

Solution

CHEMISTRY

Class 12 - Chemistry

Section A

1. **(b)** (C) > (B) > (A)

Explanation:
Haloalkanes are prepared from alcohol and halogen acids where the hydroxyl group of the alcohol is replaced by the halogen. Options (A) (B) and (C) are primary, secondary, tertiary alcohols respectively. Tertiary alcohols are more reactive than secondary and primary alcohol, the secondary halide is more reactive than primary halide and they form haloalkanes from haloacids at room temperature without catalysts. The order of reactivity of alcohols is $3^\circ > 2^\circ > 1^\circ$.
2. **(c)** nitrogenous base, pentose sugar and phosphoric acid

Explanation:
nitrogenous base, pentose sugar and phosphoric acid
3. **(b)** 2 – butene

Explanation:
2-butene on reductive ozonolysis with O_3/Zn will give CH_3CHO which has a molecular mass of 44u.
 $CH_3CH=CHCH_3 + O_3/Zn \rightarrow 2CH_3CHO$
Molecular mass of $CH_3CHO = 12 + 3 + 12 + 1 + 16 = 44u$
4. **(a)** 1

Explanation:
A chiral molecule is one that is not superimposable on its mirror image.
2-Butanol is a small molecule with a chirality center. It is the simplest alcohol containing an asymmetric carbon. For a better illustration, the four different substituents are shown in different colours.
Carbon atom C-2 of 2-butanol carries four different substituents H, CH_3 , OH, and CH_2CH_3 . Exchange of any two of these substituents would yield the opposite enantiomer. However, such an exchange does not occur spontaneously because it requires a bond breakage. Therefore, enantiomers are different, stable, coexisting compounds.
5. **(c)** 0

Explanation:
The reaction is zero order reaction. The order of all photochemical reactions is zero as it does not depend upon the concentration of reactants.
6. **(d)** (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

Explanation:
(a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)
7. **(c)** 2-Methylbutan-2-ol

Explanation:
2-Methylbutan-2-ol

8. (c) Phosphoric acid
Explanation:
 The third component of DNA, in addition to deoxyribose and a heterocyclic base, is phosphoric acid.
9. (c) Zero order
Explanation:
 light-dependent Photochemical reaction between H_2 and Cl_2 [$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$] is 0 (zero) w.r.t. to reactants.
10. (c) Prop-1-en-2-ol, tautomerism
Explanation:

$$CH_3 - C \equiv CH \xrightarrow[1\%HgSO_4]{40\%H_2SO_4} CH_3 - \underset{\substack{| \\ OH \\ \text{Pr op-1-en-2-ol} \\ (A)}}{C} = CH_2 \xrightarrow{\text{Isomerisation}} CH_3 - \underset{\substack{|| \\ O \\ \text{Acetone}}}{C} - CH_3$$
 Prop-1-en-2-ol (A) acetone are tautomers.
11. (c) Salicylic acid
Explanation:
 Salicylic acid
12. (d) Ethanolic NaCN
Explanation:
 KCN is used to increase the number of carbon atoms.
 $RX + NaCN \rightarrow RCN + KX$
 $R - CN + 4H \xrightarrow{H_2 / Raney Ni} RCH_2NH_2$
13. (c) A is true but R is false.
Explanation:
 Conjugated proteins contain a prosthetic group because conjugated proteins on hydrolysis give in addition to α -amino acids a non-protein part called the prosthetic group.
14. (c) A is true but R is false.
Explanation:
 Aldol condensation is usually carried out in a dilute solution of a strong base.
 The correct reason for the assertion is that for Cannizzaro reaction, a lack of α -H is necessary.
15. (a) Both A and R are true and R is the correct explanation of A.
Explanation:
 Both A and R are true and R is the correct explanation of A.
16. (a) Both A and R are true and R is the correct explanation of A.
Explanation:
 Methoxy ethane reacts with HI to give ethanol and iodomethane. Reaction of ether with HI follows S_N2 mechanism.

Section B

17. i. Reverse osmosis (direction of osmosis is reversed) occurs i.e. net flow of the solvent is from solution to solvent. Hence greater pressure is applied to the solvent molecules from the solution side would move into the pure solvent through a semipermeable membrane.
- ii. When acetone is added to the ethanol, molecules of acetone get in between the molecules of ethanol and break some of the hydrogen bond, which weakens the intermolecular attractive forces resulting in an increase in vapor pressure of the mixture than ethanol in a pure state.

18. $\text{CrO} < \text{Cr}_2\text{O}_3 < \text{CrO}_3$

Oxides having metal in its higher oxidation state are acidic, this is because, as the charge density on metal increases, covalency increases and thus oxides of such metals become acidic.

19. Answer the following:

(i) i. First order reaction-

Units of rate constant, $k = \text{s}^{-1}$

ii. For nth order reaction

iii. the units of rate constant, $k = \text{mol}^{(n-1)} \text{L}^{(n-1)} \text{s}^{-1}$

(ii) If activation energy is zero, rate of reaction will not depend on temperature.

20. Faraday's Law of Electrolysis:

i. Faraday's first law of electrolysis states that "the amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolytic solution".

$$Q = It$$

Where

Q = mass deposited (grams)

I = current (amps)

t = time (sec)

$$m = zIt$$

where

m = mass (grams)

z = electrochemical equivalent (g/c)

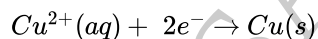
I = current (amps)

t = time (sec)

1 faraday = 96,000 coulombs

ii. Faradays' second law of electrolysis states that "the amount of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weight (Atomic Mass of Metal / Number of electrons required to reduce the cation).

The reduction of one mol of Cu to Cu can be represented as:



Since, in this reaction, there are two moles of electrons involved, so the amount of charge required is 2F.

OR

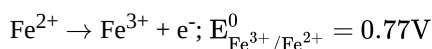
a. A is a strong electrolyte and B is a weak electrolyte.

b. Molar conductivity of a strong electrolyte (A) increases slowly with dilution this is because number of ions remain constant but the interionic distance increases on dilution this result in increase in the mobility of ions. on the other hand molar conductivity of weak electrolyte (B) increases sharply with dilution this is because degree of dissociation increases and this result in greater number of ions on dilution.

21. 2, 4, 6-Trinitrobenzoic acid.

Section C

22. Oxidation of ferrous ion means:

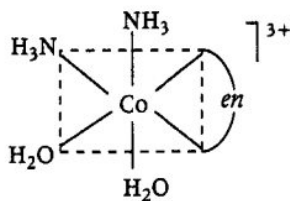


Any substance in which standard electrode potential is more than that of $\text{Fe}^{3+}/\text{Fe}^{2+}$ can oxidize ferrous ions.

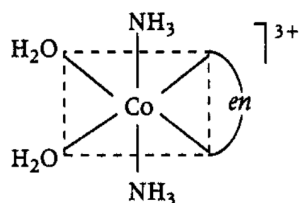
The EMF of the substance whose reduction potentials greater than 0.77v will oxidized ferrous ion. For example Br_2 , Cl_2 , and F_2 .

23. Three geometrical isomers of the given coordination compound $[\text{Co}(\text{en})(\text{H}_2\text{O})_2(\text{NH}_3)_2]^{3+}$ are shown below:

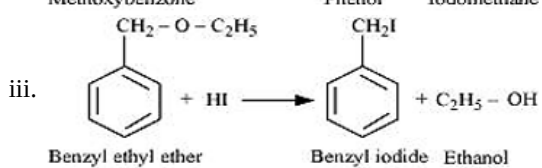
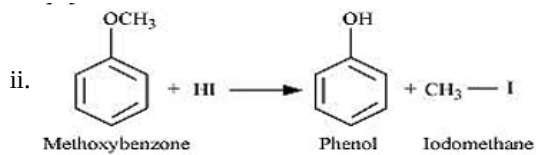
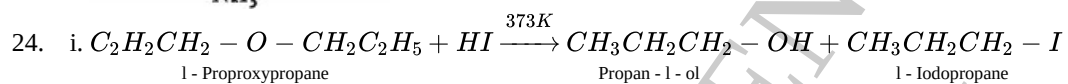
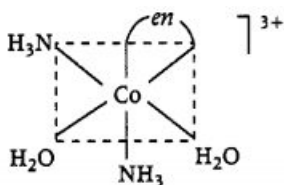
i.



ii.

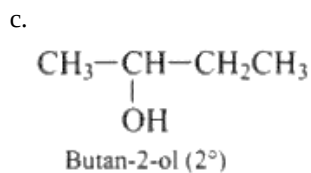
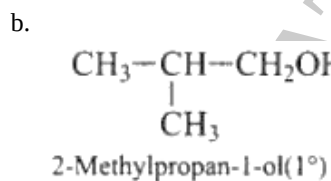
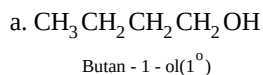


iii.



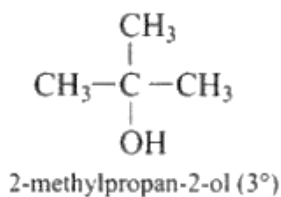
OR

Isomers of alcohols ($C_4H_{10}O$) are as follows:



The given isomer is optically active as it contains chiral carbon which has -OH group.

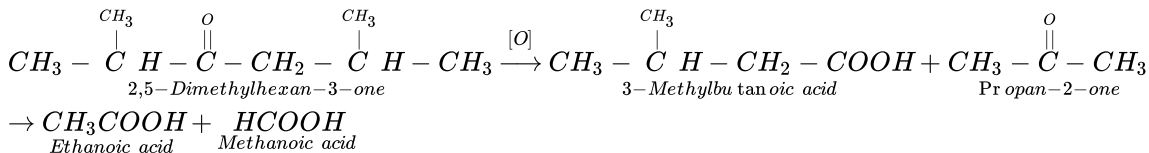
d.



The given molecule is optically inactive as the central carbon contains three similar methyl groups.

25. Being unsymmetrical ketone oxidation involves the C-C bond cleavage, oxidation occurs on either side of the C=O group giving a mixture of 2-methyl propanoic acid, 3-methylbutanoic acid, and propan-2-one. Propan-2-one on further oxidation gives a mixture

of ethanoic acid and methanoic acid.



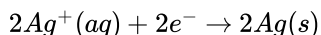
26. a. We have

$$E_{(Cu^{2+}/Cu)}^\ominus = 0.34V \text{ and } E_{(Ag^+/Ag)}^\ominus = 0.80V$$

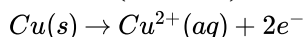
Standard emf of Cu is less than Ag, therefore it is strong reducing agent and is oxidised. Therefore Cu acts as Anode and Ag acts as Cathode.

Half cell reactions are:

At Cathode (Reduction):

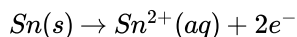


At Anode (Oxidation):

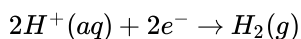


b. The reactions are :

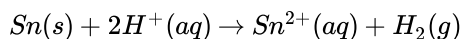
At Anode:



At Cathode:



Full cell reaction:



Standard emf of the cell is:

$$E_{cell}^0 = E_{H^+/H_2}^0 - E_{Sn^{2+}/Sn}^0$$

$$= 0 - (-0.14)V$$

$$= +0.14V$$

For this reaction n=2 moles of electrons. Using Nernst equation,

$$E_{cell} = 0.14 - \frac{0.0591}{2} \log \frac{[Sn^{2+}]}{[H^+]^2}$$

$$= 0.14 - \frac{0.0591}{2} \log \frac{0.04}{(0.02)^2}$$

$$= 0.14 - \frac{0.0591}{2} \log \frac{4}{100} \times \frac{100}{2} \times \frac{100}{2}$$

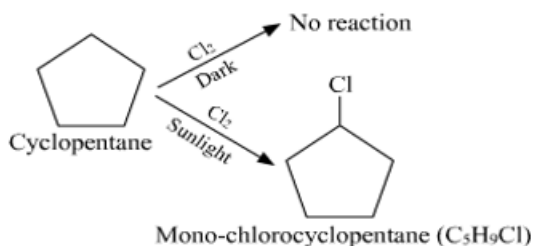
$$= 0.14 V - 0.0591 V$$

$$= 0.0809 V$$

27. A hydrocarbon with the molecular formula, C_5H_{10} belongs to the group with a general molecular formula C_nH_{2n} . Therefore, it may either be an alkene or a cycloalkane. Since hydrocarbon does not react with chlorine in the dark, it cannot be an alkene. Thus, it should be a cycloalkane. Further, the hydrocarbon gives a single monochloro compound, C_5H_9Cl by reacting with chlorine in bright sunlight. Since a single monochloro compound is formed, the hydrocarbon must contain H-atoms that are all equivalent. Also, as all H-atoms of a cycloalkane are equivalent, the hydrocarbon must be a cycloalkane. Hence, the said compound is cyclopentane.



Cyclopentane (C_5H_{10}) The reactions involved in the question are:



28. Order

- i. It is sum of powers to which concentration terms are raised in rate law or rate equation.
- ii. It is determined experimentally.
- iii. It can be zero or even in fraction

iv. The order of complex reaction can be determined and slowest step is rate determining step.

Molecularity

- It is the number of molecules taking part in the reaction.
- It is determined theoretically
- It is always in whole number
- Molecularity of each step is determined separately.

Section D

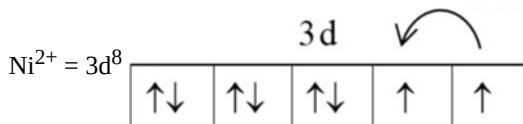
29. a. Sugars which reduce Tollens' reagent or Fehling's solution.
 b. Monosaccharides:- Fructose, Galactose
 Disaccharides:- Sucrose, lactose
 c. Glycogen, because its structure is similar to amylopectin.

OR

- Anomers / α -D-Glucose and β -D-Glucose
 - Aldehyde /-CHO group
30. a. The energy used in the splitting of degenerate d- orbitals due to the presence of ligands in a definite geometry is called Crystal Field Splitting Energy.
 b. $Ti^{3+} = 3d^1$ i.e. $t_{2g}^1 e_g^0$ Due to d-d transition.
 c. $Cr^{3+} = 3d^3$



Due to stable t_{2g}^3 configuration, hence paramagnetic.



CN^- being strong field ligand pair up the electrons and hence diamagnetic.

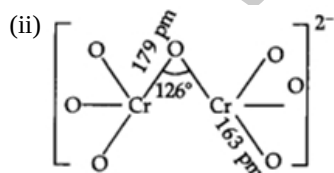
OR

CN^- being a strong ligand leads to the pairing of electrons in $[Fe(CN)_6]^{3-}$ leading to d^2sp^3 hybridization. H_2O being a weak ligand does not lead to the pairing of electrons in $[Fe(H_2O)_6]^{3+}$ leading to sp^3d^2 hybridization. / In $[Fe(CN)_6]^{3-}$, (n-1)d orbitals of central metal ion are used in hybridization (d^2sp^3). Hence inner orbital complex whereas in $[Fe(H_2O)_6]^{3+}$ n d orbitals of central metal ion are used in hybridization (sp^3d^2).

Section E

31. Attempt any five of the following:

- Due to presence of unpaired electrons in d-orbitals.
- Due to incomplete filling of d-orbitals. Due to very small energy difference between (n - 1)d and n s- orbitals.



(iii) This is because the last electron enters into f-orbital.

(iv) Reactivity of an element is dependent on the value of ionization enthalpy. In moving from Sc, the first element to Cu, the ionization enthalpy increases regularly. Therefore, the reactivity decreases as we move from Sc to Cu.

(v) In the series Sc to Zn all elements have one or more unpaired electron except zinc which has no unpaired electron as its outer electronic configuration is $3d^{10}4s^2$. Hence interatomic metallic bonding is weakest in zinc. Therefore, enthalpy of atomization is lowest.

(vi) Due to lanthanide contraction (filling of 4f before 5d orbital), the atomic radii of the second and third row transition elements are almost same. Therefore, they resemble each other much more as compared to first row elements.

(vii) $Sc(21)$ with electronic configuration $[Ar] 3d^1 4s^2$ have incompletely filled d-orbitals whereas $Ca(20)$ does not. Thus, $Sc(21)$ is a transition element.

32. It is given that vapour pressure of water, $p_1^0 = 23.8 \text{ mm}$ of Hg Weight of water taken, $w_1 = 850 \text{ g}$

Weight of urea taken, $w_2 = 50 \text{ g}$

Molecular weight of water, $M_1 = 18 \text{ gmol}^{-1}$

Molecular weight of urea, $M_2 = 60 \text{ gmol}^{-1}$

Now, we have to calculate vapour pressure of water in the solution. We take vapour pressure as p_1 .

Now, from Raoult's law, we have:

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1 + n_2}$$

$$\Rightarrow \frac{p_1^0 - p_1}{p_1^0} = \frac{\frac{w_2}{M_2}}{\frac{w_1}{M_1} + \frac{w_2}{M_2}}$$

$$\frac{23.8 - p_1}{23.8} = \frac{\frac{50}{60}}{\frac{850}{18} + \frac{50}{60}}$$

$$\frac{23.8 - p_1}{23.8} = \frac{0.83}{47.22 + 0.83}$$

$$\frac{23.8 - p_1}{23.8} = 0.0173; p_1 = 23.38 \text{ mm of Hg}$$

Hence, the vapour pressure of water in the given solution is 23.4 mm of Hg and its relative lowering is 0.0173.

OR

Vapour pressure of heptanes (p_1^0) = 105.2 kPa

Vapour pressure of octane (p_2^0) = 46.8 kPa

We know that,

Molar mass of heptane (C_7H_{16}) = $(7 \times 12) + (16 \times 1)$
 = 100 gmol^{-1}

Therefore, Number of moles of heptane = $\frac{26}{100} \text{ mol}$

= 0.26 mol

Molar mass of octane (C_8H_{18}) = $(8 \times 12) + (18 \times 1)$
 = 114 gmol^{-1}

Therefore, Number of moles of octane = $\frac{35}{114} \text{ mol}$

= 0.31 mol

Mole fraction of heptane, $x_1 = \frac{0.26}{0.26 + 0.31}$

= 0.456

And, mole fraction of octane, $x_2 = 1 - 0.456$

= 0.544

Now, partial pressure of heptane, $p_1 = x_1 p_1^0$

= 0.456×105.2

= 47.97 kPa

Partial pressure of octane, $p_2 = x_2 p_2^0$

= 0.544×46.8

= 25.46 kPa

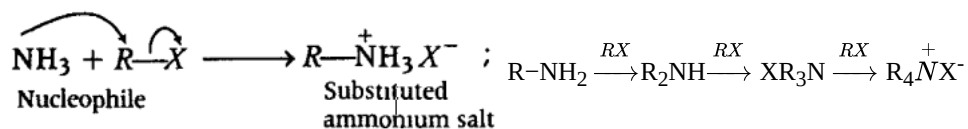
Hence, vapour pressure of solution, $p_{total} = p_1 + p_2$

= $47.97 + 25.46$

= 73.43 kPa

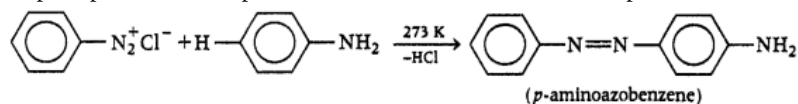
33. i.

a. **Ammonolysis** The process of cleavage of the C-X bond by ammonia molecule is known as ammonolysis. In this process, an alkyl or benzyl halide on reaction with an ethanolic solution of ammonia undergoes nucleophilic substitution reaction in which halogen atom is replaced by an amino (-NH₂) group. The reaction is carried out in a sealed tube at 373 K. The primary amine thus obtained behaves as a nucleophile and can further react with alkyl halide to form secondary and tertiary amines and further quaternary salts.



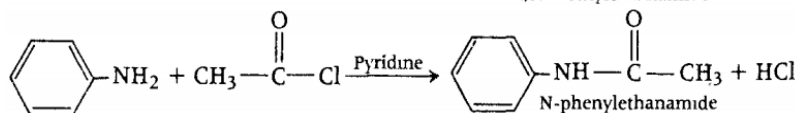
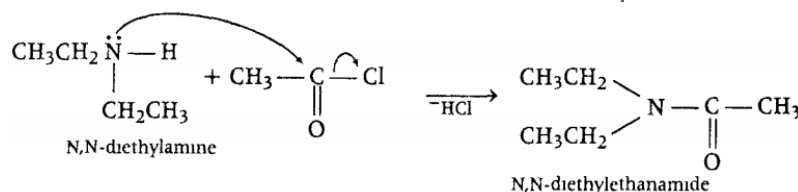
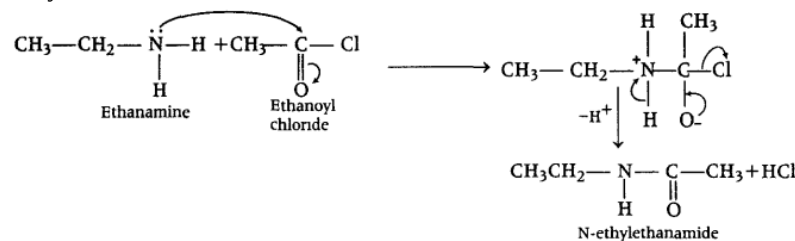
b. **Coupling reaction** Arenediazonium salts react with highly reactive (i.e. electron-rich) aromatic compounds such as aniline, phenols to form brightly coloured azo compounds, Ar-N=N-Ar. This reaction is called coupling reaction. e.g.

Benzene diazonium chloride reacts with aniline in faintly acidic medium (pH 4-5) at 273-278K, in which the molecule at its para-position is coupled with the diazonium salt to form p-aminoazobenzene. This is an example of coupling reaction.



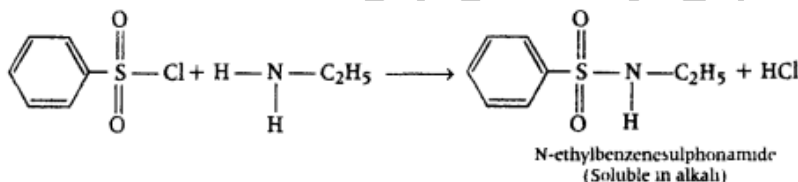
c. **Acetylation of amines** The process of introducing an acetyl group $\left(\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \right)$ into the molecule is called

acetylation of amines.



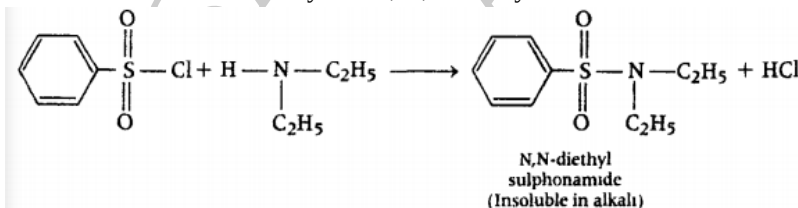
ii. The reaction of primary and secondary amines with benzenesulphonyl chloride ($\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$, known as Hinsberg's reagent to form sulphonamides is known as Hinsberg's method (or reaction). This method (or reaction) is used for separating 1°, 2° and 3° amines.

a. The reaction of benzenesulphonyl chloride with primary amine yields N-ethylbenzenesulphonamide.



The hydrogen attached to N-atom in sulphonamide is strongly acidic due to the presence of strong electron withdrawing sulphonyl group. Hence, it is soluble in alkali.

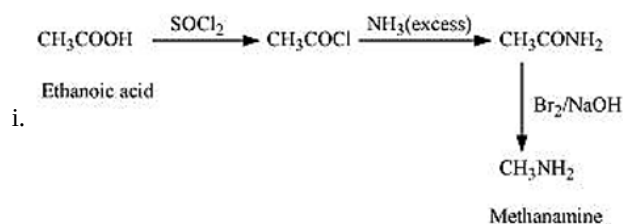
b. In the reaction with secondary amine, N, N-diethylbenzenesulphonamide is formed.

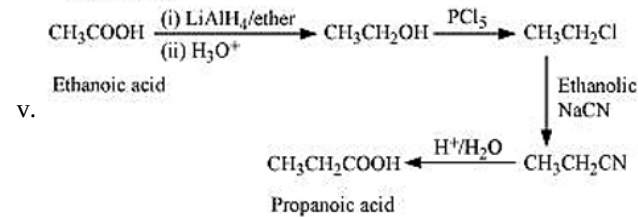
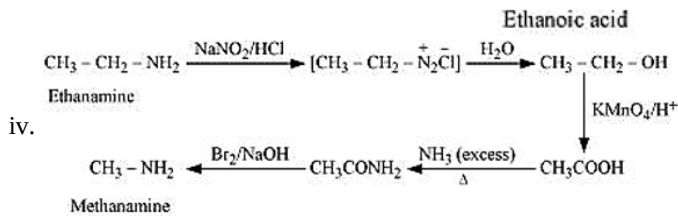
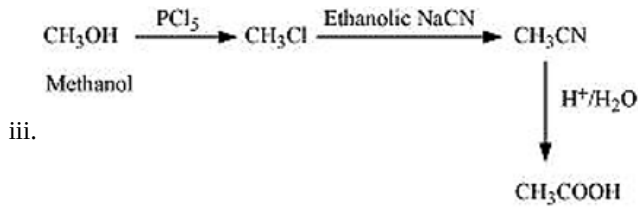
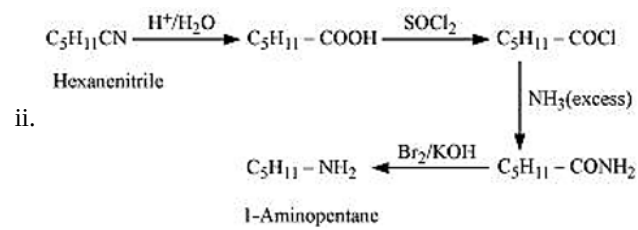


Since, N, N-diethylbenzenesulphonamide does not contain any hydrogen atom attached to nitrogen atom, it is not acidic and hence, insoluble in alkali.

c. Tertiary amines do not react with benzenesulphonyl chloride, as it doesn't contain replaceable hydrogens.

OR





SATISH SCIENCE
ACADEMY