

Solution

SECTION A

1. Frenkel defect is shown by AgCl due to smaller size of Ag^+ cation. Na^+ cannot get into interstitial sites due to their large sizes. (1)
2. The Increasing order of boiling points is :
 $(\text{CH}_3)_3\text{N} < \text{C}_2\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{OH}$ (1)
3. Medicines are more effective in colloidal state as colloids have larger surface area. They easily get assimilated, absorbed and digested. (1)

OR

The main difference between an emulsion and a gel is of the dispersion medium. If both the dispersed phase and dispersion medium are liquid in a colloidal solution, it is an emulsion. If in a solution, dispersed phase is a liquid and medium is solid it is a gel. (1)

4. An ambident nucleophile has two nucleophilic centres. It can form bond with these centres. (1/2)
 Example \rightarrow Cyanide ion (CN^-) (1/2)
 C & N both make this ion an ambident nucleophile
5. Both Glucose & Fructose are sugars. Glucose is a six-membered ring while fructose is a five-membered ring. Therefore, Glucose is a hexose sugar and fructose is a pentose sugar. (1)

OR

Lactose is a disaccharide and it can be hydrolysed. On hydrolysis, it breaks down to form one unit of Glucose and one unit of Galactose. (1)

SECTION B

6. (i) $2\text{XeF}_2 + 2\text{H}_2\text{O} \rightarrow \text{O}_2 + 2\text{Xe} + 4\text{HF}$ (1)
- (ii) $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$ (1)

OR

- (i) The increasing order of acidic character is :
 $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$
- (ii) Decreasing bond enthalpy : $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$
7. **Raoult's Law** \rightarrow For a solution of volatile liquids, the partial pressure of each component in a solution is directly proportional to its mole fraction.

Let P_1 be the vapour pressure of the solvent, x_1 be its mole fraction and P_1° be its vapour pressure in pure state.

Then, $P_1 \propto x_1$

$$\Rightarrow P_1 = X_1 P_1^\circ \quad (1)$$

Following are the two characteristics of the solution which obeys this law at all concentrations :-

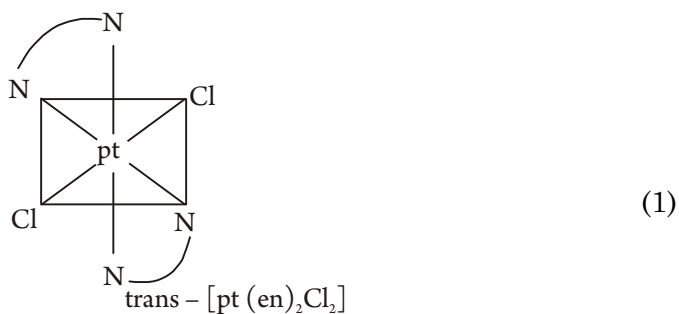
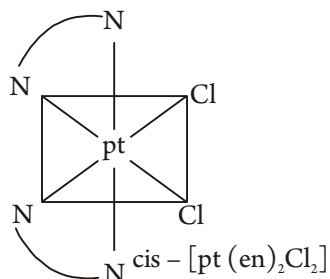
1. The enthalpy of mixing of the pure components to form the solution is zero. i.e. $\Delta_{\text{mix}} H = 0$. No heat change.
2. The volume of mixing is also zero i.e. $\Delta_{\text{mix}} V = 0$. Volume of solution would be equal to sum of volumes of two. (1)
8. (i) Rate law for the given reaction is :
 $\text{Rate} = k [\text{H}_2\text{O}_2]^1 [\text{I}^-]^1$ (1)
- (ii) The order of a multistep reaction is determined by slow step. Hence, order s $1 + 1 = 2$ (1/2)
- (iii) Step (1) is the rate determining step as it is slower step. (1/2)
9. The dark green compound (A) is K_2MnO_4
 Purple compound (B) is KMnO_4
 Compound (C) is IO_3^-

Compound (D) is I_2



10. The IUPAC name is Dichloridobis (ethane - 1,2- diammine) platinum (11) (1)

Geometrical isomers for this complex are :-



OR

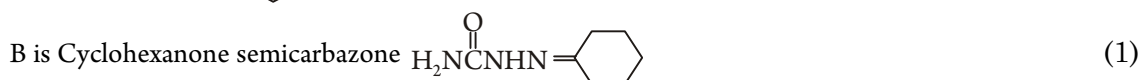
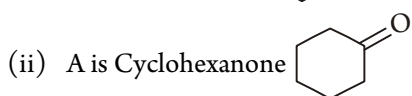
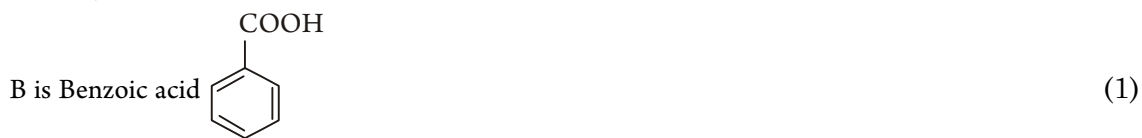
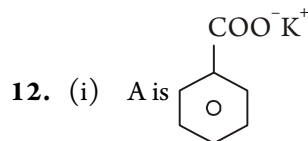


11. (i) $[CoF_6]^{3-}$ is paramagnetic (1/2)

(ii) $[Co(en)_3]^{3+}$ is more stable (1/2)

(iii) $[Co(en)_3]^{3+}$ is inner orbital complex (1/2)

(iv) $[CoF_6]^{3-}$ is a high spin complex (1/2)



SECTION C

13. Given,

Rate constant (k) = $4 \times 10^{-3} \text{ Ms}^{-1}$

initial concentration = 0.1M

Final concentration = 0.064 M

For a zero - order reaction,

$$\frac{dx}{dt} = K[A]^0 \quad (1)$$

$$\text{or } K = \frac{dx}{dt} = \frac{\text{Change in concentration}}{\text{Time interval}}$$

Put the given values, we get :

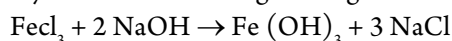
$$4 \times 10^{-3} = \frac{(0.064 - 0.1)}{\text{time}} (0.1 - 0.064) \quad (1)$$

$$\text{Time taken} = \frac{0.036}{4 \times 10^{-3}} = 9$$

∴ To reduce from 0.1 M to 0.064 M, the time taken is 9 seconds. (1)

14. (i) Activated charcoal absorbs poisonous gases and prevents it from inhalation. It also enhances the absorbent activity in the mask. (1)

(ii) Hydrated ferric oxide gains negative charge.



Sol. is represented as $\rightarrow \text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} / \text{OH}^-$

The negatively charged sol is obtained due to adsorption of OH^- ions. (1)

(iii) Chemisorption varies with temperature. It occurs slowly at low temperature. Although, it is an exothermic process, it increases with increase in temperature. (1)

15. As it is an FCC lattice, no. of atoms/unit cell (z) = 4

$$\text{Edge length}_{(a)} = 300 \text{ pm} = 300 \times 10^{-10} \text{ cm}$$

$$\text{Density } (d) = 10.8 \text{ g / cm}^3 \quad (1)$$

$$\text{Mass} = 108 \text{ g}$$

$$\text{Volume of cell } (V) = a^3 = (300 \times 10^{-10})^3 = 27 \times 10^{-24} \text{ cm}^3$$

$$\text{Volume of 108 g of element} = \frac{m}{d} = \frac{108}{10.8} = 10 \text{ cm}^3$$

$$\text{No. of units on } 10 \text{ cm}^3 = \frac{\text{Volume of 108g of element}}{\text{Volume of unit cell}}$$

$$= \frac{10}{27 \times 10^{-24}} = \frac{1}{27} \times 10^{25} = 0.0370 \times 10^{25} \text{ (approx)} \quad (1)$$

In FCC, each unit cell contains 4 atoms.

$$\text{Hence, total number of atoms} = 4 \times 0.0370 \times 10^{25} \text{ atoms}$$

$$= 0.148 \times 10^{25} = 14.8 \times 10^{23} \text{ atoms}$$

$$= 1.48 \times 10^{24} \text{ atoms} \quad (1)$$

16. 4 % Solution of sucrose :

$$W_B = 4 \text{ g (mass of solute)}, M_B = 342 \text{ g / mol}$$

$$W_S = 100 \text{ g [mass of solution]}, W_A = 100 - 4 = 96 \text{ g (mass of solvent)}$$

$$T_F = k_f \times \left[\frac{W_B}{m_B} \times \frac{1000}{W_A} \right]$$

$$T_F = 273.15 \text{ K} - 271.15 \text{ K} = 2 \text{ K}$$

$$2 = k_f \times \left[\frac{4}{342} \times \frac{96}{96} \right] \times 100$$

$$k_f = \frac{342 \times 2 \times 96}{4000} = \frac{171 \times 96}{1000} = 16.416 \quad (1)$$

5 % solution (by mass) of Glucose :

$$W_B = 5 \text{ g (mass of solute)}, W_S = 100 \text{ g (mass of solution)}$$

$$m_b = 180 \text{ g / mol}, W_A = 100 - 5 = 95 \text{ g (mass of solvent)} \quad (1)$$

$$\text{Molality (m)} = \frac{5 \times 1000}{180 \times 95} \text{ mol kg}^{-1}$$

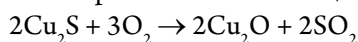
$$\Rightarrow T_f = K_f m$$

$$\Rightarrow T_f = 16.416 \times \frac{5 \times 1000}{180 \times 95} \text{ K} = 16.416 \times \frac{5000}{17100} \text{ K} = 16.416 \times 0.29 \text{ K} = 4.8 \text{ K}$$

$$\text{Hence, Freezing point of Glucose} = 273.15 \text{ K} - 4.8 \text{ K} = 268.35 \text{ K} \quad (1)$$

17. (a) (i) Zone refining is used to obtain semiconductor of high purity (1)
 (ii) Low boiling metals like zinc & mercury are purified by the process named distillation. (1)

(b) The Sulphide ores are roasted/smelted to give oxides:



This oxide (Cu_2O) can then be easily reduced to metallic copper using coke :



18. (i) Transition elements and their compounds act as a catalyst because of their tendency to form reaction intermediates with suitable reactants. These intermediates give reaction paths of lower activation energy and increase the rate of the reaction. They readily decompose & yield the products. This happens due to the presence of vacant orbitals or their tendency to form variable oxidation states. (1)
 (ii) Copper has high atomization $\Delta_a H^\circ$ & low hydration energy $\Delta_{\text{hyd}} H^\circ$, due to which the E° value is positive. E° Value for Mn is negative due to stability of half-filled configuration. It is subshell d^5 in Mn. (1)
 (iii) There is overlapping of inner orbitals and free movement of electrons across orbitals in actinoids. There is also very small energy difference between 5f and 6d levels which cannot be explained. (1)

19. (i) The monomers used for getting Nylon -6,6 are:-

1. \rightarrow Adipic acid $n\text{HooC}(\text{CH}_2)_4\text{COOH}$

2. \rightarrow Hexamethylene diamine $n\text{NH}_2(\text{CH}_2)_6\text{NH}_2$ (1)

(ii) The monomers used for getting Glyptal are :-

1. \rightarrow Ethylene Glycol $n(\text{HOCH}_2-\text{CH}_2\text{OH})$

2. \rightarrow Phthalic acid  (1)

(iii) The monomers used for getting Buna-S are :-

1. \rightarrow 1,3- Butadiene $n\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$

2. \rightarrow Styrene $n\text{C}_6\text{H}_5\text{CH} = \text{CH}_2$ (1)

OR

(i) $\left[\begin{array}{c} \text{CH}_3 \\ | \\ -\text{CH}_2 - \text{CH} - \\ | \\ \text{---} \end{array} \right]_n$ is a homopolymer as it is made up of single monomer in repeated units. (1)

(ii) Melamine and formaldehyde copolymerize to give the given melamine polymer. (1)

(iii) Sulphur bridges or cross-links between polymer chains are introduced into the structure of rubber. These cross links make rubber hard and stronger and remove the softness & gives it toughness. (1)

20. (i) Benzodiazepines which are included in a class of drugs called hypnotics are used in sleeping pills. These are also called tranquillizers (1)

(ii) Surfactants like anionic detergents benzosulphonate are used in tooth pastes. (1)

(iii) Alitame is a high potency sweetener. It is difficult to control its sweetness while using it. (1)

OR

(i) Some antibiotics are effective against a variety of diseases and are called broad -spectrum antibiotics. Example \rightarrow Teracycline (1)

(ii) Disinfectants \rightarrow They are used to kill microorganisms but not safe for living tissues. They are used for floors, drainage system, instruments etc. (1)

Example \rightarrow 1% solution of phenol (1)

(iii) Cationic detergents → These are detergents whose N atom attains a positive charge with a long hydrocarbon chain.

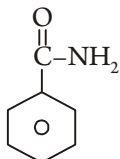
Example → Cetyl trimethyl ammonium bromide (1)

21. (i) $(\text{CH}_3)_3\text{C-I}$ is more reactive towards $\text{S}_{\text{N}}1$ than $(\text{CH}_3)_3\text{C-Br}$ because its bond dissociation enthalpy is less and hence it is easier to break. (1)

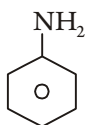
(ii) When p-nitrochlorobenzene is heated, in the presence of aqueous NaOH at 443 K, p-nitrophenol is synthesized. P-nitrophenol does not react with acid. (1)

(iii) Dextro and laevo rotatory isomers of butan -2-ol are enantiomers of each other and both have same boiling point. Due to similar boiling points they cannot be separated by fractional distillation. (1)

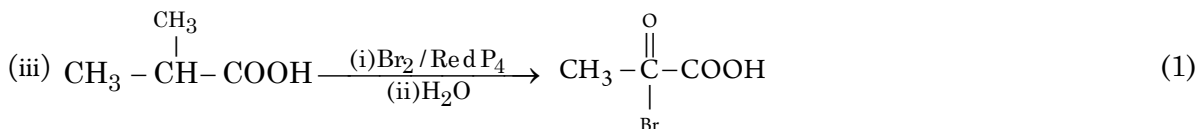
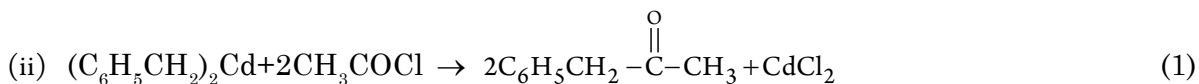
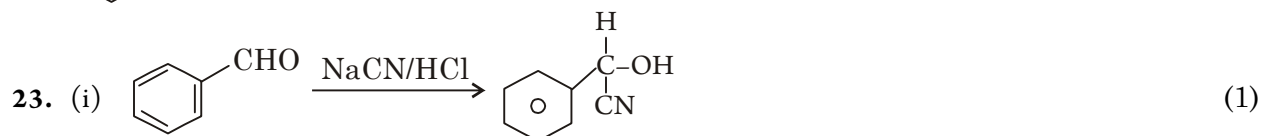
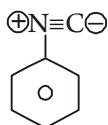
22. A → Benzamide



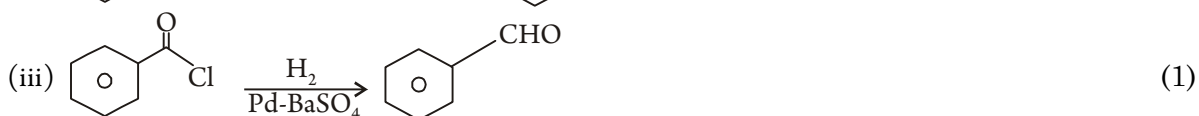
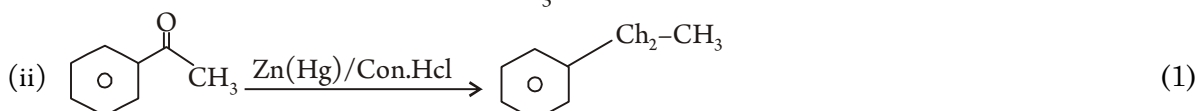
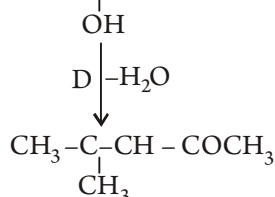
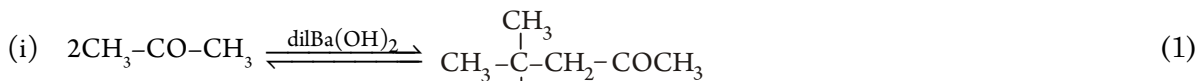
B → Aniline or Benzenamine (1)



C → Benzene isonitrile (1)



OR



24. (i) **Amylose**

- (a) Only C₁-C₄ Glycosidic linkage
 (b) Water-soluble component of starch

(ii) **Petide linkage**

It is -CONH- linkage
 which exists in proteins formed by
 condensation of amino acids,

(iii) **Fibrous proteins**

- (a) Polypeptide chains run Parallel to give
 fibre-like structure
 (b) It is insoluble in water

Amylopectin

- (a) C₁-C₄ Glycosidic linkage is present with branching
 (b) Water insduble component of starch (1)

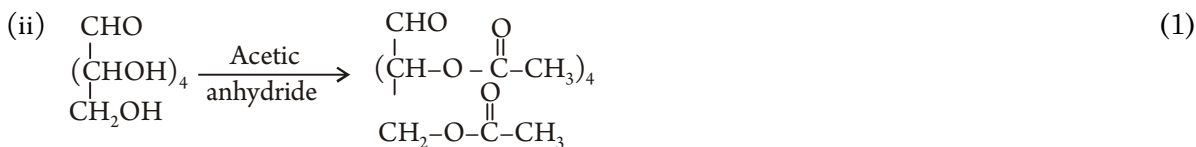
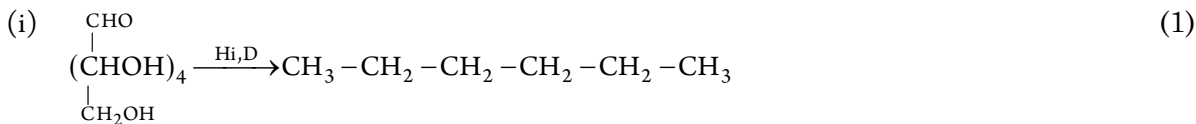
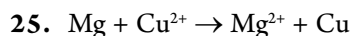
Glycosidic linkage

It is -O- linkage. In disaccharide, two monosacharide
 units are joined through O₂ atom. (1)

Globular protein

- (a) Polypeptide chains coil around to give spherical
 shape
 (b) Usually soluble in water (1)

OR

**SECTION D**

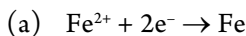
$$Q = \frac{[\text{Mg}^{2+}][\text{Cu}]}{[\text{Mg}][\text{Cu}^{2+}]} = \frac{(0.001)(1)}{(1)(0.01)} = 0.1$$

using Nerst equation,

$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{n} \log Q = 2.71 - \frac{0.0591}{2} \log 0.1 = 2.74 \text{ V} \quad (3)$$

- (i) Since the voltage applied externally is less than E_{cell} directon of current is from cathode to anode. (1)
 (ii) If the external voltage exceeds E_{cell}, the direction of flow of current is from anode to cathode. (1)

OR



$$Q = It \Rightarrow t = \frac{9650}{2} = 4825 \text{ s}$$

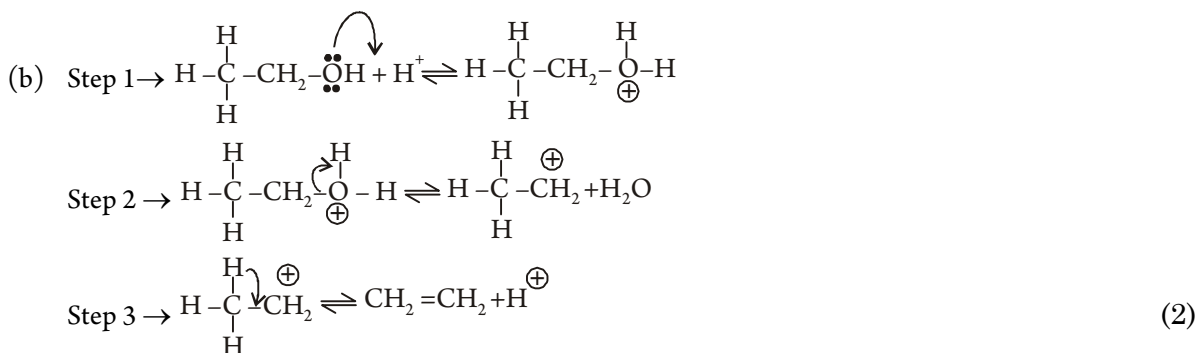
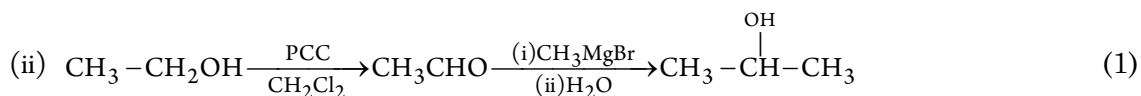
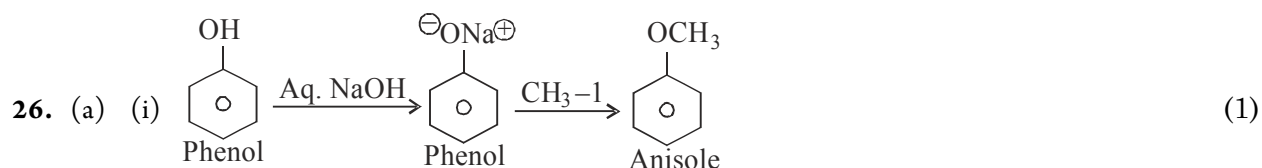
Using faraday' second law of electrolysis,

$$\Rightarrow \frac{2.8}{W_2} = \frac{56/2}{65.3/2} = \frac{56}{65.3}$$

$$\Rightarrow W_2 = 3.265 \text{ g} \quad (3)$$

- (b) (i) Electrolyte A is strong electrolyte while B is weak one. (1)
 (ii) On extrapolation of Λ_m to conc. approaching zero, we get Λ_m^o → molar conductance at infinite dilution.

In the case of weak electrolytes, Λ_m increases. So, Λ_m^o cannot be obtained. (1)

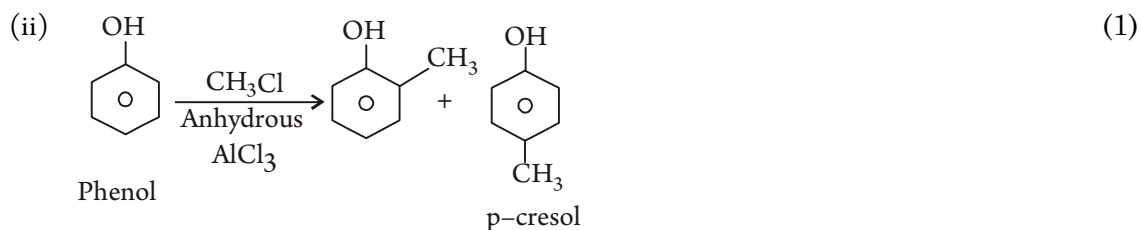
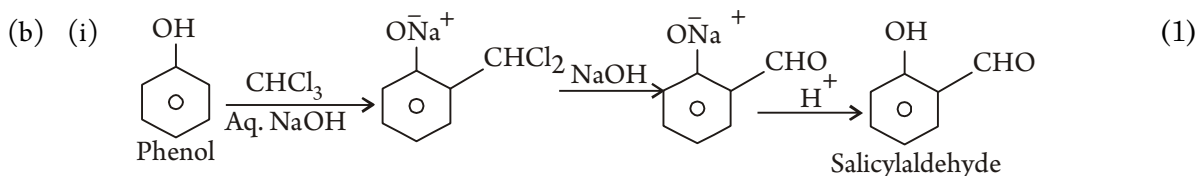


(c) -OH group of phenol is activating group. It increases the electron density at o-,p - position so that electrophile can easily attack in phenol than in benzene. (1)

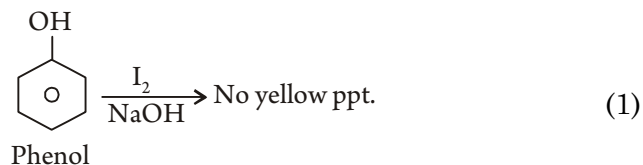
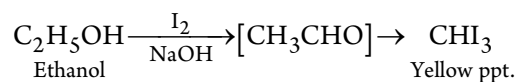
OR

(a) (i) O-nitrophenol is having intra molecular H-bonding and p-nitrophenol has intermolecular H-bonding which makes it less volatile. (1)

(ii) Sodium methoxide is a strong base. It pre-dominates elimination over substitution. (1)

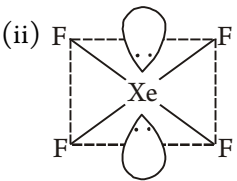


(c) Ethanol and phenol can be distinguished by iodoform test.



27. (a) (i) Sulphur in vapor state exists as S_2 which has two unpaired electrons in π -antibonding molecular orbit and it's paramagnetic. (1)
- (ii) N is small in size, N-N bond is weaker than P-P because of interelectronic repulsion of non-bonding e^- . (1)
- (iii) There is liberation of heat and increase in entropy which results in a large negative Gibb's energy change. (1)
- (b) (i) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$ (1)
(dil.)
- (ii) $Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO + 2H_2O$ (1)
(conc.)

OR

- (a) (i) $4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$ (1)
- (ii)  (1)
- (b) (i) Fluorine being smaller has negative e^- gain enthalpy. It also has very high hydration energy. So, it is a strong oxidising agent. (1)
- (ii) As electronegativity decreases, acidic strength of oxide decreases, so it decreases from N_2O_3 to Bi_2O_3 (1)
- (c) $5SO_2 + 2MnO_4^- + 2H_2O \rightarrow 5SO_4^{2-} + 4H^+ + 2Mn^{2+}$ (1)