

CBSE Board
Class XII Chemistry – Set 1
Board Paper – 2013 (Solution)

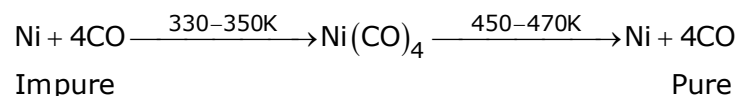
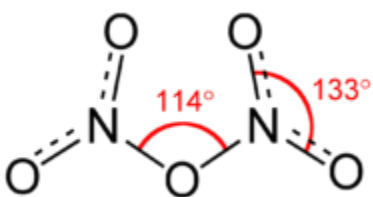
Time: 3 hours
Total Marks: 70

Sol. 1 Face centered cubic unit cell has points at all the corners as well as at the centre of each of the six faces. The contribution of each atom at the face per unit cell is $\frac{1}{2}$ and at each corner is $\frac{1}{8}$. So, the number of atoms present at corners per unit cell = $8 \text{ corner atoms} \times \frac{1}{8}$ atom per unit cell = 1 atom

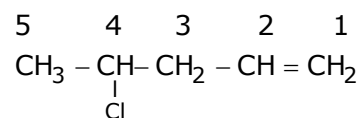
Number of atoms present at faces per unit cell = $6 \text{ atoms at faces} \times \frac{1}{2}$ atom per unit cell = 3 atoms

\therefore Total no. of atoms per unit cell = 4 atoms.

Sol. 2 Mond's process is the method used for refining of nickel metal. In this process, nickel is heated in a steam of carbon monoxide to form volatile nickel carbonyl $\text{Ni}(\text{CO})_4$. Nickel carbonyl vapours on further heating, decomposes giving pure nickel.

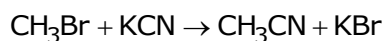

Sol. 3


The covalence of nitrogen in nitrogen pentoxide is 4.

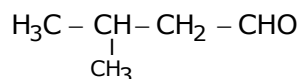
Sol. 4


IUPAC name: 4-chloropent-1-ene

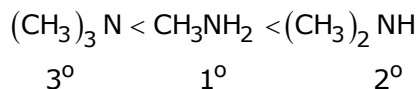
Sol. 5 CH_3Br reacts with KCN to form CH_3CN . It is a nucleophilic substitution reaction.



Sol. 6 The structure of 3-methyl butanal



Sol. 7



As a consequence of combined effects of inductive effects and solvation, the secondary amines are the strongest bases.

Sol. 8 There are three different types of RNA molecules: Messenger RNA (mRNA), Transfer RNA (tRNA) and Ribosomal RNA (rRNA)

Sol. 9 w_1 = weight of solvent (H_2O) = 1 kg = 1000 gm

w_2 = weight of solute ($\text{C}_6\text{H}_{12}\text{O}_6$) = 18 gm

M_2 = Molar mass of solute ($\text{C}_6\text{H}_{12}\text{O}_6$) = 180 g mol⁻¹

K_b = 0.52 K Kg mol⁻¹

$$T_b^0 = 373.15\text{K}$$

$$\therefore \Delta T_b = \frac{K_b \times 1000 \times w_2}{M_2 \times w_1} = \frac{0.52 \times 1000 \times 18}{180 \times 1000} = 0.052\text{K}$$

$$\therefore \Delta T_b = T_b^0 \Rightarrow 0.052 = T_b = 373.202\text{K}$$

Sol. 10

$$\text{Molar conductivity } (\Lambda_m) = \frac{\kappa \times 1000}{C}$$

$$\kappa = 0.025 \text{ S cm}^{-1}; C = 0.20 \text{ M}$$

$$\Lambda_m = \frac{0.025 \times 1000}{0.20} = 125 \text{ S cm}^2 \text{ mol}^{-1}$$

Sol. 11

(i) Smoke

Dispersed phase: Solid and dispersion medium: Gas

(ii) Milk

Dispersed phase: Liquid and dispersion medium: Liquid

OR

Sol. 11

Lyophilic colloids: The colloidal solutions in which the particles of the dispersed phase have a great affinity for the dispersion medium are called lyophilic colloids. These are reversible in nature. These are quite stable and cannot be easily coagulated by small amounts of electrolytes.

Lyophobic colloids: The colloidal solutions in which there is no affinity between particles of dispersed phase and the dispersion medium are called lyophobic colloids. These are irreversible in nature. These are unstable and can be easily coagulated on addition of small amount of electrolyte due to lack of protecting layer around charged colloidal particles.

Sol. 12

S.NO	Point of difference	Physiosorption	Chemisorption
(i)	Specificity	It is not specific in nature.	It is highly specific in nature.
(ii)	Temperature Dependence	Usually occurs at low temperature and decreases with increase in temperature.	Occurs at high temperature and increases with the increase in temperature.
(iii)	Reversibility	It is reversible in nature	It is irreversible in nature.
(iv)	Enthalpy change	Enthalpy of adsorption is low; of the order of 20-40 KJmol ⁻¹ .	Enthalpy of adsorption is high; of the order of 80-240 KJmol ⁻¹ .

Sol. 13

- (a) Dilute solution (0.5%) of NaCN or KCN is used for leaching of silver metal in the presence of air in the metallurgy of silver.
- (b) Out of C and CO, CO is a better reducing agent at the lower temperature range because the CO and CO₂ line lies below Fe, FeO line i.e. $\Delta G_{(CO,CO_2)} < \Delta G_{(Fe,FeO)}$. So, Co will reduce FeO, and will itself be oxidized to CO₂.

Sol. 14

- (i) PCl₅ on heating decomposes to give PCl₃ and Cl₂

$$PCl_5 \rightarrow PCl_3 + Cl_2$$
- (ii) H₃PO₃ on heating gives orthophosphoric acid and phosphine:

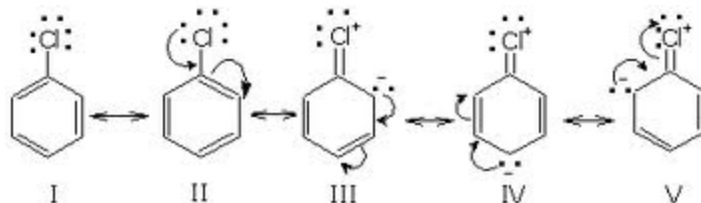
$$4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$$

Sol. 15

- (a) Cu metal in the first transition series (3d series) shows +1 oxidation state most frequently. This is because the electronic configuration of Cu is $3d^{10} 4s^1$ and after losing one electron, it acquires the stable $3d^{10}$ fully filled electronic configuration.
- (b) The color of cations is dependent on the number of unpaired electrons present in d-orbital. The electronic configuration of the following cations is as follows:
 Sc ($Z = 21$) = $3d^1 4s^2$ and $Sc^{3+} = 3d^0 4s^0$. As d-orbital is empty, it is colourless.
 V ($Z = 23$) = $3d^3 4s^2$ and $V^{3+} = 3d^2 4s^0$. As d-orbital is having 2 unpaired electrons, it undergoes d-d transition and shows green colour.
 Ti ($Z = 22$) = $3d^2 4s^2$ and $Ti^{4+} = 3d^0 4s^0$. As d-orbital is empty, it is colourless.
 Mn ($Z = 25$) = $3d^5 4s^2$ and $Mn^{2+} = 3d^5 4s^0$. As d-orbital is having 5 unpaired electrons, it shows pink color.

Sol. 16 Chlorobenzene is less reactive towards nucleophilic substitution reaction because of the following reasons:

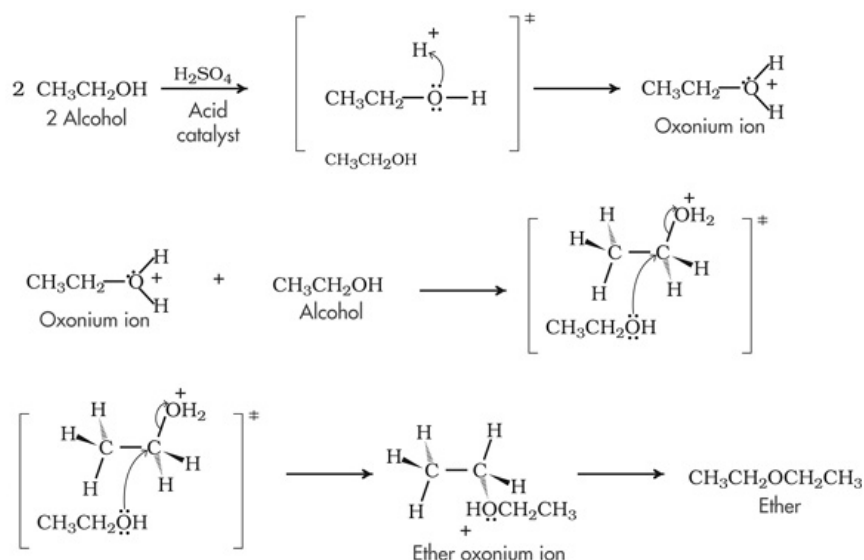
- (1) Resonance effect: The electron pair on chlorine atom is in conjugation with the π electrons of the benzene ring which results in the following resonance structures:



It results in delocalization of the electrons of C – Cl bond and a partial double bond character develops in the bond, which makes it difficult for the Nucleophile to cleave the C – Cl bond.

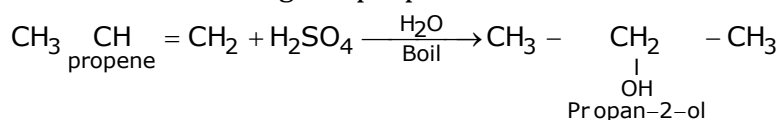
- (2) Polarity of the C-Cl bond: The sp^2 hybridized carbon atom involved in C-Cl bond in chlorobenzene is more electronegative than the sp^3 hybrid carbon atom in alkyl halide. Therefore, this sp^2 hybridised carbon atom has less tendency to release electrons to the Cl atom. Thus, lower the polarity of C-Cl, lesser is the reactivity.

Sol. 17 Mechanism for the reaction:

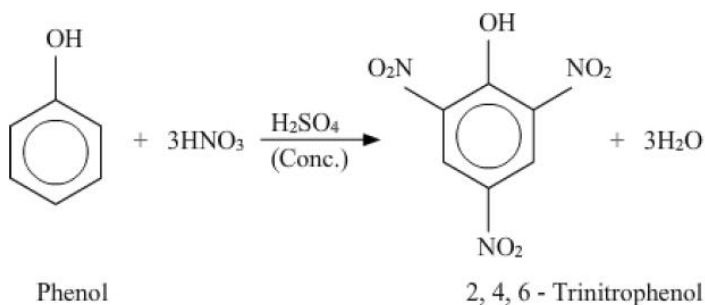


Sol. 18

- (i) Hydration of propene i.e. addition of water in the presence of H_2SO_4 in accordance with Markovnikov's rule gives propan-2-ol



- (ii) When concentrated nitric acid is added to phenol in the presence of sulphuric acid, it gives 2, 4, 6-trinitrophenol.



Sol. 19

- (a) The values showed by Sonali are knowledge of chemistry and awareness of the ill effects of junk food and care and concern for her school mates.
The value showed by the principal is responsible and understanding behavior in listening to a student's views and taking prompt action in replacing junk food with healthy food.
- (b) The water soluble vitamins are vitamin B-complex and vitamin C.

Sol. 20

- (i) The variable oxidation states of transition elements are due to the participation of ns and (n-1)d-electrons in bonding. Lower oxidation state is exhibited when ns- electrons take part in bonding. Higher oxidation states are exhibited when (n - 1) d-electrons take part in bonding.
- (ii) This is because the atomic radii of 4d and 5d transition elements are nearly same. This similarity in size is consequence of lanthanide contraction. Because of this lanthanide contraction, the radius of Hf becomes nearly equal to that of Zr.
- (iii) Transition elements act as good catalyst in chemical reaction because they can lend electrons or withdraw electrons from the reagent, depending on the nature of the reaction. The ability of transition metals to be in a variety of oxidation states, the ability to interchange between the oxidation states and the ability to form complexes with the reagents and be a good source for electrons make transition metals good catalysts.

OR

- (i) $6\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 2\text{Cr}^{3+} + 6\text{Fe}^{3+} + 7\text{H}_2\text{O}$
- (ii) $2\text{CrO}_4^{2-} + 2\text{H}^+ \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$
- (iii) $2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O}$

Sol. 21

- (i) Sodium benzoate is used as a food preservative whereas equanil is a tranquillizer and morphine is an analgesic.
- (ii) Bithional is an antiseptic added to soaps to reduce odours produced by bacterial decomposition of organic matter on the skin.
- (iii) Tranquillizers relieve stress, fatigue by inducing sense of well being, so they are used in the making of sleeping pills.

Sol. 22

- (a) When silicon is doped with boron, p-type semiconductor is obtained.
- (b) The magnetism shown in the alignment of magnetic moments is ferromagnetism.
- (c) Impurity defect is produced when AgCl is doped with CdCl_2 .

Sol. 23

- (i) $\text{CH}_3\text{CH}_2\text{Br} \xrightarrow{\text{KCN}} \text{CH}_3\text{CH}_2\text{CN} \xrightarrow{\text{LiAlH}_4} \text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2 \xrightarrow[\text{O}^\circ\text{C}]{\text{HNO}_2} \text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- (ii) $\text{CH}_3\text{COOH} \xrightarrow[\Delta]{\text{NH}_3} \underset{\text{A}}{\text{CH}_3\text{CONH}_2} \xrightarrow{\text{NaOH}+\text{Br}_2} \underset{\text{B}}{\text{CH}_3\text{NH}_2} \xrightarrow{\text{CHCl}_3+\text{Alc.KOH}} \underset{\text{C}}{\text{CH}_3\text{NC}}$

Sol. 24 IUPAC Nomenclature:

- (i) Triamminetrichlorochromium (III)
- (ii) Potassium hexacyanoferrate (III)
- (iii) Dibromidobis (ethane-1, 2-diammine) cobalt (III) ion

Sol. 25 $w_2 = 2.5 \times 10^{-2}$ g (Mass of K_2SO_4) and $M_2 = 174$ g mol⁻¹ (Molar mass of K_2SO_4)

$V = 2$ L, $R = 0.0821$ L atm K⁻¹ mol⁻¹ and $T = 25^\circ\text{C} = 298$ K

$$\text{Osmotic pressure, } \pi = \frac{w_2 RT}{M_2 V}$$

$$\pi = \frac{2.5 \times 10^{-2} \times 0.0821 \times 298}{174 \times 2} = \frac{61.1645 \times 10^{-2}}{348} = 1.76 \times 10^{-3} \text{ atm}$$

Sol. 26 At anode: $\text{Fe} \rightarrow \text{Fe}^{2+} + 2e^-$

At cathode: $2\text{H}^+ + 2e^- \rightarrow \text{H}_2$

$n = 2$

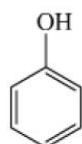
$$E_{\text{cell}} = E^\circ_{\text{cell}} - \left(\frac{0.059}{n} \right) \log \frac{C_{\text{oxid}}}{C_{\text{Red}}}$$

$$E_{\text{cell}} = 0.44 - \frac{0.059}{2} \log \frac{0.001}{1}$$

$$\therefore E_{\text{cell}} = 0.44 (-0.02955 \times -3) = 0.44 + 0.08865 = 0.53 \text{ V}$$

Sol. 27

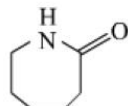
(i)



Phenol

HCHO
formaldehyde

(ii)



Caprolactam

(iii)

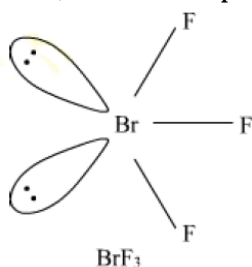
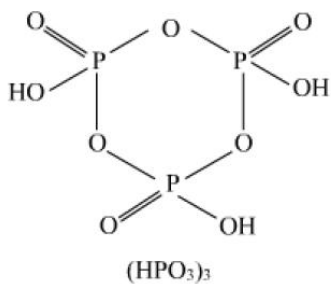
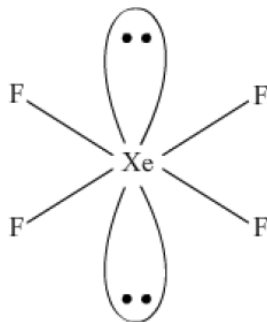
$\text{CH}_2 = \text{CH}_2$
Ethylene

Sol. 28

(a)

- (i) F atom is small in size and due to this the electron-electron repulsions between the lone pairs of F-F are very large. Thus, the bond dissociation energy of F_2 is lower than that of Cl_2 .
- (ii) PH_3 has lower boiling point than NH_3 because NH_3 molecule possess intermolecular hydrogen bonding which binds its molecules strongly whereas PH_3 has weaker Van der Waal's forces. Thus, PH_3 has lower boiling point than NH_3 .

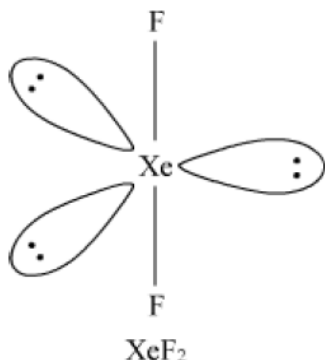
(b) The structures of following molecules are as follows:

 (i) BrF_3 , Bent T-shape

 (ii) $(HPO_3)_3$, cyclic structure

 (iii) XeF_4 , Square planar

OR

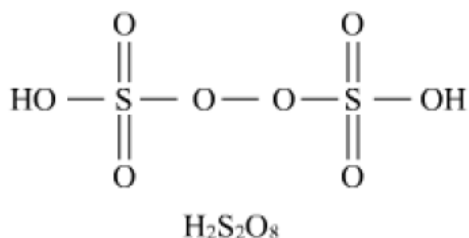
(a)

- (i) Helium mixed with oxygen under pressure is given to sea-divers for respiration. Air is not given to sea-divers because nitrogen present in air being soluble in blood will give a painful sensation called bends by bubbling out blood on moving from high pressure (in deep sea) to the low atmospheric pressure.
- (ii) Fluorine being the most electronegative atom does not exhibit positive oxidation state because the electrons in fluorine are strongly attracted by the nuclear charge because of small size of fluorine atom and therefore, removal of an electron is not possible.
- (iii) Sulphur shows catenation behavior more than that of oxygen because the oxygen atom is smaller in size as compared to sulphur, the O-O bonds in oxygen experiences repulsions due to the lone pairs present on oxygen atom and therefore, are weaker as compared to the S-S bonds.

(b) The structure of following molecules are as follows:

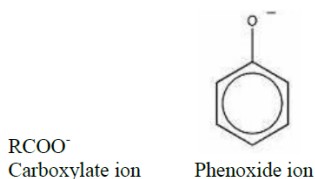
 (i) XeF_2 , Linear


(ii)

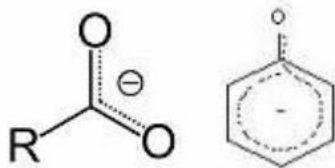


Sol. 29

- (a) On losing a proton, carboxylic acids form carboxylate ion and phenol forms phenoxide ion as follows:



Now, the negative charge is delocalized in both molecules as follows:

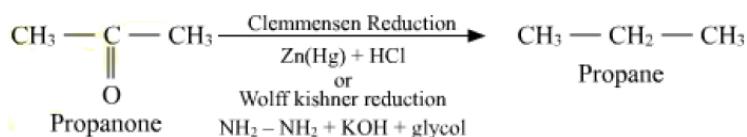


The conjugate base of carboxylic acid has two resonance structures in which negative charge is delocalized over two oxygen atoms (since O is more electronegative than C) which stabilizes the carboxylate ion. On the other hand, in phenoxide ion the charge is delocalized over entire molecule on the less electronegative atom (Carbon), thus resonance of phenoxide is not important in comparison to resonance in carboxylate ion. Further, in carboxylate ion the negative charge is effectively delocalized over two oxygen atoms whereas it is less effectively delocalized over one oxygen atom and less electronegative carbon atom.

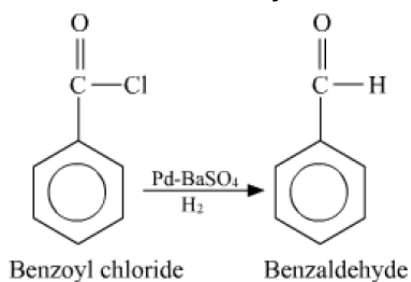
Thus, phenol is less acidic than carboxylic acids. In other words, carboxylic acids are stronger acids than phenol.

(b)

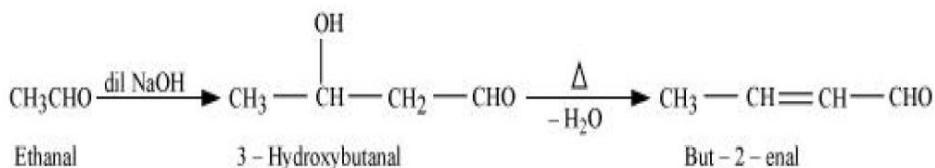
- (i) Conversion of Propanone to Propane:



- (ii) Conversion of Benzoyl chloride to benzaldehyde:

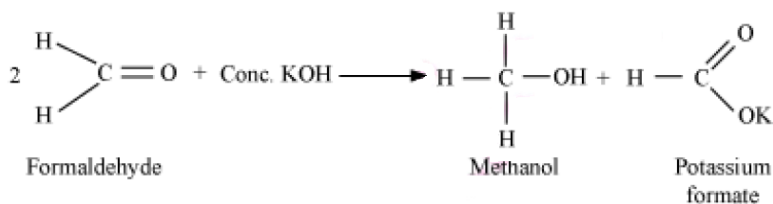


- (iii) On treatment with dilute alkali, ethanol produces 3-hydroxybutanal gives But-2-enal on heating.

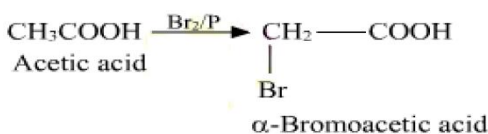


OR

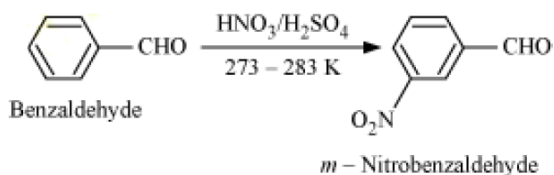
- (a)
(i)



- (ii)



- (iii)



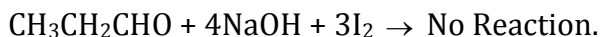
- (b)

- (i) Distinguish test between ethanal and propanal:

Iodoform Test: Ethanal gives iodoform test.



Propanal does not give this test.



- (ii) Distinguish test between Benzoic acid and Phenol:

NaHCO₃ Test: When Benzoic acid reacts with NaHCO₃, brisk effervescence of CO₂ gas evolved.



Phenols do not give any effervescence with NaHCO₃.

Sol. 30

(a)

(i) Differential rate equation: $\text{Rate} = \frac{-d[R]}{dt} = K[A]^2[B]$

(ii) On increasing the concentration of A three times as 3A:

$$\text{Rate}' = K[3A]^2[B] = 9K[A]^2[B] = 9K[A]^2[B] = 9(\text{Rate})$$

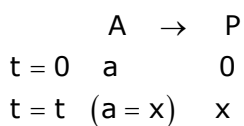
I.e. New rate is 9 times the initial rate.

(iii) On increasing the concentration of A and B as 2A and 2B:

$$\text{Rate}'' = K[2A]^2[2B] = K(4 \times 2)[A]^2[B] = 8K[A]^2[B] = 8(\text{Rate}), \text{ i.e.}$$

8 times the initial rate.

(b)



Now, it takes 40 min for 30% decomposition i.e. reactant left after 40 min is 70% of its initial concentration.

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

$$K = \frac{2.303}{40} \log \frac{a}{(70/100)a} = \frac{2.303}{40} \log 1.428$$

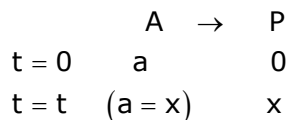
$$\therefore K = 0.00891 \text{ min}^{-1}$$

$$\therefore t_{\frac{1}{2}} = \frac{0.693}{K} = \frac{0.693}{0.008913} = 77.78 \text{ min}$$

OR

(a)

For a first order reaction


 Case 1: If 't' is the time required for 99% completion then $x = 99\%$ of a

$$(a - x) = \frac{1}{100} \times a = \frac{a}{100}$$

$$t = \frac{2.303}{K} \log \frac{a}{a - x} = \frac{2.303}{K} \log \frac{a \times 100}{a}$$

$$t = \frac{2.303}{K} \log 10^2$$

$$\therefore t = 2 \left[\frac{2.303}{K} \right]$$

 Case 2: If 't' is the time required for 90% of completion then $x = 90\%$ of a

$$a - x = \frac{10}{100} a = \frac{a}{10}$$

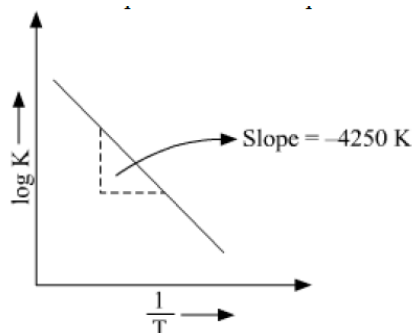
$$t = \frac{2.303}{K} \log \frac{a}{a - x} = \frac{2.303}{K} \log \frac{a \times 10}{a}$$

$$\therefore t = \frac{2.303}{K}$$

Therefore, the time required for 99% completion of 1st order reaction is twice the time required for 90% completion.

$$(b) \log k = \log A - \frac{E_a}{2.303R} \left(\frac{1}{T} \right)$$

 E_a is Activation energy

 The above equation is like $y = mx + c$ where if we plot y v/s x we get a straight line with slope 'm' and intercept 'c'.


$$\text{So, slope is equal to } = \frac{-E_a}{2.303R}$$

$$\Rightarrow \frac{-E_a}{2.303R} = -4250K \Rightarrow E_a = 4250 \times 2.303 \times 8.314 = 81,375.3535 \text{ J mol}^{-1}$$

$$\Rightarrow E_a = 81.3753 \text{ KJ mol}^{-1}$$