HIGHER SECONDARY FIRST YEAR PUBLIC EXAMINATION – MARCH - 2023

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.	a) chloropicrin	c) Both (a) and (b)
2.	a) Kerosene	b) Propene
3.	a) $\pi V = nRT$	c) Increase in pressure
4.	b) Hex-4-en-2-ol	a) 5.6
5.	c) Both (a) and (b)	d) 374.4 K
6.	b) Propene	a) Assertion is true but reason is false
7.	d) 374.4 K	a) chloropicrin
8.	c) Frictional energy	a) 
9.	a) 5.6	b) 112 g mol^{-1}
10.	a) 	a) $\pi V = nRT$
11.	b) 9	a) Kerosene
12.	a) Assertion is true but reason is false	c) Frictional energy
13.	c) Bibibium	b) Hex-4-en-2-ol
14.	b) 112 g mol^{-1}	c) Bibibium
15.	c) Increase in pressure	b) 9

PART-II

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

16. Distinguish between oxidation and reduction.

Oxidation	Reduction
Removal of electron	Addition of electron
Positive charge increases	Negative charge increases
Addition of oxygen or Removal of Hydrogen	Addition of hydrogen or removal of Oxygen

17. State Heisenberg's uncertainty principle.

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

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

Δx = uncertainties in the position

Δp = uncertainties in momentum

18. Metion the uses of plaster of paris?

- In the building industry as well as plasters.
- In immobilising bandage for fracture of bone and sprain.
- Employed in dentistry and in ornamental work.
- For making casts of statues and busts.

19. State Le-chatelier principle.

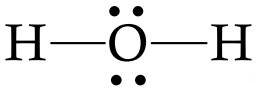
If a system at equilibrium is subjected to a disturbance, then the system will move in the direction to nullify the effect of the disturbance.

20. Define Osmotic pressure

"The pressure that must be applied to the solution to stop the influx of the solvent (to stop osmosis) through the semi permeable membrane"

21. Give the Lewis structures of the following. H_2O, HNO_3

i) H_2O



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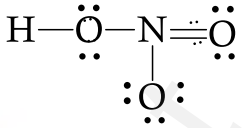
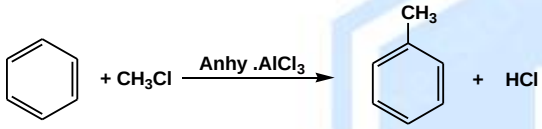
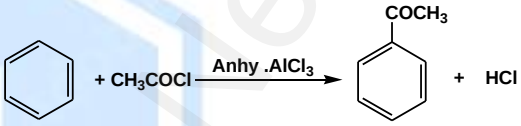


22. Write short notes on Friedel Craft's reaction.





23. What are Particulate pollutant ? Give example.

- ❖ Particulate pollutants are small solid particles and liquid droplets suspended in air.
- ❖ Examples: dust, pollen, smoke, soot and liquid droplets (aerosols) etc,.

24. Calculate the entropy change during the melting of one mole of ice into water at 0°C and 1 atm pressure. Enthalpy of fusion of ice is 6008 J mol^{-1}

$\Delta H_{fusion} = 6008\ J\ mol^{-1}$

$T_f = 0°C = 273K$

$$\Delta S_{fusion} = \frac{\Delta H_{fusion}}{T_f}$$

$$\Delta S_{fusion} = \frac{6008}{273} = 22.007\ JK^{-1}mol^{-1}$$

PART-III

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

25. Balance the following equations by oxidation number method

i) $KMnO_4 + Na_2SO_3 \rightarrow MnO_2 + Na_2SO_4 + KOH$

ii) $Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO_2 + H_2O$

- ➢ $2\ KMnO_4 + 3\ Na_2SO_3 + H_2O \rightarrow 2\ MnO_2 + 3\ Na_2SO_4 + 2\ KOH$
- ➢ $Cu + 4\ HNO_3 \rightarrow Cu(NO_3)_2 + 2\ NO_2 + 2\ H_2O$

26. Write a notes on Principal quantum number.

- It is denoted by the symbol 'n'.The 'n' can have the values 1,2,3….
- n=1 ⇒ K shell / n=2 ⇒ L shell / n= 3 ⇒ M shell / n= 4 ⇒ N shell
- The maximum number of electrons in a shell can be calculated by $2n^2$.
- The energy of the electron is given by $E_n = -\frac{1312.8\ Z^2}{n^2}\ k\ Jmol^{-1}$.
- The distance of the electron nucleus is given by $r_n = \frac{(0.529)n^2}{Z}\ A°$

27. Explain the diagonal relationship.

- The similarities in the properties between the diagonally present elements are called as Diagonal relationship.
- Eg : Li and Mg / Be and Al / B and Si

28. 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

29. Derive Ideal gas equation.

Boyle's law $V \alpha \frac{1}{P}$ ----------①

Charles law $V \alpha T$ ----------②

Avogadro's law $V \alpha n$ ----------③

From ①②③ and ⇒ $V \alpha \frac{nT}{P}$

$$V = \frac{nRT}{P}$$

$$PV = nRT$$ ⇒ Ideal gas equation

P =Pressure

R= Gas constant

T =Temperature

V=Volume

30. What are state and path functions? Give two examples.

State Function	Path Function
A state function is a thermodynamic property of a system, which has a sp□ cific value for a given state and does not depend on the path (or manner) by which the particular state is reached.	A path function is a thermodynamic property of the system whose value depends on the path by which the system changes from its initial to final states.
Example : Pressure (P), Volume (V), Temperature(T), Internal energy (U), Enthalpy (H), free energy (G) etc.	**Example:** Work (w), Heat (q).

31. An organic compound (A) with molecular formula C_2H_5Cl reacts with KOH gives compounds (B) and with alcoholic KOH gives compound (C). Identify (A),(B), and (C).

$$\underset{\text{Ethyl chloride}}{CH_3 - CH_2 - Cl} \xrightarrow{\text{dil KOH}} \underset{\text{Ethyl alcohol}}{CH_3 - CH_2 - OH} + KCl$$

(A) (B)

$$\underset{\text{Ethyl alcohol}}{CH_3 - CH_2 - OH} \xrightarrow{\text{Alcoholic KOH}} \underset{\text{Ethylene}}{CH_2 = CH_2} + KCl + H_2O$$

(C)

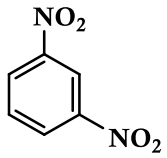
Compound	Molecular Formula	Name
(A)	$CH_3 - CH_2 - Cl$	Ethyl chloride (chloroethane)
(B)	$CH_3 - CH_2 - OH$	Ethyl alcohol (ethanol)
(C)	$CH_2 = CH_2$	Ethylene (ethene)

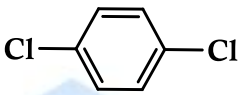
32. Explain inductive effect with suitable example.

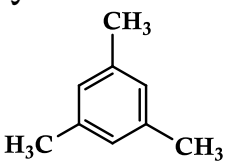
- Inductive effect is defined as the change in the polarisation of a covalent bond due to the presence of adjacent bonds, atoms or groups in the molecule.
- This is a permanent phenomenon.
- Example : $\overset{\delta\delta+}{CH_3} \rightarrow \overset{\delta+}{CH_2} \rightarrow \overset{\delta-}{Cl}$
- Highly electronegative atoms and groups with an atom carrying a positive charge are electron withdrawing groups or –I groups.
  Example: -F, -Cl, -COOH, $-NO_2$, $-NH_2$

- Highly electropositive atoms and atoms are groups which carry a negative charge are electron donating or +I groups.
  Example. Alkali metals, alkyl groups

33. Write the structural formula for the following compounds.
(i) m-dinitrobenzene (ii) p-dichlorobenzene (iii) 1,3,5trimethyl benzene

(i) 

ii) 

(iii) 

PART-IV

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

34. a) (i) A Compound on analysis gave Na = 14.31% S = 9.97% H= 6.22% and O= 69.5% calculate the molecular formula of the compound, if all the hydrogen in the compound is present in combination with oxygen as water of crystallization. (molecular mass of the compound is 322).

Element	Percentage	Atomic mass	Relative number of atoms	Simple ratio	Whole number
Na	14.31	23	$\frac{14.31}{23} = 0.62$	$\frac{0.62}{0.31} = 2$	2
S	9.97	32	$\frac{9.97}{32} = 0.31$	$\frac{0.31}{0.31} = 1$	1
H	6.22	1	$\frac{6.22}{1} = 6.2$	$\frac{6.2}{0.31} = 20$	20
O	69.5	16	$\frac{69.5}{16} = 4.34$	$\frac{4.34}{0.31} = 14$	14

- Empirical formula = $Na_2SH_{20}O_{14}$
- Empirical formula mass = (2 x 23) + (1x32) + (20x1) + (14 x16) = 322
- Molar mass = 322

$$n = \frac{\textbf{Molar mass}}{\textbf{calculated empirical formula mass}} = \frac{322}{322} = 1$$

- Molecular formula = $(Na_2SH_{20}O_{14}) \times n = (Na_2SH_{20}O_{14}) \times 1$
  Molecular formula = $Na_2S\,H_{20}O_{14}$
- Since all the hydrogen in the compound present as water
- Molecular formula = $Na_2SO_4 .10H_2O$

(OR)

b) (i) State Pauli's exclusion principle.
"No two electrons in an atom can have the same set of values of all four quantum numbers."

(ii) State Modern Periodic law
The Physical and chemical properties of the elements are the periodic functions of the atomic numbers.

35. a) (i) What are isotopes? Write the names of isotopes of hydrogen
Atoms with the same atomic numberbut different massnumbers are called isotopes.

(OR)

Atoms with the same number of protons but different numbers of neutrons are called isotopes.

- Protium ($_1H^1$ or H),
- Deuterium ($_1H^2$ or D) and
- Tritium ($_1H^3$ or T).

(ii) Give the uses of Calcium

- It is used a reducing agent in the metallurgy of Uranium.
- It is used for making cement
- It is used for making Fertilizers
- It is used in Vacuum Tubes
- It is used in dehydrating oils
- It is used to prepare Plaster of Paris

(OR)

b) (i) Derive the relationship between critical constants and Van der Waals constants.

The van der Waals equation for n moles

$$\left(P + \frac{a\,n^2}{V^2}\right)(V - nb) = nRT \text{ ----------①}$$

Critical constants Pc, Vc and Tc in terms of a and b,

$$\left(P + \frac{a}{V^2}\right)(V - b) = nRT \text{ ----------②}$$

$$PV + \frac{a}{V} - Pb - \frac{ab}{V^2} - RT = 0 \text{ ----------③}$$

Multiply equation ③ by $\frac{V^2}{P}$

$$\frac{V^2}{P}\left(PV + \frac{a}{V} - Pb - \frac{ab}{V^2} - RT\right) = 0$$

$$V^3 + \frac{aV}{P} - bV^2 - \frac{ab}{P} - Pb - \frac{RTV^2}{P} = 0 \text{----------④}$$

rearranged in powers of V

$$V^3 - \left[\frac{RT}{P} + b\right]V^2 + \left[\frac{a}{P}\right]V - \left[\frac{ab}{P}\right] = 0 \text{----------⑤}$$

$V = V_C$

$V - V_C = 0 \Rightarrow (V - V_C)^3 = 0$

$$V^3 - 3\,V_C V^2 + 3\,V_C^2 V - V_C^3 = 0 \text{----------⑥}$$

$$-3\,V_C V^2 = -\left[\frac{RT}{P} + b\right]V^2$$

$$3\,V_C = \frac{RT}{P} + b \text{----------⑦}$$

$$3\,V_C^2 = \frac{a}{P_C} \text{ ----------⑧}$$

$$V_C{}^3 = \frac{ab}{P_C} \text{ ----------⑨}$$

Divide equation ⑨ by equation ⑧

$$\frac{V_C{}^3}{3\,V_C^2} = \frac{ab\,/P_C}{a/P_C} \qquad \frac{V_C}{3} = b \qquad \mathbf{V_C = 3\,b} \text{----------⑩}$$

when equation ⑩ is substituted in ⑧

$$3\,V_C^2 = \frac{a}{P_C} \Rightarrow \mathbf{P_C} = \frac{a}{3\,V_C^2} = \frac{a}{3\,(3b^2)} = \frac{a}{3\times 9\,b^2} = \mathbf{\frac{a}{27\,b^2}} \text{ ------- ⑪}$$

$3\,V_C = \frac{RT}{P} + b$ $\qquad 3\,(3b) = \frac{RT}{\frac{a}{27\,b^2}} + b \;\Rightarrow 9b - b = \left(\frac{RT\,27b^2}{a}\right)$

$8\,b = \left(\frac{RT_C\,27b^2}{a}\right) \;\Rightarrow\; \mathbf{T_C = \frac{8\,a\,b}{27\,R\,b^2} = \frac{8\,a}{27\,R\,b}}$ ----------⑫

$$\mathbf{a = 3\,V_C^2\,P \qquad b = \frac{V_C}{3}}$$

36. a) (i) State the various statements of second law of thermodynamics.

Entropy statement:- Entropy is a measure of the molecular disorder (randomness) of a system. The entropy of an isolated system increases during a spontaneous process. Entropy is state function

Kelvin-Planck statement:- "It is impossible to construct an engine which operated in a complete cycle will absorb heat from a single body and convert it completely to work without leaving some changes in the working system".

Clausius statement:-

It is impossible to transfer heat from a cold reservoir to a hot reservoir without doing some work.

Efficiency :-

Efficiency $= \frac{\text{work performed}}{\text{heatabsorbed}}$ (or) $\eta = \frac{|q_h| - |q_c|}{|q_h|}$

(OR)

b) (i) State Law of Mass action

- At a given temperature, the rate of a chemical reaction is directly proportional to the product of the active masses of the reactants.
- Rate α $[\text{Reactant}]^x$

(ii) 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.

37. a) (i) Explain the salient features of Molecular orbital Theory

- When atoms combines to form molecules, their individual atomic orbitals lose their identity and forms new orbitals called molecular orbitals.
- The shapes of molecular orbitals depend upon the shapes of combining atomic orbitals.
- The number of molecular orbitals formed is the same as the number of combining atomic orbitals.
- Two atomic orbitals can combine to form two molecular orbitals.
- Lower energy orbital – bonding molecular orbital (denoted by σ,π & δ)
- Higher energy orbital–anti-bonding molecular orbital (denoted by $\sigma^* \; \pi^* \; \delta^*$)
- The filling of electrons in these orbitals follows Aufbau's principle,

Pauli's exclusion principle and Hund's rule as in the case of filling of electrons in atomic orbitals.

- Bond order gives the number of covalent bonds between the two combining atoms.
- Bond order $= \frac{N_b - N_a}{2}$
  - N_b = Total number of electrons present in the bonding molecular orbitals
  - N_a = Total number of electrons present in the antibonding molecular orbitals
- A bond order of zero value indicates that the molecule doesn't exist.

(OR)

b) (i) Give any three characteristics of organic compounds?

- Insoluble in water. Soluble in organic solvents like benzene, toluene ether, etc.
- They are inflammable. Their melting point and boiling points are low.
- They are characterised by functional group.
- They exhibit isomerism.
- Homologous series: A series of organic compounds each containing a characteric 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), Propane (C_3H_8) etc

(ii) Find the functional group in the following compounds.
(a) acetaldehyde (b) oxalic acid (c) di methyl ether (d) methylamine

	Compound	Functional group	
(a)	acetaldehyde	$-CHO$	Aldehyde
(b)	oxalicacid	$-COOH$	Carboxylicacid
(c)	dimethylether	$-O-$	Ether
(d)	methylamine	$-NH_2$	amine

38. a) (i) Explain the structure of benzene

- Molecular formula of benzene is C_6H_6.
- It did not decolourise bromine in carbon tetrachloride or acidified $KMnO_4$. It did not react with water in the presence of acid. So Straight chain structure not possible

Evidence of cyclic structure:

- Substitution of benzene: $C_6H_6 + 3Br_2 \xrightarrow{AlCl_3} \underset{\text{bromobenzene}}{C_6H_5Br} + HBr$
  Indicates that all the six hydrogen atoms in benzene were identical. This is possible only if it has a cyclic structure of six carbons each containing one hydrogen.
- Addition of hydrogen: $C_6H_6 + 3H_2 \xrightarrow{\text{Raney Ni}} \underset{\text{Cyclohexane}}{C_6H_{12}}$
  This confirms cyclic structure of benzene and the presence of three carbon-carbon double bond.

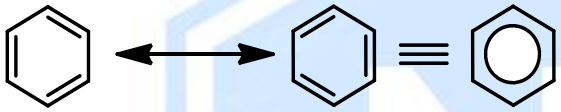
Spectroscopic measurments:

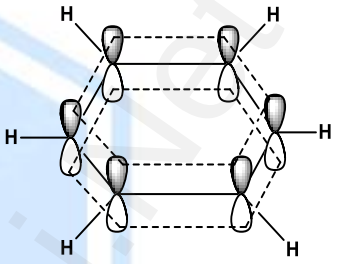
- Carbon-carbon bonds are of equal length 1.40A°.
- This value lies between carbon-carbon single bond length 1.54A° and

carbon-carbon double bond length 1.34A°.

- All the six carbon atoms of benzene are sp^2 hybridized. Six sp^2 hybrid orbitals of carbon linearly overlap with six 1s orbitals of hydrogen atoms to form six C - H sigma bonds.
- Overlap between the remaining sp^2 hybrid orbitals of carbon forms six C-C sigma bonds.
- All the σ bonds in benzene lie in one plane with bond angle 120°. Each carbon atom in benzene possesses an un hybridized p-orbital containing one electron. The lateral overlap of their p-orbital produces 3 π- bond .
- Due to delocalization, strong π-bond is formed which makes the molecule stable.

Representation of benzene:



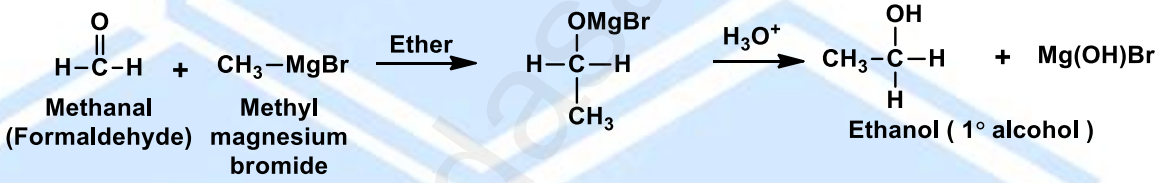


(OR)

b) (i) CH_3MgI, How will you prepare the following?

i) ethyl alcohol ii) Acetaldehyde Acetone iii) Ethyl methyl ether

i)



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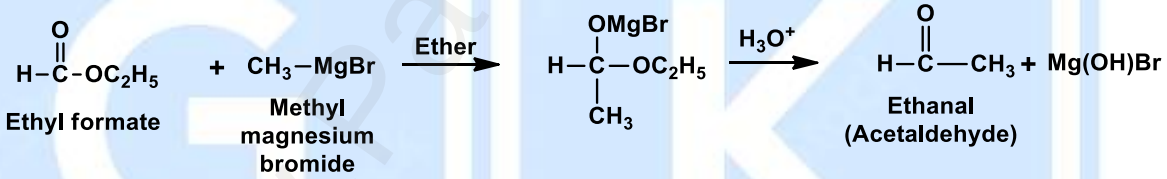

iii)

$$\underset{\text{Chloro dimethyl ether}}{CH_3-O-CH_2Cl} + CH_3MgBr \xrightarrow{\text{ether}} \underset{\text{Ethyl methyl ether}}{CH_3-O-CH_2CH_3} + MgCl(Br)$$

(ii) What is eutrophication?

- The growth of algae in extreme abundance covers the water surface and reduces the oxygen concentration in water.
- Bloom-infested water inhibits the growth of other living organisms in the water body.
- The nutrient rich water bodies support adense plant population kills animal life by depriving it of oxygen and results in loss of biodiversity.

Prepared by

N.GOPALAKRISHNAN.M.Sc.,B.Ed.
POST GRADUATE TEACHER IN CHEMISTRY
BHARATHIDASAN MAT.HR.SEC.SCHOOL
TIRUVALLUR