

Self Assessment Test-1

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) **Correct option : (a)**

Explanation : In a metallic crystal, there are number of atoms and the atomic orbitals combined together to form molecular orbitals which are very close in energy and referred to as bands. [1]

- (ii) **Correct option : (a)**

Explanation : Metals contain free electrons to move, so they are good conductor of electricity [1]

- (iii) **Correct option : (c)**

Explanation : A small energy gap is present between valence band and the conduction band in semi-conductors.

- (iv) **Correct option : (d)**

Explanation : Insulators cannot conduct electricity. [1]

OR

- Correct option : (d)**

Explanation : Valence band is occupied level i.e., filled with electrons. [1]

Following questions (No. 2 to 5) are multiple choice questions carrying 1 mark each :

2. **Correct option : (a)**

$$\text{Explanation : } d = \frac{ZM}{a^3 N_o}$$

Where Z = Number of atoms per unit cell

M = Molar mass or Atomic mass

a = length of edge

N_o = Avogadro number

[1]

3. **Correct option : (b)**

Explanation : For bcc unit cell,

$$\text{Number of atoms at corner} = 8 \times \frac{1}{8} = 1$$

Number of atoms at faces = 0

Number of atoms at centre = 1

$$\therefore \text{Total number of atoms per cell} = 1 + 1 = 2$$

[1]

4. **Correct option : (b)**

Explanation : In fcc unit cell,

$$r = \frac{\sqrt{2}a}{4} = \frac{\sqrt{2} \times 361}{4}$$

$$= 127 \text{ pm}$$

[1]

5. **Correct option : (a)**

Explanation : The number of octahedral void in ccp structure is equal to effective number of atoms.

Effective number of atoms in ccp = 4

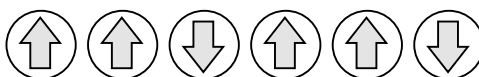
$$\therefore \text{Number of octahedral void} = 4$$

Hence, 1 octahedral void is present per atom.

[1]

6. **Correct option : (c)**

Explanation : Ferromagnetism arises due to spontaneous alignment of magnetic moments of ions or atoms in the same direction. [1]



7. **Correct option : (b)**

Explanation : The density remains unchanged in the crystals exhibiting Frenkel defect because in this defect, the ions do not missing from the crystal. One of the ion leaves its lattice position and occupies interstitial site. [1]

8. $\therefore$ An atom at the corner of the cube is shared by 8 cubes and it contributes only $\frac{1}{8}$ to a particular cube. A cube has 8 corners.

$$\therefore \text{Number of atoms of A in the unit cell} = 8 \times \frac{1}{8} = 1 \quad [1/2]$$

$\therefore$ An atom at the center of a cube belongs only to one unit cell.

$$\therefore \text{Number of atoms of B in the unit cell} = 1 \times 1 = 1 \quad [1/2]$$

Hence, formula of the compound = AB [1]

9. In a bcc unit cell

$$r = \frac{a\sqrt{3}}{4} \quad [1]$$

$$a = 4.29 \text{ \AA}$$

$\therefore$ Radius of sodium atom

$$\begin{aligned} r &= \frac{4.29\sqrt{3}}{4} \\ &= \frac{4.29 \times 1.732}{4} \\ &= 1.86 \text{ \AA} \end{aligned} \quad [1]$$

10. (i) Frenkel defect is not found in pure alkali metal halides because the size of alkali metal ions is large which does not fit in interstitial sites. [1]

(ii) In metal excess defect due to anion vacancies, the 'holes' occupied by electrons are called F-centres or colour centres. These centres are responsible for the colour of the compound. Solids containing F-centres are paramagnetic because the electrons occupying the 'holes' are unpaired. [2]

$$\begin{aligned} 11. \text{ Mass of one atom} &= \frac{290}{2.5 \times 10^{24}} \\ \therefore \text{Number of atoms per unit cell in bcc} &= 2 \\ \therefore \text{Mass of one unit} &= \frac{290}{2.5 \times 10^{24}} \times 2 \end{aligned} \quad [1]$$

$$\begin{aligned} \text{Volume of one unit (} a^3 \text{)} &= \frac{\text{Mass}}{\text{Density}} \\ &= \frac{290 \times 2}{2.5 \times 10^{24} \times 7.13} \\ &= \frac{290 \times 2}{2.5 \times 10^{24} \times 7.13} \\ &= 3.253 \times 10^{-23} \text{ cm}^3 \\ \therefore a &= 3.192 \times 10^{-8} \text{ cm} \end{aligned} \quad [1]$$

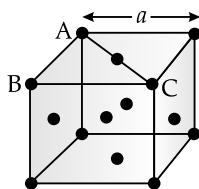
For a bcc unit cell,

$$\begin{aligned} \text{Atomic radius} \quad r &= \frac{a\sqrt{3}}{4} \\ &= \frac{3.192 \times 10^{-8} \times 1.732}{4} \\ &= 1.382 \times 10^{-8} \text{ cm} \end{aligned} \quad [1]$$

12. (i) A unit cell having lattice points at the centre of each face, in addition to the lattice points at the corners is called face centred cubic unit cell. [1]

(ii) There 4 spheres per unit cell in a fcc unit cell.

$$\text{Volume of sphere} = \frac{4}{3} \pi r^3$$



Volume of 4 spheres

$$\begin{aligned}
 &= 4 \times \frac{4}{3} \pi r^3 \\
 &= \frac{16}{3} \pi r^3
 \end{aligned}
 \quad [1]$$

In fcc unit cell, the spheres at corners are in contact with sphere at the face centre but are not touching each other.

Therefore, face diagonal AC is equal to four times the radius of sphere.

$$AC = 4r \quad [1]$$

But in right angled triangle ABC

$$\begin{aligned}
 AC &= \sqrt{AB^2 + BC^2} \\
 &= \sqrt{a^2 + a^2} \\
 &= \sqrt{2}a
 \end{aligned}$$

$$\sqrt{2}a = 4r$$

$$\therefore a = \frac{4r}{\sqrt{2}}$$

$$\begin{aligned}
 \text{Volume of the unit cell} &= a^3 = \left(\frac{4r}{\sqrt{2}} \right)^3 \\
 &= \frac{64}{2\sqrt{2}} r^3
 \end{aligned}
 \quad [1]$$

% of space occupied by spheres

$$\begin{aligned}
 &= \frac{\text{Volume of spheres}}{\text{Volume of cube}} \times 100 \\
 &= \frac{\frac{16}{3} \pi r^3}{\frac{64}{2\sqrt{2}} r^3} \times 100 \\
 &= \frac{16}{3} \times \frac{22}{7} \times \frac{2\sqrt{2}}{64} \times 100 = 74\%
 \end{aligned}
 \quad [1]$$

OR

(i) Crystalline solids exhibit anisotropic nature. [1]

(ii) Edge length of unit cell (a) = 630 pm
 $= 630 \times 10^{-10} \text{ cm}$

$$Z = 4 \text{ (fcc)}$$

$$d = 1.984 \text{ g cm}^{-3}$$

$$M = ?$$

Density of unit cell

$$d = \frac{ZM}{a^3 N_A}$$

$$\text{or } M = \frac{d \times a^3 \times N_A}{Z}$$

$$\begin{aligned} & (1.984 \text{ g cm}^{-3}) \times (630 \times 10^{-10} \text{ cm})^3 \\ &= \frac{\times (6.022 \times 10^{23} \text{ mol}^{-1})}{4} \end{aligned}$$

$$= 74.67 \text{ g mol}^{-1}$$

(iii) Density of crystal (d) = 1.53 g cm^{-3}

Molar mass (M) = 6.94 g mol^{-1}

Volume (a^3) = ?

$Z = 2$ (bcc)

$$\therefore d = \frac{ZM}{a^3 N_A}$$

$$\begin{aligned} \therefore a^3 &= \frac{ZM}{dN_A} \\ &= \frac{2 \times (6.94 \text{ g mol}^{-1})}{(1.53 \text{ g cm}^{-3})(6.022 \times 10^{23} \text{ mol}^{-1})} \\ &= 1.507 \times 10^{-23} \text{ cm}^3 \end{aligned}$$

Volume of unit cell = $15.07 \times 10^{-24} \text{ cm}^3$

[2]



OSWAAL BOOKS
LEARNING MADE SIMPLE

Self Assessment Test-2

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) Correct option : (d)

Explanation : The solubility of gas in water depends upon nature of gas, temperature and pressure [1]

- (ii) Correct option : (b)

Explanation : The dissolution of gas in water is an exothermic process as heat is liberated in this process. [1]

- (iii) Correct option : (b)

Explanation : The solubility of gas decreases with rise in temperature. It is because of the fact that kinetic energy of the gas increases with increases in temperature and its molecules have a greater tendency to escape the attraction of the solvent molecular and return to the gas phase. [1]

- (iv) Correct Option : (b)

Explanation : The effect of pressure on the solubility of a gas is given by Henry's Law. [1]

2. Correct option : (c)

Explanation : During the formation of an ideal solution, no change in enthalpy and no change in volume take place. So, $\Delta H_{\text{mix}} \neq 0$ is not correct for an ideal gas. [1]

3. Correct option : (d)

Explanation : A solution of H_2O and $\text{C}_2\text{H}_5\text{OH}$ shows positive deviation from Raoult's law because there is hydrogen bonding present in the ethyl alcohol ($\text{C}_6\text{H}_5\text{OH}$) solution and water (H_2O) molecules tend to occupy the space between them due to which some hydrogen bonds break. [1]

4. Correct option : (a)

Explanation : Osmotic pressure is a colligative property because it depends upon the number of particles. [1]

5. Correct option : (b)

Explanation : Molality = Number of moles of solute/Mass of 1000 g of solvent [1]

6. Correct option : (a)

Explanation : Cooking time is reduced in pressure cooker because boiling point of water inside is pressure cooker is elevated so more cooking is done before the water actually starts to boil. So, ultimately food is cooked faster. [1]

7. Correct Option : (c)

Explanation : The intensity of the osmotic pressure is equal to the pressure that is required to apply in the solution to prevent its dilution by the entering of water by osmosis. So, isotonic, solutions are solutions having the same osmotic pressure. [1]

8. Mass of glucose (W_B) = 10 g

Mass of water (W_A) = 90 g

Mass of solution = $W_A + W_B = 90 + 10 = 100$ g

Mass percentage of glucose

= mass of solute/mass of solution $\times 100$

$$= \frac{10}{100} \times 100$$

= 10% w/w

9. Mass of solute (acid) $W_B = 0.1$ g

Mass of solvent (water) $W_A = 22$ g

$$\Delta T_f = 273 - 272.817$$

$$= 1.817 \text{ K}$$

$$K_f = 1.86 \text{ K kg mol}^{-1}$$

$$M_B = ?$$

$$\Delta T_f = \frac{K_f \times W_B \times 1000}{M_B \times W_A}$$

$$\begin{aligned} \text{or } M_B &= \frac{K_f \times W_B \times 1000}{T_f \times W_A} \\ &= \frac{1.86 \times 0.1 \times 1000}{1.017 \times 22} \\ &= 46.2 \text{ g mol}^{-1} \end{aligned}$$

[2]

10. Mass of solute ' W_B ' = 10.8 g
Molecular mass of solute ' M_B ' = 342 g/mol
Mass of solvent ' W_A ' = 100 g
 $K_b = 0.52 \text{ K kg mol}^{-1}$

$$\begin{aligned} \Delta T_b &= \frac{K_b \times W_B \times 1000}{M_B \times W_A} \\ &= \frac{0.52 \times 10.8 \times 1000}{342 \times 100} = 0.164 \text{ K} \end{aligned}$$

Boiling point of water at 1.013 bar pressure
= 373.15 K

Boiling point of solution

$$= \text{Boiling point of water} + \Delta T_b$$

$$= 373.15 + 0.164 = 373.314 \text{ K}$$

[1]

11. $K_f = 31.8 \text{ K kg mol}^{-1}$ Mass of solute (W_B) = 10 g Mass of solvent (W_A) = 2 kg = $2 \times 1000 = 2000 \text{ g}$ $\Delta T_f = 1.08^\circ\text{C}$
Calculation of observed molecular mass

$$\begin{aligned} M_B &= \frac{K_f \times W_B \times 1000}{\Delta T_f \times W_A} \\ &= \frac{31.8 \times 10 \times 1000}{1.08 \times 2000} \\ &= 147.2 \end{aligned}$$

Calculation of van't Hoff factor(i)

$$\begin{aligned} i &= \frac{\text{Normal molecular mass}}{\text{observed molecular mass}} = \frac{94}{147.2} \\ &= 0.638 \end{aligned}$$

Calculation of degree of dissociation(α)

$$\alpha = \frac{i - 1}{1/m - 1}$$

Since X undergoes dimerisation

$$m = 2$$

$$\begin{aligned} \alpha &= \frac{0.638 - 1}{1/2 - 1} \\ &= \frac{0.638 - 1}{0.5 - 1} = \frac{-0.362}{-0.5} = 0.724 \text{ or } 72.4\% \end{aligned}$$

- 12.(i) (a) **Molarity** : Molarity of a substance in a solution is equal to the number of moles of the substance present in one litre of the solution.

$$\text{i.e. Molarity} = \frac{\text{No. of moles of substance}}{\text{Volume of solution in L}}$$

[1]

(b) Molal elevation constant : It is also called ebullioscopic constant. It is equal to the change in boiling point of one molar solution.

$$\Delta T_b = K_b m$$

(ii) Given; Mass of urea, $W_B = 15 \text{ g}$

Molar mass of urea, $M_B = 60 \text{ g}$

The solution of urea in water is isotonic to that of glucose solution.

So, $\pi_{\text{urea}} = \pi_{\text{Glucose}}$

$$C_{\text{urea}} RT = C_{\text{Glucose}} RT$$

$$\frac{n_{\text{urea}}}{V} RT = \frac{n_{\text{Glucose}}}{V} RT$$

$$\text{Or, } W_{\text{Glucose}} = \frac{15 \times 180}{60}$$

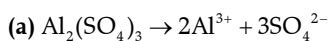
$$W_{\text{Glucose}} = 45 \text{ g}$$

So, 45 g of glucose is present in 1 L of solution

[1]

OR

[3]

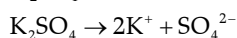


Van't Hoff factor (i)

$$= \frac{\text{Number of particles after dissociation}}{\text{Number of particles before dissociation}}$$

$$= \frac{5}{1} = 5$$

(b) Since, K_2SO_4 dissociates into three particles



$\therefore$ The freezing point of K_2SO_4 will be minimum

(c) Mass of solute (W_B) = ?

$$\begin{aligned} \text{Molecular mass of solute } (M_B) &= 36 + 8 + 48 \\ &= 92 \text{ g mol}^{-1} \end{aligned}$$

Mass of solvent (W_A) = 500 g

$$\begin{aligned} \text{Rate of reaction} &= \frac{-d[\text{N}_2\text{O}_5]}{dt} = \frac{1}{2} \left(\frac{d[\text{NO}_2]}{dt} \right) \\ &= 2 \left(\frac{d[\text{O}_2]}{dt} \right) \end{aligned}$$

[5]

Self Assessment Test-3

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

TIME : 1hr

M.M. : 25

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) **Correct option :** (a)

Since Ti^{4+}/Ti^{3+} has lower reduction potential than Fe^{3+}/Fe^{2+} , it cannot be reduced in comparison with Fe^{3+}/Fe^{2+} ions. [½]

Hence Ti^{4+} cannot oxidise Fe^{2+} to Fe^{3+} . [½]

(ii) **Correct option :** (c)

As the value of reduction potential increases the stability of +2 oxidation state increases. [½]

Therefore correct order of stability is

$Cr^{3+}/Cr^{2+} < Fe^{3+}/Fe^{2+} < Mn^{3+}/Mn^{2+}$ [½]

(iii) **Correct option :** (b)

Mercury cell is used in hearing aids. [1]

(iv) **Correct option :** (c)

Products of electrolysis depends on electrode potential of the species participating [1]

Or

Correct option : (d)

An inert electrode does not provide surface for redox reaction i.e., both oxidation and reduction as it provides surface either for oxidation or for reduction reaction. [1]

2. **Correct option:** (a)

Explanation:

$E^{\circ}Zn^{2+}/Zn = -0.76 V$

$E^{\circ}Fe^{2+}/Fe = -0.44 V$

$\therefore$ The standard reduction potential of Zn is highly negative. So, it acts a anode and protects iron by making as iron cathode. [1]

3. **Correct option :** (d)

Explanation: Fuel cells like H_2 and CH_4 convert chemical energy into electrical energy. [1]

4. **Correct option :** (a)

Explanation : Greater than value of E° , strongest will be oxidant when lesser the value of E° , strongest will be the reductant. [1]

5. **Correct option:** (d)

Explanation : Following factors can affect the conducting of aqueous solution of an electrolyte.

- Charge present on ions
- Movement of ions
- Number of ions

[1]

6. **Correct option:** (a)

Explanation : Zinc is more reactive than copper so it displaces copper from copper sulphate solution.

$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

[1]

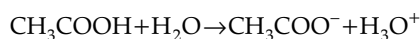
7. **Correct option:** (d)

Explanation : $2Ag + H_2SO_4 \rightarrow Ag_2SO_4 + H_2$

This reaction is not possible because the tendency to oxidize Ag is less than H_2 .

[1]

8. In case of CH_3COOH which is a weak electrolyte, the number of ions increase on dilution due to an increase in degree of dissociation resulting in drastic increase in Λ_m . [1]



In the case of CH_3COONa which is a strong electrolyte, the number of ions remains the same but the inter-ionic attraction decreases resulting in gradual increase in Λ_m . [1]

9. (i) Given : $E_{cell}^{\circ} = + 2.71 V$

and $F = 96500 C mol^{-1}$, $n = 2$

(from the given reaction)

$$\Delta_r G^\circ = -n \times F \times E_{\text{cell}}^\circ$$

$$\Delta_r G^\circ = -2 \times 96500 \text{ C mol}^{-1} \times 2.71 \text{ V}$$

$$= -523030 \text{ J/mol}$$

$$\text{or } -523.03 \text{ kJ/mol}$$

[1]

(ii) Hydrogen – Oxygen fuel cell/ fuel cell

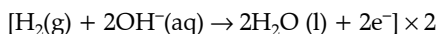
[1]

10. The process of slow conversion of metals into their undesirable compounds (usually oxide) by reaction with moisture and other gases present in the atmosphere.

[1]

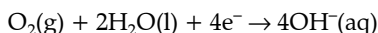
The electrochemical phenomenon of rusting can be described as

At anode:

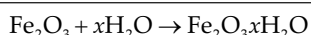
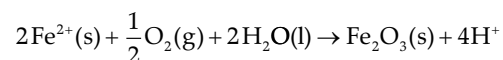
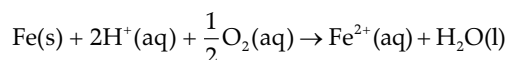


At cathode : Electrons released at anode move to another metal and reduces oxygen in the presence of H^+ . It is available in H & O_2 formed by the dissolution of CO_2 in another mole of water H^+ in water may be available in dissolution of other acidic oxides from atmosphere

[1]



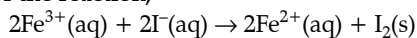
Net reaction



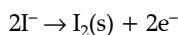
(Rust)

[1]

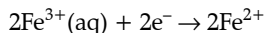
11. (i) For the reaction,



Oxidation half-reaction



Reduction half-reaction



$\therefore$ Number of electrons gain or lost (n) = 2

$$F = 96500 \text{ Jmol}^{-1}$$

$$E_{\text{cell}}^\circ = 0.236 \text{ V}$$

Standard Gibbs energy of the cell reaction.

$$\Delta G_1^\circ = -nFE_{\text{cell}}^\circ$$

$$= -2 \times 96500 \times 0.236$$

$$= -45548 \text{ Jmol}^{-1}$$

$$= -45.548 \text{ KJmol}^{-1}$$

[2]

- (ii) $I = 0.5 \text{ A}$

$$t = 2\text{Hrs} = 2 \times 3600 = 7200 \text{ sec}$$

Suppose, Number of electrons pass through metallic wire = n

$$Q = It = ne$$

$$\text{Or } It = ne$$

(e = charge of an electron = $1.6 \times 10^{-19} \text{ C}$)

$$0.5 \times 7200 = n \times 1.6 \times 10^{-19}$$

$$n = \frac{0.5 \times 7200}{1.6 \times 10^{-19}}$$

$$= 2.25 \times 10^{22} \text{ electrons}$$

[1]

12. (i) (a) Molar conductivity of a solution at a given concentration is the conducting power at all ions produced by 1 mole of an electrolyte.

[1]

(b) Secondary battery can be recharged by passing current through it in opposite direction so that can be used again.

[1]

(c) Galvanic cells that are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol, etc directly into electrical energy are called fuel cells.

- (ii) (a) Faraday's first law of electrolysis states that the amount of chemical reaction which occurs at any electrode during electrolysis by current is proportional to the quantity of electricity passed through the electrolyte. (solution or melt).

[1]

- (b) According to Kohlrausch law of independent migration of ions limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributors of the anion and cation of the electrolyte. [1]

OR

- (i) Degree of dissociation is the ratio of molar conductivity at a specific concentration to the molar conductivity at infinite dilution. [1]

$$\text{Degree of dissociation}(\alpha) = \frac{\Lambda_m^c}{\Lambda_m^0}$$

- (ii) $E^\circ_{\text{cell}} = E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Ni}^{2+}/\text{Ni}}$
 $= 0.80 \text{ V} - 0.25 \text{ V}$ [½]
 $= 0.55 \text{ V}$ [½]

$$\log K_c = \left(\frac{nE^\circ_{\text{cell}}}{0.059} \right)$$
$$= \frac{2 \times 0.55}{0.059}$$
 [½]

$$\log K_c = 18.644$$
 [½]

$$K_c = \text{Anti log } 18.644 \quad K_c = 4 \times 10^{18}$$

$$\Delta G^\circ = -nE^\circ_{\text{cell}}$$

$$= -2 \times 96500 \text{ C mol}^{-1} \times 0.55 \text{ V}$$

$$= -106,150 \text{ J mol}^{-1}$$

$$\text{Max. work} = +106,150 \text{ J mol}^{-1}$$

$$\text{or } 106.150 \text{ k J mol}^{-1}$$
 [1]

Self Assessment Test-4

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

Answer 1.

(1 × 4 = 4)

(i) **Correct option : (a)**

Explanation : If the molecules of reactants collide then old chemical bonds are broken and new bonds of products are formed. [1]

(ii) **Correct option: (d)**

Explanation : All the collisions in a reaction mixture are not effective in bringing about the chemical reactions. [1]

(iii) **Correction option: (a)**

Explanation : Only those molecules form products whose energy is equal to or more than threshold energy, therefore, the number of effective collisions is very less than total number of collisions. [1]

(iv) **Correct option : (d)**

Explanation : Greater the concentration of reactants, higher is the rate of reaction. [1]

OR

Correct option : (c)

Explanation : When reactant molecules do not possess proper orientation then these molecules do not form products, even those having equal to or greater than threshold energy. [1]

Answer 2.

(1 × 4 = 4)

Correct option : (d)

Explanation : Activation energy changes by addition of catalyst in a chemical reaction in which the rate of reaction alters. [1]

Answer 3.

Correct option: (a)

Explanation : For first order reaction,

$$\text{Half-life period, } t_{1/2} = \frac{0.693}{k}$$

Where k = rate constant

Since, the half-life period of first order reaction does not depend on initial concentration of the reactant, so on increasing concentration of the reactant, the half-life period of that reaction is not affected and order of reaction is 1. [1]

Answer 4.

Correct option: (c)

Explanation : For zero order reaction,

$$\text{Rate}(r) = K[A]^0$$

$$\text{Unit of rate } (r) = \text{mol L}^{-1} \text{ s}^{-1}$$

$$\therefore \text{Unit of rate constant } (K) = \text{mol L}^{-1} \text{ s}^{-1}$$

[1]

Answer 5.

(2)

Correct option: (a)

Explanation : Arrhenius equation is

$$k = Ae^{-E_a/RT}$$

$$\text{Or } \ln k = \ln A - \frac{E_a}{RT}$$

[1]

Answer 6.

[2]

Correct option: (d)

Explanation : Half-life period is not always independent of initial concentration. It is independent of initial concentration only in case of first order reaction. [1]

Answer 7.

[3]

Correct option: (b)

Explanation : The order of a reaction cannot be written from the balanced reaction of a equation because it can only be determined experimentally. [1]

Answer 8.**(3)****(i)**Where, E_a = Activation Energy R = Gas constant**[1]****(ii)**

$$E_{a_1} = 40 \text{ J / mol}$$

$$E_{a_2} = 80 \text{ J / mol}$$

According to Arrhenius equation,

$$k = Ae^{-E_a/RT}$$

$$\therefore E_{a_1} < E_{a_2}$$

$$\therefore k_1 < k_2$$

[1]**Answer 9.****(1 × 4 = 4)****(i)** $A + B \rightarrow P$

$$\text{Given Rate law } r = k[A]^{1/2}[B]^2$$

$$\therefore \text{Order of reaction} = \frac{1}{2} + 2 = \frac{5}{2}$$

[1]**(ii)** $k = 5.5 \times 10^{-14} \text{ s}^{-1}$

For first order reaction,

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{5.5 \times 10^{-14} \text{ s}^{-1}}$$

$$= 1.26 \times 10^{13} \text{ s}$$

[1]**Answer 10.****(1 × 4 = 4)**

$$\text{Rate} = k[A]^x[B]^y$$

$$0.05 = k[0.1]^x[0.1]^y$$

.....(i)

$$0.10 = k[0.2]^x[0.1]^y$$

.....(ii)

$$0.05 = k[0.1]^x[0.2]^y$$

.....(iii) [$\frac{1}{2}$]**(ii) ÷ (i)**

$$\frac{0.10}{0.05} = (2)^x$$

$$x = 1$$

(iii) ÷ (i)

$$\frac{0.05}{0.05} = (2)^y$$

[$\frac{1}{2}$]

$$y = 0$$

$$\text{Rate} = k[A]^1[B]^0$$

[$\frac{1}{2}$]

It is a first order reaction.

$$k = \frac{\text{rate}}{[A]} = 0.5 \text{ s}^{-1}$$

[$\frac{1}{2}$]

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.5}$$

[$\frac{1}{2}$]

$$t_{1/2} = 1.386 \text{ s}$$

[$\frac{1}{2}$]

Answer 11.**(1 × 4 = 4)**

$$t_{1/2} = \frac{0.693}{k}$$

$$k_2 = \frac{0.693}{25} \quad T_2 = 350\text{K}$$

[½]

$$k_1 = \frac{0.693}{50} \quad T_1 = 300\text{K}$$

[½]

$$\frac{k_2}{k_1} = 2$$

[½]

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$$

[½]

$$\log 2 = \frac{E_a}{2.303 \times 8.314} \left[\frac{350 - 300}{350 \times 300} \right]$$

[½]

$$E_a = 12.104 \text{ kJ/mol.}$$

[½]

Answer 12.**(1 × 4 = 4)****(i)** For the first order reaction

$$t_1 = 30 \text{ sec}$$

$$t_2 = 60 \text{ sec}$$

$$k_1 = \frac{2.303}{t_1} \log \frac{a}{(a-x)}$$

$$k_1 = \frac{2.303}{30} \log \frac{0.60}{0.30}$$

$$= \frac{2.303}{30} \log 2$$

$$k_1 = \frac{2.303}{30} \times 0.3010$$

$$= 0.0231 \text{ s}^{-1}$$

$$\text{and } k_2 = \frac{2.303}{t_2} \log \frac{a}{(a-x)}$$

$$= \frac{2.303}{60} \log \frac{0.60}{0.15}$$

$$= \frac{2.303}{60} \log 2^2$$

$$k_2 = \frac{2.303 \times 2 \times 0.3010}{60}$$

$$= 0.0231 \text{ s}^{-1}$$

$$k_1 = k_2$$

[3]

Hence, the reaction is pseudo first order reaction.

$$\text{(ii) Rate} = \frac{\Delta x}{\Delta t}$$

$$= \frac{0.30 - 0.15}{60 - 30} = \frac{0.15}{30}$$

$$= 0.005 \text{ mol L}^{-1} \text{ s}^{-1}$$

[2]

OR**(i)** $A + B \rightarrow P$

$$\text{Rate} = k[A][B]^2$$

(a) When concentration of B is doubled it means concentration of B becomes 2 times.

$$\text{Thus, Rate} = k[A]^1[2B]^2$$

$$= k[A][4B]^2$$

So the rate becomes 4 times.

[1]

(b) Order of reaction is the number of molecules whose concentration alters after the reaction.

If A is present in excess, i.e., its concentration is unaffected.

So the rate depends only on concentration of B.

$$\text{As } k = [B]^2$$

Thus, the reaction is of second order.

[1]

(ii) For the first order reaction :

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$t = 30 \times 60 = 1800 \text{ sec}$$

$$k = \frac{2.303}{1800} \log \frac{100}{100-50}$$

$$= \frac{2.303}{1800} \log 2$$

$$= \frac{2.303}{1800} \times 0.3010$$

[1]

$$\text{and } k = \frac{2.303}{t} \log \frac{a}{(a-x)}$$

$$= \frac{2.303}{k} \log \frac{100}{100-90}$$

$$= \frac{2.303}{1800} \log 10$$

$$= \frac{2.303}{k}$$

[1]

By putting the value of k here, we get

$$t = \frac{2.303 \times 1800}{2.303 \times 0.3010}$$

$$= 5.98 \times 10^3 \text{ sec}$$

[1]

□□

Self Assessment Test-5

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

Answer 1.

(1 × 4 = 4)

(i) **Correct option : (b)**

Explanation : An emulsion cannot be broken by Emulsifying agents as it is used for stabilisation of an emulsion.

(ii) **Correct option : (c)**

Explanation : Vanishing cream is an example of Oil dispersed in water.

(iii) **Correct option : (a)**

Explanation : KCl can be used to precipitate the negatively charged emulsions.

(iv) **Correct option : (a)**

Explanation : Proteins, Gums, natural soaps are categorised as O/W emulsifying agents.

Answer 2.

(1 × 4 = 4)

(i) **Correct option : (b)**

Explanation : Colloidal particles being bigger aggregates, the number of particles in a colloidal solution is comparatively small as compared to a true solution. Hence, the values of colligative properties are of small order as compared to values shown by true solutions at same concentrations. [1]

(ii) **Correct option : (a)**

Explanation : One of the reasons for the charge on the sol particles is that the sol particles acquire positive or negative charge by preferential adsorption of positive or negative ions. [1]

(iii) **Correct option : (c)**

Explanation : The Tyndall effect observed in colloidal solution is due to the fact that colloidal particles scatter light in all directions in space. This scattering of light illuminates the path of beam in the colloidal dispersion. [1]

(iv) **Correct option : (d)**

Explanation : The colour of colloidal solution depends on the wavelength of light scattered by the dispersed particles.

The colour of colloidal solution also changes with the manner in which the observer receives the light. [1]

Answer 3.

Correct option : (b)

$K_4[Fe(CN)_6]/[Fe(CN)_6]^{4-}$.

[1]

[CBSE Marking Scheme 2017]

Answer 4.

Correct option : (a)

[1]

Explanation : Cleansing of clothes takes place by micelles and their formation starts at CMC. The lesser is the CMC, the better and more economical is the detergent.

Answer 5.

(2)

Ans.

S. No.	Physisorption	Chemisorption
(i)	Due to Van der Waals forces	Due to chemical bond formation
(ii)	Reversible	Irreversible
(iii)	Enthalpy of adsorption is low (20-40 kJ/mol.)	Enthalpy of adsorption is high (80-240 kJ/mol.)
(or any other correct difference)		

[1+1]

[CBSE Marking Scheme 2017]

Detailed Answer:

S. No.	Physisorption	Chemisorption
(i)	It arises by weak Van der Waals forces.	It arises by strong forces like chemical bond.
(ii)	It usually takes place at a low temperature and decreases with increasing temperature.	It takes place at a high temperature and increases with increase in temperature.
(iii)	It is reversible.	It is irreversible.
(iv)	It depends on the ease of liquefaction of the gas.	The extent of adsorption is not related to liquefaction of the gas.
(v)	It is not very specific.	It is highly specific.
(vi)	It forms multi-molecular layers.	It forms mono-molecular layers.
(vii)	It does not require any activation energy.	It requires activation energy.

(Any two correct differences) [2]

Answer 6.

(a) Dispersed phase = liquid; Dispersion medium = liquid

(b) Due to the formation of new bonds / force of attraction between adsorbate and adsorbent.

[2]

[CBSE Marking Scheme, 2019]

Detailed Answer :

(a) Dispersed phase in milk - Liquid/oil

Dispersion medium in milk - Liquid/water.

(b) Because adsorption leads to a decrease in the residual forces on the surface of the adsorbent. This causes a decrease in the surface energy of the adsorbent. Therefore, adsorption is always exothermic. [2]

Answer 7.

(i) Lyophobic sols are liquid (dispersion medium)- hating and lyophilic sols are liquid (dispersion medium)- loving colloids. [1]

(ii) Solution is a homogeneous mixture while colloid is heterogeneous mixture / does not show tyndall effect – shows tyndall effect. [1]

(iii) Emulsion – both dispersed phase and dispersion medium are liquid Gel- Dispersed phase is liquid while dispersion medium is solid. (or any other correct difference)

[CBSE Marking Scheme 2017]

Answer 8.

(a) Because it is an exothermic reaction. [1]

(b) When AgNO_3 solution is added to KI solution, negatively charged sol of AgI is formed due to elective adsorption of I^- ion from the dispersion medium. It is represented as given below.

Negatively charged.

[1]

(c) **Differences between Adsorption and Absorption :**

S.No	Adsorption	Absorption
(i)	It is surface phenomenon. Adsorbate molecules are held at the surface of adsorbent.	Absorption occurs In the bulk of absorbing substance.
(ii)	The concentration of the adsorbate at the adsorbent is much more than that in the bulk.	Absorbed material is uniformly distributed throughout the bulk. Thus, concentration is same throughout.
(iii)	Initially rate of adsorption is rapid. It decreases slowly till equilibrium is attained.	Absorption occurs with uniform rate.
(iv)	Example: Water vapours on silica gel	Example : Water vapours are absorbed by anhydrous CaCl_2 .

[3]

Answer 9.**(1 × 4 = 4)**

In multi-molecular colloids, the colloidal particles are an aggregate of atoms or small molecules with a diameter of less than 1 nm. The molecules in the aggregate are held together by Van der Waal's forces of attraction. Examples of such colloids include gold sol and sulphur sol. In macro-molecular colloids, the colloidal particles are large molecules having colloidal dimensions. These particles have a high molecular mass. When these particles are dissolved in a liquid, sol is obtained. For example : Starch, nylon, cellulose, etc. [3]

Certain substances tend to behave like normal electrolytes at lower concentrations. However, at higher concentrations, these substances behave as colloidal solutions due to the formation of aggregated particles. Such colloids are called aggregated colloids. [2]

□□



Self Assessment Test-6

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

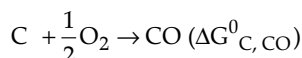
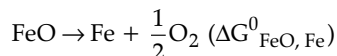
Answer 1.

(1 × 4 = 4)

(i) Correct option : (d)

Explanation : $\text{FeO} + \text{C} \rightarrow \text{Fe} + \text{CO}$

It can be seen as a couple of two simpler reactions :



Total Gibb's energy change becomes

$$\Delta G_{(\text{C, CO})}^0 < \Delta_{(\text{Fe, FeO})} \Delta_r G^0$$

In ΔG^0 versus T plotting Fe to FeO goes upwards and the plot for C to CO goes downwards.

At temperature above point A, the C to CO lines comes below Fe to FeO and $\Delta G_{(\text{C, CO})}^0 < \Delta G_{(\text{Fe, FeO})}^0$

So, in this range, C will reduce FeO to Fe and itself be oxidised to CO.

[1]

(ii) Correct option : (a)

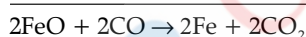
Explanation : Below point 'A' Gibb's free energy changes for the formation of CO_2 (carbon dioxide) from CO (carbon monoxide) has lower value that means, it has more negative value than Gibbs free energy change for the formation of FeO (ferrous oxide). Hence, FeO will be reduced by CO only below point 'A'.

[1]

(iii) Correct option : (a)

Explanation : At point D both the curves of oxidation of iron (Fe) and oxidation of carbon monoxide (CO) meet each other.

Thus, ΔG^0 for the reaction $\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$ is zero.



$$\Delta G^0 = (-280 + 280) = 0$$

[1]

(iv) Correct option : (d)

Answer 2.

(1 × 4 = 4)

(i) Correct option : (b)

Explanation : Due to oil the sulphide ores get wet and become lighter and rises to the surface along with froth but impurities wetted by water become heavier and settle down.

(ii) Correct option : (a)

Explanation : Pine oil (collector) enhances the non-wettability of the ore particles, which becomes lighter and hence rise to the surface along with the froth.

(iii) Correct option : (a)

Explanation : The role of the depressants is to separate two sulphide ores by selectively preventing one ore from forming froth. NaCN acts as a depressant in case of an ore containing ZnS and PbS as it selectively prevents ZnS from coming to the froth but allows PbS to come with the froth.

(iv) Correct option : (c)

Explanation : A suspension of the powdered ore is made with water. Collectors enhance the non-wettability of the mineral particles. The mineral particles become wet by oils while gangue particles by water.

Answer 3.**Correct option : (b)***Explanation :* In the metallurgy of Aluminium, graphite anode is oxidised to carbon monoxide and carbon dioxide.**Answer 4.****Correct option: (b)****[1]***Explanation :* Copper (Cu) is extracted through the process of hydro-metallurgical process and in this process, salts of metal are dissolved in suitable solvent like water and then reduced by more electropositive element so that the pure metal can get displaced by more electropositive element.**Answer 5.****(2)**

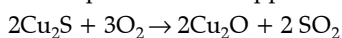
Method used for refining of

Nickel- Mond's process

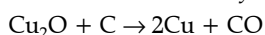
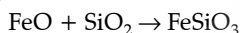
Copper- Electrolytic refining

[1]**Answer 6.****(2)**

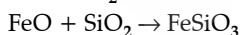
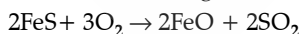
The sulphide ores of copper are roasted/smelted to give oxides :

**[1]**

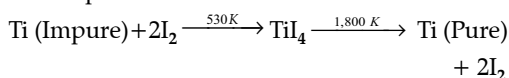
The oxide can be easily reduced to metallic copper using coke.

**[1]****Answer 7.****(3)****(i)** Zone refining.**[1]****(ii)** Leaching / Bayer's process.**[1]****(iii)** Coke act as a reducing agent resulting in formation of CO.**[1]****Answer 8.****(3)****(i)** Zinc is refined by electrolytic refining.**(a)** This method is based upon the phenomenon of electrolysis.**(b)** The crude metal is made anode whereas a thin sheet of pure metal is made cathode.**(c)** Electrolyte is the solution of some salt of metal.**[2]****(ii)** In the extraction of copper, silica (SiO_2) acts as 'flux'. It reacts with FeO and removes it as slag (FeSiO_3).

(Flux) Slag

[1]**Answer 9.****(1 × 4 = 4)****(a)** Ellingham diagram which relates Gibbs free energy and temperature at below 710K. $\Delta G_{(\text{C}, \text{CO}_2)} < \Delta G_{(\text{C}, \text{CO})}$. Thus, CO_2 is a better reducing agent than CO while above 710K, CO becomes a very good reducing agent.**[1]****(b)** Sulphide ores cannot be reduced easily but oxide ores can be easily reduced. So, sulphide ores are generally converted into oxides before reduction.**[1]****(c)** Copper pyrites contain iron sulphide in addition to copper sulphide. In the reverberatory furnace, copper ore is roasted to give oxides. FeO is removed by adding silica from the matte containing Cu_2S and FeS.**[1]**

(Slag)

(d) At the high temperature carbon and hydrogen react with metals to form carbides and hydrides respectively. Hence, they are not used as reducing agents.**[1]****(e)** Ti reacts with iodine to form TiI_4 which is volatile and decomposes to give Ti at high temperature to give extra pure titanium.**[1]**

□□

Self Assessment Test-7

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) **Correct option : (c)**

Explanation : $\text{BrO}_4^- > \text{IO}_4^- > \text{ClO}_4^-$
decreasing order of oxidising power.

[1]

- (ii) **Correct option : (b)**

Explanation : Isoelectronic pairs are those ions/species which have same numbers of electrons in their molecules.

$\text{Br} = 3e^-$ $\text{O} = 6e^-$ $\text{F} = e^-$

$\text{BrO}_2^- = 7e^- + 12e^- + 1e^-$

(from -ve charge on the ion) = $20e^-$

$\text{BrF}_2^+ = 7e^- + 13e^- + (+ve \text{ charge}) = 20e^-$

[1]

- (iii) **Correct option : (b)**

Explanation : $\text{MI} > \text{MBr} > \text{MCl} > \text{MF}$ is incorrect representation of the ionic character of metal halides. The ionic character of halides is in the order $\text{MF} > \text{MCl} > \text{MBr} > \text{MI}$.

[1]

- (iv) **Correct option : (b)**

Explanation : Interhalogens are more reactive than other halogens except Fluorine because X-X' bonds are weaker than X-X bonds.

[1]

OR

- Correct option : (c)**

Explanation : Chlorine water on standing loses its yellow colour due to formation of HCl and HOCl.

[1]

2. **Correct option : (c)**

Explanation : P_4 molecules in white phosphorus have angular strain therefore white phosphorus is very reactive.

[1]

3. **Correct option : (c)**

Explanation : Since central metal of anion is P, let's calculate the oxidation state (Y).

$$1 + 2 \times 1 + Y + 2 \times (-2) = 0$$

$$\Rightarrow Y = +1$$

[1]

4. **Correct option : (a)**

Explanation : Nitrogen does not show allotropy because of its small size and high electronegativity.

[1]

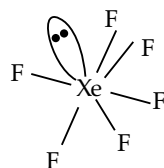
5. **Correct option : (d)**

Explanation : In solid state PCl_5 is an ionic solid with $[\text{PCl}_4]^+$ tetrahedral and $[\text{PCl}_6]^-$ octahedral

[1]

6. **Correct option: (b)**

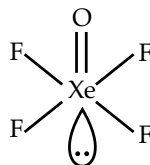
Explanation :



sp^3d^3 - distorted octahedral

(due to bond pair-lone pair repulsion) [1]

7. **Correct option: (a)**



sp^3d^2 - square pyramidal

8. The conditions used to maximise the yield of H_2SO_4 by contact process :

(i) High pressure

(ii) Low temperature

(iii) V_2O_5 is used as catalyst

(Any two) 2

9. (i) $2\text{Ag} + \text{PCl}_5 \rightarrow 2\text{AgCl} + \text{PCl}_3$ [1]

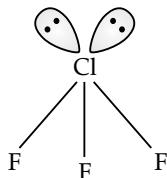
(ii) $\text{CaF}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4(\text{s}) + 2\text{HF}$ (or H_2F_2) [1]

10. (i) Because as N can't form 5 covalent bonds as its maximum covalency is three. The octet cannot be extended as it doesn't have d orbital, while P can extend its octet as it has empty d orbital. [1]

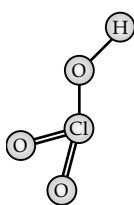
(ii) This is due to very small size of oxygen atom, repulsion between electrons is large in relatively small 2p sub-shell. [1]

(iii) In H_3PO_2 there are 2 P – H bonds, whereas in H_3PO_3 there is 1 P-H bond. [1]

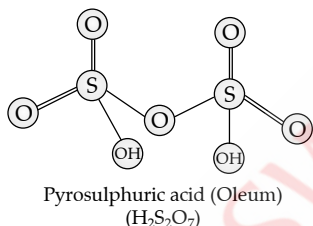
11. (i) ClF_3



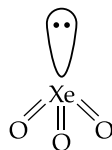
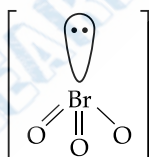
(ii) HClO_3



(iii) $\text{H}_2\text{S}_2\text{O}_7$



12. (i)



(ii) Fluorine is a much stronger oxidizing agent than chlorine. The oxidizing power depends on three factors.

1. Bond dissociation energy
2. Electron gain enthalpy
3. Hydration enthalpy

The electron gain enthalpy of chlorine is more negative than that of fluorine. However, the bond dissociation energy of fluorine is much lesser than that of chlorine. Also, because of its small size, the hydration energy of fluorine is much higher than that of chlorine.

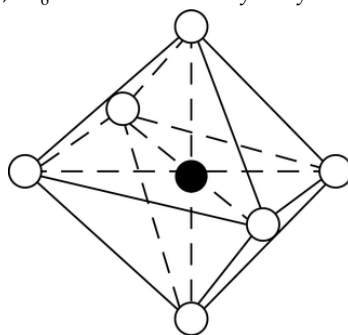
Fluorine is much stronger oxidising agent than chlorine. [2]

(iii) H_2SO_4 is a dibasic acid which ionises in two stages and shows two dissociation constants K_{a1} and K_{a2} . The acid is dissociated into H^+ and HSO_4^- ions for which K_{a1} is very large indicating strong acid. However, in the second stage the negatively charged HSO_4^- ion has much less tendency to donate a proton to H_2O as compared to neutral H_2SO_4 , hence K_{a2} is very small. [2]

OR

(i) HF is a weaker acid because the strength of an acid is determined by how completely that acid will dissociate. Since the bond between HF is stronger than the bond between HCl, HCl will more completely dissociate which makes it a stronger acid. [1]

- (ii) In SF_6 , the sulphur atom is surrounded by six fluorine atoms which does not allow the water molecule to access and attack the sulphur atom. Hence, SF_6 is inert towards hydrolysis. [2]



- (iii) Xenon is large in size and has large atomic mass as well as radius. Due to larger atomic radius the force of attraction between the outer electrons and the protons in the nucleus is weak and thus easily available. [2]

●●

Self Assessment Test-8

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) Correct option : (d)

Explanation : Density is measured as mass per unit volume. While moving in a period from left to right, the atomic mass increases while the radius decreases. As the radius decreases so does the volume of the atom, hence the density increases in a period.

As Fe(26), Co(27), Ni(28), Cu(29) are part of 1st series of transition metals, density increases from Fe to Cu. [1]

(ii) Correct option : (c)

Explanation : Although Zirconium belongs to 4d transition series and Hafnium to 5d transition series even then they show similar physical and chemical properties. [1]

(iii) Correct option : (a)

Explanation : Owing to the lanthanoid contraction, the atomic radii of the second and third row transition elements is almost same. Hence they resemble each other much more as compared to first row elements. [1]

(iv) Correct option : (a)

Explanation : Copper does not liberate hydrogen from acids as copper is lower in the electrochemical series than hydrogen. A more reactive element can displace a less reactive element from its salt solution. [1]

2. (i) Correct option : (d)

Explanation : Characteristic oxidation state of lanthanoids is +3 but Cerium also shows +4 oxidation state because it has a tendency to attain a noble gas configuration by obtaining $4f^0$ configuration in +4 state. Ce has $4f^1 5d^1 6s^2$ configuration. [1]

(ii) Correct option : (a)

Explanation : The filling of 4f before 5d orbitals result in decrease of atomic radii which is called lanthanoid contraction which in turn compensates for increase in atomic size with increasing atomic number. [1]

(iii) Correct option : (b)

Explanation : The magnetic moment of Cr^{3+} is 3.87 B.M. and that of Co^{2+} is 4.87 B.M. Magnetic moment of transition metal is calculated by spin only formula whereas for lanthanide both spin and orbital contribution will count. Cr^{3+} and Co^{2+} ions have same number of unpaired electrons. Hence due to symmetrical electronic configuration there is no orbital contribution in Cr^{3+} ion. However appreciable orbital contribution takes place in Co^{2+} ion. [1]

(iv) Correct option : (c)

Explanation : Ionisation enthalpies of Ce, Pr and Nd (actinoids) are higher than Th, Pa and U (lanthanoids) because in the beginning, when 5f orbitals begin to be occupied, electrons will penetrate less into the inner core. The 5f electrons will therefore, be more effectively shielded from the nuclear charge than 4f electrons of the corresponding lanthanoids. Therefore, outer electrons are less firmly held and they are available for bonding in the actinoids. [1]

3. Correct option : (a)

Explanation : Co will form MF_3 type compounds. Co (27 atomic no.) has electronic configuration of $[\text{Ar}] 3d^7 4s^2$. As it has 3 unpaired electrons in the d orbital, it can pair up with halogens to give MF_3 type compounds.

4. Correct option : (d)

Explanation : Actinoids form more stable complexes as compared to lanthanoids because they utilise their 5f orbitals with 6d orbitals in bond formation while lanthanoids do not use their 4f orbitals for bonding. [1]

5.

- (i) Because of strong interatomic interactions / Strong metallic bonding between atoms. [1]
 (ii) Due to stable $3d^5$ configuration, interatomic interaction is poor between unpaired electrons. [1]
[CBSE Marking Scheme 2019]

Detailed Answer :

- (i) The transition elements have high enthalpies of atomization because they have large number of unpaired electrons in their atoms. This results in stronger interatomic interaction and stronger bonding between atoms. [1]
- (ii) Mn has low melting point because of $3d^5 4s^2$ configuration, which is highly stable and delocalised, so are not available for bonding, as a result interatomic forces becomes weaker. Hence Mn has low melting point bounded half-filled a orbital electrons with nucleus results in strong interatomic interaction. [1]
6. (a) $5\text{SO}_3^{2-} + 2\text{MnO}_4^- + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 3\text{H}_2\text{O} + 5\text{SO}_4^{2-}$ [1]
 (b) $2\text{MnO}_4^- + \text{H}_2\text{O} + \text{I}^- \rightarrow 2\text{MnO}_2 + 2\text{OH}^- + \text{IO}_3^-$ [1]
7. (a) Due to d-d-transition. [1]
 (b) Due to higher oxidation state of Mn_2O_7 /Due to high polarizing power of Mn(VII). [1]
 (c) In the crystal lattice, transition elements have interstitial vacant spaces into which small sized non-metal atoms such as H, B, C or N are trapped. These compounds are non-stoichiometric, neither typically ionic nor covalent. e.g., TiC , MH , Fe_3H etc. [1]
8. (i) Most stable oxidation state of Ni = +2. [½]
 It is because $(\text{IE}_1 + \text{IE}_2)$ of Ni is lesser than Pt [½]
 Most stable oxidation state of Pt = +4 [½]
 It is because $(\text{IE}_3 + \text{IE}_4)$ of Pt is lesser than Ni [½]
- (ii) Platinum (Pt) easily forms compounds in +4 oxidation state because energy required to remove four electrons for Pt is lesser than Ni. [1]
9. (i) (a) Because of comparable energies of $(n-1)d$ and ns orbitals / Incomplete filling of d -orbital.
 (b) These elements have completely filled orbitals in ground state.
 Zn has electronic configuration : $[\text{Ar}] 3d^{10} 4s^2$
 Cd has electronic configuration : $[\text{Kr}] 4d^{10} 5s^2$
 Hg has electronic configuration : $[\text{Xe}] 4f^{14} 5d^{10} 6s^2$
 These elements do not form strong metallic bonds because of the absence of unpaired electrons hence they are soft.
 (c) Because Mn^{2+} is more stable ($3d^5$) than Mn^{3+} ($3d^4$), while Cr^{+3} is more stable due to $t^3_2 g/d^3$ configuration. 1
- (ii) (a) $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$
 (b) $\text{Mn}^{3+} = [\text{Ar}] 4s^0 3d^4$ (4 unpaired e^-)
 $\text{Cr}^{+3} = [\text{Ar}] 4s^0 3d^3$ (3 unpaired e^-)
 Since Mn^{3+} has more unpaired electrons, it is more paramagnetic.

●●

Self Assessment Test-9

Time : 1 hrs.

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) **Correct option: (a)**

Explanation : The degeneracy of the d orbitals is removed in the octahedral complexes due to ligand electron-metal electron repulsions to yield three orbitals of lower energy, t_{2g} set and two orbitals of higher energy, e_g set. [1]

(ii) **Correct option: (b)**

Explanation : The crystal field splitting, Δ_o , depends upon the field produced by the ligand and charge on the metal ion. Some ligands are able to produce strong fields in which case, the splitting will be large whereas others produce weak fields and consequently result in small splitting of d orbitals. [1]

(iii) **Correct option: (d)**

Explanation : Spectrochemical series is an experimentally determined series based on the absorption of light by complexes with different ligands in which ligands are arranged in a series in the order of increasing field strength. [1]

(iv) **Correct option: (b)**

Explanation : In tetrahedral coordination entity formation, the d orbital splitting is inverted and is smaller as compared to the octahedral field splitting. The orbital splitting energies are not sufficiently large for forcing pairing and, therefore, low spin configurations are rarely observed. [1]

OR

(i) **Correct option: (a)**

Explanation: $[\text{Fe}(\text{CN})_6]^{3-}$ is paramagnetic because the ligand (CN^-) present in the complex ion is strong field ligand so it favours spin pairing. Hence, it is a low spin complex with one unpaired electron. [1]

2. **Correct option: (a)**

3. **Correct option: (b)**

Explanation : A homoleptic chemical compound is a metal compound with all ligands identical. [1]

4. **Correct option: (c)**

Explanation : $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$ most stable complex species. [1]

5. **Correct option: (b)**

Explanation : NH_4^+ is a cation which does not have the ability to lend an electron pair so it cannot act like a ligand. [1]

6. **Correct option: (a)**

Explanation : $[\text{Fe}(\text{CN})_6]^{3-}$ involves d^2sp^3 hybridisation with one unpaired electron and $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ involves sp^3d^2 hybridisation with five unpaired electrons. This difference is due to the presence of strong ligand CN^- and weak ligand H_2O in these complexes. [1]

7. **Correct option: (c)**

Explanation : Because of the presence of weak and strong ligands in complexes, if CFSE is high, the complex will show low value of magnetic moment and vice versa, e.g. $[\text{CoF}_6]^{3-}$ and $[\text{Co}(\text{NH}_3)_6]^{3+}$, the former is paramagnetic and the latter is diamagnetic. [1]

8. (i) Tetraamminedichlorido chromium (III) ion

1

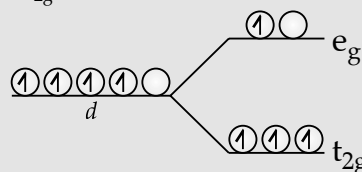
(ii) Geometrical isomerism / cis-trans.

1

9. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Fe}(\text{CN})_6]^{3-}$ exist in the +3 oxidation state i.e., in d^5 configuration.

Due to presence of five unpaired electrons $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ has magnetic moment 5.92 BM whereas $[\text{Fe}(\text{CN})_6]^{3-}$ has 1.74 BM moment due to presence of one unpaired electron. 2

10. (i) When $\Delta_o < P$, it is weak field and high spin situation. As a result, one electron entered in e_g orbital and 3 electrons in t_{2g} .

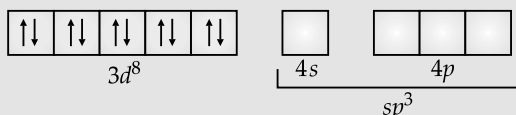


(i) Electronic configuration : $t_{2g}^3 e_g^1$

1/2

(ii) $\text{Ni}(\text{CO})_4$: The outermost electronic configuration will be $3d^8 4s^2 4p^0$.

CO is the strong ligand, causes pairing up of the 4s electrons into the 3d electrons



Thus, the hybridization will be sp^3 (tetrahedral).

1/2

11. (i) Tetraamminedichloridochromium (III) chloride.

1

(ii) In $[\text{NiCl}_4]^{2-}$; Cl^- act as weak ligand therefore does not cause forced pairing, thus electrons will remain unpaired hence paramagnetic.

1

In $[\text{NiCO}_4]$; CO act as strong ligand therefore causes forced pairing, thus electrons will become paired hence diamagnetic.

1

12. (a) $\text{K}[\text{Cr}(\text{H}_2\text{O})_2(\text{C}_2\text{O}_4)_2] \cdot 3\text{H}_2\text{O}$

IUPAC name :

Pottasiumdiaquadioxalatochromate (III) trihydrate.

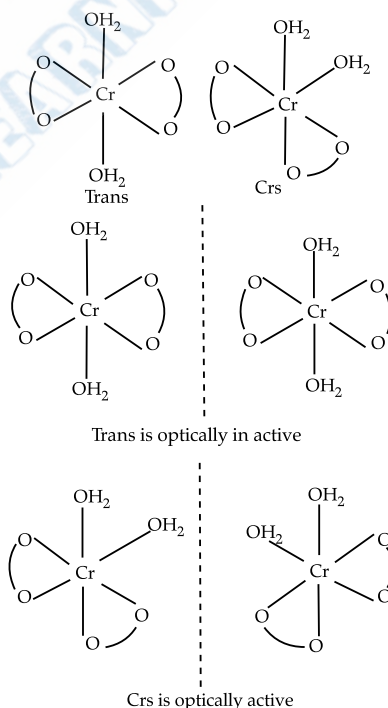
Oxidation state of chromium : 3

Electronic configuration : $3d^3 : t_{2g}^3$

Coordination number : 6

Shape : Octahedral

Stereochemistry :



Magnetic moment :

$$m = \sqrt{n(n+2)} = \sqrt{3(3+2)}$$

$$= \sqrt{15} = 3.872 \approx 4 \text{ BM}$$

[1]

(b) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$

IUPAC name :

Pentaamminechloridocobalt (III) chloride.

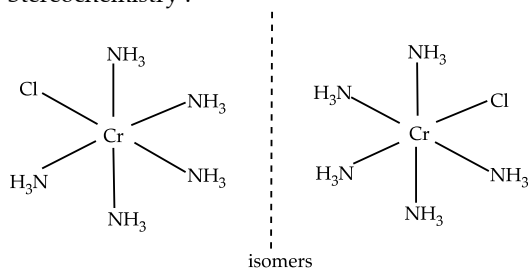
Oxidation state of Co : +3

Coordination number : 6

Shape : Octahedral

Electronic configuration : $d^6 : t^6_{2g}$

Stereochemistry :

**Magnetic moment = 0****(c) $[\text{CrCl}_3(\text{py})_3]$**

IUPAC name :

Trichloridotripyridinechromium (III)

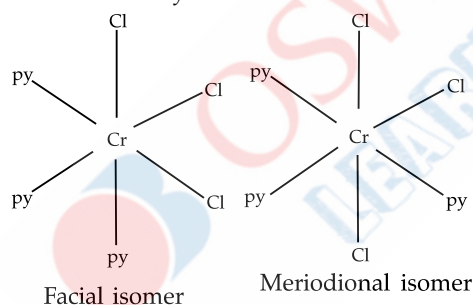
Oxidation state of chromium : +3

Electronic configuration : $d^3 : t^3_{2g}$

Coordination number : 6

Shape : Octahedral

Stereochemistry :



Both isomers are optically active. Therefore, a total of four isomers exist.

Magnetic moment :

$$m = \sqrt{n(n+2)} = \sqrt{3(3+2)}$$

$$= \sqrt{15} = 3.872 \approx 4 \text{ BM}$$

[1]

(d) $\text{Cs}[\text{FeCl}_4]$

IUPAC name :

Caesiumtetrachloroferrate (III)

Oxidation state of Fe : +3

Electronic configuration : $d^3 : t^3_{2g}$

Coordination number : 4

Shape : Optically inactive

Magnetic moment :

$$m = \sqrt{n(n+2)} = \sqrt{4(4+2)}$$

$$= \sqrt{24} = 4.89 \approx 5 \text{ BM}$$

[1]

(e) $K_4[Mn(CN)_6]$

IUPAC name :

Pottasium hexacyanomanganate (III)

Oxidation state of manganese : +2

Electronic configuration : $d5 : t_{2g}^5$

Coordination number : 6

Shape : Optically inactive

Magnetic moment :

$$m = \sqrt{n(n+2)} = \sqrt{1(1+2)}$$

$$= \sqrt{3} = 1.732 \text{ BM}$$

[1]

OR

Specify the oxidation numbers of the metals in the following coordination entities :

(a) $[Co(H_2O)(CN)(en)_2]^{2+}$ (b) $[CoBr_2(en)_2]^+$ (c) $[PtCl_4]^{2-}$ (d) $K_3[Fe(CN)_6]$ (e) $[Cr(NH_3)_3Cl_3]$

[A]

Ans: (a) $[Co(H_2O)(CN)(en)_2]^{2+}$ Let the oxidation number of Co be x . The charge on the complex is +2.

$$\begin{array}{ccccccc} [Co & (H_2O) & (CN) & (en)_2]^{2+} \\ \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & 0 & + & (-1) & + & 2(0) = +2 \end{array}$$

$$x - 1 = +2$$

$$x = +3$$

[1]

(b) $[CoBr_2(en)_2]^+$

$$\begin{array}{ccccccc} [Co & (Br)_2 & (en)_2]^+ \\ \downarrow & \downarrow & \downarrow \\ x & + & 2(-1) & + & 2(0) = +1 \end{array}$$

$$x - 2 = +1$$

$$x = +3$$

[1]

(c) $[PtCl_4]^{2-}$ Let the oxidation number of Pt be x . The charge on the complex is -2.

$$\begin{array}{ccc} [Pt & (Cl)_4]^{2-} \\ \downarrow & \downarrow \\ x & + & 4(-1) = -2 \end{array}$$

$$x - 4 = -2$$

$$x = +2$$

[1]

(d) $K_3[Fe(CN)_6]$

$$\begin{array}{ccc} [Fe & (CN)_6]^{3-} \\ \downarrow & \downarrow \\ x & + & 6(-1) = -3 \end{array}$$

$$x = +3$$

[1]

(e) $[Cr(NH_3)_3Cl_3]$

$$\begin{array}{ccc} [Cr & (NH_3)_3 & Cl_3] \\ \downarrow & \downarrow & \downarrow \\ x & + & 3(0) + 3(-1) = 0 \end{array}$$

$$x - 3 = 0$$

$$x = +3$$

[1]

••

Self Assessment Test-10

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) **Correct option: (c)**

Explanation : Cl^+ is the electrophile species which attacks benzene ring to form chlorobenzene. [1]

(ii) **Correct option: (c)**

Explanation : In haloarenes, halogen group withdraws electrons through -I effect and release electrons through +R effect. However, the inductive effect is stronger than resonance effect and causes net electron withdrawal. As a consequence, the electrophilic substitution reactions in haloarenes occur slowly. [1]

(iii) **Correct option: (a)**

Explanation : Haloalkanes are not very soluble in water because they cannot form hydrogen bonds with water as the energy required to break hydrogen bonds in water is higher than the energy released when new bonds between the haloalkane and water are formed. [1]

(iv) **Correct option: (b)**

Explanation : In monohaloarenes, halogen atom increases the electron density at ortho and para position. So, further electrophilic substitution occurs at ortho and para positions. [1]

OR

Correct option: (a)

[1]

Explanation : Chlorobenzene can not undergo nucleophilic substitution reaction easily as compared to chloroethane. It is due to partial double bond character of C-Cl bond in chlorobenzene due to resonance.

1. **Correct option : (b)**

[1]

Explanation : Toluene reacts with a halogen in the presence of iron (III) chloride giving ortho and para halo compounds. The reaction is electrophilic substitution reaction.

3. **Correct option : (d)**

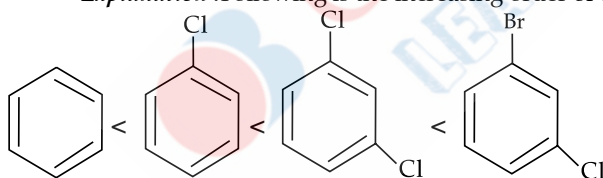
Explanation : As the size of the alkyl group increases the boiling point increases. [1]

4. **Correct option: (a)**

Explanation : Formation of alkyl chlorides from alkanes can be carried out by chlorination in the presence of UV light. Chlorine molecule under UV light forms free radicals, which react with alkanes to form a mixture of isomeric mono- and polyhaloalkanes. [1]

5. **Correct option: (a)**

Explanation : Following is the increasing order of the density of compounds.



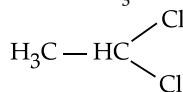
The following questions (Q. no. 6 & 7), a statement of assertion followed by a statement of reason is given.

Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

6. **Correct option: (c)**

Explanation : Ethylidene chloride is a gem-dihalide where two halogen atoms are present on the same carbon atom. Formula- CH_3CHCl_2

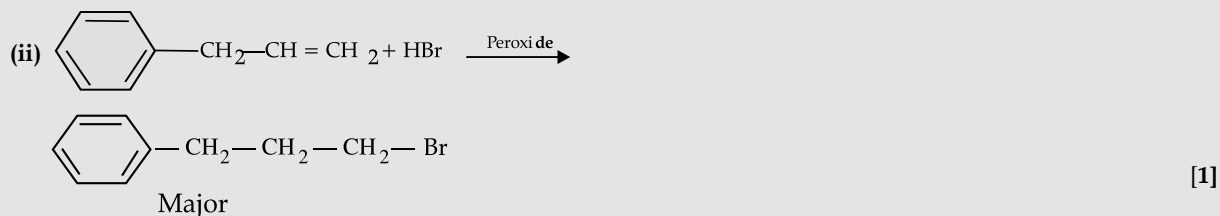
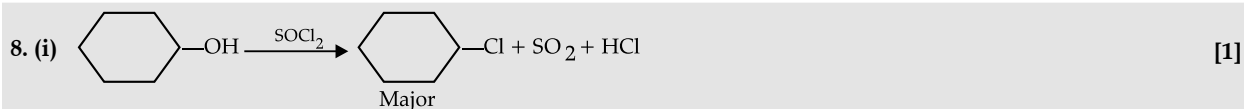


Ethylidene chloride

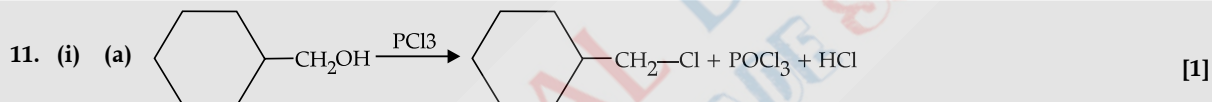
[1]

7. **Correct option: (a)**

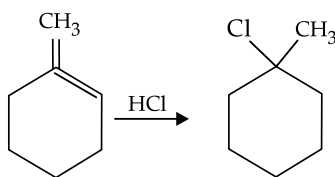
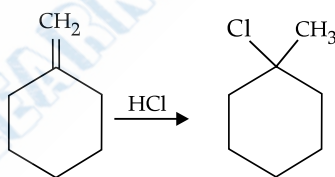
Explanation : Haloalkanes contain halogen atom (s) attached to the sp^3 hybridised carbon atom of an alkyl group. 2-Bromopentane is a haloalkane. [1]



Ans. (ii) (a) CH_3I will react faster in $\text{S}_{\text{N}}2$ reaction because CH_3I has a better leaving group than CH_3Br . [1]
(b) CH_3Cl will react faster in $\text{S}_{\text{N}}2$ reaction because 1° alkyl halide undergoes faster reaction than 3° alkyl halide. [1]



12. (a)



(b) The order of reactivity of compounds towards nucleophilic substitution reaction:
 $\text{III} > \text{II} > \text{I}$

As the electron withdrawing groups increase in the compound, the possibility of nucleophilic substitution increases. Hence Trinitro chlorobenzene is most reactive towards nucleophilic substitution as it contains 3- NO_2 groups. [2]

(c) Due to liberation of free iodine. [1]

OR

(a) (i) Vinyl chloride does not respond to NaOH and silver nitrate test because of partial double bond character due to resonance. [1]

(ii) Hydride ion / H^- [1]

(b)



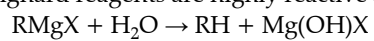
[1]



[1]

(c) Grignard reagents are highly reactive and react with water to give corresponding hydrocarbons.

[1]



••



Self Assessment Test-11

Time : 1 Hour

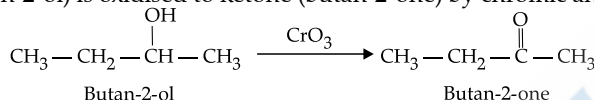
Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS

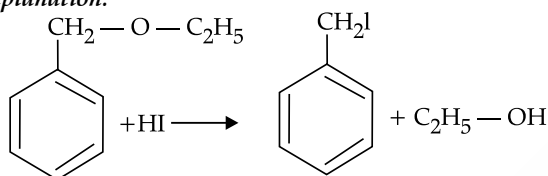
1. (i) **Correct option: (a)**

Explanation : Secondary alcohols always produce ketones on oxidation with chromic acid. Secondary alcohol (butan-2-ol) is oxidised to ketone (butan-2-one) by chromic anhydride (CrO_3).



(ii) **Correct option: (c)**

Explanation:



Benzyl ethyl ether

Benzyl iodide Ethanol

[1]

(iii) **Correct option: (b)**

[1]

(iv) **Correct option: (b)**

Explanation : Weakest acid has the strongest conjugate base.

[1]

OR

Correct option: (b)

Explanation: Conversion of alkyl halides into alcohols involves substitution reaction.

[1]

2. **Correct option: (d)**

Explanation:

H_2/Pd , LiAlH_4 and NaBH_4 are used to convert RCHO into primary alcohols.

[1]

3. **Correct Option: (a)**

Explanation: Ethylene glycol is soluble in water and non-volatile. It decreases freezing point of water so it is used as antifreeze in the car engine.

[1]

4. **Correct option: (b)**

Explanation : Phenol reacts with concentrated sulphuric acid and conc. nitric acid to form picric acid i.e. 2,4,6-trinitrophenol.

[1]

5. **Correct option: (c)**

Explanation : Neutral ferric chloride is used for detection of phenolic group as phenols react with neutral FeCl_3 to give violet, blue or green colour of soluble complex compounds.

[1]

6. **Correct Option : (a)**

[1]

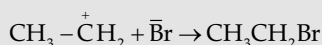
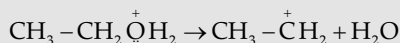
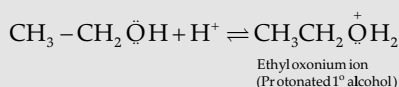
Explanation : Denatured alcohol is formed to make it unfit for human consumption by adding some amount of copper sulphate and pyridine.

[1]

7. **Explanation :** 2-Chloroethanol, is more acidic than ethanol due to $-\text{I}$ effect of chlorine atom.

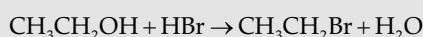
[1]

8. (i) $\text{H} - \text{Br} \rightleftharpoons \text{H}^+ + : \bar{\text{Br}}$



[1]

Overall reaction:

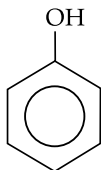


(ii) **Reimer-Tiemann reaction : Try yourself. Refer L.A.T.Q.I.9(i)**

[1]

9. (a) O-Nitrophenol is more volatile as it has intramolecular hydrogen bonding. Whereas p- nitrophenol has inter molecular H- bonding and hence boils at relatively higher temperature. [1]

(b)



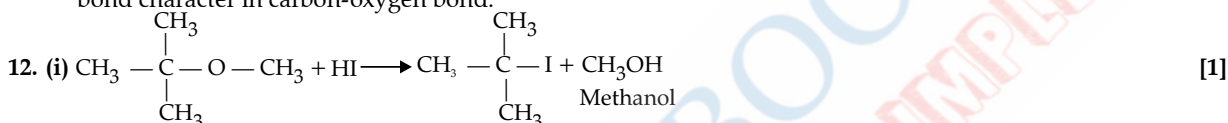
as phenoxide ion is more stable due to resonance which is absent in alkoxide ion. [1]

10. (a) 2, 5 - dinitrophenol. [1]

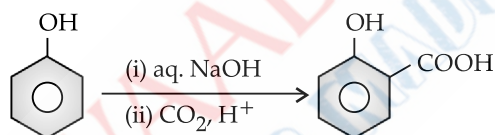
(b) 2-Phenylethanol. [1]

(c) 1-Ethoxy-2-methylpropane. [1]

11. (a) The dipole moment of two C=O bonds are equal and opposite as CO₂ is linear, so they cancel out each other and CO₂ is a non-polar molecule. However R-O-R is non-linear and the two dipoles do not cancel the effect of each other. Therefore, there is a finite resultant dipole and hence R-O-R is a polar molecule. [1]
- (b) Alcohols have higher boiling points as compared to ethers of similar molecular masses because of the intramolecular hydrogen bonding due to presence of OH group. [1]
- (c) In phenol, conjugation of unshared electron pair over oxygen with aromatic ring results in partial double bond character in carbon-oxygen bond. [1]



(iii)



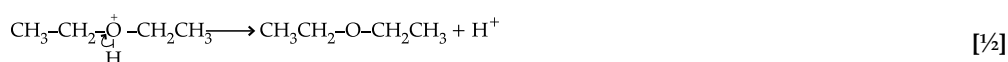
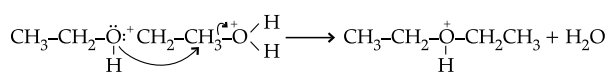
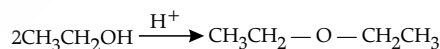
2- Hydroxybenzoic acid (Salicylic acid)

- (iv) 2-Bromo-3-methylbut-2-en-1-ol. [1]

(v) Phenylethanol. [1]

OR

- (i) (a) In phenol, the lone pair of electrons on oxygen involves in delocalization which results in their non-availability for the protonation. Whereas in ethanol, the electrons on oxygen atom are not delocalised which results in their availability for protonation. [1]
- (b) The variation can be established by intermolecular hydrogen bonding, where alcoholic hydrogen is bounded to a strongly electronegative oxygen atom to give rise to dipole of the form Et-O^{δ-}-H^{δ+} which arise the boiling point. [1]
- Whereas, C-O bonds in dimethyl ether are polar. Carbon bonded with hydrogen is moderately electronegative compared to oxygen. In the absence of intermolecular hydrogen bonding, ether becomes more volatile. [1]
- (c) Attack of I⁻ ion on anisole is through S_N² mechanism, which attacks the lesser hindered CH₃ group forming CH₃I. Also, C-O bond in ether is difficult to break due to resonance. [1]



Self Assessment Test-12

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

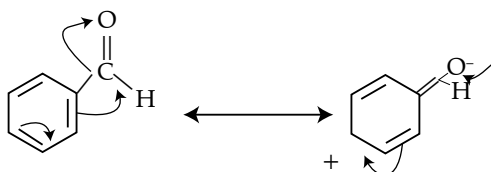
(1 mark each)

1. (i) Correct option : (b)

Explanation : Chromyl chloride and chromic oxide are used in the oxidation of methyl benzene to benzoic acid. This reaction is known as Etard reaction. [1]

(ii) Correct option : (c)

Explanation : Carbon atom of the carbonyl group benzaldehyde is less electrophilic than that of propanal because polarity of the carbonyl group is reduced in benzaldehyde due to resonance. Hence it is less reactive towards nucleophilic addition reaction.



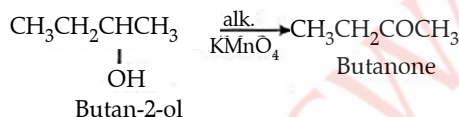
[1]

(iii) Correct option : (b)

Explanation : Tollen's test is given positive by aromatic aldehydes. It is used to differentiate aldehydes and ketones as Tollen's reagent acts as a mild oxidising agent and oxidises the aldehydes to corresponding carboxylic acids and itself gets reduced forming silver mirror. Ketones do not reduce the reagent. [1]

(iv) Correct option : (d)

Explanation :



[1]

OR

Correct option: (a)

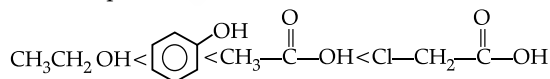
Explanation: Clemmensen reduction involves reduction of ketones (or aldehydes) to alkanes using zinc amalgam and concentrated hydrochloric acid. Benzophenone into diphenylmethane reduction is carried out by this method. [1]

2. Correct option : (d)

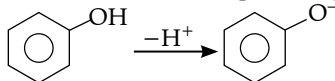
Explanation : CH_3CHO will not give Cannizzaro reaction because it contains α -hydrogen while other three compounds have no α -hydrogen. Hence, they will give Cannizzaro reaction.

3. Correct option : (c)

Explanation : Phenol is more stable than alcohol due to formation of more stable conjugate base after removal of H^+ from phenol.



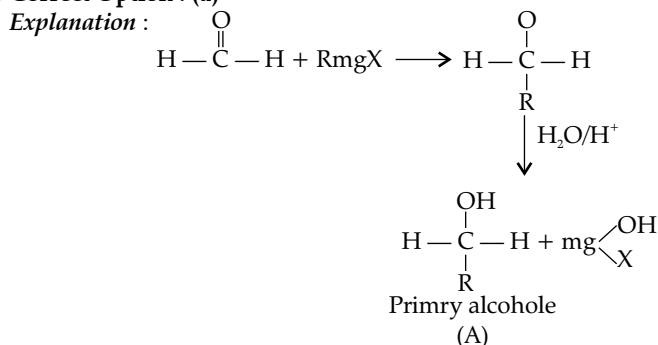
Whereas, carboxylic acid is more acidic than acetic acid due to formation of more stable conjugate base after removal of H^+ as compared to phenol.



Chloroacetic acid is more acidic than acetic acid due to the presence of electron withdrawing chlorine group attached to α - carbon of carboxylic acid.

4. Correct Option : (b)

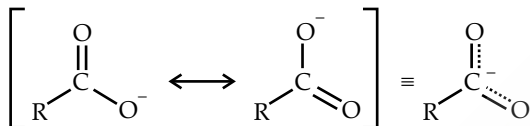
Explanation : When benzoic acid reacts with aq. sodium bicarbonate (NaHCO_3), then evolution of carbon dioxide with brisk effervescence takes place which there is no reaction of phenol with aq NaHCO_3 . [1]

5. Correct Option : (a)**6. Correct option : (a)**

Explanation: Formaldehyde is a planar molecule as it contains sp^2 hybridised carbon atom.

7. Correct option : (d)

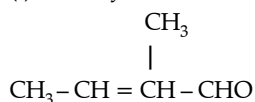
Explanation: The α -hydrogen atom in carbonyl compounds is less acidic as the anion formed after the loss of carboxylic hydrogen atom is resonance stabilised (conjugate base of carboxylic acid).



8. (i) $\text{C}_6\text{H}_5\text{COCH}_3 < \text{CH}_3\text{COCH}_3 < \text{CH}_3\text{CHO}$. [1]

(ii) $\text{CH}_3\text{COOH} < \text{Cl}-\text{CH}_2-\text{COOH} < \text{F}-\text{CH}_2-\text{COOH}$ [1]

9. (i) 2-Methylbut-2-enal [½]



(ii) Pent-2-enal [½]



10. (a) (i) [½]

Experiment	Ethanal	Propanone
1. Tollens' Test : Warm the organic compound with freshly prepared ammonical silver nitrate solution (Tollens' reagent).	A bright silver mirror is produced.	No silver mirror is formed.
2. Fehling's Test : Heat the organic compound with Fehling's reagent.	A reddish brown precipitate is obtained.	No precipitate is obtained.
(Any one test)		

[1]

(ii)

Experiment	Pentan-2-one	Pentan-3-one
Iodoform Test: The organic compound is heated with iodine in presence of sodium hydroxide solution.	A yellow precipitate is obtained.	No yellow precipitate is obtained.

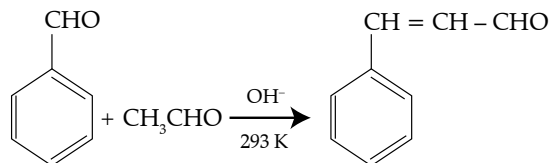
[1]

Or any other suitable test.

(b) 4-Methoxybenzoic acid < Benzoic acid < 4-Nitrobenzoic acid < 3,4-Dinitrobenzoic acid. [1]

11. The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in ethanal. [1]

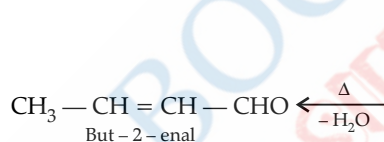
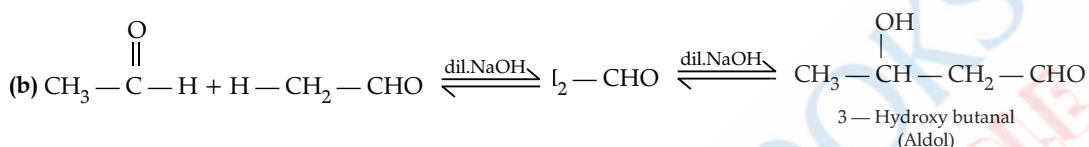
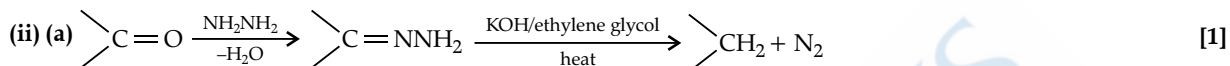
The polarity of the carbonyl group is reduced in benzaldehyde due to resonance hence less reactive than ethanal. [1]



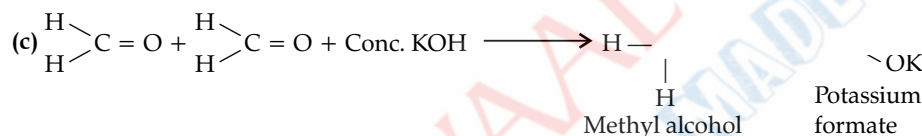
[1]

12. (i) (a) Because the positive charge on carbonyl carbon of CH_3CHO decreases to a lesser extent due to one electron releasing (+I effect) CH_3 group as compared to CH_3COCH_3 (two electron releasing $-\text{CH}_3$ group) and hence more reactive. [1]

(b) Because carboxylate ion (conjugate base) is more resonance stabilized than phenoxide ion. [1]

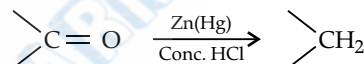


[1]

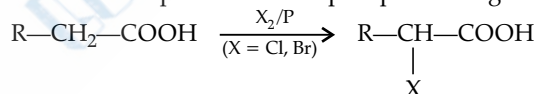


OR

(i) (a) **Clemmensen reduction** : The carbonyl group of aldehydes and ketones is reduced to >CH_2 group on treatment with zinc amalgam and concentrated HCl. [1]

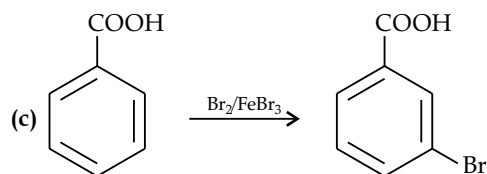
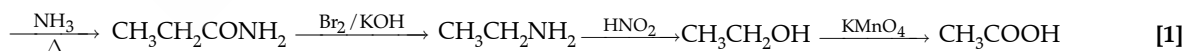
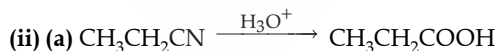


(b) **Hell-Volhard-Zelinsky reaction** : Carboxylic acids having an α -hydrogen are halogenated at the α -position on treatment with chlorine or bromine in the presence of red phosphorus to give α -halo-carboxylic acids. [1]



(Or by any other suitable method)

(Note : Award full marks for correct chemical equation; award $\frac{1}{2}$ mark if only correct statement is written)



[1]

(Or any other suitable method can be used for each conversion)

Self Assessment Test-13

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

1. (i) **Correct option:** (d)

Explanation: Lower aliphatic amines such as methyl amine and ethyl amine exist as gases under standard conditions. [1]

- (ii) **Correct option:** (a)

Explanation: 1° amine i.e. methyl amine (CH_3NH_2) possesses two hydrogen atoms directly attached to nitrogen atom which result in hydrogen bonding, so, it possesses highest boiling point. [1]

- (iii) **Correct option:** (c)

Explanation: Greater the +I effect, greater will be the basicity of amines. In ethyl amine, $-\text{C}_2\text{H}_5$ group is strong +I group which releases its bonding electrons towards nitrogen due to which electron density increases and it can undergo protonation easily. Hence, ethyl amine is most basic amine. [1]

- (iv) **Correct option:** (a)

Explanation: Lower amines are readily soluble in water which decreases with an increase in molecular weight. So, methyl amine is highly soluble in water. [1]

2. **Correct option:** (d)

Explanation: Gabriel-phthalimide synthesis deals with primary alkyl halides to form primary amines. It does not give isobutyl amine which is a secondary amine. [1]

3. **Correct option:** (b)

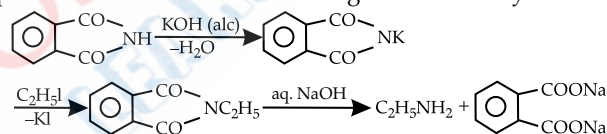
Explanation: Since tertiary amines do not possess H-atom on N-atom, so, they do not form hydrogen bonds and due to which they have lowest boiling points amongst isomeric amines. [1]

4. **Correct option:** (c)

Explanation: Primary and secondary amines are distinguished by nitrous acid (HNO_2). Primary amines react with HNO_2 to give alcohols with effervescence of N_2 gas while secondary amines give only nitrosoamine which gives Liebermann's nitrosoamine test. [1]

5. **Correct option :** (a)

Explanation : Potassium phthalimide is the source of nitrogen in Gabriel synthesis.

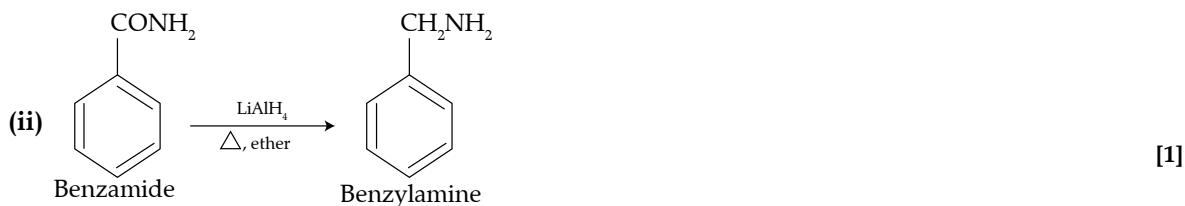
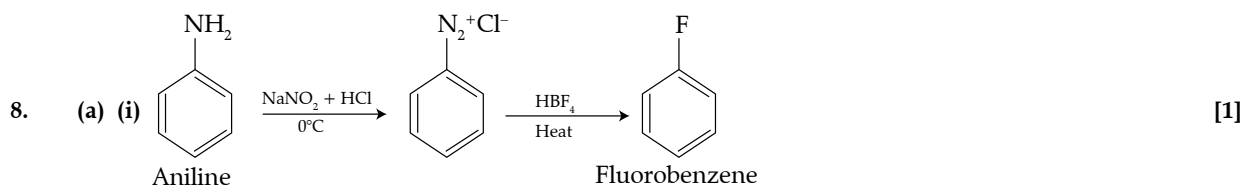


6. **Correct option:** (b)

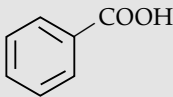
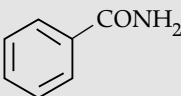
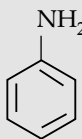
Explanation : Hoffmann bromamide reaction is given by amides and resulting amines contain one C less than the parent amide. Primary amines are less basic than secondary and tertiary ones. [1]

7. **Correct option:** (a)

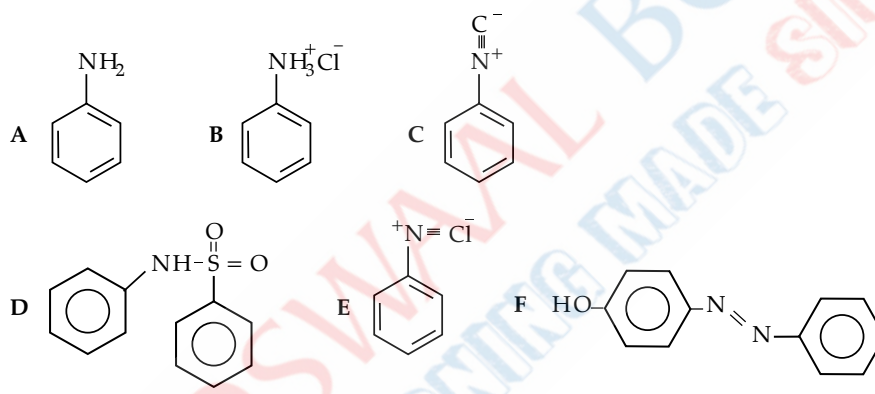
Explanation : Only a small amount of HCl is required in the reduction of nitro compounds with iron scrap and HCl in the presence of steam, just to initiate the reaction as FeCl_2 formed gets hydrolysed to release HCl during the reaction. [1]



9. (b) (i) A : $\text{CH}_3\text{CH}_2\text{CONH}_2$ [½]
 B : $\text{CH}_3\text{CH}_2\text{NH}_2$ [½]
 (ii) A : $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ [½]
 B : $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ [½]

10. A-  [½ + ½]
 Benzoic acid
 B-  [½ + ½]
 Benzamide
 C-  [½ + ½]
 Aniline

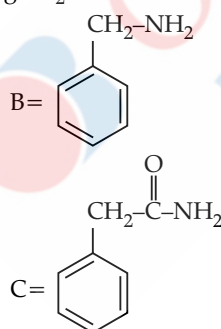
11.



[½ each]

12. (a) A =
- AgNO_2

[½]

D = $\text{CHCl}_3 + \text{KOH}$, Heat.

[½]

(b) (i)

Experiment	Aniline	Benzylamine
Azo dye test : Dissolve the amine in HCl, cool it and then add cold aqueous solution of NaNO_2 and then solution of β -naphthol	A brilliant orange red dye is observed.	No dye is formed.

[1]

(ii)

Experiment	Methylamine	Dimethylamine
Carbylamine test : To the organic compound add chloroform and ethanolic potassium hydroxide and heat	A foul smelling substance (isocyanide)	No dye is formed.

[1]

(or any other suitable test)

(c) A = $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$

[½]

B = $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

[½]

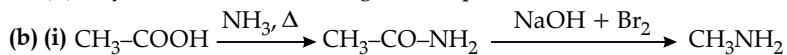
OR

(a) (i) In strongly acidic medium, aniline is protonated to form the anilium ion which is meta directing.

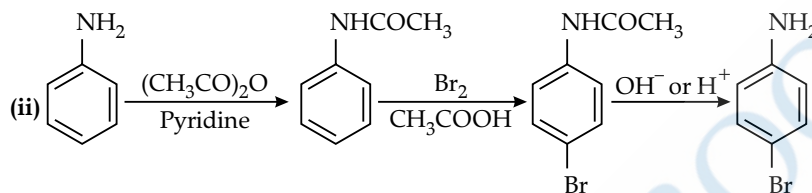
[1]

(ii) Aryl halides do not undergo nucleophile substitution with the anion formed by phthalimide.

[1]



[1]



[1]

(c) p-Nitoraniline < Aniline < p-Toludine.

[1]

□□

Self Assessment Test-15

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. **Explanation:** Chain growth polymerisation takes place in the presence of an initiator. i.e benzoyl peroxide, Lewis acid or Lewis base. [1]

(ii) **Correct option:** (b)

Explanation: In chain growth, polymerisation, elemental composition of polymer remains same because no elimination of small molecule takes place in this polymerisation. [1]

(iii) **Correct option:** (b)

Explanation: Addition polymer means a chain growth polymer because it is formed by successive addition of monomer units to the growing chain by a chain mechanism. [1]

(iv) **Correct option:** (a)

Explanation: Nylon-6,6 is a step growth polymer. It is not referred to as chain growth polymer because during its formation, small molecule. i.e water is eliminated in each step. [1]

Following questions (No. 2–5) are Multiple Choice Questions carrying 1 mark each.

2. **Correct option :** (d)

Explanation : Glycogen is a polymer of glucose found in liver, brain and muscles of animals. Cellulose is a polymer found in plant while amylose and amylopectin are structural units of starch. [1]

3. **Correct option :** (a)

Explanation: Cis-polyisoprene is a natural rubber which is obtained from a rubber tree *Hevea brasiliensis*. [1]

4. **Correct option :** (b)

Explanation : Low density polythene is tough but not hard (it's flexible) and a poor conductor of electricity. It has a highly branched structure. [1]

5. **Correct option :** (b)

Explanation : Low density polythene (LDP) is a polymer of ethene formed under high pressure and has a highly branched structure. Traces of dioxygen or peroxide act as catalyst. [1]

In the following questions (Q.No: 6–7), a statement of assertion followed by a statement of reason is given. Choose the connect answer out of the following choices

(a) Assertion and Reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and Reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

6. **Correct option:** (d)

Explanation: Natural rubber is a linear polymer of isoprene while synthetic rubbers like Neoprene are homopolymers of 1,3 -butadiene derivative or copolymer of 1,3 -butadiene and other monomer. [1]

7. **Correct option:** (a)

Explanation: Rayon is a semi-synthetic polymer and also a better choice than cotton fabric because properties of cellulose are improved by acetylation while processing. [1]

Answer type-I and carry 2 marks each

8. The polymers may be defined as the compound of high molecular mass formed by the combination of large number of small molecules. i.e. monomer units. [1]

The poly dispersity index (PDI) is the ratio of the mass average molecular mass to the number average molecular mass.

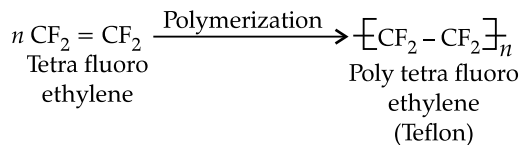
$$PDI = \frac{\bar{m}_w}{\bar{m}_n}$$

Where $\bar{m}_w$ = mass average molecular mass

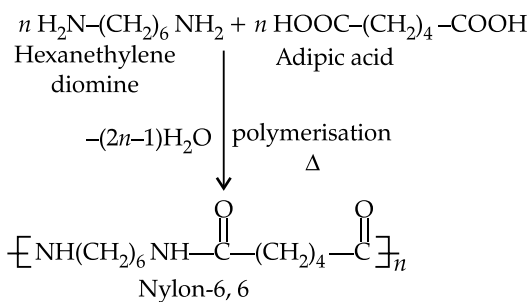
$\bar{m}_n$ = number average molecular mass

[1]

9. (i) Teflon



(ii) Nylon-6,6



10: (i) Addition

[1]

(ii) Condensation/Hydrolysis

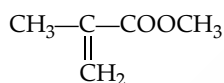
[1]

(iii) Condensation

[1]

11.

(i) Monomer unit of PMMA : Methyl methacrylate



[1]

(ii) Monomer unit of PAN :

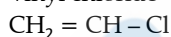
Acrylonitrile



[1]

(iii) Monomer unit of PVC :

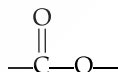
Vinyl chloride



Long Answer Type carrying 5 marks.

12. (i) Polyesters

These are the polymers having ester linkage

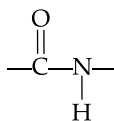


Example: Terelene

[1]

(ii) Polyamides

These are the polymers having amide linkage



Example: Nylon-6,6

[1]

(iii) Natural polymers

These are the polymers obtained from nature.

Example: natural rubber

[1]

(iv) Synthetic polymers

These are the polymers synthesized in the laboratory.

Example: Synthetic rubber (Buna-S)

[1]

(v) Biodegradable polymers

These are the polymers which can undergo biogradation in the presence of micro-organisms.

Example: PHBV

[1]

OR

Ans: (i) The polymers which can be synthesised by intermolecular combination of monomer units with the elimination of small molecules like H_2O , ROH etc are called condensation polymers.

[1]

Example: Nylon-6,6

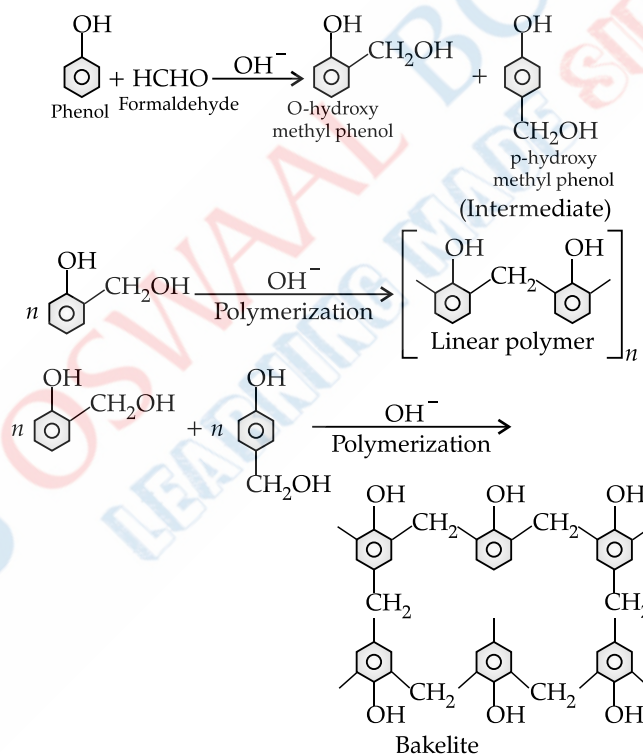
[½]

Bakelite

[½]

(ii) Synthesis of Bakelite :

It is prepared by the condensation polymerisation of phenol and formaldehyde in basic medium.



[2]

Uses of Bakelite :

It is used for making combs, electrical goods, telephone bases, gramophone records etc.

[1]

Self Assessment Test-16

Time : 1 Hour

Max. Marks : 25

SOLUTIONS

[A] OBJECTIVE TYPE QUESTIONS :

(1 mark each)

1. (i) **Correct option: (c)**
Explanation : The substances used for the cure of mental diseases are called tranquilizers. [1]
- (ii) **Correct option: (b)**
Explanation : The tranquilizers are also called psycho-therapeutic drugs because they act as drugs to cure mental diseases. [1]
- (iii) **Correct option: (c)**
Explanation : Barbituric acid serves as a good tranquilizer. [1]
- (iv) **Correct option: (b)**
Explanation : Sedatives act as depressant because they directly impact the brain by promoting the production of particular neurotransmitter chemicals that slow down activity. [1]
Correct option : (c)
Explanation : Paracetamol is an analgesic which is used to relieve pain. [1]
2. **Correct option: (a)**
Explanation : Antipyretics are medicinal compounds which lower body temperature. [1]
3. **Correct option: (d)**
Explanation : Aspirin is both analgesic and antipyretic as it lowers body temperature and also relieves pain. [1]
4. **Correct option: (b)**
Explanation : Veronol, a barbituric drug is used as sedative as it acts as depressant. [1]
5. **Correct option: (c)**
Explanation : Sulpha drug contains sulphonamide group. Salvarasan is not a sulpha drug, it contains arsenic. [1]
6. **Correct option: (c)**
Explanation : Chemical messengers are chemicals that enable communication of message between neurons and muscles. Chemicals do not enter the cell but bind to the receptor. [1]
7. (a) **Broad spectrum antibiotics :** Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria.
e.g. Chloramphenicol.
(any other suitable example.) [1]
- (b) **Analgesics:** Reduce or abolish pain without causing impairment of consciousness, mental confusion, incoordination or paralysis or some other disturbances of nervous system.
e.g. Aspirin / paracetamol, etc.
(any other suitable example.) [1]
8. (a) **Analgesic :** These are the chemical substances which relieve pain.
e.g : Aspirin [1]
- (b) **Disinfectant :** These are the chemical substances which are used to kill micro-organisms but cannot be applied on living tissues.
e.g : Phenol (1%) [1]
9. (i) Phenol / 0.2% phenol is antiseptic while 1% is disinfectant. [1]
- (ii) Aspartame. [1]
- (iii) Cationic detergents are quaternary ammonium salts of amines with acetates, chlorides or bromides anions/
Cationic part has a long chain hydrocarbons which is involved in cleansing action. [1]
10. (i) Treatment of hyperacidity $\frac{1}{2}$
Class : Antacids $\frac{1}{2}$
- (ii) Relieve pain and produce sleep $\frac{1}{2}$
Class : Narcotic analgesics $\frac{1}{2}$
- (iii) Relieve pain and reduce fever $\frac{1}{2}$
Class : Non- Narcotic analgesics / Analgesics $\frac{1}{2}$
11. (a) (i) Dettol (a mixture of chloroxylenol and terpenol) is commonly used antiseptic for wounds, cuts etc [1]
- (ii) Bithional is added to soaps to impart them antiseptic properties. [1]

- (b) (i) Controlling depression and hypertension ½
 Class : Tranquilizers ½
 (ii) Relieve pain and reduce fever ½
 Class : Non- Narcotic analgesics / Analgesics ½
 (iii) Kills or inhibits the growing of microorganisms ½
 Class : Antibiotic ½

OR

- (ii) Food preservatives are used to prevent food spoilage due to microbial growth. [½]
 Example: Salt(NaCl)/Sugar/Vinegar/Vegetable oil/Sodium benzoate
 (Any one example) [½]
 (iii) Norethindrone
 Ethinylestradiol [½ + ½] [R]

Ans. (a)

Soaps	Detergents
(i) They are sodium or potassium salts of long chain fatty acids.	(i) They are sodium or potassium salt of sulphonic acids by hydrocarbons.
(ii) Soaps cannot be used with hard water.	(ii) Detergents work well with both hard and soft water.
(iii) They are biodegradable.	(iii) They are non-biodegradable.

(Any two difference) [2]

- (b) (i) Sucralose (or any other) [1]
 (ii) Food preservatives are used to prevent food spoilage due to microbial growth. [½]
 Example: Salt(NaCl)/Sugar/Vinegar/Vegetable oil/Sodium benzoate
 (Any one example) [½]
 (c) Norethindrone
 Ethinylestradiol [½+½]

●●●●