11th STD.

PUBLIC EXAMINATION - MARCH 2025

Reg. No.

PART - III

CHEMISTRY

(With Answers)

TIME ALLOWED : 3.00 HOURS] [MAXIMUM MARKS : 70

Instructions : (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Note : Draw diagrams and write equations wherever necessary.

PART - I

Note : (i) Answer **all** the questions. **(15 × 1 = 15)**

(ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

1. **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.**

2. Which of the following compound has the same percentage of Carbon as in Ethylene (C_2H_4)?

   a) Benzene b) Propene

   c) Ethane d) Ethyne

3. The value of the heat of combustion for Benzoic acid is :

   a) $-7223\ kJ\ mol^{-1}$ b) $-2237\ kJ\ mol^{-1}$

   c) $-2327\ kJ\ mol^{-1}$ d) $-3227\ kJ\ mol^{-1}$

4. Ozone depletion will cause :

   a) bio-magnification b) forest fires

   c) global warming d) eutrophication

5. 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

6. How many electrons in an atom with atomic number 105 can have value of $(n + l) = 8$?

   a) 15 b) 30

   c) Unpredictable d) 17

7. Among the following, the compound that contains, ionic, covalent and co-ordinate linkage is :

   a) NH_3 b) NaCl

   c) NH_4Cl d) None of these

8. If Temperature and Volume of an ideal gas is increased to twice its values, the initial pressure P becomes :

   a) P b) 4 P c) 3 P d) 2 P

9. $\frac{K_C}{K_P}$ for the reaction, $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is :

   a) RT b) $\frac{1}{RT}$

   c) $(RT)^2$ d) $\sqrt{RT}$

10. The element with positive electron gain enthalpy is:

    a) Argon b) Hydrogen

    c) Fluorine d) Sodium

11. Ethylidene chloride on treatment with aqueous KOH gives :
    a) formaldehyde b) acetaldehyde
    c) glyoxal d) ethylene glycol

12. Sodium is stored in :
    a) Water b) Kerosene
    c) Alcohol d) None of these

13. 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

14. Which of the following is optically active?
    a) Meso-tartaric acid b) 3-Chloropentane
    c) Glucose d) 2-Chloro propane

15. Which of the following species does not exert a resonance effect?
    a) $C_6H_5NH_2$ b) C_6H_5OH
    c) $C_6H_5\overset{+}{N}H_3$ d) C_6H_5Cl

Part - II

Note : Answer **any six** questions. Question No. **24** is **Compulsory.** **(6 × 2 = 12)**

16. Define Relative Atomic Mass.
17. State Heisenberg's Uncertainty principle.
18. Name the three types of covalent Hydrides.
19. Give the Mathematical expression that relates gas volume and moles.
20. State the Third law of Thermodynamics.
21. What is Sublimation?
22. What is Inductive effect?
23. Define Smog.
24. 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.

Part - III

Note : Answer **any six** questions. Question No.**33** is **Compulsory.** **(6 × 3 = 18)**

25. Calculate the relative molecular mass of the following.
    (i) Ethanol (C_2H_5OH)
    (ii) Glucose ($C_6H_{12}O_6$)
26. Briefly give the basis for Pauling's Scale of electronegativity.
27. How do you convert para hydrogen into ortho hydrogen?
28. Can a gas with Vander Waals constant a = 0 be liquefied? Explain.
29. What are the limitations of Henry's law?
30. Explain the covalent character in ionic bond.
31. What is Isomerism? Give its types.
32. What are the uses of Chlorobenzene?
33. Write the equations for the chain reaction between Methane and Chlorine in the presence of light.

Part - IV

Note : Answer all the questions. **(5 × 5 = 25)**

34. (a) (i) Define Molar Volume.
    (ii) What are the limitations of Bohr's atom model?

    (OR)

    (b) (i) Why halogens act as oxidising agents?
    (ii) State the trends in the periodic variations of electronegativity in Groups and Periods.

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

    (OR)

    (b) Explain an indirect method to calculate lattice enthalpy of Sodium chloride crystal.

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

(OR)

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

37. (a) Discuss the formation of O_2 molecule using Molecular Orbital (MO) theory with diagram.

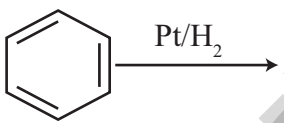
(OR)

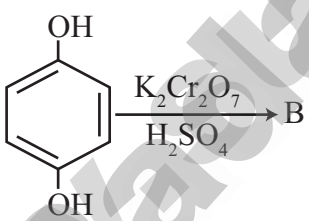
(b) (i) Give the IUPAC names of the following compounds.

(I) $CH_3-CH_2-\underset{\underset{OH}{|}}{CH}-CHO$

(II) $CH_3-C\equiv C-\underset{\underset{Cl}{|}}{CH}-CH_3$

(ii) Identify 'A' and 'B'.

(I) 

(II) 

38. (a) How will you convert Benzene to the following compounds?
    (i) Chloro benzene
    (ii) Cyclohexane
    (iii) Maleic acid

(OR)

(b) Write short notes on the following.
    (i) Raschig process
    (ii) Dow's process
    (iii) Williamson's Ether synthesis

ANSWERS

Part - I

1. b) Both **Assertion** and **Reason** are true and **Reason** is the correct explanation of **Assertion**
2. b) Propene
3. d) $-3227\ kJ\ mol^{-1}$
4. a) bio-magnification
5. a) Staggered > Skew > Eclipsed
6. d) 17
7. c) NH_4Cl
8. a) P
9. c) $(RT)^2$
10. a) Argon
11. b) acetaldehyde
12. b) Kerosene
13. c) 3
14. c) Glucose
15. c) $C_6H_5\overset{+}{N}H_3$

Part - II

16. The relative atomic mass is defined as the ratio of the average atomic mass to the unified atomic mass unit.

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

17. (i) Heisenberg's uncertainty principle states that 'It is impossible to accurately determine both the position and the momentum of a microscopic particle simultaneously'.

(ii) The product of uncertainty (error) in the measurement is expressed as follows.

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

where, Δx and Δp are uncertainties in determining the position and momentum, respectively.

18. (i) Electron precise (CH_4, C_2H_6)
    (ii) Electron deficient (B_2H_6)
    (iii) Electron -rich hydrides (NH_3, H_2O)

19. (i) The ideal gas equation, PV = nRT, is an equation which relates volume and number of moles of a gas.
(ii) Where, P is pressure, V is the volume, T is the temperature in Kelvin, n is the number of moles of a gas and R is the gas constant.

20. (i) The third law of thermodynamics states that the entropy of pure crystalline substance at absolute zero is zero.
(ii) It can also be stated as it is impossible to lower the temperature of an object to absolute zero in a finite number of steps.
(iii) Mathematically,
$\lim_{T\to 0} S = 0$ for a perfectly ordered crystalline state.

21. Few substances like benzoic acid, naphthalene and camphor when heated pass directly from solid to vapor without melting (ie liquid). On cooling the vapours will give back solids. Such phenomenon is called sublimation.

22. It is defined as the change in the polarization of a covalent bond due to the presence of adjacent bonded atoms or groups in the molecule. It is denoted as 1 effect. This is a permanent phenomenon.

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

24. **Given data:**

$[NH_3] = 1.8 \times 10^{-2}$ M

$[N_2] = 1.2 \times 10^{-2}$ M

$[H_2] = 3 \times 10^{-2}$ M

$K_c = ?$

Solution :

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

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

$$= \frac{1.8\times10^{-2}\times1.8\times10^{-2}}{1.2\times10^{-2}\times3\times10^{-2}\times3\times10^{-2}\times3\times10^{-2}}$$

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

Part - III

25. (i) Ethanol (C_2H_5OH)

$(2\times12)+(5\times1)+(1\times16)+(1\times1) = \mathbf{46\ g}$

(ii) Glucose ($C_6H_{12}O_6$)

$(6\times12)+(12\times1.008)+(6\times16) = \mathbf{180.096\ u}$

26. **Pauling's scale:**

(i) Electronegativity is the relative tendency of an element present in a covalently bonded molecule to attract the shared pair of electrons towards itself.

(ii) Pauling assigned arbitrary value of electro negativities for hydrogen and fluorine as 2.2 and 4 respectively.

(iii) Based on this the electronegativity values for other elements can be calculated using the following expression.

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

Where E_{AB}, E_{AA} and E_{BB} are the bond dissociation energies of AB, A_2 and B_2 molecule respectively X_A and X_B are electronegativity values of A and B.

27. **Conversion of para into ortho hydrogen :**

(i) By treatment with catalyst like Pt or Fe.
(ii) By passing an electric discharge
(iii) By heating to 800°C or more.
(iv) By mixing with paramagnetic molecules like O_2, NO, NO_2.
(v) By mixing with nascent hydrogen or atomic hydrogen.

28. (i) a = 0 for a Vander waals gas i.e for a real gas. Vander waals constant a = 0. It cannot be liquefied.
(ii) If a = 0, there is a very less inter action between the molecules of the gas
(iii) a is the measure of strength of vander waals force of attraction between the molecules of the gas.
(iv) If a is equal to zero, the vander waals force of attraction is very less and the gas cannot be liquefied.

29. (i) Henry's law is applicable at moderate temperature and pressure only.

(ii) Only the less soluble gases obeys Henry's law

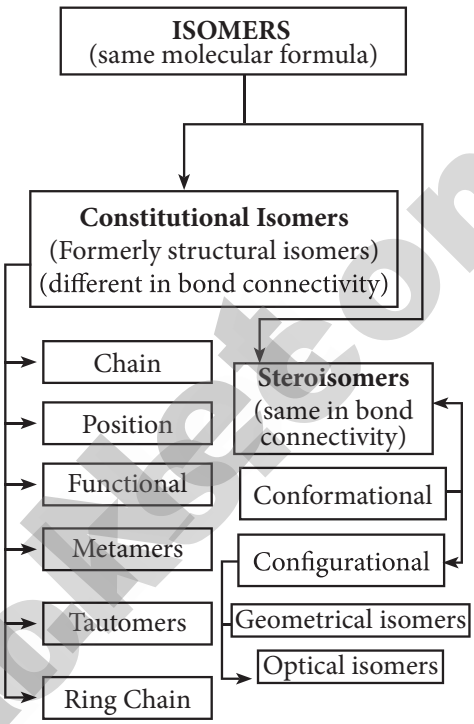
(iii) The gases reacting with the solvent do not obey Henry's law. For example, ammonia or HCl reacts with water and hence does not obey this law.

$$NH_3 + H_2O \rightleftharpoons NH^+_4 + OH^-$$

(iv) The gases obeying Henry's law should not associate or dissociate while dissolving in the solvent.

30. The partial covalent character in ionic compounds can be explained on the basis a polarisation. 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. The term 'isomerism' was given by Berzelius, and its represents of existence of two or more compounds with the same molecular formula but different structure and properties (physical, chemical, or both). Compounds exhibiting this isomerism are called isomers. The difference in properties of two isomers is due to difference in (bond connectivity or spatial arrangement) the arrangement of atoms within their molecules. Isomerism is broadly divided into two types. i. Constitutional isomerism, ii. stereoisomerism.



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

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

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

33.

$$CH_4 + Cl_2 \xrightarrow[\text{Heat}]{\text{Light or}} \underset{\text{methyl chloride}}{CH_3Cl} + HCl$$

$$CH_3Cl + Cl_2 \xrightarrow[\text{Heat}]{\text{Light or}} \underset{\text{methylene chloride}}{CH_2Cl_2} + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow[\text{Heat}]{\text{Light or}} \underset{\text{chloroform}}{CHCl_3} + HCl$$

$$CHCl_3 + Cl_2 \xrightarrow[\text{Heat}]{\text{Light or}} \underset{\text{carbontetrachloride}}{CCl_4} + HCl$$

Part - IV

34. (a)

(i) The volume occupied by one mole of any substance in the gaseous state at a given temperature and pressure is called molar volume. One mole of an Ideal gas is equal to 22.4 L (Or) 22400*ml* at STP conditions.

(ii) **Limitation of Bohr's atom model :**

- The Bohr's atom model is applicable only to species having one electron such as hydrogen, Li^{2+} etc. and 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 why the electron is restricted to revolve around the nucleus in a fixed orbit in which the angular momentum of the electron is equal to $nh/2\pi$.

(OR)

(b)

(i) Halogens act as oxidising agents because their electronic configuration is $ns^2\ np^5$ so all the halogens are ready to gain one electron to attain the nearest inert gas configuration. An oxidising agent is the one which is ready to gain an electron. So all the halogens act as oxidising agents. Also halogens are highly electronegative with low disorientation energy and high negative electron gain enthalpies. Therefore, halogens have a high tendency to gain an electron.

(ii) **Variation along a period :** Ionisation energy usually increases along a period. This is due to increase of nuclear change and decrease in size as we move from left to right in a period.

Periodic variation in group : Ionisation energy decreases down a group. As we move down a group, the valence electron occupies new shells, the distance between the nucleus and the valence electron increases. So, the nuclear forces of attraction on valence electron decreases and hence ionisation energy also decreases down a group.

35. (a)

(i) Magnesium plays an important role in many biochemical reactions catalysed by enzymes. It is the co-factor of all enzymes that utilize ATP in phosphate transfer and energy release. It also essential for DNA synthesis and is responsible for the stability and proper functioning of DNA. It is also used for balancing electrolytes in our body. Deficiency of magnesium results into convulsion and neuromuscular irritation.

(ii) Calcium is a major component of bones and teeth. It is also present in blood and its concentration is maintained by hormones (calcitonin and parathyroid hormone). Deficiency of calcium in blood causes it to take longer time to clot. It is also important for muscle contraction.

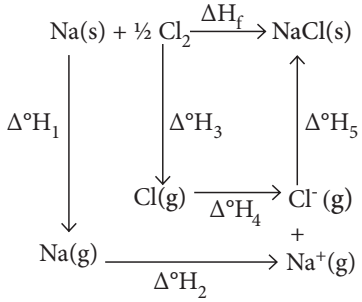
(iii) Chlorophyll, contains magnesium which plays an important role in photosynthesis.

(OR)

(b) Let us use the Born - Haber cycle for determining the lattice enthalpy of NaCl as follows:

Since the reaction is carried out with reactants in elemental forms and products in their standard states, at 1 bar, the overall enthalpy change of the reaction is also the enthalpy of formation for NaCl. Also, the 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.

Let us calculate the lattice energy of sodium chloride using Born-Haber cycle



$\Delta^\circ H_f$ = heat of formation of sodium chloride
$= -411.3$ kJ mol^{-1}

$\Delta^\circ H_1$ = heat of sublimation of $Na_{(S)} = 108.7$ kJ mol^{-1}

$\Delta^\circ H_2$ = ionisation energy of $Na_{(g)} = 495.0$ kJ mol^{-1}

$\Delta^\circ H_3$ = dissociation energy of $Cl_{2(g)} = 244$ kJ mol^{-1}

$\Delta^\circ H_4$ = Electron affinity of $Cl_{(g)} = -349.0$ kJ mol^{-1}

U = Lattice energy of NaCl

$\Delta^\circ H_f = \Delta^\circ H_1 + \Delta^\circ H_2 + \frac{1}{2}\Delta^\circ H_3 + \Delta^\circ H_4 + \Delta^\circ H_5$

$\therefore \Delta^\circ H_5 = (\Delta^\circ H_f) - (\Delta^\circ H_1 + \Delta^\circ H_2 + 1/2\,\Delta^\circ H_3 + \Delta^\circ H_4)$

$\Rightarrow \Delta^\circ H_5 = (-411.3) - (108.7 + 495.0 + 122 - 349)$

$\Delta^\circ H_5 = (-411.3) - (376.7)$

$\therefore \Delta^\circ H_5 = -788$ kJ mol^{-1}.

This negative sign in lattice energy indicates that the energy is released when sodium is formed from its constituent gaseous ions Na^+ and Cl^-.

36.(a)

Condition	Stress	Direction in which equilibrium shifts
Concentration	Addition of reactants (increase in reactant concentration)	Forward reaction
	Removal of products (decrease in product concentration)	
	Addition of products (increase in product concentration)	Reverse reaction
	Removal of reactants (decrease in reactant concentration)	
Pressure	Increase of pressure (Decrease in volume)	Reaction that favours fewer moles of the gaseous molecules
	Decrease of pressure (Increase in volume)	Reaction that favours more moles of the gaseous molecules
Temperature (Alters equilibrium constants)	Increase (High T)	Towards endothermic reaction
	Decrease (Low T)	Towards exothermic reaction
Catalyst (Speeds up the attainment of equilibrium)	Addition of catalyst	No effect
Inert gas	Addition of inert gas at constant volume	No effect

(OR)

(b) **According to Raoult's law,**

$p_A \alpha x_A$ .... (1)

$p_A = kx_A$

when $x_A = 1$, $k = p^o_A$

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

Therefore,

$p_A = p^o_A x_A$ .... (2)

Similarly, for component 'B'

$p_B = p^o_B x_B$ .... (3)

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 pressure of the individual components.

Hence,

$p_{total} = p_A + p_B$ .... (4)

Substituting the values of p_A and p_B from equations (2) and (3) in the above equation,

$p_{total} = x_A p^o_A + x_B p^o_B$ .... (5)

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

Therefore,

$p_{total} = (1 - x_B)\, p^o_A + x_B p^o_B$ .... (6)

$p_{total} = p^o_A + x_B (p^o_B - p^o_A)$ .... (7)

The above equation is of the straight-line equation form y = mx+c.

37. (a) **Molecular orbital diagram of oxygen molecule (O_2) :**

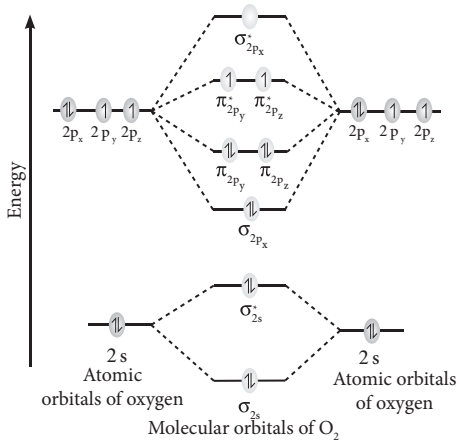
Electronic configuration of O atom $1s^2\ 2s^2\ 2p^4$

Electronic configuration of O_2 molecule

$\sigma^2_{1s}, \sigma^{*2}_{1s}, \sigma^2_{2s}, \sigma^{*2}_{2s}, \sigma^2_{2p_x}, \pi^2_{2p_y}, \pi^2_{2p_z}, \pi^{*1}_{2p_y}, \pi^{*1}_{2p_z}$

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

Molecule has two unpaired electrons hence it is paramagnetic.



MO Diagram for O_2 molecule

(OR)

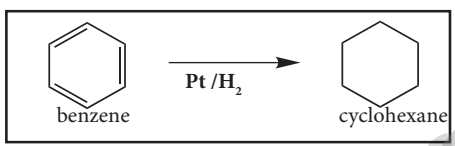
(b) **(i)**

(I) - 2-hydroxybutanal

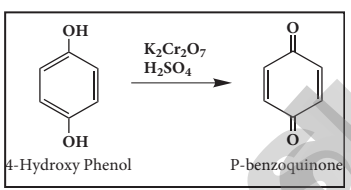
(II) - 4-chloropent-2-yne

(ii)

(I)

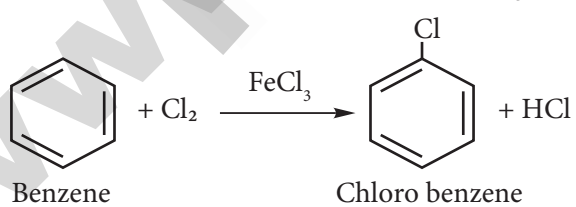


(II)



38. (a)

(i) **Chloro benzene :** Chloro benzene is prepared by the direct chlorination of benzene in the presence of lewis acid catalyst like $FeCl_3$

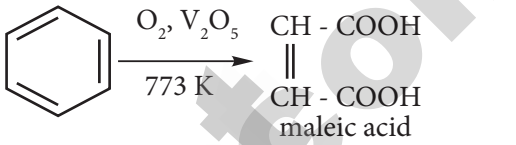


(ii) **Cyclohexane :** Benzene can add on to three moles of hydrogen in the presence of nickel catalyst to give cyclohexane.

$$C_6H_6 + 3H_2 \xrightarrow{\text{Raney Ni}} C_6H_{12}$$

cyclohexane

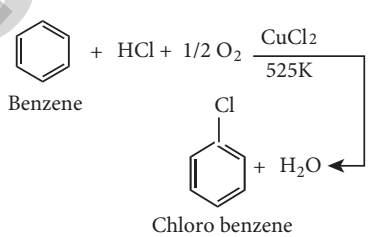
(iii) Maleic acid :



(OR)

(b)

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) **Dows Process :**

$$C_6H_5Cl + NaOH \xrightarrow[300\ atm]{350°C} C_6H_5OH + NaCl$$

Chlorobenzene — Phenol

This reaction is known as Dow's Process.

(iii) **Williamson's Ether synthesis:** Haloalkane, when boiled with sodium alkoxide gives corresponding ethers.

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

$$CH_3CH_2Br + NaOCH_2CH_3 \rightarrow CH_3CH_2OCH_2CH_3 + NaBr$$

Bromo ethane — Sodium ethoxide — diethyl ether

★★★