

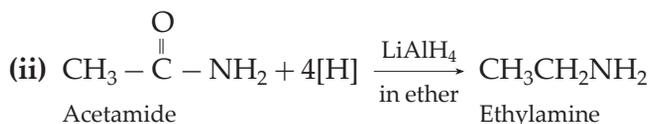
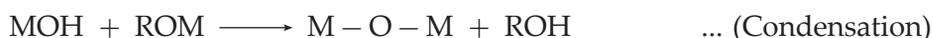
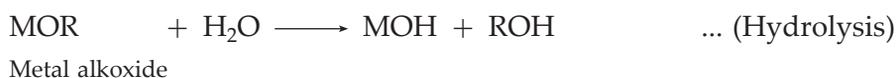
CHEMISTRY

SOLUTION : PRACTICE PAPER – 5

SECTION – A

- Q. 1. (i) (d) Co–Th
(ii) (c) trisaccharide
(iii) (c) an ether
(iv) (c) $\geq 4.2 \times 10^{-25} \text{ mol/dm}^3$
(v) (c) 9
(vi) (c) 0.68
(vii) (a) Nylon
(viii) (c) dry cleaning agent
(ix) (b) propane
(x) (c) decreasing E_a

- Q. 2. (i) The reactions involved in the sol-gel process are as follows :



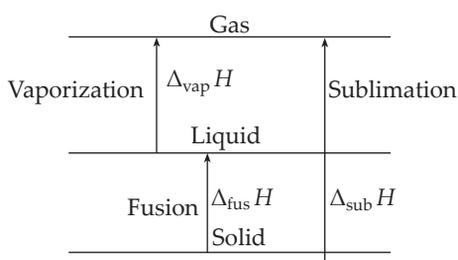
- (iii) Decreasing order of reactivity by $\text{S}_{\text{N}}1$ mechanism of alkyl halides is tertiary alkyl halide (3°) > secondary alkyl halide (2°) > primary alkyl halide (1°).
- (iv) Applications of coordination compound : (*Any two*)
(1) In biology (2) In medicine (3) To estimate hardness of water
(4) Electroplating.
- (v) ${}_{24}\text{Cr} : 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
- (vi) $E_{\text{cell}}^0 = \frac{2.303 RT}{nF} \log_{10} K = \frac{0.0592}{n} \log_{10} K$ at 25°C
- (vii) The second law of thermodynamics states that the total energy change of the system and its surroundings (universe) increases in a spontaneous process.
 $\Delta S_{\text{total}} = (\Delta S_{\text{sys}} + \Delta S_{\text{surr}}) > 0$

(viii) A membrane which allows to pass only solvent molecules but not the large solute particles through it, is called semipermeable membrane.

SECTION – B

Q. 3. The conversion of solid into vapour can be considered to occur in two steps :

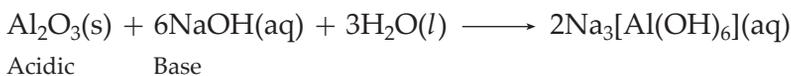
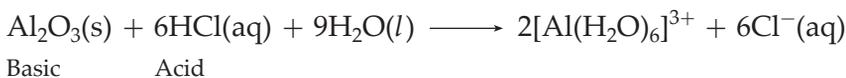
(i) Solid to liquid (ii) Liquid to vapour.



Representing $\Delta_{\text{fus}} H$, $\Delta_{\text{vap}} H$ and $\Delta_{\text{sub}} H$

Hence, we can write $\Delta_{\text{sub}} H = \Delta_{\text{fus}} H + \Delta_{\text{vap}} H$

Q. 4. **Amphoteric oxides** : The oxide, which reacts with a base as well as with an acid to give salt is called an amphoteric oxide.



Q. 5. To prevent generating waste, there is the need to develop the Zero Waste Technology (ZWT). ZWT in a chemical synthesis should result in waste product being zero or minimum. To use the waste product of one system as the raw material for other system is also the aim of ZWT.

For example :

- (1) Cement and brick industry can use the bottom ash of thermal power station as the raw material.
- (2) Thermal power station can use the effluent coming out from cleansing of machinery parts as coolant water.

Carbohydrates	Class
(1) Glucose	Monosaccharide
(2) Sucrose	Disaccharide
(3) Galactose	Monosaccharide
(4) Lactose	Disaccharide

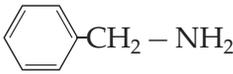
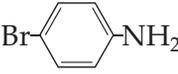
Q. 7. Given : $c = 0.02 \text{ M AgNO}_3$; $R_{\text{soln}} = 947 \text{ } \Omega$; Cell constant = $b = 2.3 \text{ cm}^{-1}$; $\Lambda = ?$; $k = ?$

$$\text{Formula : } k = \frac{\text{Cell constant}}{R_{\text{soln}}} = \frac{b}{R_{\text{soln}}}$$

$$\therefore k = \frac{2.3}{947} = 0.002429 \text{ } \Omega^{-1} \text{ cm}^{-1}$$

$$\therefore \Lambda = \frac{k \times 1000}{c} = \frac{0.002429 \times 1000}{0.02} = 121.5 \text{ } \Omega^{-1} \text{ cm}^2 \text{ mol}^{-1}$$

Q. 8.

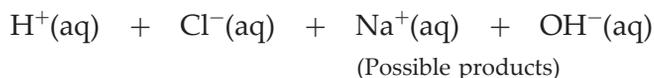
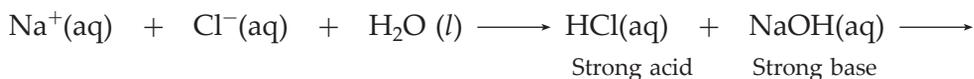
	Common name	Structure	IUPAC name
(1)	Benzylamine		Phenylmethanamine
(2)	<i>p</i> -Bromoaniline		4-Bromoaniline or 4-Bromobenzenamine

Q. 9. (1) Sodium chloride is a salt of strong acid HCl and strong base NaOH.

(2) When NaCl is dissolved in water, it dissociates completely into its ions.



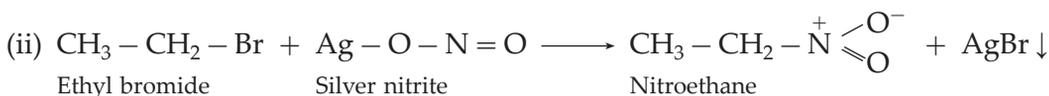
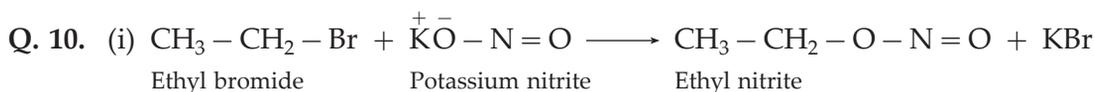
(3) Na^+ and Cl^- ions have no tendency to react with water. This is because the possible products, NaOH and HCl of such reactions are strong electrolytes which dissociate completely in aqueous solutions.



(4) Thus, the reactants and products are the same. It means there is no reaction.

(5) This implies that neither cation nor anion of the salt reacts with water. In other words there is no hydrolysis.

(6) The equality $[\text{OH}^-] = [\text{H}^+]$, produced by ionization of water is not disturbed and the solution is neutral.



Q. 11. Given : $P_1^0 = 640 \text{ mm Hg}$; $W_1 = 39 \text{ g} = 39 \times 10^{-3} \text{ kg}$; $W_2 = 2.175 \times 10^{-3} \text{ kg}$; $P_1 = 600 \text{ mm Hg}$;
 $M_1 = 78 \times 10^{-3} \text{ kg/mol}$; $M_2 = ?$

$$\text{Formula : } \frac{P_1^0 - P_1}{P_1^0} = \frac{W_2 \times M_1}{W_1 \times M_2}$$

$$\frac{640 - 600}{640} = \frac{2.175 \times 10^{-3} \times 78 \times 10^{-3}}{39 \times 10^{-3} \times M_2}$$

$$\therefore M_2 = \frac{2.175 \times 10^{-3} \times 78 \times 10^{-3}}{39 \times 10^{-3}} \times \frac{640}{(640 - 600)} = 69.6 \times 10^{-3} \text{ kg mol}^{-1} = \mathbf{69.6 \text{ g mol}^{-1}}$$

Q. 12.	Polymer	Monomer
(i)	Synthetic rubber	$\begin{array}{c} \text{Cl} \\ \\ \text{H}_2\text{C} = \text{C} - \text{CH} = \text{CH}_2 \end{array}$ Chloroprene
(ii)	Teflon	$\text{CF}_2 = \text{CF}_2$ Tetrafluoroethene

Q. 13. Electrometallurgy : It is a process in which metal is extracted by electrolytic reduction of molten metallic compound.

Action of C on Fe_2O_3 :



Q. 14.	hcp lattice	ccp lattice
1.	The spheres of third layer occupy depressions, between spheres of second layer, that are above the spheres of first layer.	1. The spheres of third layer occupy depressions, between spheres of second layer that are above the triangular depressions of first layer.
2.	The spheres of third layer are exactly aligned with those of first layer.	2. The spheres of third layer are not aligned with those of first or second layer.
3.	The pattern of spheres is repeated in every alternate layers.	3. The pattern of spheres is repeated after three layers.
4.	It forms ABAB... pattern.	4. It forms ABCABC... pattern.

SECTION – C

Q. 15. Definition of the van't Hoff factor (i) : It is defined as a ratio of the colligative property of the solution of electrolyte divided by the colligative property of nonelectrolyte solution of the same concentration.

OR

$$i = \frac{\text{Colligative property of electrolyte solution}}{\text{Colligative property of nonelectrolyte solution of the same concentration}}$$

Relation between relative lowering of vapour pressure and molar mass of nonvolatile solute :

Consider a solution in which W_1 g of a solvent of molar mass M_1 contains W_2 g of a nonvolatile solute of molar mass M_2 .

$$\text{Then moles of a solvent} = n_1 = \frac{W_1}{M_1}$$

$$\text{moles of a solute} = n_2 = \frac{W_2}{M_2}$$

$$\text{Mole fraction of the solute} = x_2 = \frac{n_2}{n_1 + n_2} \approx \frac{n_2}{n_1} \text{ since for a dilute solution } n_1 \gg n_2.$$

$$\therefore x_2 = \frac{W_2 / M_2}{W_1 / M_1} = \frac{W_2 \times M_1}{W_1 \times M_2}$$

If P_1^0 and P_1 are the vapour pressures of pure solvent and solution respectively, then

$$\text{relative lowering of vapour pressure} = \frac{P_1^0 - P_1}{P_1^0}$$

Relative lowering of vapour pressure = mole fraction of solute in the solution.

$$\therefore \frac{P_1^0 - P_1}{P_1^0} = x_2$$

$$\therefore \frac{P_1^0 - P_1}{P_1^0} = \frac{W_2 \times M_1}{W_1 \times M_2}$$

Q. 16. Tollen's reagent : It is an ammoniacal silver nitrate, $[\text{Ag}(\text{NH}_3)_2]^+ \text{OH}^-$

Cannizzaro reaction	Aldol reaction
1. Cannizzaro reaction is given by aldehydes not having alpha hydrogen atom.	1. Aldol reaction is given by aldehydes and ketones possessing alpha hydrogen atom.
2. In this reaction an aldehyde is converted to the corresponding acid and an alcohol.	2. In this reaction aldehydes and ketones are converted into aldol and ketols, respectively.
3. It is a disproportionation reaction.	3. It is an addition reaction.
4. It requires concentrated alkali as a catalyst.	4. It requires dilute alkali as a catalyst.

Q. 17. Given : $\Delta H = -900 \text{ kJ mol}^{-1}$; $T = 300 \text{ K}$; $P = 1 \text{ atm}$;

$$\text{Mass of ethane} = m = 12 \times 10^{-3} \text{ kg};$$

$$\text{Molar mass of ethane } (\text{C}_2\text{H}_6) = 30 \times 10^{-3} \text{ kg mol}^{-1}; \Delta H = ?; \Delta U = ? W = ?$$

$$\text{Moles of } \text{C}_2\text{H}_6 = n = \frac{m \text{ kg}}{M \text{ kg mol}^{-1}} = \frac{12 \times 10^{-3}}{30 \times 10^{-3}} = 0.4 \text{ mol}$$

$$(a) W = -\Delta n_g RT$$

$$\therefore \Delta n_g = 2 - 4.5 = -2.5$$

$$\therefore W = -2.5 \times 8.314 \times 300 = -6236 \text{ J} = -6.236 \text{ kJ}$$

Work done for combustion of 1 mole = -6.236 kJ

\therefore for combustion of 0.4 mol

$$W = -6.236 \times 0.4 = -2.494 \text{ kJ}$$

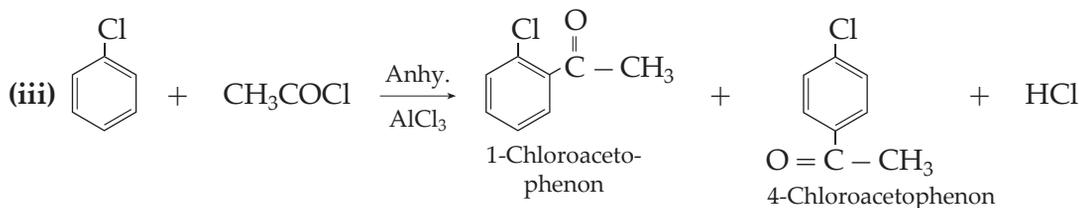
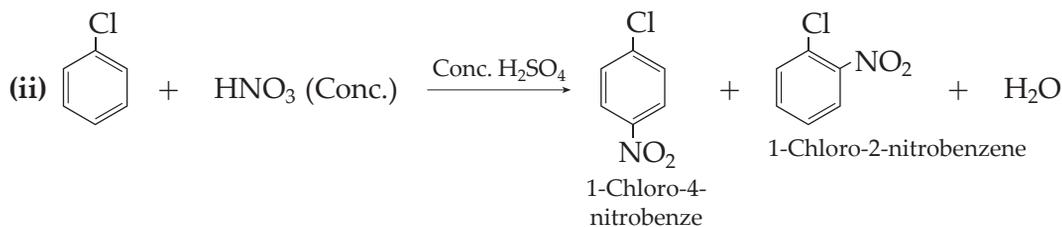
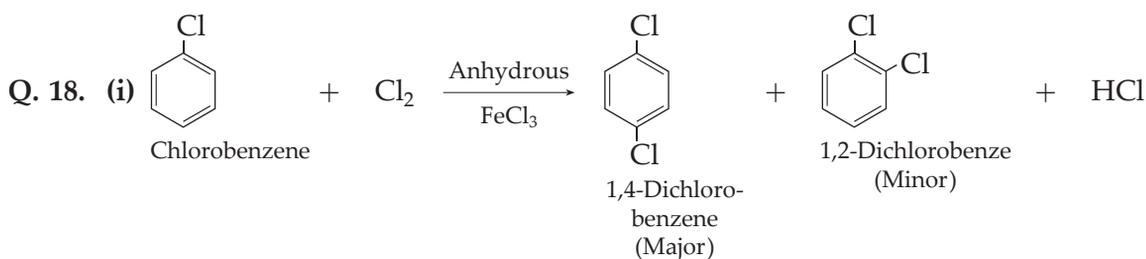
(b) For combustion of 1 mol of C_2H_6 , $\Delta H = -900 \text{ kJ}$

\therefore for combustion of 0.4 mol

$$\Delta H = 0.4 \times 900 = -360 \text{ kJ}$$

$$(c) \Delta H = \Delta U + \Delta n_g RT$$

$$\therefore \Delta U = \Delta H - \Delta n_g RT = -360 + 2.494 = -357.5 \text{ kJ.}$$



Q. 19. (a) Before changing the concentration of B

$$\text{Initial rate} = R_1 = k[A]_1[B]_1$$

After change in concentration of B

$$[B]_{\text{final}} = [B_2] = \frac{1}{3}[B]_1$$

$$\therefore R_2 = k[A]_1[B]_2 = k[A]_1 \times \frac{1}{3}[B]_1$$

$$\therefore \frac{R_2}{R_1} = \frac{k[A]_1 \times \frac{1}{3}[B]_1}{k[A]_1[B]_1} = \frac{1}{3}$$

$$\therefore R_2 = \frac{1}{3} R_1$$

Hence, the rate of the reaction will be decreased by a factor 3.

(b) When the concentration of each reactant is tripled, then the final concentrations will be,

$$[A]_2 = 3[A]_1 \text{ and } [B]_2 = 3[B]_1$$

$$\therefore R_2 = k \times 3[A]_1 \times 3[B]_1$$

$$\therefore \frac{R_2}{R_1} = \frac{k \times 3[A]_1 \times 3[B]_1}{k [A]_1 [B]_1} = 9$$

$$\therefore R_2 = 9R_1$$

Hence, the rate of the reaction will be increased 9 times.

(c) When the concentration A is doubled and that of B is halved then the final concentrations will be,

$$[A]_2 = 2[A]_1 \text{ and } [B]_2 = \frac{1}{2} [B]_1$$

$$\therefore R_2 = k [A]_2 [B]_2$$

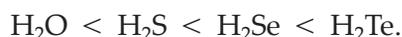
$$\therefore R_2 = k \times 2[A]_1 \times \frac{1}{2} [B]_1 = k[A]_1 [B]_1$$

$$\therefore \frac{R_2}{R_1} = \frac{k[A]_1 [B]_1}{k[A]_1 [B]_1} = 1$$

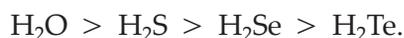
$$\therefore R_2 = R_1$$

Rate of the reaction will remain unchanged.

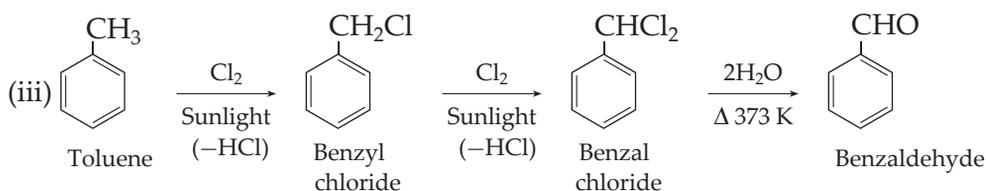
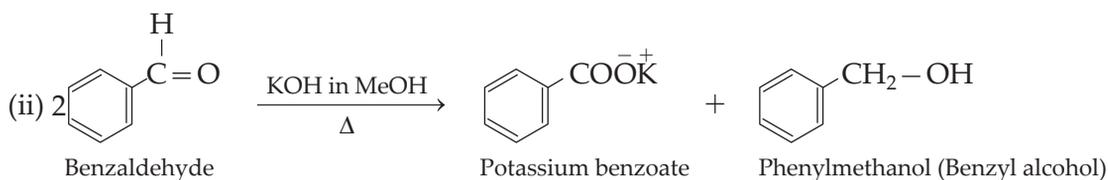
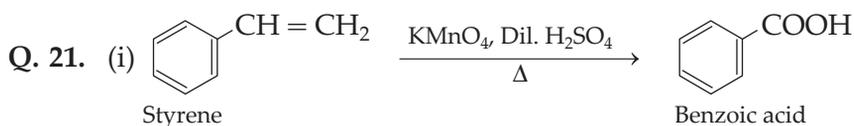
Q. 20. (i) Acidic character in increasing order :



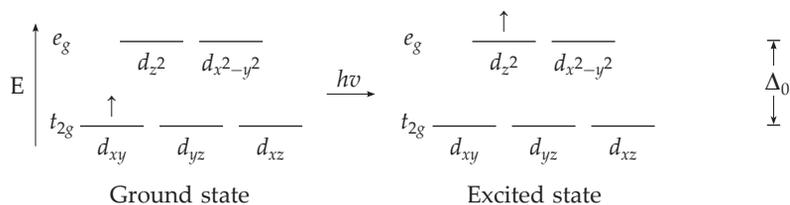
(ii) Thermal stability of hydrides of group 16 elements decreases in the order :



(iii) All hydrides except H_2O possess reducing property which increases in the order :



- Q. 22.** (i) In $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ complex the oxidation state of titanium ion is +3. The valence electron configuration of titanium ion is $[\text{Ar}]3d^1$.
- (ii) In ground state, 3d electron occupies one of lower energy d_{xy} , d_{yz} or d_{xz} orbital.
- (iii) When complex absorbs light, the absorbed energy promotes d-electron to one of higher energy d_{z^2} or $d_{x^2-y^2}$ orbital.



- (iv) Such a $d-d$ transition imparts colour to the complex.

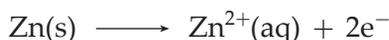
EAN rule states that the metal atom/ion continues to accept pairs from ligands till the total number of electrons present around the metal ion in the complex becomes equal to the atomic number of next rare gas atom.

Q. 23. Effect of dilution on conductivity :

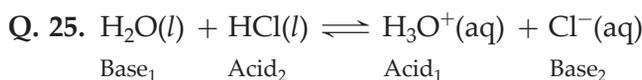
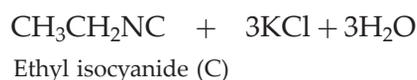
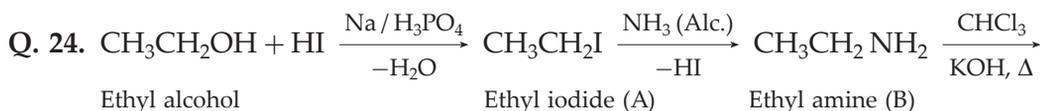
- (1) Conductivity is the conductance of unit volume (1 cm^3) of the electrolytic solution.
- (2) When the solution is diluted, total number of ions increases as degree of dissociation increases.
- (3) However, an increase in total number of ions is not in proportion of dilution.
- (4) Therefore, the number of ions per unit volume of solution actually decreases. This results in decrease of conductivity on dilution, i.e. with decrease in concentration.

Anode is negative in galvanic cell :

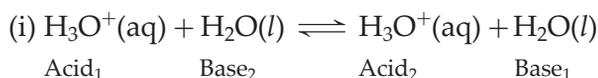
- (1) According to IUPAC conventions, the electrode of a galvanic cell where deelectronation or oxidation takes place releasing electrons is called anode.



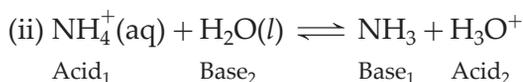
- (2) The electrons released due to oxidation reaction are accumulated on the metal electrode surface. Therefore the metal electrode becomes negatively charged. Hence, anode in the galvanic cell is considered to be negative.



Since water accepts a proton, it acts as a base.



Conjugate base of H_3O^+ is H_2O .



Conjugate base of NH_4^+ is NH_3 .

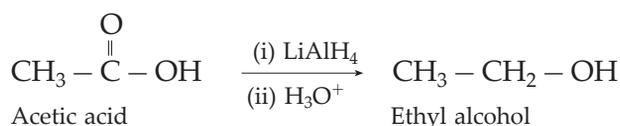
Q. 26. Extraction of iron is carried out in Blast furnace.

Catalytic properties of *d*-block elements :

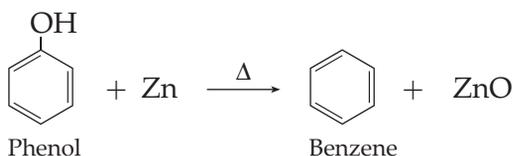
- (1) *d*-Block elements or transition metals and their compounds or complexes influence the rate of a chemical reaction and hence act as catalysts.
- (2) In homogeneous catalysis, a catalyst forms an unstable intermediate compound which decomposes into products and regenerates the catalyst.
- (3) In heterogeneous catalysis, the metal provides large surface area for the reactants to get adsorbed on the surface of solid catalysts.
- (4) Hence, compounds of Fe, Co, Ni, Pt, Pd, Cr, etc. are used as catalysts in many reactions.

SECTION – D

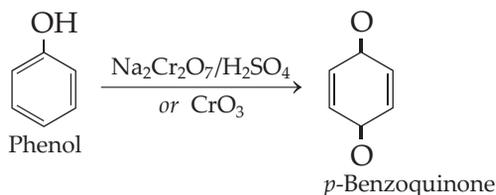
Q. 27. (i) Acetic acid to ethyl alcohol :



(ii) Phenol to benzene :



(iii) Phenol to *p*-benzoquinone :



Gases that deplete ozone layer :

Nitrogen oxide (NO) released from exhaust systems of car or supersonic jet aeroplanes and chlorofluorocarbons (Freons) used in aerosol sprays and refrigerators deplete ozone layer.

Q. 28.	Endothermic reaction	Exothermic reaction
	1. In endothermic reaction heat is absorbed from the surroundings.	1. In exothermic reaction heat is given out to the surroundings.
	2. Sum of enthalpies of products is greater than sum of enthalpies of reactants, i.e. $\Sigma H_{\text{products}} > \Sigma H_{\text{reactants}}$	2. Sum of enthalpies of products is less than sum of enthalpies of reactants, i.e. $\Sigma H_{\text{products}} < \Sigma H_{\text{reactants}}$
	3. Enthalpy of reaction, ΔH is positive.	3. Enthalpy of reaction, ΔH is negative.
	4. Products are less stable than reactants.	4. Products are more stable than reactants.

Reducing sugar : Maltose

Non-reducing sugar : Sucrose

Ores : The minerals that contain a high percentage of metals and from which metals can be profitably extracted are called ores.

Q. 29. Given : $X = 10 \text{ g}$; $\rho = 11.35 \text{ g/cm}^3$; $a = 500 \text{ pm} = 5.00 \times 10^{-8} \text{ cm}$

Formula : Number of unit cells in $X \text{ g}$ of metal = $\frac{X}{\rho a^3}$

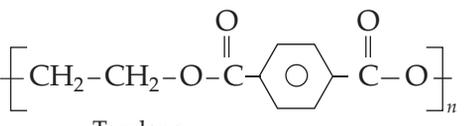
$$= \frac{10}{11.35 \times (5.00 \times 10^{-8})^3}$$

$$= \frac{10}{11.35 \times (5.00)^3 \times 10^{-24}}$$

$$= \frac{10}{11.35 \times 125} \times 10^{24} = 7 \times 10^{21}$$

Following are the advantages of nanotechnology :

- (1) Nanotechnology has revolutionized electronics and computing.
- (2) Nanotechnology has benefited the energy sector by making solar power more economical and energy storage more efficient.
- (3) Nanotechnology has transformed the medical field with the manufacture of smart drugs which help cure the life threatening diseases like cancer and diabetes faster and without side effects.

Structure of terylene :  Terylene	Monomer of terylene : Ethylene glycol $\left(\begin{array}{cc} \text{CH}_2 - \text{CH}_2 \\ \quad \quad \\ \text{OH} \quad \text{OH} \end{array} \right)$
--	---

Q. 30. The rate constant k and half-life period $t_{1/2}$ are related as

$$(t_{1/2})_1 = \frac{0.693}{k_1} \quad \text{and} \quad (t_{1/2})_2 = \frac{0.693}{k_2}$$

$$\therefore \frac{(t_{1/2})_2}{(t_{1/2})_1} = \frac{0.693/k_2}{0.693/k_1} = \frac{k_1}{k_2}$$

