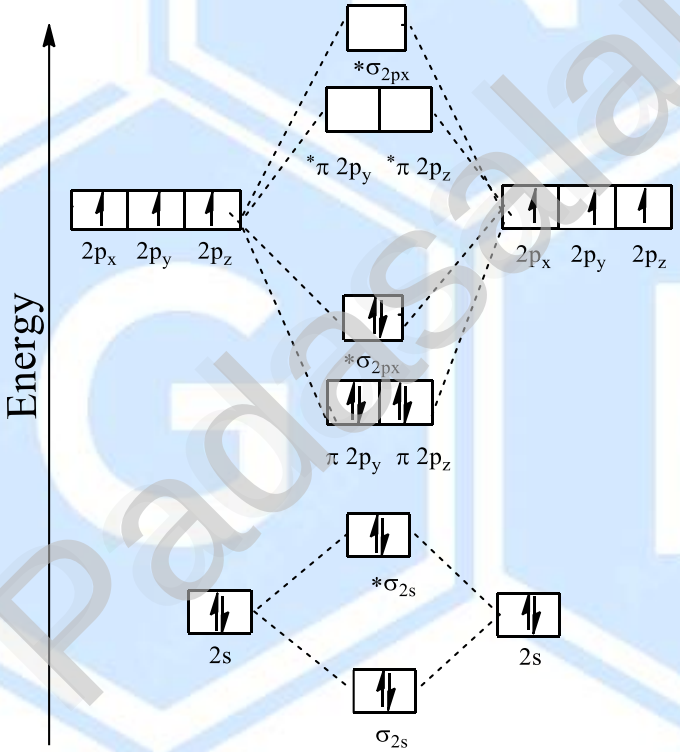
Integrated form of van't Hoff equation.

$$\Rightarrow \boxed{\log\left(\frac{K_2}{K_1}\right) = \frac{\Delta H^o}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]} \quad ---⑤$$

37. a) (i) Discuss the formation of N_2 molecule using MO Theory

- Electronic configuration of Nitrogen : $1s^2\ 2s^2\ 2p^3$
- Electronic configuration of Nitrogen molecule :

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



$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{10 - 4}{2} = 3$$

- ❖ Molecule has no unpaired electrons
- ❖ Hence it is <u>diamagnetic</u>.

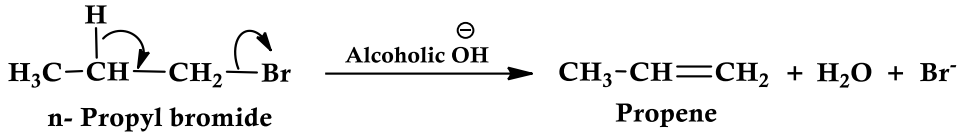
(OR)

b) (i) Give the IUPAC name the following compounds.

A)	$H_3C-CH_2-\overset{\overset{O}{\|\|}}{C}-OH$	Propanoic acid
B)	$H_3C-CH_2-\overset{\overset{O}{\|\|}}{C}-CH_2CH_3$	Pentan-3-one
C)	$H_3C-CH_2-CH_2-\overset{\overset{CH_3}{\|}}{N}-CH_3$	N,N-dimethylpropan-1-amine

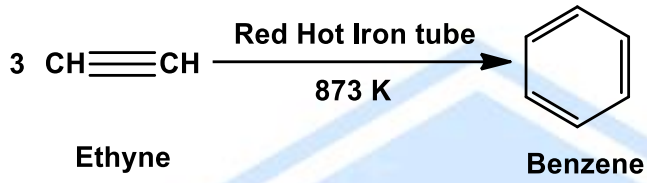
ii) **Write β – elimination reaction.**

β – elimination

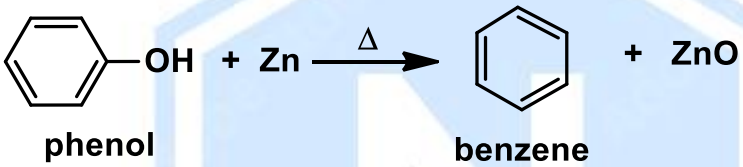


38. a) (i) **How will you prepare benzene from the following?**

A)



B)



(ii) **Write the uses of DDT.**

- It is used as organic pesticide.
- Control certain insects which carries diseases like malaria and yellow fever.
- Used in farms to control some agricultural pests.
- Used in building construction as pest control.

(OR)

b) **How is acid rain formed? Explain its effect**

❖ The oxides of sulphur and nitrogen is absorbed by the water in the clouds and converted into sulphuric acid and nitric acid.

$$2SO_2 + O_2 + 2H_2O \longrightarrow 2H_2SO_4$$
$$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$$

❖ The pH of rain water becomes **5.6**. This is called as Acid rain.

Effects of acid rain

⊙ Damage to building (stone leprosy)
⊙ Affects plants and animal life in aquatic ecosystem
⊙ Harmful for agriculture,tree and plants as it removes nutrients
⊙ Corrodes water pipes
⊙ Respiratory ailment in humans and animals.

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