Tirupathur District – Halfyearly Examination – Dec - 2024

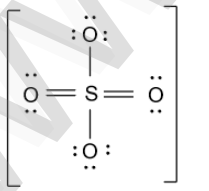
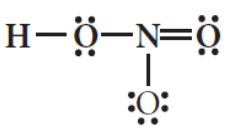
11th Std Chemistry – Answer Key

Part **– I** **15 x 1 = 15**

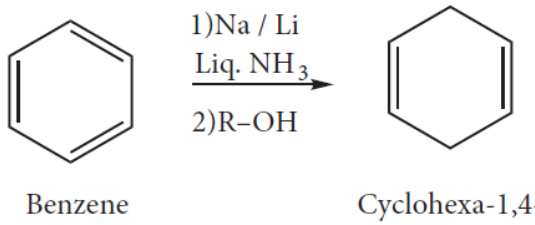
Q. No	Answer	Q. No	Answer
1	c) both (a) and (b)	9	d) both (a) and (c)
2	c) 2	10	b) square plannar
3	a) s > p > d > f	11	d) both (a) and (c)
4	c) amphoteric oxide	12	b) ROR
5	d) Both assertion and reason are false	13	a) Nitro benzene
6	c) 10^{-4} K	14	c) Benzene
7	b) q = 0	15	c) Bio magnification
8	d) $(RT)^2$		

Part **– II**

Answer any 6 questions and question No. 24 is compulsory. **6 x 2 = 12**

16	**Explain Aufbau principle?** In the ground state of the atoms, the orbitals are filled in the order of their increasing energies. That is the electrons first occupy the lowest energy orbital available to them.	2	2
17	**How do you convert para hydrogen into ortho hydrogen?** The para-form can be catalytically transformed into ortho-form by, • Adding platinum or iron catalyst. • By passing an electric discharge. • Heating above 800°C. • Mixing with paramagnetic molecules such as O_2, NO, NO_2. • By adding nascent/atomic hydrogen.	2x1	2
18	**Write Graham' s Law of Diffusion?** The rate of diffusion or effusion is inversely proportional to the square root of molar mass. (or) Rate of diffusion $\propto \frac{1}{\sqrt{M}}$	2	2
19	**Define molar heat capacity. Give its unit.** It is defined as "The amount of heat absorbed by one mole of the substance to raise its temperature by 1 kelvin". **SI unit:** JK^{-1} mol^{-1}	1 1	2
20	**Draw the Lewis structures for the following species.** **i) SO_4^{2-} :** Sulphate ion  **ii) HNO_3 :** Nitric acid 	2x1	2
21	**Identify the functional group in the following compounds.** **i) di methyl ether =** –O– **ii) 2 – methyl butanal =** –CHO	2	2

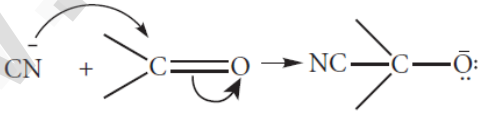
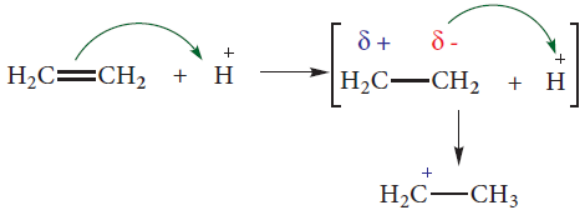
Prepared by Dr.R.Karthic, PG Assistant (Chemistry), GHSS – Vallipattu

22	**Define Birch reduction?**  Benzene Cyclohexa-1,4-diene	2	2
23	**Write a short note on BOD.** The total amount of oxygen in milligrams consumed by microorganisms in decomposing the waste in one litre of water at 20oC for a period of 5 days is called biochemical oxygen demand (BOD) and its value is expressed in ppm.	2	2
24	**Complete the following reactions.** **a)** $CHCl_3 + HNO_3 \xrightarrow{\Delta} CCl_3NO_2 + H_2O$ (Chloropicrin) **b)** $CCl_4 + H_2O \xrightarrow{\Delta} COCl_2 + 2HCl$ (phosgene)	1 1	2

Part – III

Answer any 6 questions and question No. 33 is compulsory. **6 x 3 = 18**

25	**Distinguish between Oxidation and Reduction. (Mar-23)** **1** Addition of oxygen / Addition of hydrogen **2** Removal of hydrogen / Removal of oxygen **3** Reaction in which oxidation number of the element increases / Reaction in which oxidation number of the element decreases **4** Loss of electron / Gain of electron	3x1	3
26	**How many radial nodes for 2s, 5d, 4f orbitals exhibit? How many angular nodes?** orbitals: 2s, 5d, 4f n: 2, 5, 4 *l*: 0, 2, 3 radial nodes n - *l* - 1: 1, 2, 0 angular nodes *l*: 0, 2, 3	3x1	3
27	**Explain the diagonal relationship.** • On moving diagonally across the periodic table, the second and third period elements show certain similarities. • Even though the similarity is not same as we see in a group, it is quite pronounced in the following pair of elements. Li → Be → B → C Na Mg Al Si The similarity in properties existing between the diagonally placed elements is called 'diagonal relationship'.	3	3

28	**How is plaster of paris prepared? Write its one use?** • It is a hemihydrate of calcium sulphate. • It is obtained when gypsum, $CaSO_4 \cdot 2H_2O$, is heated to 393 K. $2CaSO_4.2H_2O_{(S)} \longrightarrow 2CaSO_4.\frac{1}{2}H_2O + 3H_2O$ **Uses: (any one)** • Building industries (plasters) • Immobilising (bone fracture or sprain) • Dentistry, in ornamental work and for making casts of statues and busts.	2 1	3
29	**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.** $K_C = \frac{[NH_3]^2}{[N_2][H_2]^3}$ $= \frac{1.8\times10^{-2}\times1.8\times10^{-2}}{1.2\times10^{-2}\times3\times10^{-2}\times3\times10^{-2}\times3\times10^{-2}}$ $K_C = 1\times10^{3}\ L^2\ mol^{-2}$	1 1 1	3
30	**Define (i) osmosis (ii) osmotic pressure.** Osmosis is a spontaneous process by which the solvent molecules pass through a semi permeable membrane from a solution of lower concentration to a solution of higher concentration. The pressure that must be applied to the solution to stop the influx of the solvent (to stop osmosis) through the semipermeable membrane is called osmotic pressure.	1½ 1½	3
31	**Explain electromeric effect.** • Electromeric is a temporary effect which operates in unsaturated compounds (containing >C=C<, >C=O, etc...) in the presence of an attacking reagent. • Let us consider two different compounds (i) compounds containing carbonyl group (>C=O) and (ii) unsaturated compounds such as alkenes (>C=C<). • When a nucleophile approaches the carbonyl compound, the π electrons between C and O is instantaneously shifted to the more electronegative oxygen. • This makes the carbon electron deficient and thus facilitating the formation of a new bond between the incoming nucleophile and the carbonyl carbon atom.  • On the other hand, when an electrophile such as H^+ approaches an alkene molecule, the π electrons are instantaneously shifted to the electrophile and a new bond is formed between carbon and hydrogen. • This makes the other carbon electron deficient and hence it acquires a positive charge. 	3	3

32	**How do react ethylene with Baeyer's Reagent.** $CH_2=CH_2 + H_2O \xrightarrow[H_2O+[O]]{\text{Cold dilute alkaline } KMnO_4} \underset{\underset{OH}{|}}{CH_2} - \underset{\underset{OH}{|}}{CH_2} + MnO_2$ Ethylene glycol	3	3
33	**A hydrocarbon C_3H_8 (A) reacts with HBr to form compound (B). Compound (B) reacts with aqueous potassium hydroxide to give (C) of molecular formula C_3H_8O. What are (A) (B) and (C). Explain the reactions.** Mere attempt **(Reason:** The hydrocarbon C_3H_8 should be given as C_3H_6**)**	3	3

Part – **IV**

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

34

a) A Compound on analysis gave the following percentage composition C=54.55%, H=9.09%, O=36.36%. Determine the empirical formula of the compound. (5)

Element	Percentage	Atomic mass	Relative number of moles	simple ratio
C	54.55	12	$\frac{54.55}{23} = 4.55$	$\frac{4.55}{2.27} = 2$
H	9.09	1	$\frac{9.09}{1} = 9.09$	$\frac{9.09}{2.27} = 4$
O	36.36	16	$\frac{36.36}{16} = 2.27$	$\frac{2.27}{2.27} = 1$

Emperical formula = C_2H_4O

2

1

5

ii) Principal quantum number (2)

- This quantum number represents the energy level in which electron revolves around the nucleus and is denoted by the symbol 'n'.
- The 'n' can have the values 1, 2, 3,… n=1 represents K shell; n=2 represents L shell and n = 3, 4, 5 represent the M, N, O shells, respectively.
- The maximum number of electrons that can be accommodated in a given shell is $2n^2$.
- 'n' gives the energy of the electron, $E_n = \frac{(-1312.8)Z^2}{n^2}$ KJ mol^{-1} and the distance of the electron from the nucleus is given by $r_n = \frac{(0.529)n^2}{Z}$ A°

2

(or) b) i) Discuss any three similarities between lithium and Magnesium. (3)

1. Both lithium and magnesium are harder than other elements in their groups
2. Lithium and magnesium react slowly with water. Their oxides and hydroxides are much less soluble and their hydroxides decompose on heating.
3. Both form a nitride, Li_3N and Mg_3N_2, by direct combination with nitrogen
4. They do not give any superoxides and form only oxides, Li_2O and MgO
5. The carbonates of lithium and magnesium decompose upon heating to form their respective oxides and CO_2.
6. Lithium and magnesium do not form bicarbonates.

3x1

5

	7. Both LiCl and $MgCl_2$ are soluble in ethanol and are deliquescent. They crystallise from aqueous solution as hydrates, $LiCl \cdot 2H_2O$ and $MgCl_2 \cdot 8H_2O$		
	ii) Write the biological importance of sodium and potassium? (2) Monovalent sodium and potassium ions are found in large proportions in biological fluids. • These ions perform important biological functions such as maintenance of ion balance and nerve impulse conduction. • A typical 70 kg man contains about 90 g of sodium and 170 g of potassium. • Sodium ions are found primarily on the outside of cells, being located in blood plasma and in the interstitial fluid which surrounds the cells. • These ions participate in the transmission of nerve signals, in regulating the flow of water across cell membranes and in the transport of sugars and amino acids into cells. • potassium ions are the most abundant cations within cell fluids, where they activate many enzymes, participate in the oxidation of glucose to produce ATP. • Sodium–potassium pump plays an important role in transmitting nerve signals.	2x1	
35	**a) i) Explain the pauling method for the determination of ionic radius. (3)** • Pauling assumed that ions present in a crystal lattice are perfect spheres, and they are in contact with each other. Therefore, $d = r_{C^+} + r_{A^-}$ ……. (1) **(or)** • Where d is the distance between the centre of the nucleus of cation C^+ and anion A^- **(or)** • r_{C^+}, 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 is inversely proportional to the effective nuclear charge felt at the periphery of the ion. **(or)** $r_{C^+} \propto \frac{1}{Z_{eff}(C^+)}$ …… (2) $r_{A^-} \propto \frac{1}{Z_{eff}(A^-)}$ …… (3) Where Z_{eff} is the effective nuclear charge and $Z_{eff} = Z - S$ Dividing the equation 2 by 3 $\frac{r_{C^+}}{r_{A^-}} = \frac{Z_{eff}(A^-)}{Z_{eff}(C^+)}$ …… (4) On solving equation (1) and (4) the values of r_{C^+} and r_{A^-} can be obtained.	1 ½ ½ 1	5
	ii) Mention the uses of deuterium. (2) (any two) • To prepare heavy water – used as a moderator in nuclear reactors. • Deuterium exchange reactions - deuterium can replace reversibly hydrogen in compounds either partially or completely depending upon the reaction conditions. • It is commonly used as a tracer to study organic reaction mechanisms.	2x1	

a) State the various statements of second law of thermodynamics. (5)

1. Entropy statement: The entropy of an isolated system increases during a spontaneous process. — 1

- Entropy is a measure of the molecular disorder (randomness) of a system.

2. Kelvin-Planck statement: It is impossible to construct a machine that absorbs heat from a hot source and converts it completely into work by a cyclic process without transferring a part of heat to a cold sink. — 2

(or)

Efficiency = $\frac{\text{work performed}}{\text{heat absorbed}}$; Efficiency = $\left[1 - \frac{T_C}{T_h}\right]$ X 100 — 1

3. Clausius statement: It is impossible to transfer heat from a cold reservoir to a hot reservoir without doing some work. — 2

Total: 5

36

a) i) Derive the values of critical constants in terms of van der Waals constants. (Mar-23)

The van der Waals equation for n moles is

$$\left(P + \frac{an^2}{V^2}\right) (V - nb) = nRT \quad \ldots\ldots\ldots (1)$$ — 1

For 1 mole,

$$\left(P + \frac{a}{V^2}\right) (V - b) = RT \quad \ldots\ldots\ldots (2)$$

From the equation we can derive the values of critical constants Pc, Vc and Tc in terms of a and b, the van der Waals constants, On expanding the above equation,

$$PV + \frac{a}{V} - Pb - \frac{ab}{V^2} - RT = 0 \quad \ldots\ldots\ldots (3)$$

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

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

$$V^3 + \frac{aV}{P} - bV^2 - \frac{ab}{P} - \frac{RTV^2}{P} = 0 \quad \ldots\ldots\ldots (4)$$

When the above equation is rearranged in powers of 'V' — 1

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

The equation (5) is a cubic equation in V. On solving this equation, we will get three solutions.

At the critical point all these three solutions of V are equal to the critical volume V_C. The pressure and temperature become P_c and T_c respectively.

i.e, $V = V_C$

$$V - V_C = 0$$

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

$$V^3 - 3V_C V^2 + 3V_C^2 V - V_C^3 = 0 \quad \ldots\ldots\ldots (6)$$

As equation (5) is identical with equation (6) we can equate the coefficients of V2, V and constant terms in equation (5) and (6).

$$3 V_C = \frac{RT_C}{P_C} + b \quad \ldots\ldots\ldots (7)$$

Total: 5

$$3V_C^2 = \frac{a}{P_C} \quad \text{..... (8)}$$

$$V_C^3 = \frac{ab}{P_C} \quad \text{..... (9)}$$

Divide equation (9) by equation (8),

$$\frac{V_C^3}{3V_C^2} = \frac{\frac{ab}{P_C}}{\frac{a}{P_C}}$$

$$\frac{V_C}{3} = b$$

i.e. $V_C = 3b$ ..... (10) 1

the value of V_C is substituted in equation (8),

$$3V_C^2 = \frac{a}{P_C}$$

$$P_C = \frac{a}{3\,V_C^2} = \frac{a}{3(3b^2)} = \frac{a}{3 \times 9b^2} = \frac{a}{27b^2}$$

$$P_C = \frac{a}{27b^2} \quad \text{..... (11)}$$ 1

substituting the values of Vc and Pc in equation (7)

$$3\,V_C = b + \frac{RT_C}{P_C}$$

$$3\,(3b) = b + \frac{RT_C}{\left(\frac{a}{27\,b^2}\right)}$$

$$9b - b = \left(\frac{RT_C}{a}\right) 27b^2$$

$$8b = \frac{T_C\,R\,27b^2}{a}$$

$$\therefore\ T_C = \frac{8ab}{27\,R\,b^2} = \frac{8\,a}{27\,R\,b}$$

$$T_C = \frac{8\,a}{27\,R\,b} \quad \text{..... (12)}$$ 1

The critical constants can be calculated using the values of van der waals constant of a gas and vice versa.

$$a = 3\,V_C^2\,P_C \text{ and } b = \frac{V_C}{3}$$

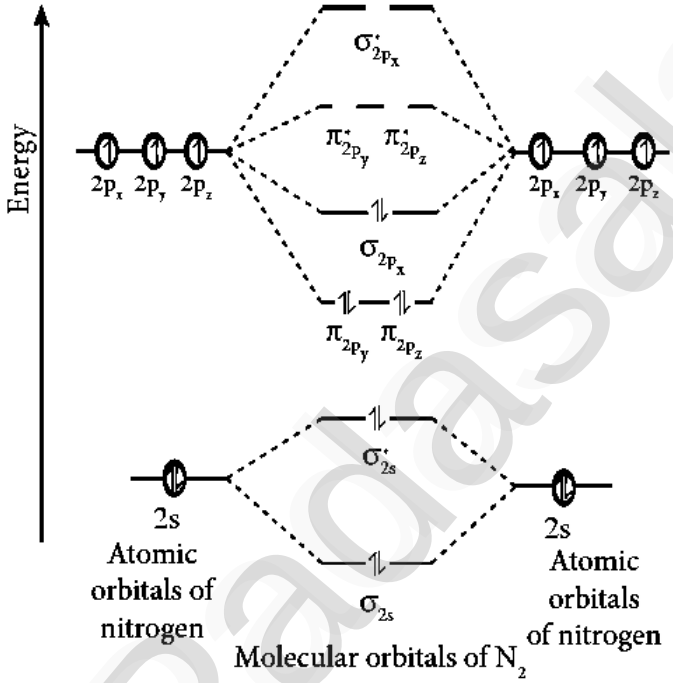
(or) b) i) Derive a general expression for the equilibrium constant K_P and K_C for the reaction (3)

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

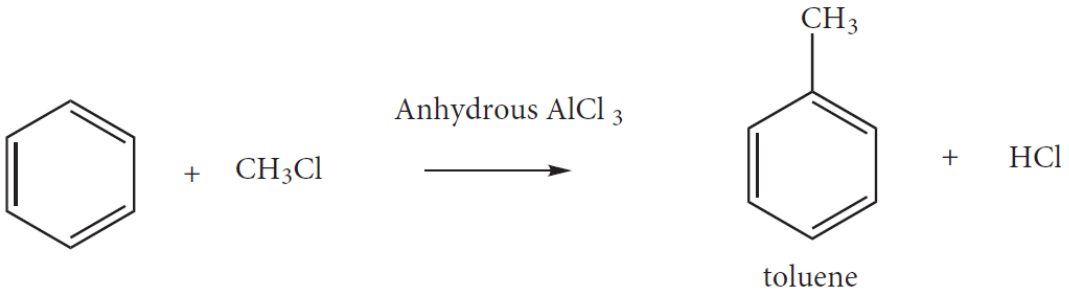
	H_2	I_2	HI
Initial number of moles	a	b	0
Number of moles reacted	x	x	0
Number of moles at equilibrium	a - x	b - x	2x
Molar concentration at equilibrium	$\frac{a-x}{v}$	$\frac{b-x}{v}$	$\frac{2x}{v}$

Applying law of mass action,

$$K_C = \frac{[HI]^2}{[H_2]\,[I_2]} = \frac{\left(\frac{2x}{V}\right)^2}{\left(\frac{a-x}{V}\right)\left(\frac{b-x}{V}\right)} = \frac{4x^2}{v^2} \times \frac{V^2}{(a\text{-}x)\,(b\text{-}x)}$$ 1

	$K_C = \frac{4x^2}{(a-x)(b-x)}$ The equilibrium constant Kp can also be calculated as follows: $K_P = K_C (RT)^{\Delta ng}$ Here, $\Delta ng = n_P - n_r = 2 - 2 = 0$ Hence, $K_P = K_C$ $K_P = \frac{4x^2}{(a-x)(b-x)}$	1 1	
	ii) State and explain Henry's law? (2) "The partial pressure of the gas in vapour phase (vapour pressure of the solute) is directly proportional to the mole fraction(x) of the gaseous solute in the solution at low concentrations". This statement is known as henry's law. $P_{solute} \propto X_{solute\ in\ solution}$ $P_{solute} = K_H X_{solute\ in\ solution}$	2	
37	**a) Discuss the formation of N_2 molecule using MO theory with diagram? (5)**  Electronic configuration of Nitrogen atom = $1s^2\ 2s^2\ 2p^3$ Electronic configuration of N_2 molecule = $\sigma^2_{1s}, \sigma^{*2}_{1s}, \sigma^2_{2s}, \sigma^{*2}_{2s}, \pi^2_{2p_y}, \pi^2_{2p_z}, \sigma^2_{2p_x}$ Bond order = $\frac{N_b - N_a}{2} = \frac{10-4}{2} = 3$. Molecule has no unpaired electrons. Hence, it is **diamagnetic.**	2 1 1 1	5
	(or) b) i) Give the IUPAC names for the following compounds. (3) A) $CH_3 - C \equiv C - CH(Cl) - CH_3$ = 4 – chloro pent – 2 – yne B) $CH_3 - CH_2 - CH(OH) - CHO$ = 2 – hydroxy butanal C) $CH_3 - CH_2 - C(=O) - OH$ = Propanoic acid	1 1 1	
	ii) State inductive effect. (2) 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.	2	

a) i) How will you prepare Toluene from Benzene. (3) — 3



ii) Write Finkelstein reaction. (2) — 2

$$CH_3CH_2Br + NaI \xrightarrow[\Delta]{\text{Acetone}} CH_3CH_2I + NaBr$$

Bromoethane Iodoethane

38 — **5**

(or) b) i) Differentiate Viable and non-viable particulates (3) — 1½ + 1½

	Viable particulate	Non-viable particulate
1	The viable particulates are the small size living organisms such as bacteria, fungi, moulds, algae, etc. which are dispersed in air.	The non- viable particulates are small solid particles and liquid droplets suspended in air.
2	Some of the fungi cause allergy in human beings and diseases in plants.	There are four types of non-viable particulates in the atmosphere. Eg: Smoke, Dust, Mists and Fumes

ii) Write short note on stone leprosy? (2) — 2

Acid rain causes extensive damage to buildings and structural materials of marbles. This attack on marble is termed as Stone leprosy.