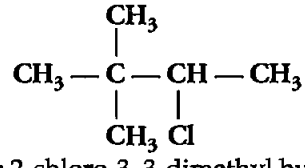
Chemistry 2013 (Outside Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

1. **Of physisorption or chemisorption, which has a higher enthalpy of adsorption ?** [1]
   Answer : Chemisorption.
2. **Name the method used for refining of copper metal.** [1]
   Answer : Electrolytic refining of copper metal.
3. **Name two poisonous gases which can be prepared from chlorine gas.** [1]
   Answer : Chloropicrin or tear gas (CCl_3NO_2) and phosgene gas ($COCl_2$).
4. **Write the IUPAC name of the following compound :** [1]



   Answer : 2-chloro-3, 3-dimethyl butane.
5. **Rearrange the following compounds in the increasing order of their boiling points:** [1]
   CH_3–CHO, CH_3–CH_2–OH_2, $CH_3 - CH_2 - CH_3$
   Answer : $CH_3CH_2CH_3 < CH_3CHO < CH_3CH_2OH$
6. **Write the structure of N-methylethanmine.** [1]
   Answer : $CH_3 - \underset{\underset{H}{|}}{N} - CH_2 - CH_3$

7. What are the products of hydrolysis of sugar ? [1]

Answer : Glucose and fructose.

8. Is $(CH_2 - \underset{\underset{Cl}{|}}{CH})$ a homopolymer or a copolymer ? [1]

Answer : Homopolymer.

9. Account for the following : ** [2]

(i) Schottky defects lower the density of related solids.

(ii) Conductivity of silicon increases on doping it with phosphorus.

10. Aluminium crystallizes in an FCC structure. Atomic radius of the metal is 125 pm, what is the length of the side of the unit cell of the metal ? [2]

11. The standard electrode potential (E°) for Daniell cell is + 1.1 V. Calculate Δ G° for the reaction : [2]

$Zn\,(s) + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu\,(s)$

(1 F = 96500 C/mol)

Answer : $n = 2,\ E^\circ_{cell} = 1.1$ volt, $1F = 96500\ C\ mol^{-1}$

$\Delta_r G^\circ = -nFE^\circ_{cell}$

$= -2 \times 96500 \times 1.1$

$= -212.3\ kJ\ mol^{-1}$

12. For a reaction A + B → P, the rate law is given by [2]

$r = k[A]^{1/2}[B]^2$

(a) What is the order of this reaction ?

(b) A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14}\ s^{-1}$. Find the half life of the reaction.

Answer : (a) Order of reaction $= \frac{1}{2} + 2 = 5/2$

(b) For first order reaction,

$$\text{Half life } (t_{1/2}) = \frac{0.693}{k}$$

$$= \frac{0.693}{5.5 \times 10^{-14}} = 1.26 \times 10^{13}$$

13. (a) Name the method used for removing gangue from sulphide ores. [2]

(b) How is wrought iron different from steel ?

Answer : (a) Froth floatation method.

(b) Wrought iron is the purest form of iron with 0.2-0.5% carbon and steel is an alloy of iron. Wrought iron is produced from cast iron.

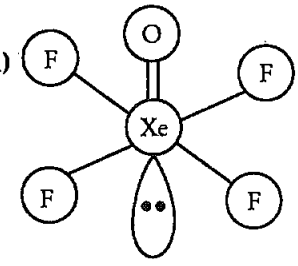
Steel is an alloy of iron and other elements. It has carbon content of 0.1-1.5%.

They also have different properties, industrial and decorative applications.

14. Draw the structures of the following molecules: [2]

(i) $XeOF_4$ (ii) H_3PO_3**

Answer : (i)



15. How are interhalogen compounds formed ? What general compositions can be assigned to them ? [2]

Answer : Interhalogen compounds are formed by direct combination of halogens or by reaction of halogen on lower interhalogen compounds. The general composition of interhalogen compounds are :

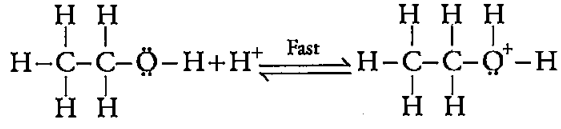
$$XX',\ XX'_3,\ XX'_5,\ XX'_7$$

16. Explain the mechanism of the following reaction : [2]

$$CH_3 - CH_2 - OH \xrightarrow[443\ K]{H^+} CH_2 = CH_2 + H_2O$$

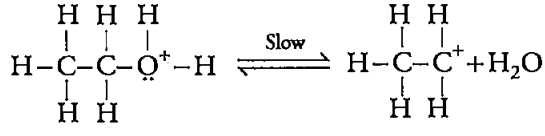
Answer : Mechanism : It involves three steps :

1. Formation of protonated alcohol

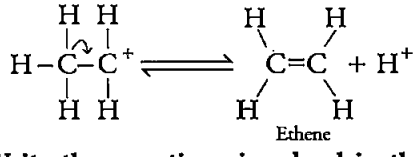


Ethanol

2. Formation of carbocation



3. Formation of ethene by elimination of a proton



Ethene

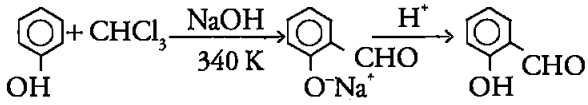
17. Write the equations involved in the following reactions : [2]

(i) Reimer-Tiemann reaction

(ii) Williamson ether synthesis

Answer : (i)

** Answer is not given due to change in present syllabus.



(Phenol) (Salicyladehyde)

(ii) $C_6H_5-ONa \xrightarrow{CH_3I} C_6H_5-OCH_3 + NaI$

Sodium Phenoxide Methyoxy Benzene

18. Define thermoplastic and thermosetting polymers. Give one example of each. [2]

OR

What is a biodegradable polymer ? Give an example of biodegradable aliphatic polyester.

Answer : Thermoplastic Polymers : They are plastics which becomes soft on heating and can be remoulded. They have less forces e.g. Polythene.

Thermosetting Polymers : They do not become soft on heating and cannot be remoulded. They have strong force of attraction *e.g.* bakelite.

OR

Natural polymers such as starch and cellulose that naturally disintegrate themselves, over a period of time are called biodegradable polymers. Example of biodegradable aliphatic polyester is PHBV (Poly-β-hydroxybutyrate-co-β-hydroxy Vaterate).

19. The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature. [3]

[R = 8.314 J/K mol^{-1}, log 4 = 0.6021

Answer : Given,

$T_1 = 293K$, $T_2 = 313$ K.

$R = 8.314\ J\ K^{-1}\ Mol^{-1}$

$\log 4 = 0.6021$

$$Ea = \frac{2.303RT_1T_2}{T_2 - T_1}\log\frac{K_2}{K_1}$$

$$Ea = \frac{2.303\times8.314\times293\times313}{20}\times\log4$$

$$Ea = 52.86\ k\ J\ mol^{-1}$$

20. What are the characteristics of the following colloids ? Give one example of each. [3]
(i) Multimolecular colloids (ii) Lyophobic sols (iii) Emulsions.

Answer : (i) On dissolution, a large number of atoms or molecules of a substance aggregate to form colloidal particles. This colloid is called a multimolecular colloid. *e.g.* Sulphur sol.

(ii) The colloids in which there is no affinity between the particles of dispersed phase and dispersion medium are called lyophobic colloids. They are not stable, that is easily coagulated and irreversible. They are produced only by special methods. eg. As_2S_3 sol, $Fe(OH)_3$ sol.

(iii) Emulsions are colloids in which both dispersed phase and dispersing medium are liquid and immiscible with each other *eg.* Milk, cod liver oil, etc.

****Answer is not given due to change in present syllabus.**

21. Give reasons for the following : [3]
(i) When R is an alkyl group $R_3P = 0$ exist but $R_3N = 0$ doesn't.
(ii) $PbCl_4$ is more covalent than $PbCl_2$.
(iii) N_2 is much less reactive at room temperature.**

Answer : (i) Due to absence of d-orbitals, N cannot form $p\pi-d\pi$ multiple bonds. Thus, it cannot expand its covalency beyond 4. In $R_3N = 0$, N has covalency 5 so it does not exist. On the other hand, due to presence of d-orbitals, P forms $p\pi-d\pi$ multiple bonds and expand its covalency beyond 4. In $R_3P=0$ covalency of P is 5 hence it exists.

(ii) Because 'Pb' is in +4 oxidation state in $PbCl_4$ and has high charge/size ratio than Pb^{2+}. According to Fazan's rule, a higher charge on cation or anion makes compound more covalent, +4 state is more stable than +2 state. Hence $PbCl_4$ is more covalent than $PbCl_2$

22. For the complex $[NiCl_4]^{2-}$, write [3]
(i) the IUPAC name
(ii) the hybridization type
(iii) the shape of the complex
(Atomic no. of Ni = 28)

OR

What is meant by crystal field splitting energy ? On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t_{2g} and e_g in an octahedral field when
(i) $\Delta_o > P$
(ii) $\Delta_o < P$

Answer : (i) Tetrachloridonickelate (II) ion

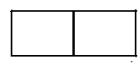
(ii) sp^3 hybridisation

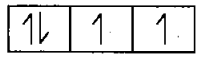
(iii) Tetrahedral shape.

OR

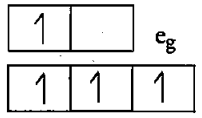
In octahedral complexes, the d-orbitals split into two sets, one with two orbitals of high energy (t_{2g}) and three orbitals with lower energy (e_g). The difference in energy levels of these sets is the crystal field splitting energy.

(i) When $\Delta_0 > P$, electronic configuration is $t_{2g}^4\ e_g^0$.





(ii) When $\Delta_0 < P$, electronic configuration is $t_{2g}^3 e_g^1$



23. Give reasons for the following : [3]

(i) Ethyl iodide undergoes S_N2 reaction faster than ethyl bromide.

(ii) (±) 2-Butanol is optically inactive.

(iii) C–X bond length in halobenzene is smaller than C–X bond length in CH_3–X.

Answer : (i) I^- ion is better leaving group than Br^-ion, therefore, ethyl iodide reacts faster than ethyl bromide in S_N2 reaction.

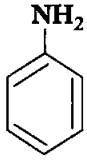
(ii) (±) 2-butanol is optically inactive because it is racemic mixture *i.e.* it has enantiomers in equal amount and hence they cancel each other's rotation of plane polarised light.

(iii) In halobenzene halogen atom is attached to sp^3 hybridized carbon while in CH_3-X sp^2 hybridized carbon which is smaller in size than sp^3 hybridized carbon attached to the halogen. Therefore C–X bond in halobenzene is shorter than in CH_3–X.

24. Complete the following reactions : [3]

(i) $CH_3CH_2NH_2 + CHCl_3 + Alc.KOH \rightarrow$

(ii) $C_6H_5N_2^+Cl^- \xrightarrow[\text{Room Temp.}]{\text{Water}}$

(iii)  + HCl (aq.) $\longrightarrow$

Answer :

(i)

$$CH_3CH_2NH_2 + CHCl_3 + 3KOH_{(aq)} \rightarrow CH_3CH_2-NC + 3KCl + 3H_2O$$

(ii)

$$C_6H_5N_2^+Cl^- \xrightarrow[(\text{room temp.})]{H_2O} C_6H_5OH + N_2 + HCl$$

(iii) $C_6H_5NH_2 + HCl(aq) \rightarrow C_6H_5NH_3Cl$

25. (i) What class of drug is Ranitidine ? [3]

(ii) If water contains dissolved Ca^{2+} ions, out of soaps and synthetic detergents, which will you use for cleaning clothes ?

(iii) Which of the following is an antiseptic ?

0.2% phenol, 1% phenol

Answer : (i) Antacid.

(ii) Soap gets precipitated in hard water hence it can't be used to wash clothes. On the other hand, synthetic detergents do not precipitate in hard water because its calcium salt is soluble in water. Therefore, it can be used to wash clothes in hard water.

(iii) 0.2% phenol.

26. Calculate the emf of the following cell at 25°C : [3]

$$Ag(s)\left|Ag^+(10^{-3}M)\right\|Cu^{2+}(10^{-1}M)\left|Cu(s)\right.$$

Given $E^0_{cell} = +0.46V$ & $\log 10^n = n$.

Given cell notation is incorrect correct cell formula is

$$Cu^{2+}(10^{-1}M)\left|Cu(s)\right\|Ag^+(10^{-3}M)\left|Ag(s)\right.$$

Answer : According to Nernst equation,

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log\frac{[Cu^{2+}]}{[Ag^-]^2}$$

$$= 0.46 - \frac{0.0591}{2}\log\frac{10^{-1}}{[10^{-3}]^2}$$

$$= 0.46 - \frac{0.591}{2}\log 10^5$$

$$= 0.46 - \frac{0.0591}{2}\times 5$$

$$= 0.46 - 0.14775$$

$$E_{cell} = 0.31V$$

27. Shanti, a domestic helper of Mrs. Anuradha, fainted while mopping the floor. Mrs. Anuradha immediately took her to the nearby hospital where she was diagnosed to be severely 'anaemic'. The doctor prescribed an iron rich diet and multivitamins supplement to her. Mrs. Anuradha supported her financially to get the medicines. After a month, Shanti was diagnosed to be normal.

(i) What values are displayed by Mrs. Anuradha ?**

(ii) Name the vitamin whose deficiency causes 'pernicious anaemia'. [3]

(iii) Give an example of a water soluble vitamin.

(ii) Pernicious anaemia is caused due to deficiency of Vitamin B_{12}.

(iii) Vitamin C and Vitamin B.

28. (a) State Raoult's law for a solution containing volatile components. How does Raoult's law become a special case of Henry's law ?

(b) 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing

****Answer is not given due to change in present syllabus.**

point of benzene by 0.40 K. Find the molar mass of the solute. (K_f for benzene = 5.12 K kg/ mol) [5]

OR

(a) Define the following terms :

(i) Ideal solution (ii) Azeotrope

(iii) Osmotic pressure.

(b) A solution of glucose ($C_6H_{12}O_6$) in water is labelled as 10% by weight. What would be the molality of the solution ?

(Molar mass of glucose = 180 g/mol)

Answer : (a) Raoult's law states that the partial pressure of a vapour of a component in the solution is directly proportional to its mole fraction in the solution.

Raoult's law becomes a special case of Henry's law as it states that the partial pressure of gas in vapour phase is directly proportional to the mole fraction of the gas in the solution.

(b) $$M = \frac{1000.k_f.w_2}{w_1.\Delta T_f} = \frac{1000 \times 5.12 \times 1}{50 \times 0.4}$$

$$M = 256\,g$$

OR

(a) (i) A solution that obeys Raoult's law over all ranges of temperature and concentration and shows no attractive forces between components, is called as ideal solution.

(ii) A liquid mixture which distill at constant temperature without undergoing any change in its composition is called Azeotropes.

(iii) The minimum external pressure required to prevent osmosis is known as osmotic pressure.

(b) Given :

Molecular Mass of Glucose (M_B) = 180

% by wt. = (W_B) = 10

Molality (m) = ?

We know

$$m = \frac{W_B \times 1000}{M_B \times W_A}$$

$$W_A = 100 - 10 = 90$$

$$m = \frac{10 \times 1000}{90 \times 180}$$

$$m = 0.617\ m$$

29. (a) Give reasons for the following : [5]

(i) Mn^{3+} is a good oxidising agent.

(ii) $E^\circ_{M^{2+}/M}$ values are not regular for first row transition metals (3d series).

(iii) Although 'F' is more electronegative than 'O', the highest Mn fluoride is MnF_4, whereas the highest oxide is Mn_2O_7.

(b) Complete the following equations :

(i) $2CrO_4^{2-} + 2H^+ \rightarrow$ **(ii)** $KMnO_4 \xrightarrow{\Delta}$

OR

(a) Why do transition elements show variable oxidation states ?

(i) Name the element showing maximum number of oxidation states among the first series of transition metals from Sc (Z = 21) to Zn (Z = 30).

(ii) Name the element which shows only +3 oxidation state.

(b) What is lanthanoid contraction ? Name an important alloy which contains some of the lanthanoid metals.

Answer : (i) Mn^{+3} has electronic configuration $3d^4\ 4^\circ$. It gains one electron on reduction and become $3d^5 4^\circ$ which is half filled stable configuration. Hence it is a good oxidizing agent.

(ii) Due to extra stability of half and fully filled d-orbitals and variations in ionization energies $E^\circ_{M^{2+}/M}$ values are not regular.

(iii) Due to the ability of oxygen to form multiple bonds with metals and because oxygen stabilizes the highest oxidation state even more than fluorine.

(b)(i) $2CrO_4^{2-} + 2H^+ \longrightarrow Cr_2O_7^{2-} + H_2O$

(ii) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + O_2 + MnO_2$

OR

(a) Due to the presence of incomplete d-orbitals, transition elements shows variable oxidation states.

(i) Manganese shows oxidation states from +2 to +7.

(ii) Scandium (Sc).

(b) Lanthanide contraction refers to the steady and regular decrease in atomic size along the period from La^{3+} to Lu^{3+} eg. Misch metal alloy which contains 95% lanthanoids and 5% iron.

30. (a) How will you convert the following : [5]

****Answer is not given due to change in present syllabus.**

(i) Propanone to Propan-2-ol

(ii) Ethanal to 2-hydroxy propanoic acid

(iii) Toluene to benzoic acid

(b) Give simple chemical test to distinguish between :

(i) Pentan-2 -one and Pentan-3 -one

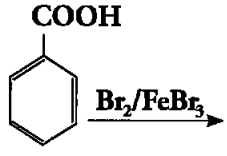
(ii) Ethanal and Propanal

OR

(a) Write the products of the following reactions :

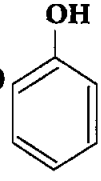
(i) $CH_3\text{-}CO\text{-}CH_3 \xrightarrow[\text{Conc.HCl}]{\text{Zn - Hg}} ?$

(ii) $CH_3\text{-}CO\text{-}Cl \xrightarrow{Pd - BaSO_4} ?$

(iii) 

(b) Which acid of each pair shown here would you expect to be stronger ?

(i) $F-CH_2-COOH$ or $Cl-CH_2-COOH$

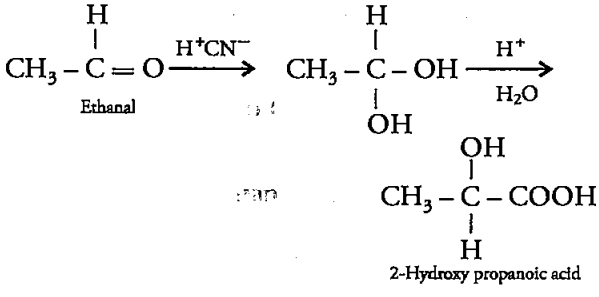
(ii) 

or CH_3COOH

Answer : (a)

(i) $\underset{\text{Propanone}}{CH_3COCH_3} \xrightarrow[NaBH_4]{LiAlH_4 \text{ or}} \underset{\text{Propan-2-ol}}{CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3}$

(ii)



(iii) $\underset{\text{Co/Mn acetate}}{C_6H_5^+-CH_3 \xrightarrow{O_2}} C_6H_5-COOH$

(b) (i) Pentan-2-one gives iodoform test but pentan-3-one does not

$$\underset{\text{Pentan-2-one}}{CH_3-\overset{\displaystyle O}{\overset{||}{C}}-CH_2-CH_3} + 3NaOI \xrightarrow[\text{heat}]{NaOH/I_2} \underset{\text{Iodoform}}{CHI_3\downarrow} + \underset{\text{sodium hypoidite}}{2NaOH + CH_3CH_2CH_2COONa}$$

$$\underset{\text{Pentan-3-one}}{CH_3-CH_2-\overset{\displaystyle O}{\overset{||}{C}}-CH_2-CH_3} \xrightarrow[NaOH/I_2]{3NaOI} \rightarrow \text{No reaction}$$

(ii) Ethanal gives iodoform test but propanal does not.

$$\underset{\text{Sodium formate}}{H-\overset{\displaystyle O}{\overset{||}{C}}-ONa} + \underset{\text{Idoform}}{CHI_3} + 3NaOI + 3H_2O$$

$$\underset{\text{Propanal}}{CH_3-CH_2-\overset{\displaystyle O}{\overset{||}{C}}-H} + I_2 + NaOH \rightarrow \text{No Reaction}$$

OR

(a) (i)

$$\underset{\text{Acetone}}{CH_3-CO-CH_3} \xrightarrow[\text{Conc. HCl}]{Zn-Hg} \underset{\text{Propane}}{CH_3CH_2CH_3} + H_2O$$

(ii)

$$\underset{\text{Acetyl chloride}}{CH_3-CO-Cl} + H_2 \xrightarrow[BaSO_4]{Pd} \underset{\text{Acetaldehyde}}{CH_3-CHO} + HCl$$

(iii)

$$\underset{\text{Benzoic acid}}{C_6H_5\text{-}COOH} \xrightarrow{Br_2/FeBr_3} \underset{\text{m-bromo-benzoic acid}}{\text{O-COOH (Br)}} + HBr$$

(b) (i) F–CH_2–COOH is a stronger acid than Cl–CH_2–COOH, because F is more electronegative than Cl, so it will favour release of H^+ ion faster by dragging electron density towards itself more as compared to Cl.

(ii) Acetic acid CH_3COOH is stronger acid than phenol. Acetic acid forms carboxylate ion and phenol forms phenoxide ion. Carboxylate ion is more stable than phenoxide ion due to resonance.

●●

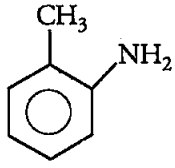
Chemistry 2013 (Outside Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note: Except for the following questions, all the remaining questions have been asked in previous set.

1. Write the structure of 2-aminotoluene. [1]

Answer :



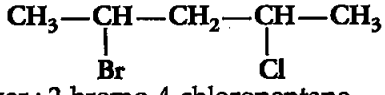
2. Which aerosol depletes ozone layer ? [1]

Answer : Chloroflurocarbon (CFCs) present in aerosols depletes ozone layer.

4. Ethanal is soluble in water. Why ? [1]

Answer : Ethanal is soluble in water due to Hydrogen bonding.

5. Write the IUPAC name of the following compound : [1]



Answer : 2-bromo-4-chloropentane.

7. Write the name of linkage joining two amino acids. [1]

Answer : Peptide linkage.

8. Give one example of a condensation polymer. [1]

Answer : Dacron or Nylon–6, 6.

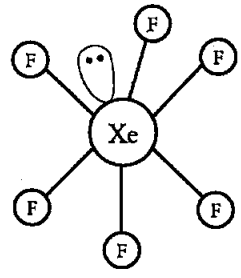
9. (a) Why does presence of excess of lithium makes LiCl crystals pink ?** [2]

(b) A solid with cubic crystal is made of two elements P and Q Atoms of Q are at the corners of the cube and P at the body-centre. What is the formula of the compound ?**

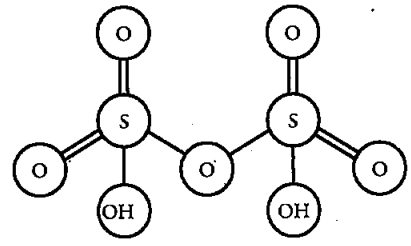
14. Draw the structures of the following molecules : [2]

(i) XeF_6 (ii) $H_2S_2O_7$

Answer : (i)



(ii)



18. Outline the principles of refining of metals by the following methods : [2]

(i) Zone refining (ii) Vapour phase refining

Answer : (i) This method is based on the principle that the impurities are more soluble in the molten state than in the solid state of metal.

(ii) In this process the metal is converted to its volatile compound, collected elsewhere and then decomposed to give pure metal.

19. Define the following terms giving an example of each : [2]

(i) Associated colloids (ii) Lyophilic sol

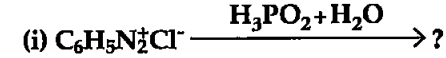
(iii) Adsorption.

Answer : (i) Associated colloids are colloidal substances which at low concentrations behave as normal electrolytes but at higher concentration they aggregate to form colloids. eg. Soaps and detergents.

(ii) Lyophilic sols are the colloids in which the particles of dispersed phase have a strong affinity for the dispersion medium. They are reversible in nature because on precipitation they can be easily converted back to colloidal form by adding dispersion medium. *eg.* Starch sol.

(iii) The aggregation of a substance on the surface of liquid or solid is known as adsorption eg. Adsorption of poisonous gases on charcol.

22. Write the main products of the following reactions : [2]

(i) 

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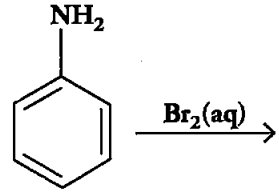


**** Answer is not given due to change in present syllabus.**

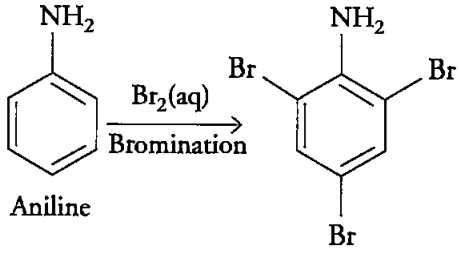
(iii) $CH_3-\underset{\underset{O}{\|}}{C}-NH_2 \xrightarrow{Br_2+NaOH} ?$

Answer : (i)

$C_6H_5N_2^+Cl^- \xrightarrow{H_3PO_2 + HCl} C_6H_6 + N_2 + HCl + H_3PO_3$

Benzenediazonium chloride — Benzene

(ii)



Aniline — 2,4,6-Tribromoaniline

(iii)

$CH_3-\underset{\underset{O}{\|}}{C}-NH_2 \xrightarrow{Br_2+4NaOH} CH_3NH_2 + 2NaBr + Na_2CO_3 + 2H_2O$

Acetamide — Methylamine

27. Give reasons for the following : [3]

(i) Oxygen is a gas but sulphur is a solid.

(ii) O_3 acts as a powerful oxidising agent.

(iii) BiH_3 is the strongest reducing agent amongst all the hydrides of Group 15 elements.**

Answer : (i) Oxygen is smaller in size than sulphur. Due to small size, it can effectively form $p\pi - p\pi$ bonds, and forms diatomic O_2 molecule. The intermolecular forces in oxygen are weak van der Waals forces, which causes it to exists as gas. On the other hand, sulphur does not form strong S=S double bonds and exists as puckered structure held together by covalent bonds and exists as polyatomic molecule. So, it exists as solid.

(ii) O_3 act as powerful oxidising agent because it decompose to give nascent oxygen.

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Chemistry 2013 (Outside Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

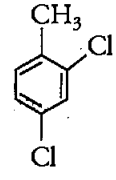
Note: Except for the following questions, all the remaining questions have been asked in previous sets.

1. What is especially observed when a beam of light is passed through a colloidal solution ? [1]

Answer : Tyndall effect is observed due to scattering of light.

2. What is the basicity of H_3PO_3 and why ? [1]**

3. Write the IUPAC name of the following compound : [1]



Answer : 2, 4–dichlorotoluene

8. Write the structure of prop-2-en-1-amine. [1]

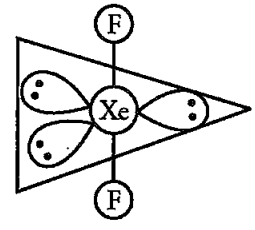
Answer : $H_2C=CH-CH_2-NH_2$

12. Draw the structures of the following molecules : [2]

(i) N_2O_5 (ii) XeF_2**

Answer :

(ii)



13. (a) What change occurs when AgCl is doped with $CdCl_2$?**

(b) What type of semiconductor is produced when silicon is doped with boron ? [2]**

18. Name the principal ore of aluminium. Explain the significance of leaching in extraction as aluminium. [2]

Answer : Bauxite ($Al_2O_3.2H_2O$) is the principal ore of aluminium. The significance of leaching in extraction of aluminium is to prepare pure alumina from the bauxite ore in the following steps :

$Al_2O_3 + 2NaOH + 3H_2O \xrightarrow[\Delta]{473\text{-}523\ K} 2Na[Al(OH)_4]$

(s) (aq) (Cl) — Sod.metaaluminate (aq)

$SiO_2 + 2NaOH \xrightarrow[\Delta]{473\text{–}523K} Na_2SiO_3 + H_2O$

Sodium Silicate

After filtration of impurities sodium meta aluminate is neutralized by passing CO_2.

$$\underset{(aq)}{2Na[Al(OH)_4]} + \underset{(q)}{2CO_2} \rightarrow \underset{(s)}{Al_2O_3.xH_2O\downarrow} + \underset{(aq)}{2NaHCO_3}$$

$$\underset{(s)}{Al_2O_3\,xH_2O} \xrightarrow{1473K} \underset{\text{Alumina}\ (s)}{Al_2O_3} + \underset{(g)}{xH_2O}$$

19. Define the following terms with an example in each case : [3]

(i) Macromolecular Sol (ii) Peptization

(ii) Emulsion.

Answer : (i) Macromolecular sol : They are molecules of large size having high molecular masses. Due to long chain, the van der Waals forces are stronger. Eg. rubber, nylon, etc.

(ii) Peptization : It is the process of converting a precipitate into colloidal solution by shaking it with dispersion medium in the presence of small amount of electrolyte. E.g. A preciptate of AgI can be peptized by shaking with a dilute solution of silver nitrate.

(iii) Emulsion : A type of colloidal solution in which both the dispersed phase and dispersion medium are liquid and are immiscible with each other is called emulsion. Ex. milk.

21. Give reasons for the following : [3]

(i) Though nitrogen exhibits +5 oxidation state, it does not form pentahalide.**

(ii) Electron gain enthalpy with negative sign of flourine is less than that of chlorine.

(iii) The two oxygen-oxygen bond lengths in ozone molecules are identical.

(ii) Due to small size, fluorine atom has high electro negativity and strong electron – electron repulsions in its compact 2p orbitals, its electron gain enthalpy is less than that of chlorine.

(iii) The two oxygen bond lengths in ozone are identical due to resonance.

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Chemistry 2013 (Delhi) SET I

Time allowed : 3 hours **Maximum marks : 70**

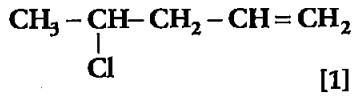
1. How many atoms constitute one unit cell of a face-centered cubic crystal ? [1]**

2. Name the method used for refining of Nickel metal. [1]

Answer : Method used for refining of nickel metal is Mond's process.

3. What is the covalency of nitrogen in N_2O_5 ?[1]**

4. Write the IUPAC name of :



[1]

Answer : 4-chloropent-1-ene.

5. What happens when CH_3-Br is treated with KCN ? [1]

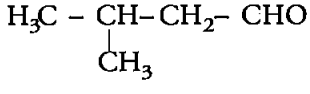
Answer :

$$\underset{\text{Methyl Bromide}}{CH_3Br} + \underset{\text{Potassium cyanide}}{KCN} \rightarrow \underset{\text{Methyl Cyanide}}{CH_3CN} + \underset{\text{Potassium Bromide}}{KBr}$$

It is a nucleophilic substitution reaction.

6. Write the structure of 3-methyl butanal. [1]

Answer :



7. Arrange the following in increasing order of their basic strength in aqueous solution : CH_3NH_2, $(CH_3)_3N$, $(CH_3)_2NH$. [1]

Answer :

$$\underset{3^\circ\text{amine}}{(CH_3)_3N} < \underset{1^\circ\text{amine}}{CH_3NH_2} < \underset{2^\circ\text{amine}}{(CH_3)_2NH}$$

8. What are the types of RNA molecule which perform different functions ? [1]

Answer : Three types of RNA molecules which perform different functions are :

(i) Messenger RNA (m-RNA)

(ii) Transfer RNA (t-RNA)

(iii) Ribosomal RNA (r-RNA)

9. 18 g of glucose, $C_6H_{12}O_6$ (Molar Mass = 180g/mol) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil ? [2] (K_b for water = 0.52 K kg mol^{-1}, boiling point of pure water = 373.15 K)

Answer : Given,

Weight of solvent (H_2O) (W_1) = 1 kg

Weight of solute ($C_6H_{12}O_6$) (W_2) = 18 gm

Molar mass of solute (M_2) = 180 g/mol

K_b = 0.52 K kg mol^{-1}

T_b° = 373.15 K

****Answer is not given due to change in present syllabus.**

We know that

$$\therefore \Delta T_b = \frac{K_b \times 1000 \times W_2}{M_2 \times W_1}$$

$$= \frac{0.52 \times 1000 \times 18}{180 \times 1000}$$

$$= 0.052\,K$$

$$\therefore \Delta T_b = T_b - T_b^\circ = 0.052$$

$$0.052 = T_b - 373.15$$

$$T_b = 373.202\,K$$

Hence, boiling point of solution is 373.202 K

10. The conductivity of 0.20 M solution of KCl at 298 K is 0.025 S cm^{-1}. Calculate its molar conductivity. [2]

Answer : Given $k = 0.025\,S\,cm^{-1}$

Molarity, M = 0.20 M

Molar conductivity

$$(\Lambda m) = \frac{\kappa \times 1000}{M}$$

$$= \frac{0.025 \times 1000}{0.20}$$

$$\therefore \Lambda_m = 125\,S\,cm^2 mol^{-1}$$

11. Write the dispersed phase and dispersion medium of the following colloidal system : [2]

(i) Smoke (ii) Milk.

OR

What are lyophilic and lyophobic colloids ? Which of these sols can be easily coagulated on addition of small amounts of electrolytes ?

Answer : (i) Dispersed Phase in Smoke : Solid, dispersion medium in smoke : Gas

(ii) Dispersed Phase in Milk : Fats (liquid), dispersion medium in milk: Water (liquid)

OR

Answer : Lyophilic Colloids : These are the colloidal solutions in which dispersed phase has great affinity for dispersion medium. Such solutions are quite stable and are reversible in nature. e.g. starch, proteins, etc.

Lyophobic Colloids (Liquid Hating) : These are the colloidal solutions in which dispersed phase has very little affinity for the dispersion medium. Such solutions are unstable and are irreversible in nature. *eg.*, (As_2S_3 Sol).

Lyophobic colloids can be easily coagulated because on addition of small amount of electrolyte, the charge on colloidal particles is removed, as a result the particles will come closer to each other and then aggregate to form a cluster which settle down under the force of gravity.

12. Write the differences between physisorption and chemisorption with respect to the following : [2]

(i) Specificity (ii) Temperature dependence (iii) Reversibility and (iv) Enthalpy change

Answer :

S. No.	Point of difference	Physisorption	Chemisorption
(i)	Specificity	It is not specific in nature *i.e.*, all gases are adsorbed on all solids to some extent.	This is highly specific in nature. *i.e.*, it occurs only when there is some possibility of compound formation between the gas being adsorbed and the solid being adsorbent.
(ii)	Temperature dependence	Low temperature is favourable for physisorption. It decreases with increase in temperature	High temperature is favourable for chemisorptions. It 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 *i.e.*, 20-40 $kJmol^{-1}$	Enthalpy of adsorption is high *i.e.*, 40-4000 $kJ\,mol^{-1}$

13. (a) Which solution is used for the leaching of silver metal in the presence of air in the metallurgy of silver ?

(b) Out of 'C' and 'CO', which is a better reducing agent at the lower temperature range in the blast furnace to extract iron from the oxide ore ? [2]

Answer : (a) Dilute solution *i.e.*, 0.5% NaCN and KCN is used for leaching of silver metal in the presence of air.

$$4Ag + 8NaCN + 2H_2O + O_2 \rightarrow 4Na[Ag(CN)_2] + 4NaOH$$

Sodium. dicyanoargentate (I)

(b) Out of C and CO, CO is a better reducing agent at lower temperature range in the blast furnace to extract iron from the oxide ore because

in Ellingham diagram $\Delta G_{(CO, CO_2)} < \Delta G_{(Fe, FeO)}$ SO, CO will reduce FeO to Fe and will oxidized to CO_2.

$$FeO + CO \xrightarrow{1123\,K} Fe + CO_2$$

14. What happens when [2]

(i) PCl_5 is heated ? **(ii) H_3PO_3 is heated ?**

Write the reaction involved.

Answer : (i) PCl_5 on heating gives PCl_3 and Cl_2.

$$PCl_5 \xrightarrow{Heat} PCl_3 + Cl_2$$

(ii) H_3PO_3 on heating gives orthophosphoric acid and phosphine.

$$4H_3PO_3 \xrightarrow{\Delta} \underset{\text{orthophosphoric acid}}{3H_3PO_4} + \underset{\text{Phosphine}}{PH_3}$$

15. (a) Which metal in the first transition series (3*d* series) exhibits + 1 oxidation state most frequently and why ?

(b) Which of the following cations are coloured in aqueous solutions and why ? [2]

Sc^{3+}, V^{3+}, Ti^{4+}, Mn^{2+}

(Atomic Nos. Sc = 21, V = 23, Ti = 22, Mn = 25)

Answer : (a) Cu is the only metal in the first transition series (3*d* series) which exhibits +1 oxidation state more frequently. This is because the electronic configuration of Cu is $3d^{10}\,4s^1$ and after losing one s electron it acquires a stable $3d^{10}$ configuration.

(b) The colour of cations depend upon the number of unpaired electrons present in *d*-orbital. The electronic configuration of the following cations is as follows :

Sc (Atomic number 21) = $3d^1 4s^2$ and $Sc^{3+} = 3d^0 4s^0$. As d-orbital is empty, it is colourless.

V (atomic number 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 depicts green colour.

Ti (Atomic number 22) = $3d^2 4s^2$ and $Ti^{+4} = 3d^0 4s^0$. As '*d*' orbital is empty, it is colourless.

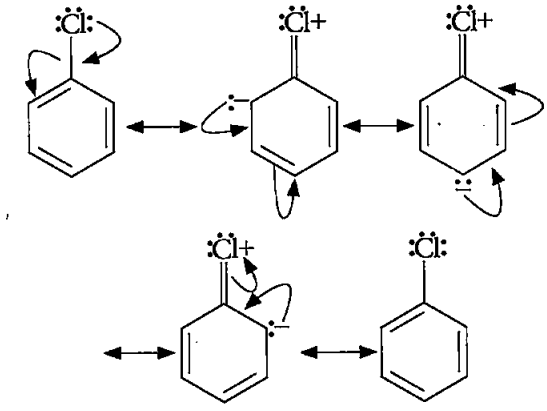
Mn(Atomic number 25) = $3d^5 4s^2$ and $Mn^{+2} = 3d^5 4s^0$. As '*d*' orbital has 5 unpaired electrons, it depicts pink colour.

Thus, V^{3+} and Mn^{2+} ions are coloured in their aqueous solution due to the presence of unpaired electron.

16. Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same. [2]

Answer : Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction because of the following reasons :

1. Resonance Effect : The electron pair on chlorine atom is in conjugation with the benzene-electrons of the benzene ring which results in the following resonating structures :



This results in delocalization of 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.

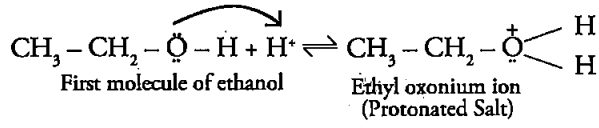
2. The nucleophile suffers repulsion from the increased electron density on the benzene ring as a result the nucleophile is unable to make a close approach for the attack on the molecule.

17. Explain the mechanism of the following reaction: [2]

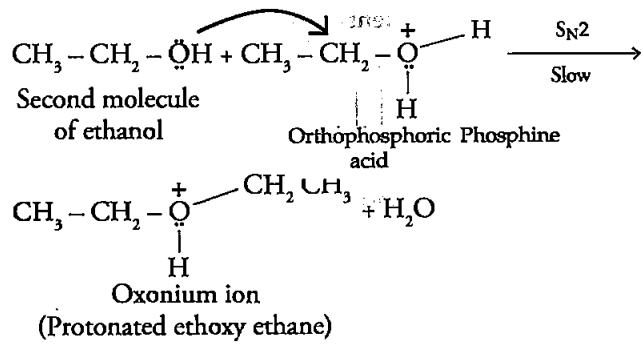
$$2CH_3—CH_2—OH \xrightarrow[413\,K]{H^+} CH_3CH_2—O—CH_2—CH_3 + H_2O$$

Answer : The mechanism of the reaction is given below :

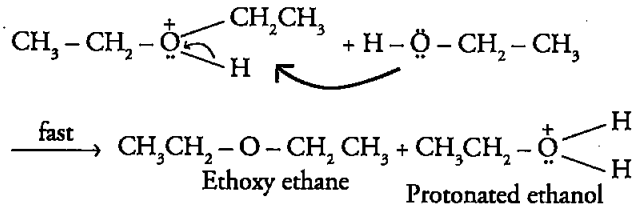
Step 1 : Protonation of alcohol



Step 2 : Attack by nucleophile on protonated alcohol molecule



Step 3 : Loss of proton : to form ethoxy ethane



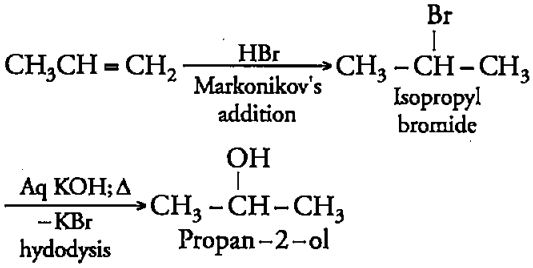
Ethoxy ethane Protonated ethanol

18. How will you convert : [2]

(i) Propene to Propan-2-ol ?

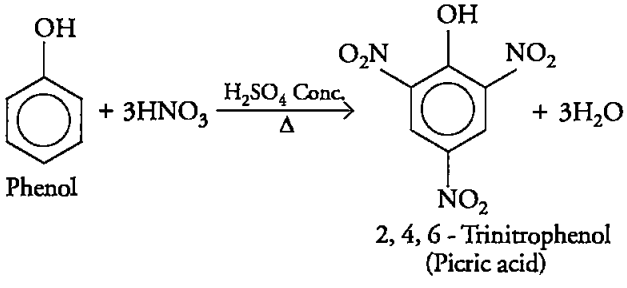
(ii) Phenol to 2, 4, 6 – trinitrophenol ?

Answer : **(i)** When H_2SO_4 is added to propene, propan-2-ol is formed. The addition of H_2SO_4 takes place in accordance with Markovnikov's rule.



Isopropyl bromide Propan–2–ol

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



Phenol 2, 4, 6 - Trinitrophenol (Picric acid)

19. (a) What type of semiconductor is obtained when silicon is doped with boron ?** [3]

(b) What type of magnetism is shown in the following alignment of magnetic moments ?**

(c) What type of point defect is produced when AgCl is doped with $CdCl_2$?**

20. Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2 L of water at 25°C, assuming that it is completely dissociated. [3]

**** Answer is not given due to change in present syllabus.**

($R = 0.0821$ L atm K^{-1} mol^{-1}, Molar mass of $K_2SO_4 = 174$ g mol^{-1})

Answer : We know

$$\pi = iCRT \Rightarrow \pi = \frac{inRT}{V} \Rightarrow \pi = i \times \frac{w}{M} \times \frac{1}{V} RT$$

Given : $w = 2.5 \times 10^{-2}$, g = 0.025 g

V = 2 L, T = 25°C = 298 K

$M = K_2SO_4 = 2 \times 39 + 32 + 4 \times 16 = 174$ g mol^{-1}

K_2SO_4 dissociates completely as

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

Ions produced = 3 *i.e.*, $i = 3$

$$\text{Hence, } \pi = \frac{3 \times 0.025\text{g}}{174\,\text{g mol}^{-1}} \times \frac{1}{2\text{L}} \times 0.0821 \times 298\text{ K}$$

$$\pi = 5.27 \times 10^{-3}\text{ atm}$$

21. Calculate the emf of the following cell at 298 K : [3]

Fe(s) | Fe^{2+} (0.001 M) | | H^+ (1M) | H_2(g) (1 bar), Pt(s)

(Given $E^\circ_{cell} = +0.44$ V)

Answer :

At anode : $Fe \rightarrow Fe^{2+} + 2e^-$

At cathode: $2H^+ + 2e^- \rightarrow H_2$

So, total number of electrons (n) transferred = 2

Given that : $E^\circ_{cell} = +0.44$ V

Temperature (T) = 298 K

We know,

$$E_{cell} = E^\circ_{cell} - \left(\frac{2.303RT}{nF}\right) \log \frac{a_{oxi}}{a_{red}}$$

$$E_{cell} = E^\circ_{cell} - \left(\frac{0.05916\text{ V}}{n}\right) \log \frac{[Fe^{2+}]}{[H^+]^2}$$

$$= 0.44 - \frac{0.5916}{2} \log \frac{0.001}{1}$$

$$= 0.44 - 0.02955 \times (-3)$$

$$= 0.44 + 0.08865$$

$$\therefore\ E_{cell} = 0.53\text{ V}$$

22. How would you account for the following ? [3]

(i) Transition metals exhibit variable oxidation states.

(ii) Zr (Z = 40) and Hf (Z = 72) have almost identical radii.

(iii) Transition metals and their compounds act as catalyst.

OR

Complete the following chemical equations:

(i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow$

(ii) $2CrO_4^{2-} + 2H^+ \rightarrow$

(iii) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow$

Answer : (i) The variable oxidation states of transition elements is 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 atomic radii of $4d$ and $5d$ transition elements are nearly same. This similarity in size is a consequence of lanthanide contraction which is due to weak shielding of d-electrons. As a result, the radii of Hf becomes nearly equal to that of Zr.

(iii) The catalytic activity of transition elements and their compound is due to the following reasons :

1. Due to their tendency to show variable oxidation state transition metal form instable intermediate compounds and provides a new path for the reaction with lower activation energy.

2. In some cases, the transition metals provide a suitable large surface area with free valencies or ion which reactant can adsorbed.

OR

(i) $Cr_2O_7^{2-} + 6Fe^{2+} + 14H \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

(ii) $2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$

(iii) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+}$ 10CO 8H O $+10CO_2 + 8H_2O$

23. Write the IUPAC names of the following coordination compounds : [3]

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

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

(iii) $[CoBr_2(en)_2]^+$, **(en = ehylenediamine)**

Answer : (i) Triamminetrichloridochromium(III)

(ii) Potassium hexacyanoferrate(III)

(iii) Dibromidobis-(ethylene-diammine) cobalt (III) ion

24. Give the structures of A, B and C in the following reactions: [3]

(i)

$$C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow[\Delta]{NH_3} C$$

(ii)

$$C_6H_5NO_2 \xrightarrow{Sn + HCl} A \xrightarrow[273K]{NaNO_2+HCl} B \xrightarrow[\Delta]{H_2O/H^+} C$$

Answer : (i)

$$\underset{\text{Benzene diazonium chloride}}{C_6H_5N_2^+Cl^-} \xrightarrow{CuCN} \underset{\text{(A) Benzonitrile}}{C_6H_5CN} \xrightarrow{H_2O/H^+}$$

$$\underset{\text{(B) Benzoic acid}}{C_6H_5COOH} \xrightarrow[\Delta]{NH_3} \underset{\text{Ammonium benzoate}}{C_6H_5COO^-NH_4^+} \xrightarrow{\Delta} \underset{\text{(C) Benzamide}}{C_6H_5CONH_2}$$

(ii)

$$\underset{\text{Nitrobenzene}}{C_6H_5NO_2} \xrightarrow{Sn+HCl} \underset{\text{(A) Aniline}}{C_6H_5NH_2} \xrightarrow[273K]{NaNO_2+HCl} \underset{\text{(B) Benzene diazonium Chloride}}{C_6H_5N^+ \equiv NCl^-} \xrightarrow[\Delta]{H_2O/H^+} \underset{\text{(C) Phenol}}{C_6H_5OH}$$

25. Write the names and structures of the monomers of the following polymers : [3]

(i) Buna–S **(ii) Neoprene**

(iii) Nylon-6, 6

Answer : (i) Buna - S :

$CH_2 = \underset{\underset{\text{stryene}}{C_6H_5}}{\underset{|}{CH}}$ and $\underset{\text{Buta–1,3–diene}}{CH_2 = CH - CH = CH_2}$

(ii) Neoprene :

$$\underset{\text{Chloroprene}}{CH_2 = CH - \overset{\overset{Cl}{|}}{C} = CH_2}$$

(iii) Nylon-6, 6 :

$$\underset{\text{Adipic acid}}{HO - \overset{\overset{O}{\|}}{C} - (CH_2)_4 - \overset{\overset{O}{\|}}{C} - OH} \text{ and } \underset{\text{Hexamethylenediamine}}{H_2N - (CH_2)_6 - NH_2}$$

26. After watching a programme on TV about the adverse effects of junk food and soft drinks on the health of school children, Sonali, a student of Class XII, discussed the issue with the principal. Principal immediately instructed the canteen contractor to replace the fast food with the fibre and vitamins rich food like sprouts, salad, fruits etc. This decision was welcomed by the parents and the students. [3]

After reading the above passage, answer the following questions :

(a) What values are expressed by Sonali and the Principal of the school ?**

(b) Give two examples of water-soluble vitamins.

Answer :

(b) The two water soluble vitamins are vitamin B and Vitamin C (Ascorbic acid).

27. (a) Which one of the following is a food preservative ? **[3]**

Equanil, Morphine, Sodium benzoate

(b) Why is bithional added to soap ?

(c) Which class of drugs is used in sleeping pills ?

Answer : (a) Sodium benzoate is used as a food preservative whereas equanil is a tranquilizer and morphine is a narcotic analgesic.

(b) Bithional is an antiseptic so it is added to soaps to reduce the odours produced by bacterial decomposition of organic matter on the skin.

(c) Tranquilizers relieve stress, fatigue by inducing sense of well being, so they are used in sleeping pills.

28. (a) A reaction is second order in A and first order in B. **[5]**

(i) Write the differential rate equation.

(ii) How is the rate affected on increasing the concentration of A three times ?

(iii) How is the rate affected when the concentrations of both A and B are doubled ?

(b) A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ for this reaction.

(Given : log 1.428 = 0.1548)

OR

(a) For a first order reaction, show that time required for 99% completion is twice the time required for the completion of 90% of reaction.

(b) Rate constant 'k' of a reaction varies with temperature 'T' according to the equation :

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

Where E_a is the activation energy. When a graph is plotted for log k Vs. $\frac{1}{T}$, a straight line with a slope of –4250 K is obtained. Calculate 'E_a' for the reaction. (R = 8.314 JK^{-1} mol^{-1})

Answer : (a) (i) A reaction is second order in A and first order in B.

$$\text{Rate} = \frac{-d[R]}{dt} = K[A]^2[B]$$

(ii) On increasing the concentration of 'A' three times *i.e.* 3A; the rate of reaction becomes 9 times of the initial rate.

Rate = $K[3A]^2[B] = 9K[A]^2[B]$ = 9 times rate.

(iii) On increasing the concentration of A and B as 2A and 2B. The rate of reaction becomes 8 times of the initial rate.

Rate = $K[2A]^2[2B] = 8K[A]^2[B]$ = 8 times rate

(b)

	A	→	P
$t =$	0		0
$t = t\ (a\text{-}x)$	x		

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

$$\text{So, } (a-x) = \frac{70}{100} \times a = \frac{7}{10}a$$

Using the formula,

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

$$= \frac{2.303}{40}\log\frac{a}{(7/10)a}$$

$$= 0.00891\,\text{min}^{-1}$$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.008913}$$

$$\therefore \quad t_{1/2} = 77.78 \text{ min}$$

OR

(a) For a first order reaction,

	A	→	P
At, t=0	a		0
At, t=t	$(a\text{-}x)$		x

$$t_{99\%} = \frac{2.303}{K}\log\frac{100}{1} \qquad \text{eq. (i)}$$

$$t_{90\%} = \frac{2.303}{K} = \frac{100}{10} \qquad \text{eq. (ii)}$$

on Comparing eq (i) and (ii)

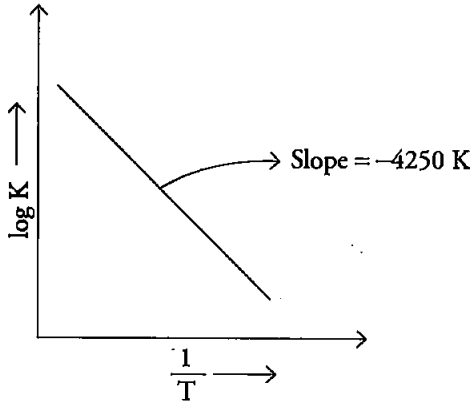
$$\frac{t_{99\%}}{t_{90\%}} = \frac{\log 100}{\log 1} \quad \therefore \ t_{99\%} = 2t_{90\%}$$

****Answer is not given due to change in present syllabus.**

$\therefore$ the time required for 99% completion of 1st order reaction is twice the time required for 90% completion.

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

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



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

$\frac{-E_a}{2.303R} = -4250\ K$

$\therefore Ea = 4250 \times 2.303 \times 8.314\ (JK^{-1}\ mol^{-1})$

$= 81{,}375.3535\ Jmol^{-1}$

$Ea = 81.3733\ kJ\ mol^{-1}$

29. (a) Give reasons for the following : [5]

(i) Bond enthalpy of F_2 is lower than that of Cl_2.

(ii) PH_3 has lower boiling point than NH_3.**

(b) Draw the structures of the following molecules :

(i) BrF_3 (ii) $(HPO_3)_3$ (iii) XeF_4**

OR

(a) Account for the following :

(i) Helium is used in diving apparatus.

(ii) Flourine does not exhibit positive oxidation state.

(iii) Oxygen shows catenation behaviour less than sulphur.

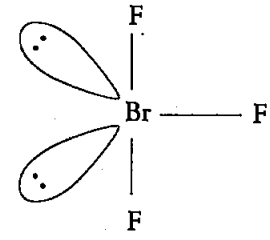
(b) Draw the structures of the following molecules.

(i) XeF_2 (ii) $H_2S_2O_8$

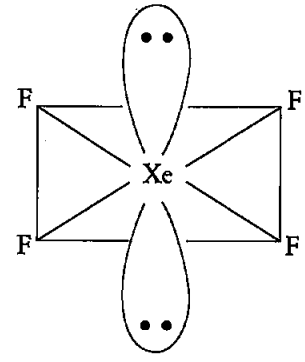
****Answer is not given due to change in present syllabus.**

Answer : (a) (i) Bond enthalpy of F_2 is lower than that of Cl_2 because 'F' atom is small in size and due to this the electron-electron repulsions between the lone pairs of F–F electrons are very large. Thus, the bond dissociation energy of F_2 is lower than that of Cl_2.

(b) (i) BrF_3, Bent T-shape



(iii) XeF_4, square planar



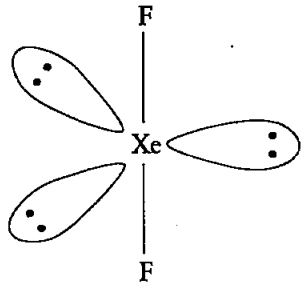
OR

(a)(i) Helium mixed with oxygen under pressure is given to sea-divers for artificial respiration because of its very low solubility in blood. Air is not given 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 to the atmospheric pressure. Thus, oxygen-helium mixture is used.

(ii) Fluorine being the most electronegative atom does not exhibit positive oxidation state because, it does not have d-orbitals for octet expansion and therefore, it shows only a negative oxidation state of –1.

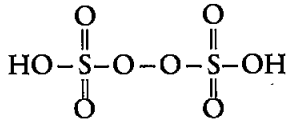
(iii) Oxygen shows catenation behaviour less than sulphur because the oxygen atom is smaller in size as compared to sulphur due to this the lone pair of electron in O–O bonds in oxygen experiences more repulsion as compared to the S–S bonds and thus, S–S forms strong bond.

(b) XeF_2,



XeF_2, Shape : Linear

(ii) $H_2S_2O_8$



30. (a) Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol. Give two reasons. [5]

(b) How will you bring about the following conversions?

(i) Propanone to propane

(ii) Benzoyl chloride to benzaldehyde

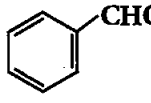
(iii) Ethanal to but-2-enal.

OR

(a) Complete the following reactions :

(i) $2H-\underset{\underset{O}{\|}}{C}-H \xrightarrow{\text{Conc·KOH}}$

(ii) $CH_3COOH \xrightarrow{Br_2/P}$

(iii)  $\xrightarrow[273-283\ K]{HNO_3/H_2SO_4}$

(b) Give simple chemical tests to distinguish between the following pairs of compounds :

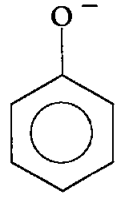
(i) Ethanal and Propanal

(ii) Benzoic acid and Phenol.

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

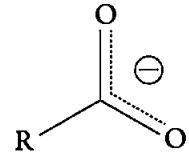
RCOO–

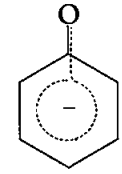
Carboxylate ion



Phenoxide ion

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 declocalized over two oxygen atoms which stabilizes the carboxylate ion.

On the other hand, in phenoxide ion the charge is delocalized over entire molecule on the less electronegative atom, thus resonance of phenoxides is not important in comparison to resonance in carboxylate ion.

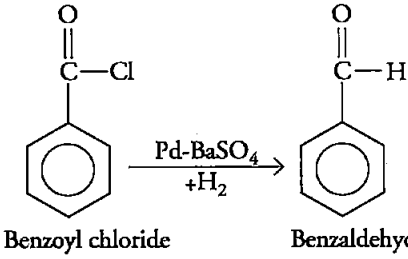
Further, in carboxylate ion the negative charge is effectively delocalized over two oxygen atoms whereas it is less effectively delocalized over one oxygen atom and less electronegative carbon atom.

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 :

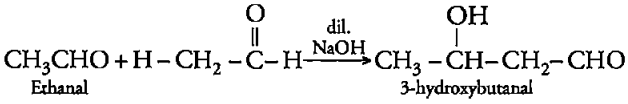
$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow[\text{Reduction}]{NaBH_4,\ CH_3OH} \underset{\text{2–Propanol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3} \xrightarrow[443K]{\text{Conc.}H_2SO_4} \underset{\text{Propene}}{CH_3-CH=CH_2} \xrightarrow[Ni]{+H_2} \underset{\text{Propane}}{CH_3-CH_2-CH_3}$$

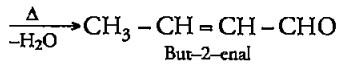
(ii) Conversion of benzoyl chloride to benzaldehyde :



Benzoyl chloride Benzaldehyde

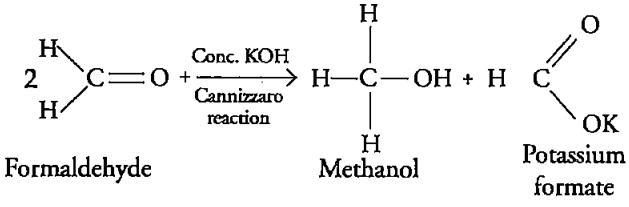
(iii) On treatment with dilute alkali, ethanol produces 3-hydroxybutanal gives But-2-enal on heating



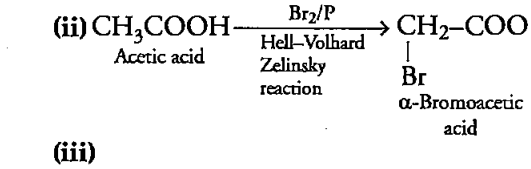


OR

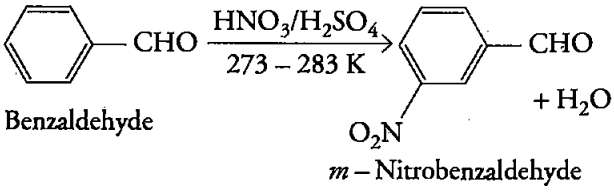
(a)(i)



(ii)

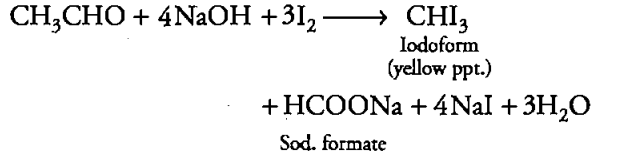


(iii)



(b) (i) Ethanol and Propanal :

Iodoform Test : When ethanol is treated with sodium hydroxide and ammonia, iodoform is obtained.

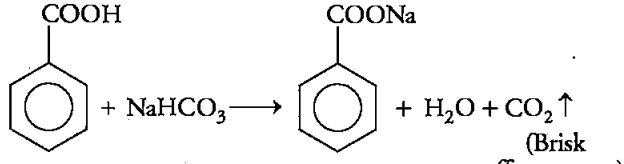


Propanal does not give this test

$CH_3CH_2CHO + 4NaOH + 3I_2 \rightarrow$ No reaction

(ii) Benzoic acid and phenol :

$NaHCO_3$ Test : When benzoic acid is treated with $NaHCO_3$ brisk efferversence of CO_2 gas were evolved.



Phenol does not give this test :

$C_6H_5OH + NaHCO_3 \rightarrow$ No reaction

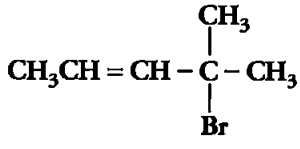
●●

Chemistry 2013 (Delhi) SET II

Time allowed : 3 hours **Maximum marks : 70**

Note: Except for the following questions, all the remaining questions have been asked in previous set.

1. **What type of stoichiometric defect is shown by AgCl ?**** [1]
2. **Write the IUPAC name of :** [1]



Answer : 4-Bromo-4-methylpent-2-ene

4. **What type of bonding helps in stabilizing the α-helix structure of proteins ?** [1]

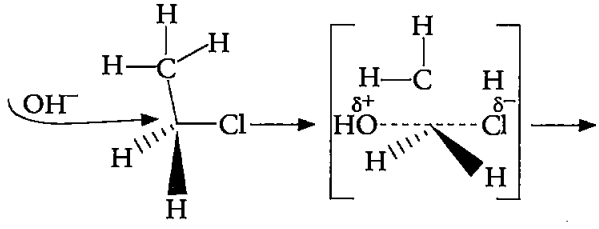
Answer : Hydrogen bonding between the NH group of each amino acid residue and the >C = O of an adjacent turn of the helix helps in stabilizing the α-helix structure of proteins.

6. **What inspired N. Bartlett for carrying out reaction between Xe and PtF_6 ?** [1]

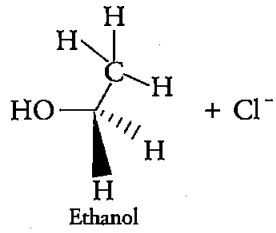
Answer : N. Bartlett observed that the first ionization enthalpy of molecular oxygen is almost identical with that of xenon. So after preparing red coloured compound $O_2^+PtF_6^-$ he made efforts to prepare $Xe^+PtF_6^-$ by mixing PtF_6 and Xe.

7. **What happens when ethyl chloride is treated with aqueous KOH ?** [1]

Answer : When C_2H_5Cl reacts with aq. KOH, substitution Nucleophilic bimolecular (S_N2) reaction takes place and Ethanol is formed.



****Answer in not given due to change in present syllabus.**



Ethanol

And inversion of configuration also takes place.

8. Write the structure of 4-chloropentan-2-one. [1]

Answer : $CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

9. How will you convert the following ? [2]

(i) Propan-2-ol to propanone.

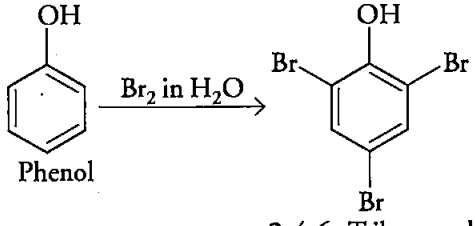
(ii) Phenol to 2, 4, 6 – tribromophenol ?

Answer : (i) Propan-2-ol to propanone :

$$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow{K_2Cr_2O_7 + H_2SO_4} CH_3-\overset{\overset{O}{\|}}{C}-CH_3$$

Propane–2–ol Propanone

(ii) Phenol to 2, 4, 6-tribromophenol:



Phenol 2,4,6–Tribromophenol

11. What is the difference between oil/water (O/W) type and water/oil (W/O) type emulsions? Give an example of each type. [2]

Answer : Emulsion of oil-in-water has oil as dispersed phase and water as dispersion medium. For example, Milk etc.

Emulsion of water-in-oil has water as dispersed phase and oil as dispersion medium. For example, Cod liver oil etc.

17. (a) Which of the following ores can be concentrated by froth floatation method and why ?

Fe_2O_3, ZnS, Al_2O_3

(b) What is the role of silica in the metallurgy of Copper ? [2]

Answer : (a) Only sulphide ores are concentrated by this process because pine oil selectively wets the sulphide ore and hence bring it to the froth.

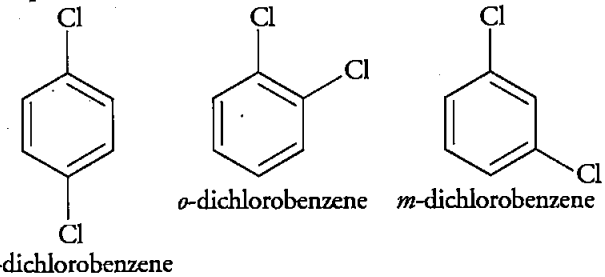
(b) Silica is added in the reverberatory furnance during the extraction of copper to remove iron oxide present in the ore. Iron oxide reacts with silica and is removed as slag of iron silicate.

$$FeO + SiO_2 \rightarrow \underset{\text{Slag}}{FeSiO_3}$$

18. (a) Why does *p*-dichlorobenzene has a higher m.p. than its *o*- and *m*- isomers? [2]

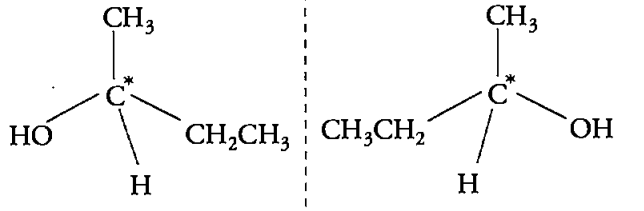
(b) Why is (–) – Butan-2-ol optically inactive ?

Answer : (a) p-dichlorobenzene has higher melting point than ortho and meta isomer. This is because the para isomer is having a symmetrical structure and therefore, its packing is more efficient as compared to the ortho and meta isomer, therefore, it shows higher melting point.



p-dichlorobenzene *o*-dichlorobenzene *m*-dichlorobenzene

(b) The (±) – Butan-2-ol is optically inactive because it is racemic mixture and exists in two enantiomeric forms which are non-superimposable mirror images of each other. Both the isomers are present in equal amounts therefore, it does not rotate the plane of polarized light and is optically inactive.



50% – (+) Butan -2-ol 50% – (–) Butan -2-ol

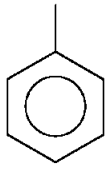
23. Write the names and structures of the monomers of the following polymers : [3]

(i) Polystyrene

(ii) Dacron

(iii) Teflon

Answer : Polymers with their monomers and their structures:

Polymer	Monomer	Structure
(i) Polystyrene	Styrene (Vinyl benzene)	$CH = CH_2$ 
(ii) Dacron	1. Ethylene glycol 2. Terephthalic acid	1. $HOH_2C - CH_2OH$ 2. $HOOC - C_6H_4 - COOH$
(iii) Teflon	Tetrafluoroethene	$CF_2 = CF_2$

27. Write the types of isomerism exhibited by the following complexes : [3]

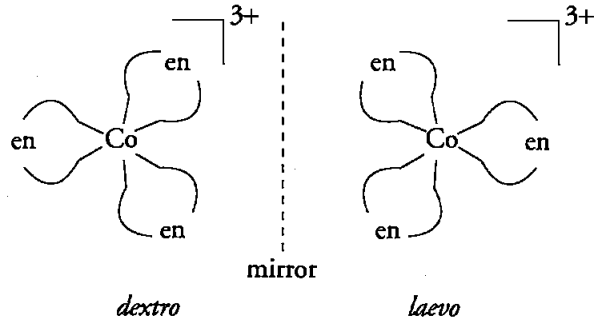
(i) $[Co(NH_3)_5Cl]SO_4$

(ii) $[Co(en)_3]^{3+}$

(iii) $[Co(NH_3)_6]\,[Cr(CN)_6]$

Answer : (i) Ionisation isomerism

(ii) Optical isomerism



(iii) Coordination isomerism

●●

Chemistry 2013 (Delhi) SET III

Time allowed : 3 hours **Maximum marks : 70**

Note: Except for the following questions, all the remaining questions have been asked in previous sets.

1. What type of substances would make better Permanent Magnets, Ferromagnetic or Ferrimagnetic ?** [1]

3. What is the composition of 'Copper matte' ? [1

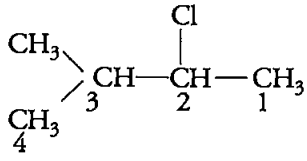
Answer : Composition of 'Copper matte' is Cu_2S and FeS.

5. What is a glycosidic linkage ? [1]

Answer : The linkage between the two monosaccharide units through oxygen atom accompanied by the loss of a water molecule is called glycosidic linkage.

6. Write the IUPAC name of $(CH_3)_2CH.CH(Cl)CH_3$ [1]

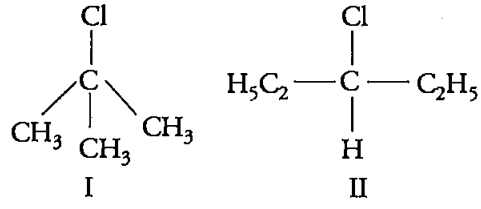
Answer :



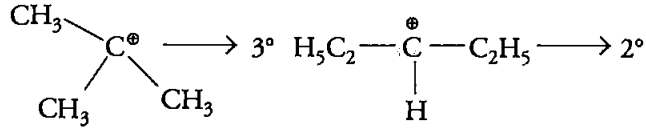
2-Chloro-3-methylbutane

7. Which compound in the following pair undergoes faster S_N1 reaction ? [1]

Answer :



The carbocation formed when compounds I and II undergo S_N1 reaction are shown below :

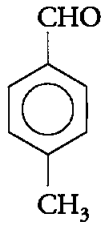


As 3° carbocation is more stable than 2° carbocation, hence compound I undergoes faster S_N1 reaction.

8. Write the structure of *p*-Methylbenzaldehyde molecule.

Answer : [1]

**Answer in not given due to change in present syllabus.



9. What is the difference between multi-molecular and macromolecular colloids ? Give one example of each. [2]

Answer : Difference between Multi-molecular and Macromolecular colloids :

Point of Difference	Multi-molecular Colloid	Macro-molecular Colloid
Definition	When a large number of atoms or small molecules (having diameters of less than 1 nm) of a substance combine together in a dispersion medium to form aggregates having size in the colloidal range, the colloidal solutions thus formed are called multimolecular colloid.	When substances which have very high molecular masses are dispersed in suitable dispersion medium, the resulting colloidal solutions are known as macromolecular colloids.
Example	Gold sol, sulphur sol.	Starch, cellulose.

14. (a) Give an example of zone refining of metals.

(b) What is the role of cryolite in the metallurgy of aluminum ? [2]

Answer : (a) Zone Refining of Metals : This method is used for production of semiconductor and other metals of very high purity like germanium, silicon, boron, gallium and indium.

(b) Role of Cryolite in Metallurgy of Aluminium : Cryolite is added to lower the melting point of mixture and to increase the conductivity of electrolyte.

17. Account for the following : [2]

(i) The C—Cl bond length in chlorobenzene is shorter than that in CH_3—Cl.

(ii) Chloroform is stored in closed dark brown bottles.

Answer : (i) This is due to partial double bond character to C-Cl bond (due to resonance in C_6H_5Cl).

(ii) Chloroform in the presence of air gets oxidized to phosgene. Phosgene is carbonyl chloride and is represented as $COCl_2$. To prevent the formation of phosgene, chloroform is stored in dark coloured bottles. The reaction represented as $CHCl_3 + \frac{1}{2}O_2 \rightarrow COCl_2 + HCl$

18. How will you convert : [2]

(i) Propene to Propan-1-ol? (ii) Ethanal to Propan-2-ol ?

Answer :

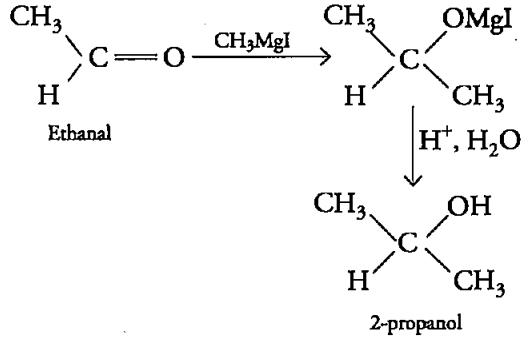
(i)

$$\underset{\text{Propene}}{CH_3CH=CH_2} + HBr \xrightarrow{\text{Peroxide}}$$

$$CH_3CH_2CH_2Br + KOH_{(aq.)} \downarrow \Delta$$

$$\underset{\text{Propan–1–ol}}{CH_3CH_2CH_2OH}$$

(ii)



23. Give the structures of products A, B and C in the following reactions : [3]

(i)

$$CH_3CH_2Br \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[0°C]{HNO_2} C$$

(ii)

$$CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{NaOH+Br_2} B \xrightarrow{CHCl_3+Alc.KOH} C$$

Answer :

(i)

$$CH_3CH_2Br \xrightarrow{KCN} \underset{A}{CH_3CH_2CN} \xrightarrow{LiAlH_4} \underset{B}{CH_3CH_2CH_2NH_2} \xrightarrow[0°C]{HNO_2} \underset{C}{CH_3CH_2CH_2OH}$$

(ii)

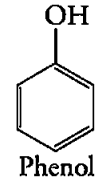
$$CH_3COOH \xrightarrow[\Delta]{NH_3} \underset{A}{CH_3CONH_2} \xrightarrow{NaOH+Br_2} \underset{B}{CH_3NH_2} \xrightarrow{CHCl_3+Alc.KOH} \underset{C}{CH_3NC}$$

27. Write the names and structures of the monomers of the following polymers : [3]

(i) Bakelite (ii) Nylon-6 (iii) Polythene

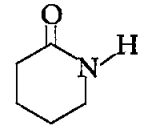
Answer :

(i)



Phenol and HCHO Formaldehyde

(ii)



Caprolactam

(iii) $CH_2=CH_2$

Ethene