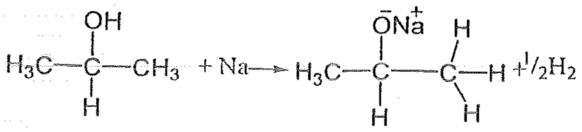


(v) Propanone

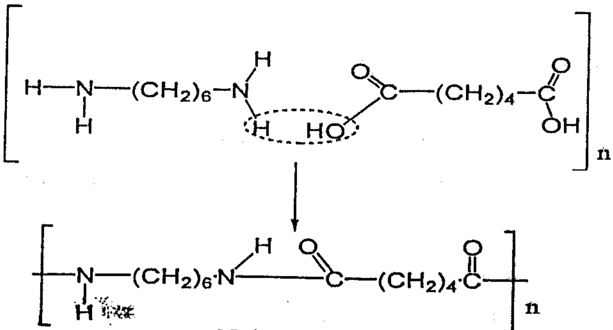
(b) (i) In the addition of HX (X=halogen) to unsymmetrical alkene, the hydrogen atom is added to an unsaturated carbon atom with more hydrogen atoms

(ii) There are organic peroxide present, free radical present, halogen/uv.

(c) (i) The combination of simple identical molecules called monomers to large complex molecules called polymers with or without the loss of small molecules like water and ammonia

(ii) Addition polymerisation

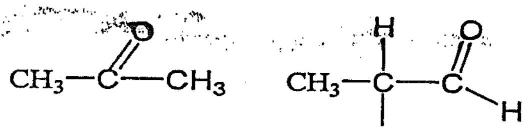
(d) (i)



Nylon

(iii) Peptide bond

(e)



functional group isomerism

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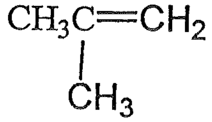
9. (i)

A $CH_3CH_2CH{=}CH_2$

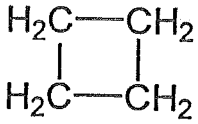
B $CH_3CH{=}CHCH_3$

C



$CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}{=}CH_2$

D

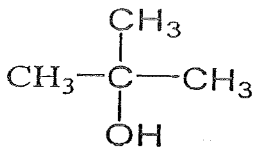


(ii)

$$CH_3CH_2CH{=}CH_2 + H_2 \xrightarrow[140^\circ C]{Ni} CH_3CH_2CH_2{-}CH_3$$

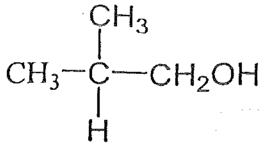
(b) (i) $CH_3CH_2CH_2CH_2OH$

$CH_3CH_2CH(OH)CH_3$



$(CH_3)_3C{-}OH$

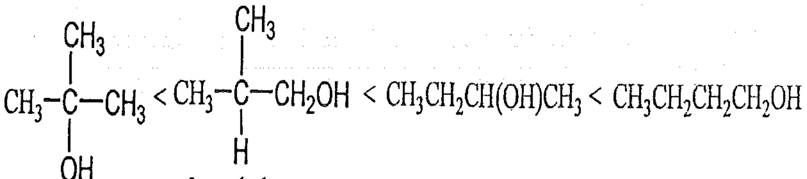
2-methylpropan-2-ol



$CH_3{-}CH(CH_3){-}CH_2OH$

2-methylpropan-1-ol

(ii)



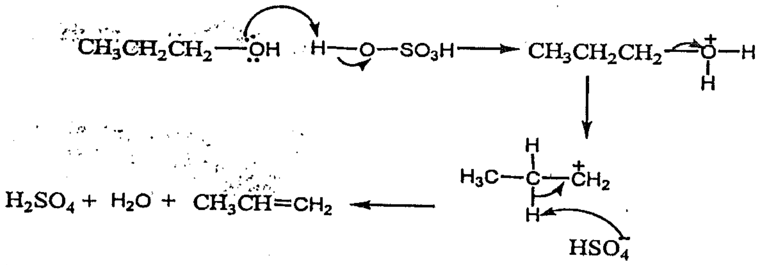
$$(CH_3)_3C{-}OH < CH_3{-}CH(CH_3){-}CH_2OH < CH_3CH_2CH(OH)CH_3 < CH_3CH_2CH_2CH_2OH$$

2-methylpropan-2-ol 2-methylpropan-1-ol

Due to compactness of the molecules thus the strength of the van der waal forces is decreasing (this is because of steric hindrance which prevent the formation of H-bonds between the molecules)

(c) (i) Dehydrating agent

(ii)



(iii) Warm with excess acidified potassium dichromate

(iv) The colour of the dichromate changes from orange to green.

(d) (i)

$$CH_3CH_2CH_2OH(l) + \frac{9}{2}O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$$

(ii) It is used to generate energy hence it is used as fuel

SET 4: SECTION C (CGCEB 2012)

Organic Chemistry

7. (a) (i) (x) KCN/in ethanol; heat under reflux
(y) H^+/H_2O; heat under reflux
OR OH^-/H_2O; heat under reflux

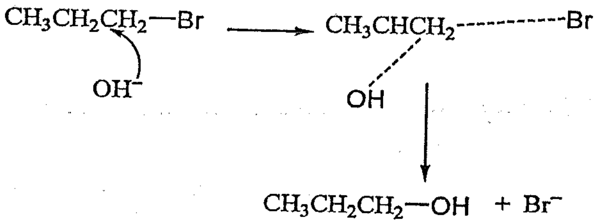
(ii)

Product	Formula or name
B	Pentanonitrile (Or Cyanopropane) ($CH_3CH_2CH_2CH_2C \equiv N$

D	Ammonium ion (NH_4^+) with acid hydrolysis or ammonia (NH_3) with alkaline hydrolysis
E	$CH_3CH_2CHClCOOH$ (2-chlorobutanoic acid)
G	Propane $CH_3CH_2CH_3$
H	Propan-1-ol ($CH_3CH_2CH_2OH$)

(iii) Nucleophilic substitution reaction

(iv)



(b) (i)

$CH_3CH_2CHBrCH_3$ (major product)

$CH_3CH_2CH_2CH_2Br$ (minor product)

(ii) $CH_3CH_2CHBrCH_3$

Because secondary (2°) carbocation is more stable than primary (1°) carbocation.

(iii) In the addition of HX (hydrogen halide) to unsymmetrical alkene the hydrogen atom is added to the unsaturated carbon atom with more hydrogen atoms.

(c) (i)

Elements	C	H	Cl
Ratio of % composition	45.9	8.9	45.2
Ratio by mole	$\frac{45.9}{12} = 3.825$	$\frac{8.9}{1} = 8.9$	$\frac{45.2}{35.5} = 1.273$
Mole ratio (divide by the smallest)	$\frac{3.825}{1.273} = 3$	$\frac{8.9}{1.273} = 7$	$\frac{1.273}{1.273} = 1$
Empirical formula	C_3H_7Cl		

(ii) $(C_3H_7Cl)n = Mf$

$(4 \times 12 + 7 \times 1 + 35.5 \times 1)n = 78.5$

$(36 + 7 + 35.5)n = 78.5$

$(78.5)n = 78.5 \Rightarrow n = \frac{78.5}{78.5} = 1$

C_3H_7Cl

(iii) The halogeno-alkane is heated with sodium metal to convert any chorine atom present to sodium chloride. Add nitric acid and add aqueous silver nitrate. If a white precipitate is observed, then chlorine is present in the compound

---

8. (a) (i) They have the C=O group present in all their compounds

The general formula is RC=O (aldehyde) and RR'CO (ketone), R and R' may be aliphatic or aromatic.

(ii) By the oxidation of primary or secondary alcohol.

(iii) *Aldehyde will give a silver mirror with ammoniaccal silver nitrate ($NH_3/AgNO_3$) but ketone will not

$$RCHO + Ag(NH_3)_2^+ + H_2O \rightarrow RCOOH + 2Ag + 2NH_4^+$$

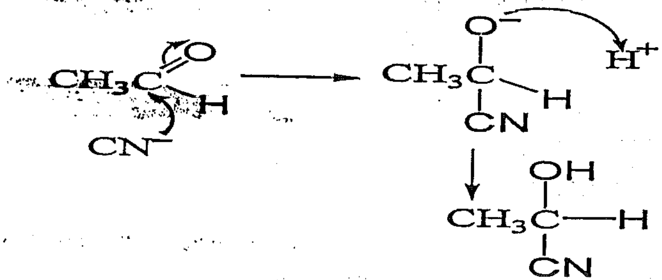
*Aldehyde will reduce fehling's solution from blue to a red precipitate of copper(I) oxide while ketone will not.

(v) This is because the carbonyl group is highly polar due to differences in electronegativity. This leads to a significant dipole-dipole interaction between the molecules.

(e) (i) The addition of an electron rich species to an electron deficient side.

(ii) CN^-

(iii)



(iv) H^+/H_2O or OH^-/H_2O; heat under reflux

(c) (i) P, CH_3CH_2CHO (Propanal) and

Q, CH_3COCH_3

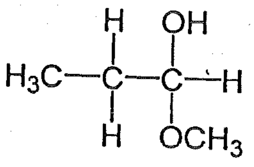
(ii) propanone-2,4-dinitrophenylhydrazone

(iii)

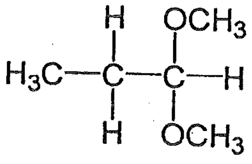
CH_3CH_2OH and $CH_2CH(OH)CH_3$ =(position isomer) —— $CH_3CH_2CH_2OH$ and $CH_3CH(OH)CH_3$

$CH_3CH_2CH_2OH$ and CH_3-O—CH_2CH_3 (functional group isomer)

(iv)

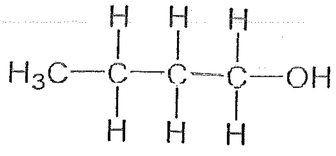

$$H_3C-CH_2-CH(OH)(OCH_3)$$

1-methoxypropan-1-ol
(Hemi-acetal)

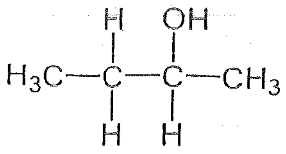

$$H_3C-CH_2-CH(OCH_3)_2$$

1,1-dimethoxypropane
(Acetal)

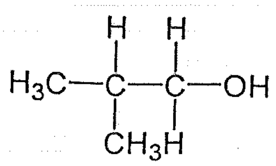
9. (a)



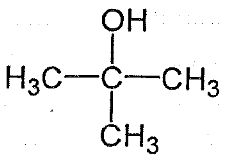
butan-1-ol



butan-2-ol



2-methylpropan-1-ol



2-methylpropan-2-ol

(b) Both compounds will liberate white fumes of HCl with PCl_5 at room temperature indicating the presence of OH-group

(c) (i) S is more acidic than R

The phenoxide ion in S is stabilized by resonance. Or the negative charge in the phenoxide ion in S is delocalized around the benzene ring while in R the hydroxyl group is attached to an alkyl group thus the negative charge on the alcoxide group is localized.

Or The $CH_3CH_2^-$ in R is electron donating (+ inductive) so reduces tendency to lose proton (H^+)

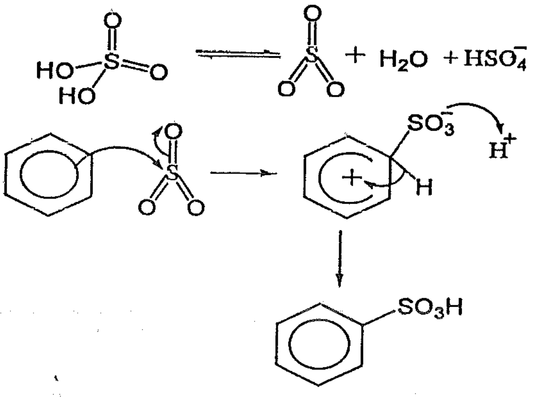
(ii) S will give a violet (or purple) colour with neutral iron(III) chloride solution. While T will not

(iii)

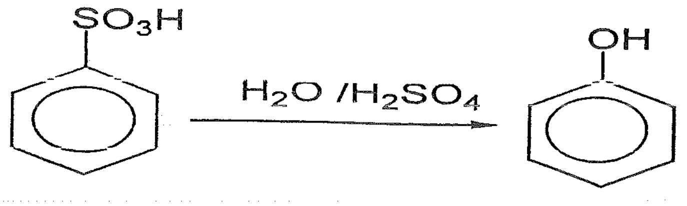
$$CH_3CH_2OH + CH_3COOH \underset{reflux}{\overset{H_2SO_4}{\rightleftharpoons}} CH_3COOCH_2CH_3 + H_2O$$

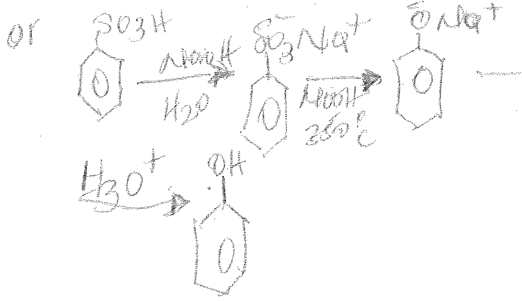
$$C_6H_5OH + CH_3COOH \xrightarrow[heat]{NaOH} C_6H_5\text{-}O\text{-}\overset{\overset{O}{\parallel}}{C}\text{-}CH_3$$

(d) (i)

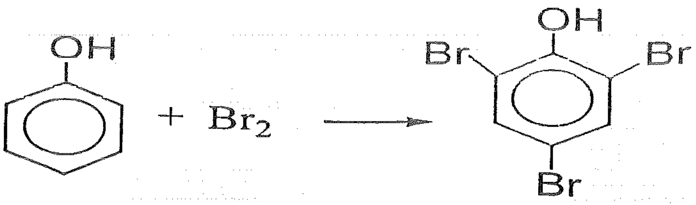


(ii) The sodium phenoxide is extracted from the mixture with water and acidified with sulphuric acid to obtain free phenol

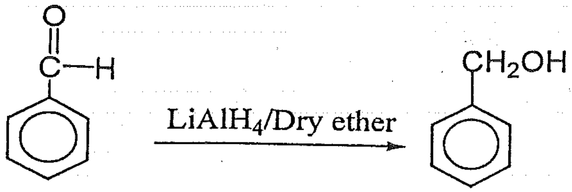




(iii)

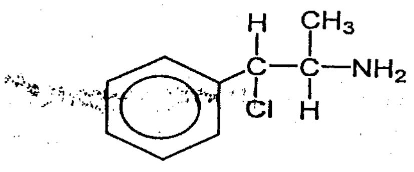


(e)



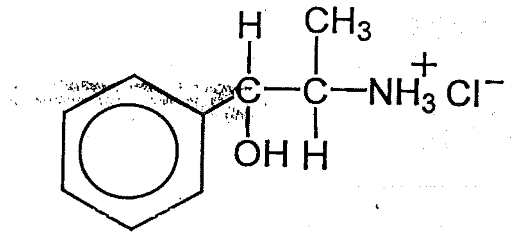
SET 5: SECTION C (CGCEB 2013)
ORGANIC CHEMISTRY

7. (i) (A)

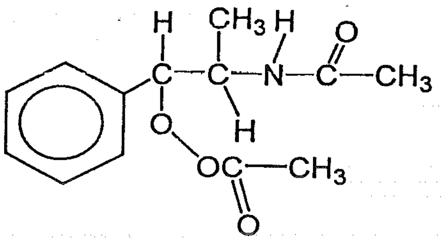


1-chloro-1-phenylpropan-2-amine

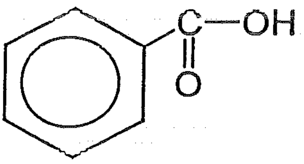
(B)



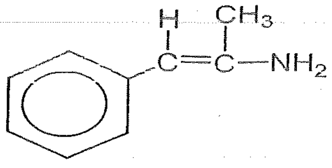
(C)



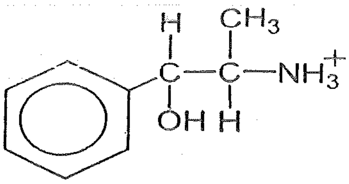
(D)

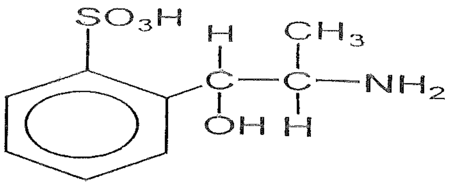


E



cis-1-phenylprop-1-en-2-amine

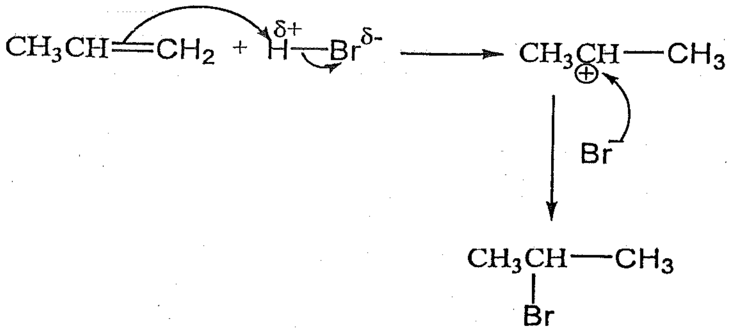




(ii) Crystallization (NB: compound A is a solid)

(iii) The compound should have a constant melting point.

(b).



(c). (i) step 1 $H^+/KMnO_4$, heat

Step 2 PCl_5; at room temperature or $SOCl_2$, heat under reflux

Step3 methanol/ warm

(ii) $C_6H_5COOH + NaOH/CaO \xrightarrow[\Delta]{} C_6H_6 + Na_2CO_3$

Decarboxylation

(d). (i) CH_3COOH will liberate CO_2 with sodium carbonate or $NaHCO_3$. The CO_2 turn lime water milky. $HCOOCH_3$ will not.

(ii) CH_3COCH_3 will give an orange precipitate with 2,4-dinitrophenylhydrazine while $CH_3CO_2CH_3$ will not

OR CH_3COCH_3 will give a yellow precipitate with $I_2/NaOH$ While $CH_3CO_2CH_3$ will not.

(iii) CH_3CONH_3 will liberate ammonia when warm with sodium hydroxide. The ammonia turns red litmus paper blue while $CH_3CH_2NH_2$ will not

8. *(a)*

Spectroscopic method	Information obtained
Mass Spectrometer	Molar mass or Fragmentation Patterns
Infrared spectrometer	Bond types or functional group
NMR spectroscopy	Identification of the environment of H-atom or C-13 atom or atom with odd number of electrons.

(b) (A)

Element	C	H	Cl
No. mole	$\frac{0.24}{12}=$ 0.020	$\frac{0.05}{1}$ = 0.0500	$\frac{0.355}{35.5}=0.0100$
Mole ratio	$\frac{0.0200}{0.0100}=2$	$\frac{0.050}{0.0100}$0 = 5	$\frac{0.0100}{0.0100}=1$
Empirical formula	C_2H_5Cl		

(B) The molar mass of the compound is 64.5g/mol. This is the fragment with the highest mass known as the molecular fragment.

(C) (i)

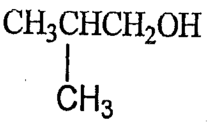
$$(C_2H_5Cl)n = Mf$$
$$\Rightarrow (2 \times 12 + 5 \times 1 + 35.5)n = 64.5$$
$$(64.5)n = 64.5 \Rightarrow n = \frac{64.5}{64.5} = 1$$
$$Mf = C_2H_5Cl$$

(ii)

Mass point	Species
15	$^+CH_3$
49	$^+CH_2Cl$
51	$^+CH_3Cl$ (isotopes possible)

(iii) The organic compound is heated with sodium to convert any halide present to sodium halide. The sodium halide is treated with silver nitrate acidified with dilute nitric acid. If a white precipitate is observed, then chlorine is present in the compound.

(c). (i) Chain isomerism

$CH_3CH_2CH_2CH_2OH$ and 
$CH_3CH(CH_3)CH_2OH$

(ii) Functional group isomerism

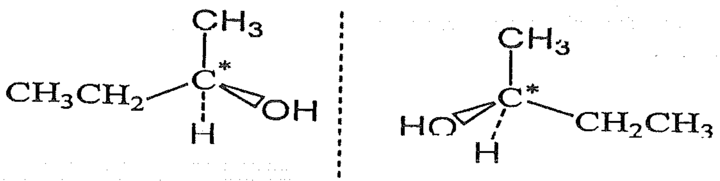
$CH_3CH_2CH(OH)CH_3$ and $CH_3CH_2\text{-}O\text{-}CH_2CH_3$

(iii) Position isomerism

$CH_3CH_2CH_2CH_2OH$ and $CH_3CH_2CH(OH)CH_3$

(iv) Optical isomerism

$CH_3CH_2CH(OH)CH_3$

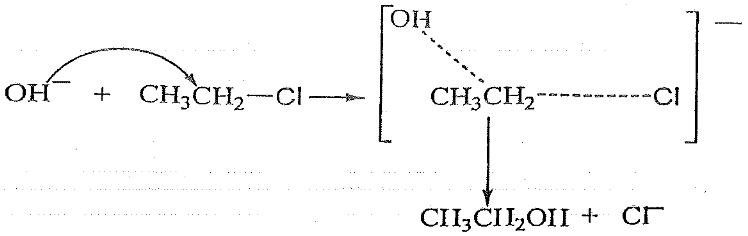


Enantiomers

(d). (i) Dilute KOH or NaOH : *reflux*

(ii) Hot conc.NaOH/alcohol or conc.KOH/alcohol. Condition: *reflux*

(e).



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9. (a) (i)

10. $CH_3COOH + SOCl_2 \xrightarrow[heat]{} CH_3COCl + SO_2 + HCl$

$CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$

(ii) $CH_3COOH + \text{conc. } NH_3 \xrightarrow[\Delta]{} CH_3CONH_3 + H_2O_{(g)}$

(iii) $CH_3COOH + CH_3OH \xleftrightarrow{Conc.H_2SO_4} CH_3COOCH_3 + H_2O$

(f) (i) CH_3COOH carbon dioxide with Na_2CO_3 while CH_3COCl will not.

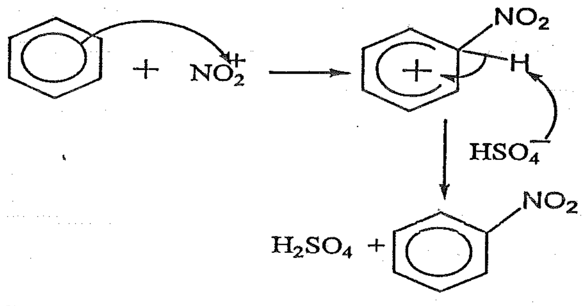
(ii) CH_3CONH_3 releases ammonia when warm with conc. NaOH while CH_3COOH will not

(g) (i) C Phenylamine

(D) Benzenediazonium chloride or Phenyldiazonium chloride

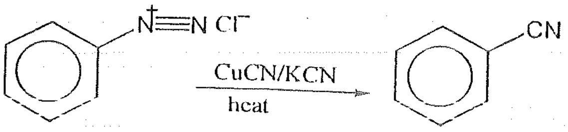
Stage 1	Type of reaction	Reagent/reaction condition
Step 1	Electrophilic substitution	Conc.H_2SO_4 + conc. HNO_3 , >55°C, reflux Acid must be concentrated
Step 2	Reduction	Sn/conc. HCl: heat under reflux
Step 3	Diazotization reaction	Conc. HCl/$NaNO_2$, temperature <5°C in ice bath.

(iii)

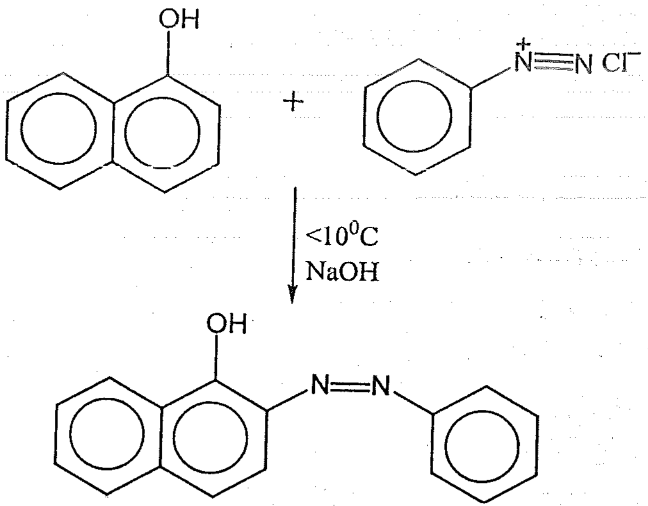


(iv) **Steam distillation**

(v) (A)



(B)



SET 6: SECTION C (CGCEB 2014)

Organic Chemistry

7. (a) ether

(b) J the molecule contains weak intermolecular dipole-dipole force while the other molecule (K, L, M and N) contain intermolecular hydrogen bond between their molecules.

(c) Functional group isomerism

(d) L will give cloudiness with Lucas reagent (Zn/conc.HCl) after 5minute while K (primary alcohol) will not at room temperature.

$$CH_3CH(OH)CH_3 \xrightarrow{Zn/Conc.HCl} CH_3CH(Cl)CH_3$$

L will give a (positive iodoform test) yellow precipitate of CHI_3 with $NaOH/I_2$ (iodoform reagent) but K (give a negative iodoform test) will not

(e) (i) $HOOC - CH = CH - COOH$

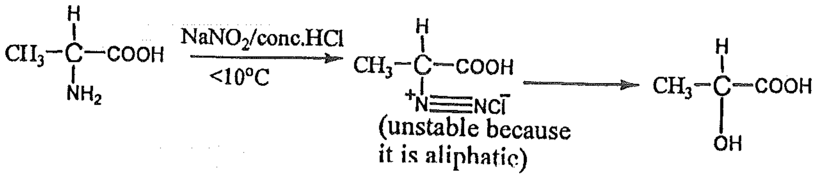
Geometric isomerism

(ii) The presence of a double bond in the molecule which prevents free rotation in space

(iii) The cis isomer will dehydrate at a temperature of 150°C while the trans isomer will simply sublimes. OR the cis isomer will have intramolecular hydrogen bond hence low boling point while the trans will have intermolecular hydrogen bond hence high boiling point.

(f) (i) amino acid

(ii) (A)



(unstable because it is aliphatic)