HIGHER SECONDARY FIRST YEAR (+1)

CHEMISTRY – MAY - 2022 – ANSWERKEY

PART – A

I. ANSWER THE FOLLOWING QUESTIONS. $[15 \times 1 = 15]$

		TYPE – A		TYPE – B
1	c)	C_8H_{18}	a)	1p + 2n
2	b)	– 2°C	c)	(1)- (iv), (2)- (iii), (3)- (i), (4)- (ii)
3	a)	$-C(CH_3)_3 > -CH(CH_3)_2 > -CH_2CH_3 > -CH_3$	b)	NO
4	b)	NO	c)	$\frac{mass}{volume}$
5	d)	If both assertion and reason are true but reason is not the correct explanation of assertion.	C)	C_8H_{18}
6	c)	$\frac{mass}{volume}$	a)	Lithium
7	b)	for a system at equilibrium, Q is always less than the equilibrium constant	a)	$-C(CH_3)_3 > -CH(CH_3)_2 > -CH_2CH_3 > -CH_3$
8	c)	(1)- (iv), (2)- (iii), (3)- (i), (4)- (ii)	C0	Stark effect
9	a)	Lithium	b)	for a system at equilibrium, Q is always less than the equilibrium constant
10	b)	$MgCl_2$	d)	Tautomers
11	a)	1p + 2n		$MgCl_2$
12	a)	O_2^{2-}	b)	– 2°C
13	c)	Stark effect	b)	O_2^{2-}
14	d)	Near the hydrogen chloride bottle	d)	If both assertion and reason are true but reason is not the correct explanation of assertion.
15	d)	Tautomers	d)	Near the hydrogen chloride bottle

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PART – B		
II.	**ANSWER ANY SIX QUESTIONS. (Q.No : 24 is compulsory)**	$[6 \times 2 = 12]$
16	**Define Gram equivalent mass.**	
	Gram equivalent mass is defined as the mass of an element (compound or ion) that combines or displaces 1.008 g hydrogen or 8 g oxygen or 35.5 g chlorine. gram equivalent mass has the unit $g\ eq^{-1}$ or $\text{Gram equivalent mass} = \frac{\text{molar mass}}{\text{equivalent factor}}$	
17	**Calculate the maximum number of electrons that can be accommodated in L shell.**	
	For L shell n=2 $2n^2 = 2(2)^2 = 8$ 2s=2 electrons 2p=6 electrons Total= 8 electrons	
18	**Mention the three types of covalent hydrides**	
	• Electron precise $(CH_4, C_2H_6, SiH_4, GeH_4)$ • Electron deficient(B_2H_6) • electron-rich hydrides (NH_3, H_2O)	
19	**What are the conditions for the spontaneity of a process?**	
	• If the enthalpy change of a process is negative, then the process is exothermic and may be spontaneous. **(ΔH is negative)** • If the entropy change of a process is positive, then the process may occur spontaneously. **(ΔS is positive)** • The gibbs free energy which is the combination of the above two $(\Delta H - T\Delta S)$ should be negative for a reaction to occur spontaneously, i.e. the necessary condition for a reaction to be spontaneous is $\mathbf{\Delta H - T\Delta S < 0}$	
20	**Explain sign convention of heat**	
	1. If heat is absorbed by the system :$+q$ 2. If heat is evolved by the system : $-q$	
21	**Give a balanced chemical equation for the equilibrium reaction for which the equilibrium constant is given by expression** $K_c = \left(\frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}\right)$	
	Chemical equation is, $4\,NO + 6H_2O \rightleftharpoons 4NH_3 + 5O_2$	
22	**Define the term "isotonic solution".**	
	Two solutions having same osmotic pressure at a given temperature are called isotonic solutions.	

23	**How will you convert Ethyl chloride to ethane?**
	• Alkyl halides can be converted to alkanes by reduction with nascent hydrogen. • The hydrogen for reduction may be obtained by using any of the following reducing agents: Zn+HCl, Zn+CH_3COOH, Zn-Cu couple in ethanol, $LiAlH_4$ etc., $C_2H_5Cl \xrightarrow[Zn/HCl]{[H]} C_6H_5NH_2 + HCl$
24	**Complete the following reactions:**
	(i) $C_6H_5Cl + 2NH_3 \xrightarrow[50\ atm]{250°C} C_6H_5NH_2 + NH_4Cl$ (ii) $C_6H_5Cl + 2Na + Cl - C_6H_5 \xrightarrow[Ether]{} C_6H_5 - C_6H_5 + 2NaCl$

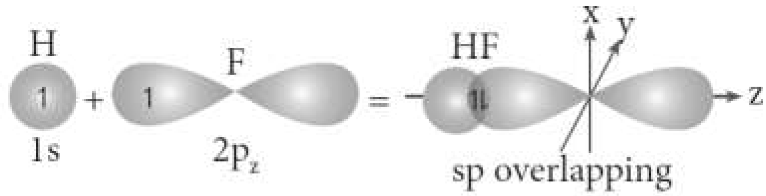
PART – C

III	**ANSWER ANY SIX QUESTIONS. (Q.No : 33 is compulsory)**	$[6 \times 3 = 18]$

25	**Calculate the Oxidation number of underlined elements.**	
	(i) $\underline{C}O_2$ x + 2 (– 2) = 0 **x = +4**	(ii) $H_2\underline{S}O_4$ 2 (+ 1) + x + 4 (– 2) = 0 2 + x – 8 = 0 **x = +6**
26	**Define electron affinity.**	
	• It is defined as the amount of energy released (required in the case noble gases) when an electron is added to the valence shell of an isolated neutral gaseous atom in its ground state to form its anion. • It is expressed in kJ mol^{-1} $A + e^- \rightarrow A^- + EA$	
27	**State Dalton Law of partial pressures.**	
	• The total pressure of a mixture of non-reacting gases is the sum of partial pressures of the gases present in the mixture • $P_{Total} = p_1 + P_2 + p_3 \ldots\ldots$	
28	**Write the formula to calculate the molar mass of a solute from relative lowering of vapour pressure values.**	
	$\frac{\Delta P}{P^\circ_{solvent}} = \frac{P^\circ_{solvent} - P_{solution}}{P^\circ_{solvent}}$ $\frac{\Delta P}{P^\circ_{solvent}} = \frac{w_B \times M_A}{M_B \times w_A}$ Molar mass of the solute $M_B = \frac{P^\circ_{solvent} \times w_B \times M_A}{\Delta P \times w_A}$	

29 Describe the formation of HF molecule by orbital overlap.

- Electronic configuration of hydrogen atom is $1s^1$
- Valence shell electronic configuration of fluorine atom : $2s^2\ 2p_x^2 2p_y^2 2p_z^1$
- When half filled 1s orbital of hydrogen linearly overlaps with a half filled $2p_z$ orbital of fluorine, a σ-covalent bond is formed between hydrogen and fluorine.



30 What is meant by optical isomerism?

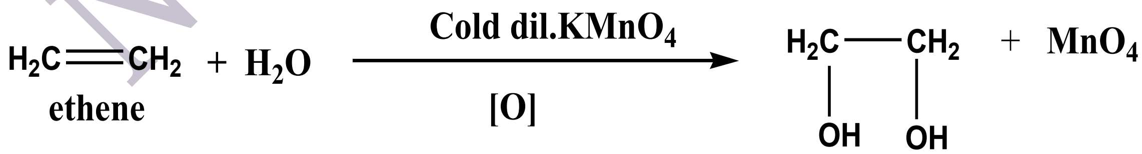
- Compounds having same physical and chemical property but differ only in the rotation of plane of the polarized light are known as optical isomers and the phenomenon is known as optical isomerism.

31 Give any three differences between nucleophiles and electrophiles.

Nucleophiles	Electrophiles
Nucleophiles are reagents that has high affinity for electro positive centers.	Electrophiles are reagents that are attracted towards negative charge or electron rich center.
They are usually negatively charged ions or electron rich neutral molecules (contains one or more lone pair of electrons)	They are either positively charged ions or electron deficient neutral molecules.
All Lewis bases act as nucleophiles.	All Lewis acids act as electrophiles.

32 What happens when ethylene is passed through cold dilute alkaline potassium permanganate?

Alkenes react with Baeyer' s reagent to form vicinal diols. The purple solution (Mn^{7+}) becomes dark green (Mn^{6+}), and then produces a dark brown precipitate (Mn^{4+})



33 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.

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

$$K_c = \frac{[1.8 \times 10^{-2}]^2}{[1.2 \times 10^{-2}][3 \times 10^{-2}]^3} = \mathbf{1 \times 10^3 \quad L^2 mol^{-1}}$$

PART – D

III **ANSWER ANY SIX QUESTIONS.** $[5 \times 5 = 25]$

34 a) **(i) How many orbitals are possible for n= 4?**

n=4 l=0,1,2,3

4s orbitals	1
4p orbitals	3
4d orbitals	5
4f orbitals	7
TOTAL	16 orbitals

b) **(ii)Write the electronic configuration and orbital diagram for nitrogen.**

Nitrogen (Z= 7) = $1s^2\ 2s^2\ 2p_x^1 2p_y^1 2p_z^1$ or $1s^2\ 2s^2\ 2p^3$

1s	2s	2p		
↿⇂	↿⇂	↿	↿	↿
$1s^2$	$2s^2$	$2p_x^1$	$2p_y^1$	$2p_z^1$

OR

a) **Describe the Pauling method for the determination of ionic radius.**

- Ionic radius of uni-univalent crystal can be calculated using Pauling's method from the inter ionic distance between the nuclei of the cation and anion.

$$d = r_{C^+} + r_{A^-} \text{-------------------} (1)$$

Where

d is the distance between the centre of the nucleus of cation C^+ & anion A^-

r C^+ and r $A^-$are the radius of the cation and anion respectively.

- Pauling also assumed that the radius of the ion having noble gas electronic configuration (Na^+ and Cl^- having $1s^2\ 2s^2, 2p^6$ ^{6} configuration) is inversely proportional to the effective nuclear charge felt at the periphery of the ion.

$$r_{C^+}\ \alpha\ \frac{1}{(Z_{eff})_{C^+}} \text{-------------------} (2)$$

$$r_{A^-}\ \alpha\ \frac{1}{(Z_{eff})_{A^-}} \text{-------------------} (3)$$

Where Z_{eff} is the effective nuclear charge and $Z_{eff} = Z - S$

Dividing the equation 2 by 3

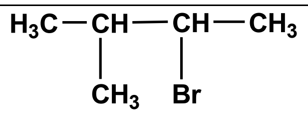
$$\frac{r_{C^+}}{r_{A^-}} = \frac{(Z_{eff})_{A^-}}{(Z_{eff})_{C^+}} \text{-------------------} (4)$$

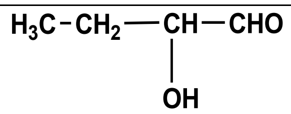
On solving equation (1)and (4) the values of r_{A^-} and r_{C^+} can be obtained

35	**a)**	**What are the reasons for the anomalous properties of Beryllium?**	
		• Its small size and high polarising power • Relatively high electronegativity and ionisation enthalpy as compared to other members • Absence of vacant d-orbitals in its valence shell	
	b)	**Give any three properties of Beryllium that are different from other elements of the group**.	
		Beryllium	**Other elements of the family**
		High melting and boiling point Low melting and boiling point	Forms covalent compounds form ionic compounds
		temperature React with water	Does not react with water even at elevated
		Does not combine directly with halogens.	Does not combine directly with hydrogen Combine directly with hydrogen
		Combine directly with halogens	Halides are covalent.
		Halides are electrovalent.	Forms covalent compounds form ionic compounds
		OR	
	a)	**Explain the characteristics of internal energy.**	
	b)	• The internal energy of a system is an **extensive property**. It depends on the amount of the substances present in the system. If the amount is doubled, the internal energy is also doubled. • The internal energy of a system is a **state function**. It depends only upon the state variables (T, P, V, n) of the system. 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 $\Delta U = U_f - Ui$ • In a cyclic process, there is no internal energy change. $\Delta U(cyclic) = 0$ • If the internal energy of the system in the final state (U_f) is less than the internal energy of the system in its initial state (U_i) then ΔU would be **negative.** $\Delta U = U_f - U_i = -ve\ (U_f < U_i)$ • If the internal energy of the system in the final state (U_f) is greater than the internal energy of the system in its initial state(U_i), then ΔU would be **positive**. $\Delta U = U_f - U_i = +ve\ (U_f > U_i)$	

36	**a)**	**How will you deternine the molar mass of solute from elevation of boiling point?**
		If the solution is prepared by dissolving wB g of solute in wA g of solvent, then the molality is, $$m = \frac{\text{Number of moles of solute} \times 1000}{\text{weight of solvent in grams}} = \frac{w_B}{M_B} \times \frac{1000}{W}$$ $$\text{Number of moles of solute} = \frac{w_B}{M_B}$$ M_B =molar mass of the solute Therefore, $$\Delta T_b = \left[\frac{K_b \times w_B \times 1000}{M_B \times W}\right]$$ $$M_B = \left[\frac{K_b \times w_B \times 1000}{\Delta T_b \times W}\right]$$
		OR
	b)	**Define: (i) Bond length (ii) Bond angle (iii) Bond enthalpy**
		(i) Bond length • The distance between the nuclei of the two covalently bonded atoms is called bond length. (ii) Bond angle • Fixed angle between two covalent bonds in a molecule and this angle is termed as bond angle (iii)Bond enthalpy • The bond enthalpy is defined as the minimum amount of energy required to break one mole of a particular bond in molecules in their gaseous state. • The unitof bond enthalpy is $kJ\ mol^{-1}$.
37	**a)**	**How will you determine the ionic character in covalent bond using electronegativity values?**
		• The extent of ionic character in a covalent bond can be related to the electronegativity difference to the bonded atoms. • In a typical polar molecule, $A^{\delta-} - B^{\delta+}$, the electronegativity diff erence $(\chi_A - \chi_B)$, can be used to predict the percentage of ionic character as follows. If the electronegativity difference $(\chi_A - \chi_B)$, is • equal to 1.7, then the bond A-B has 50% ionic character • if it is greater than 1.7, then the bond A-B has more than 50% ionic character • if it is lesser than 1.7, then the bond A-B has less than 50% ionic character.
		OR

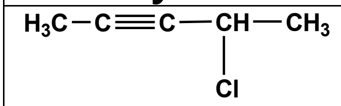
b) Give the IUPAC names of the following compounds.


2-bromo-3-methylbutane


2-hydroxybutanal

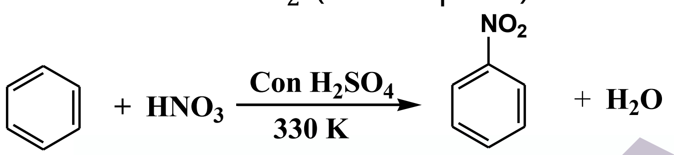
$H_3C-O-CH_3$
Methoxymethane

$H_2C=CH-CH=CH_2$
Butan-1,3 diene

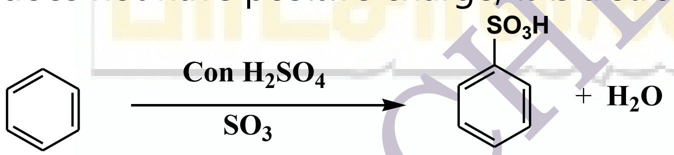

4-chloropent-2-yne

38 a) How will you prepare the following compounds from benzene?
(i) Nitrobenzene (ii) Benzene sulphonic acid (iii) BHC

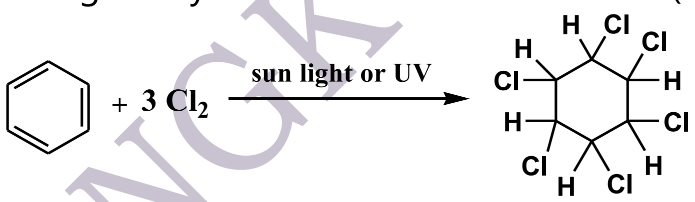
(i) When benzene is heated at 330K with a nitrating mixture (Con. HNO_3 + Con. H_2SO_4), nitro benzene is formed by replacing one hydrogen atom by nitronium ion $\overset{+}{N}O_2$ (electrophile)



(ii) Benzene reacts with fuming sulphuric acid (Con H_2SO_4 + SO_3) and gives benzene sulphonic acid. The electrophile SO_3 is a molecule. Although it does not have positive charge, it is a strong electrophile.



iii) Benzene reacts with three molecules of Cl_2 in the presence of sun light or UV light to yield Benzene Hexa Chloride (BHC) $C_6H_6Cl_6$.



b) Simplest alkene (A) reacts with HCl to from compound (B). Compound (B) reacts with ammonia to form compound (C) of molecular formula C_2H_7N. Compound (C) undergoes carbylamines test. Identify (A), (B) and (C).

$CH_2 = CH_2 + HCl \rightarrow CH_3CH_2Cl$
(A) **(B)**

$CH_3CH_2Cl + NH_3 \rightarrow CH_3CH_2NH_2$
(C)

(A)	$CH_2 = CH_2$	Ethene **(OR)** Ethylene
(B)	CH_3CH_2Cl	Chloroethane **(OR)** ethyl chloride
(C)	$CH_3CH_2NH_2$	Ethylamine or aminoethane