

XITH CHEMISTRY PUBLIC EXAM

ANSWER KEY - 2025

PART -A

I. CHOOSE THE CORRECT ANSWER.

(15 x 1 =15)

1. Among the following, the compound that contains, ionic, covalent, and Coordinate linkage is

- a) NH_3 b) NaCl c) NH_4Cl d) none of these

2. Ethylidene chloride on treatment with aqueous KOH gives

- a) formaldehyde b) **acetaldehyde** c) glyoxal d) ethylene glycol

3. If temperature and volume of an ideal gas is increased to twice its values, the initial pressure P becomes

- a) **P** b) $4P$ c) $3P$ d) $2P$

4. The order of stabilities of various conformations of Ethane are:

- a) **Staggered > Skew > Eclipsed**
 b) Eclipsed > Skew > Staggered
 c) Eclipsed > Staggered > Skew
 d) Skew > Staggered > Eclipsed

5. The Van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

- a) 2 b) 0 c) **3** d) 1

6. The value of the heat combustion for Benzoic acid is

- a) -7223 kJ/mol b) -2237 kJ/mol c) -2327 kJ/mol d) **-3227 kJ/mol**

7. Sodium is stored in

- a) water b) **kerosene** c) alcohol d) none of these

8. Which of the following is optically active?

- a) Meso -tartaric acid b) 3-chloropentane
 c) **Glucose** d) 2-Chloropropane

9. The element with positive electron gain enthalpy is

- a) **argon** b) hydrogen c) fluorine d) sodium

10. How many electrons in an atom with atomic number 105 can have $(n + 1) = 8$?

- a) 15 b) 30 c) Unpredictable d) **17**

11. Which of the following species does not exert a resonance effect?

- a) $\text{C}_6\text{H}_5\text{NH}_2$ b) $\text{C}_6\text{H}_5\text{OH}$ c) **$\text{C}_6\text{H}_5\text{NH}_3$** d) $\text{C}_6\text{H}_5\text{Cl}$

12. Which of the following compound(s) has/have a percentage of carbon same as that in ethylene (C_2H_4)?

- a) benzene b) **propene** c) ethane d) ethyne

13. Ozone depletion will cause

- a) **bio magnification** b) forest fires
 c) global warming d) eutrophication

14. $\frac{K_c}{K_p}$ for the reaction, $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ is

- a) RT b) $\frac{1}{RT}$ c) **$(RT)^2$** d) \sqrt{RT}

15. Assertion: Permanent hardness of water is removed by treatment with Washing Soda.

Reason: Washing soda reacts with soluble Calcium and Magnesium chlorides and sulphates in hard water to form insoluble carbonates.

- a) assertion is true but reason is false
 b) **both assertion and reason are true and reason is the correct explanation of assertion**
 c) both assertion and reason are false

d) both assertion and reason are true but reason is not the correct explanation of assertion

PART-II

II. ANSWER ANY 6 QUESTIONS (Q.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.

$$\text{Relative atomic mass (A}_r\text{)} = \frac{\text{Average mass of the atom}}{\text{Unified atomic mass}}$$

17. State Heisenberg's uncertainty principle.

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

$$\Delta x \cdot \Delta p \geq h/4\pi$$

Δx - uncertainties in determining the position

Δp - uncertainties in determining the momentum

18. Discuss the three types of Covalent hydrides.

- Electron deficient hydride - B₂H₆
- Electron rich hydride - Water, NH₃
- Electron Precise Hydride - Methane

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

The mathematical expression that relates gas volume and moles is Avogadro's hypothesis. It may be expressed as

$$V \propto n, V_1/n_1 = V_2/n_2 = \text{constant}$$

where V_1 and n_1 are the volume and number of moles of a gas and

V_2 and n_2 are a different set of values of volume and number of moles of the same gas at the same temperature and pressure.

20. State the third law of thermodynamics.

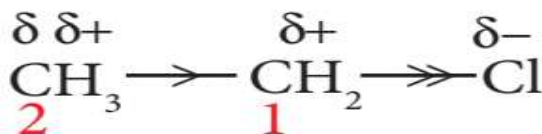
The entropy of pure crystalline substance at absolute zero is zero.

21. What is Sublimation?

Sublimation is the process in which a substance changes directly from a solid to a gas without passing through the liquid state.

22. What is inductive effect?

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.

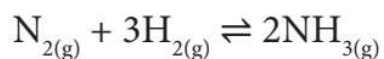


23. Define Smog.

Smog is a combination of smoke and fog which forms droplets that remain suspended in the air.

24. The equilibrium concentrations of NH₃, N₂ and H₂ 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 NH₃ from N₂ and H₂.

Given data: [NH₃] = 1.8 × 10⁻² M [N₂] = 1.2 × 10⁻² M [H₂] = 3 × 10⁻² M K_c = ?



$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} = \frac{1.8 \times 10^{-2} \times 1.8 \times 10^{-2}}{1.2 \times 10^{-2} \times 3 \times 10^{-2} \times 3 \times 10^{-2} \times 3 \times 10^{-2}}$$

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

PART - III

III ANSWER ANY 6 QUESTIONS (Q.NO:33 IS COMPULSORY). (6 X 3 = 18)

25. Calculate the molar mass of the following.

i) Ethanol (C ₂ H ₅ OH)	ii) Glucose (C ₆ H ₁₂ O ₆)
Molar mass = (2 × 12) + (6 × 1) + (1 × 16) = 24 + 6 + 16 = 46 g mol ⁻¹	Molar mass = (6 × 12) + (12 × 1) + (6 × 16) = 72 + 12 + 96 = 180 g mol ⁻¹

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

- According to Pauling the EN value of Hydrogen is 2.1 and for Fluorine is 4.0.
- Based on this the electronegativity values for other elements can be calculated using the following expression

$$(\chi_A - \chi_B) = 0.182 \sqrt{E_{AB} - (E_{AA} \times E_{BB})^{1/2}}$$

- χ_A, χ_B is electronegativity of A and B
- E_{AB}, E_{AA}, E_{BB} are the bond dissociation energies of AB, A₂ and B₂ molecules.

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

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

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

If the van der Waals constant (a) = 0 for gas, then it behaves ideally, (i.e.,) there is no intermolecular forces of attraction. So it cannot be liquefied. Moreover,

$$P_c = a/27b^2$$

If $a = 0$, then $P_c = 0$; therefore it cannot be liquefied.

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

- Only the less soluble gases obey Henry's law
- Henry's law is applicable at moderate temperature and pressure only.
- The gases reacting with the solvent do not obey Henry's law.
- For example, ammonia reacts with water and hence does not obey this law.

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.
- ❖ In 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 polarisation.

31. What is isomerism? Give its types.

Isomerism is a phenomenon where two or more compounds have the same molecular formula but different structures or arrangements of atoms, leading to different chemical and physical properties.

Types of Isomerism:

1. **Structural Isomerism (Constitutional Isomerism)** – Isomers differ in the arrangement of atoms in the molecule.

Types of structural isomerism:

- Chain isomerism
- Position isomerism
- Functional isomerism
- Metamerism
- Tautomerism

2. **Stereoisomerism** – Isomers have the same molecular and structural formulas but differ in the spatial arrangement of atoms.

Types of stereoisomerism:

- Geometrical (Cis-Trans) Isomerism
- Optical Isomerism

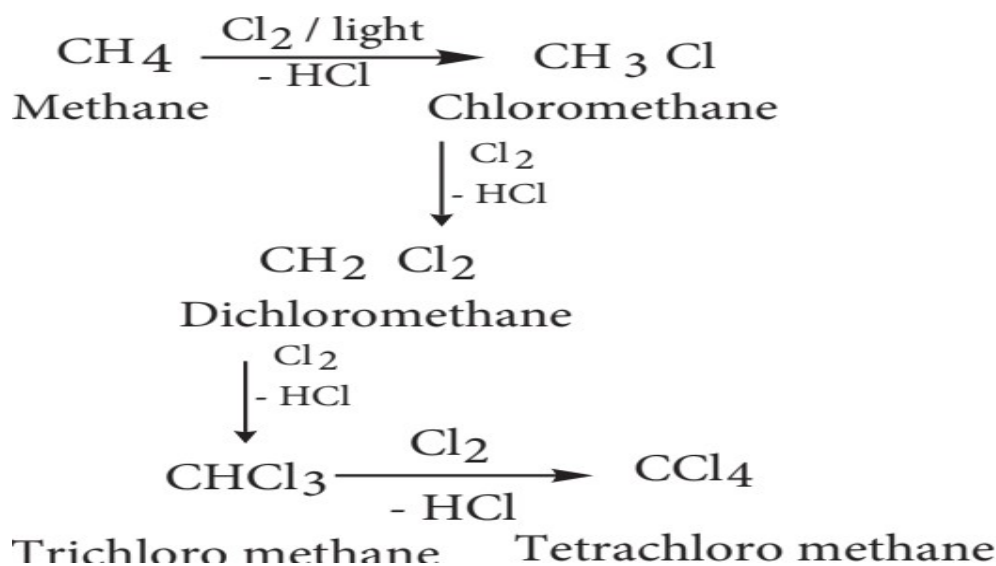
32. What are the uses of Chlorobenzene.

i) Chloro benzene is used in the manufacture of pesticides like DDT

ii) It is used as high boiling solvent in organic synthesis.

iii) It is used as fibre - swelling agent in textile processing.

33. Write the equations for the chain reaction between Methane and Chlorine in the presence of light.



PART-IV

IV ANSWER ALL THE QUESTIONS.

(5 X 5 =25)

34. a) i) Define Molar Volume.

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

273 K and 1 atm pressure - molar volume 22.4 litre.

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

- The Bohr's atom model is not applicable to multi electron atoms.
- It was unable to explain the splitting of spectral lines in the presence of magnetic field (Zeeman effect) or an electric field (Stark effect).
- Bohr's theory was unable to explain the angular momentum of the electron

(OR)

34. b) i) Why halogens act as oxidising agents?

- Halogens have high electro negativity
- Electronic configuration of halogens are $ns^2 np^5$
- Hence it accepts one electron it becomes a stable fully filled $ns^2 np^6$ configuration.

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

	Group	Periods
Electronegativity	Decreases	Increases
Reason	1. When a electron is added to the new shell of an atom	1. When a electron is added to the same shell of an atom
	2. Nuclear charge decreases.	2. Nuclear charge increases

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

Biological importance of Calcium

- Calcium is a major component of bones and teeth.
 - Deficiency of calcium causes longer time for blood to clot.
- It is also important for muscle contraction.

- It is maintained by hormones

Biological importance of Magnesium.

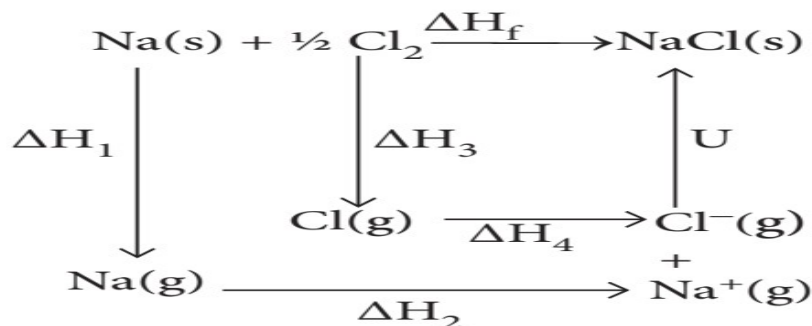
- Magnesium plays a important role in Bio-chemical reactions catalyzed by enzymes

- Magnesium is essential for the synthesis and functioning of the DNA
- Magnesium is used for balancing the electrolyte in the body
- Deficiency of Mg caused Neuro -Muscular irritation
- Magnesium is present in Chlorophyll and play a main role in

Photosynthesis.

(OR)

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



Formation of NaCl can be considered in 5 steps. The sum of the enthalpy changes of these steps is equal to the enthalpy change for the overall reaction from which the lattice enthalpy of NaCl is calculated.



Sublimation : $\text{Na}_{(s)} \rightarrow \text{Na}_{(g)} \quad \Delta H_1^\circ$

Dissociation : $\frac{1}{2} \text{Cl}_{2(g)} \rightarrow \text{Cl}_{(g)} \quad \Delta H_2^\circ$

Ionisation : $\text{Na}_{(s)} \rightarrow \text{Na}^+_{(g)} + e^- \quad \Delta H_3^\circ$

Electron affinity : $\text{Cl}_{(g)} + e^- \rightarrow \text{Cl}^-_{(g)} \quad \Delta H_4^\circ$

Lattice enthalpy : $\text{Na}^+_{(g)} + \text{Cl}^-_{(g)} \rightarrow \text{NaCl}_{(s)} \quad \Delta H_5^\circ = ?$

$$\Delta H = \Delta H_1^\circ + \Delta H_2^\circ + \Delta H_3^\circ + \Delta H_4^\circ + \Delta H_5^\circ$$

$$\Delta H = \Delta H_f^\circ - (\Delta H_1^\circ + \Delta H_2^\circ + \Delta H_3^\circ + \Delta H_4^\circ)$$

$$\Delta H_5^\circ = \text{Lattice enthalpy of NaCl.}$$

By the above method, indirectly lattice enthalpy of NaCl is calculated if the values of ΔH_f° , ΔH_1° , ΔH_2° , ΔH_3° and ΔH_4° are given.

36. a) Using Le-Chatelier's Principle explain the effect of the following factors on equilibrium. i) Concentration ii) Pressure iii) Temperature iv) Catalyst v) Inert gas.

Le Chatelier's Principle states that when a system at equilibrium is subjected to a change in conditions (concentration, pressure, temperature, etc.), the system adjusts itself to counteract the applied change and restore a new equilibrium.

Effects of Various Factors on Equilibrium:

1. Concentration:

- If the concentration of a reactant is increased, the equilibrium shifts to the right (forward direction) to consume the added reactant and form more products.
- If the concentration of a product is increased, the equilibrium shifts to the left (reverse direction) to form more reactants.

2. Pressure:

- Pressure affects gaseous reactions where the number of moles of reactants and products are different.
- If pressure is increased, the equilibrium shifts toward the side with fewer moles of gas to reduce pressure.
- If pressure is decreased, the equilibrium shifts toward the side with more moles of gas to increase pressure.
- If the number of moles of gas is the same on both sides, pressure change has no effect on equilibrium.

3. Temperature:

- If temperature is increased, the equilibrium shifts in the direction of the endothermic reaction (absorbing heat).
- If temperature is decreased, the equilibrium shifts in the direction of the exothermic reaction (releasing heat).
- For exothermic reactions (ΔH is negative), increasing temperature favors the reverse reaction.
- For endothermic reactions (ΔH is positive), increasing temperature favors the forward reaction.

4. Catalyst:

- A catalyst does not change the position of equilibrium; it only increases the rate at which equilibrium is attained by lowering the activation energy for both forward and reverse reactions equally.

5. Inert Gas:

- If an inert gas is added at constant volume, it has no effect on equilibrium because it does not change the partial pressures of the reacting gases.
- If an inert gas is added at constant pressure, the total volume increases, reducing the partial pressures of the reactants and products, causing equilibrium to shift toward the side with more moles of gas.

(OR)

36. b) Derive the expression for vapour pressure of binary solution of liquid in liquids using Raoult's law.

- Now, let us consider a binary liquid solution formed by dissolving a liquid solute 'A' in a pure solvent 'B' in a closed vessel.
- Both the components A and B present in the solution would evaporate and an equilibrium will be established between the liquid and vapour phases of the components A and B.
- The French chemist Raoult, proposed a quantitative relationship between the partial pressures and the mole fractions of two components A & B, which is known as Raoult's Law.
- This law states that "in the case of a solution of volatile liquids, the partial vapour pressure of each component (A & B) of the solution is directly proportional to its mole fraction".

According to Raoult's law,

$$p_A \propto x_A$$

$$p_A = k \cdot x_A$$

$$\text{when } x_A = 1, k = p^*_A$$

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

Therefore,

$$p_A = p^*_A x_A$$

Similarly, for component 'B'

$$p_B = p^*_B x_B$$

x_A and x_B 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.

$$\text{Hence, } P_{\text{total}} = p_A + p_B$$

Substituting the values of p_A and p_B from equations and in the above equation,

$$P_{\text{total}} = x_A p^*_A + x_B p^*_B$$

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

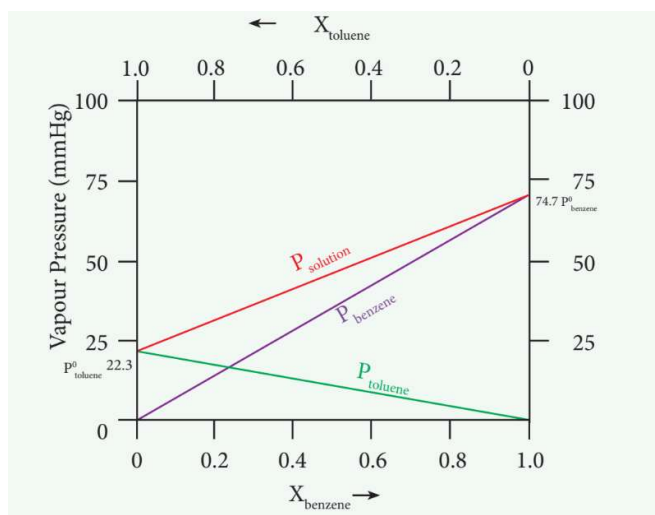
Therefore,

$$P_{\text{total}} = (1 - x_B) p^*_A + x_B p^*_B$$

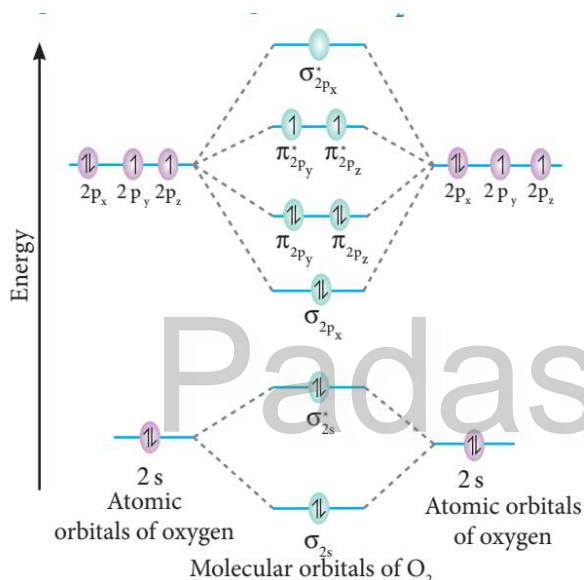
$$P_{\text{total}} = p^*_A + x_B (p^*_B - p^*_A)$$

The above equation is of the straight-line equation form $y = mx + c$. The plot of P_{total} versus x_A will give a straight line with $(p^*_B - p^*_A)$ as slope and p^*_A as the y intercept.

Let us consider the liquid solution containing toluene (solute) in benzene (solvent). The variation of vapour pressure of pure benzene and toluene with its mole fraction is given in the graph.



37 a) Discuss the formation of O₂ molecule using Molecular Orbital (MO) theory with diagram.



Molecular orbital diagram of oxygen molecule (O₂)

Electronic configuration of O atom is **1s² 2s² 2p⁴**

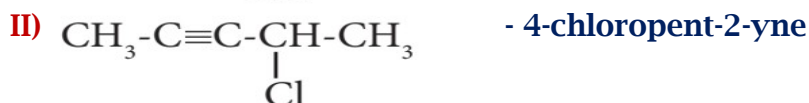
Electronic configuration of O₂ molecule
 $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \sigma_{2p_x}^2, \pi_{2p_y}^2, \pi_{2p_z}^2, \pi_{2p_y}^{*1}, \pi_{2p_z}^{*1}$

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

Molecule has *two unpaired electrons*. Hence, it is **paramagnetic**.

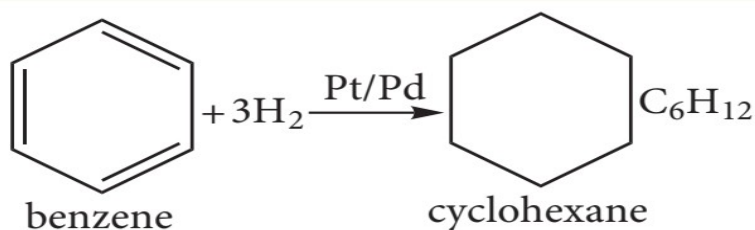
(OR)

b) Give the IUPAC name of the following compounds.

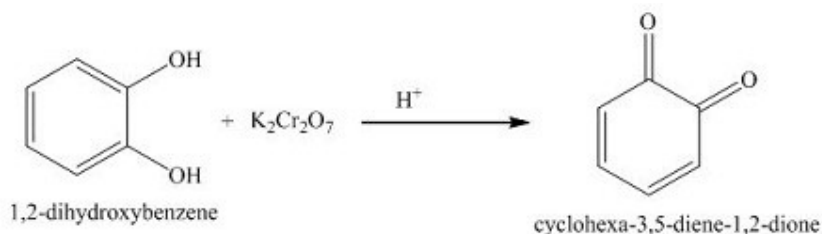


ii) Identify 'A' and 'B'.

Answer: i)



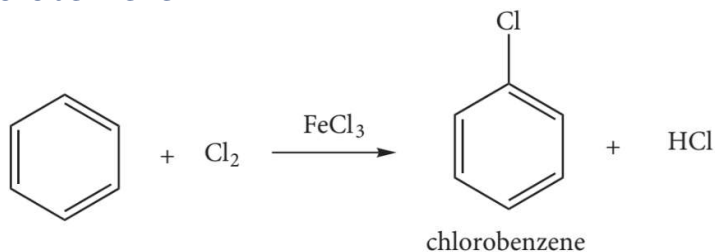
ii)



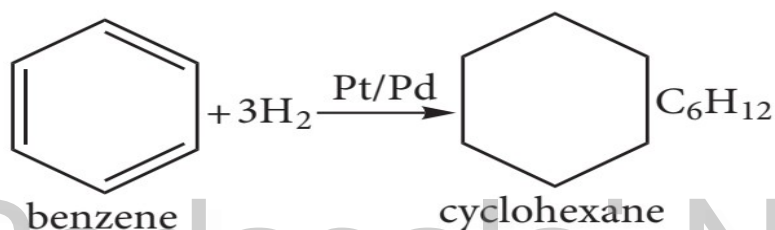
38. a) How will you convert Benzene to the following compounds?

i) Chloro benzene ii) Cyclohexane iii) Maleic acid

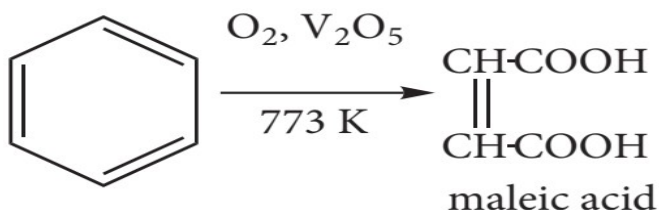
Answer: i) Chlorobenzene



ii) Cyclohexane:



iii) Maleic acid:



38. b) Write a short notes on the following:

i) Raschig process

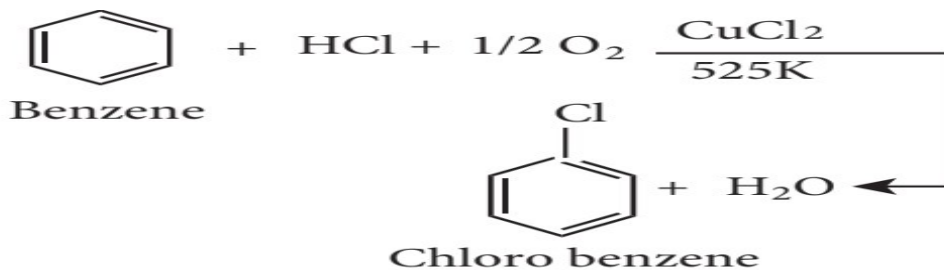
ii) Dow's process

iii) Williamson's Ether synthesis

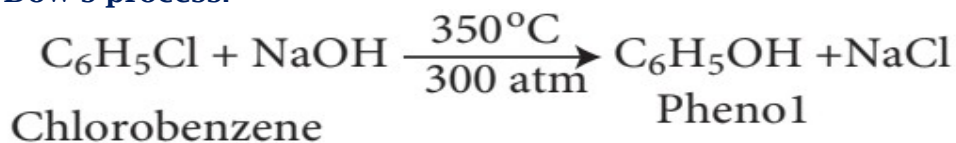
Answer:

i) Raschig process

Chloro benzene is commercially prepared by passing a mixture of benzene vapour, air and HCl over heated cupric chloride. This reaction is called Raschig process.



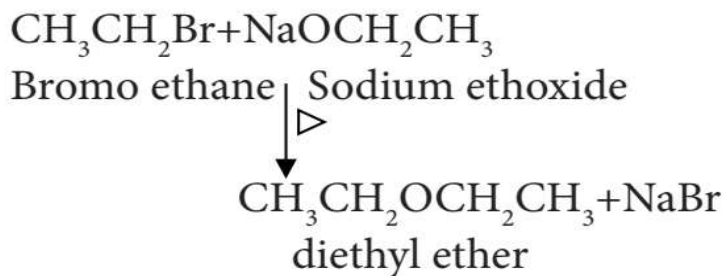
ii) Dow's process:



iii) Williamson's Ether synthesis

Haloalkane, when boiled with sodium alkoxide gives corresponding ethers.

Example : This method can be used to prepare mixed (unsymmetrical) ethers also.



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