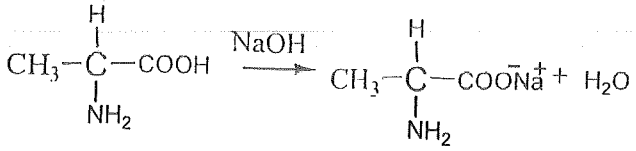
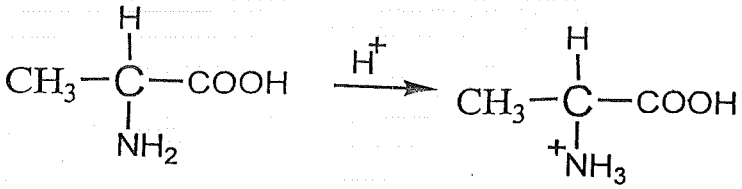
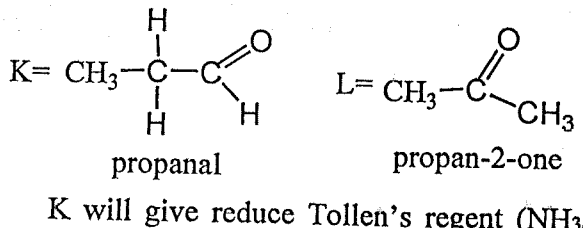
(B)



(C)



(g) (i)

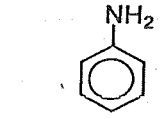


propanal propan-2-one

(ii) K will give reduce Tollen's regent ($NH_3/AgNO_3$ ''ammoniacal silver nitrate'') with the deposition of silver at the wall of the test tube as mirror on warming while L will not.
K will give a red precipitate of Cu_2O with Fehling's reagent ($CuSO_4$ + sodium potassium tartarate) on warming. While L will not
L will give a yellow precipitate of CHI_3 (iodoform) I_2/NaOH while K will not.

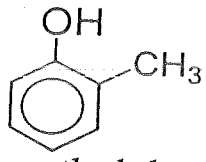
---

8 (a) (i) delocalized π-electron.
(ii) Hydrogen chloride ($HCl_{(g)}$)
(b) (i) conc.HNO_3/conc.H_2SO_4: 55-60°C; reflux (warm). The acid must be concentrated
(ii) $NaNO_2$/conc.HCl: <5°C
(iii) phosphornic acid H_3PO_2 on warming
(iv) CH_3OCl/NaOH
(v) CuCN/KCN: warm or reflux
(vi) $LiAlH_4$/dry ether or Na and ethanol or H_2/Ni; 140°C
(vii) H+/conc.$KMnO_4$: warm
(C) (i) Reduction reaction
(ii) Steam distillation
(d) (C)



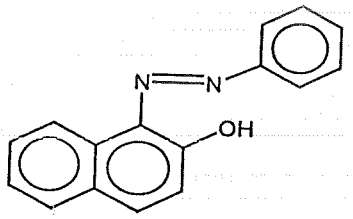
aniline or phenylamine

(F)



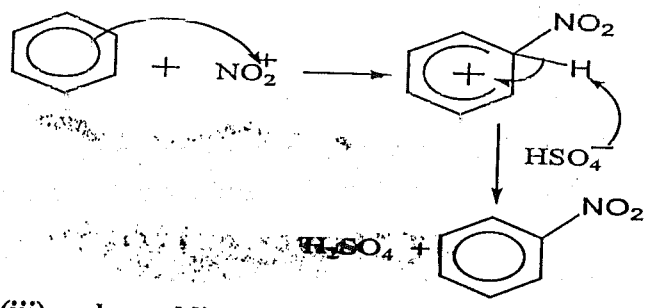
2-methylphenol

(I)

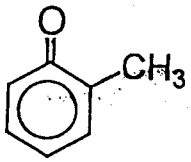


(e) (i) It is the displacement of an atom or group in an electron rich species by an electron deficient species.

(ii)



(iii) benzaldhyde



$KMnO_4/H^+$ is a strong oxidising agent, it oxidises the OH-group to a keto group

(f) By using a reflux condenser or fume cupboard

(g) Compound H will liberate carbon dioxide with sodium carbonate or $NaHCO_3$ while compound E will not.

---

9. (a) (i) In the addition of an asymmetrical reagent to asymmetrical alkene, the hydrogen atom is added to the unsaturated carbon atom with more hydrogen atoms.

(ii) $CH_3CH = CH_2 + HBr \xrightarrow{ROOR} CH_3CH_2CH_2Br$

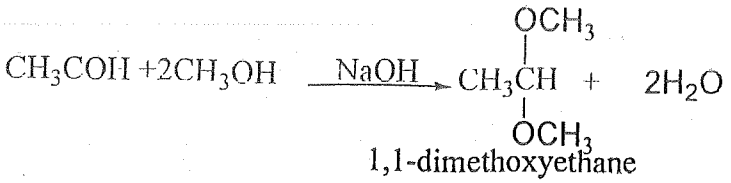
(b) (i) Propene and ethyne will decolourise reddish brown solution of bromine in carbon tetrachloride or bromine water to colourless

(ii) Ethyne will give a white precipitate of silver dicarbide with ammoniacal silver nitrate ($NH_3/AgNO_3$) on reflux while propene will not.

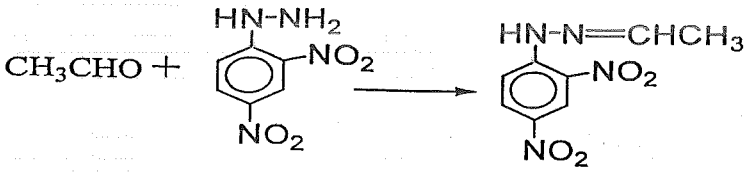
- Ethyne will give a red precipitate of copper(I) dicarbide with copper(I) chloride but propene will not

(c) (i) A chemical reaction in which two molecules combine to form a larger molecule with the elimination of a small molecule (e.g. H_2O)

(ii)

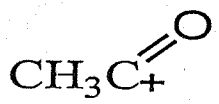


1,1-dimethoxyethane

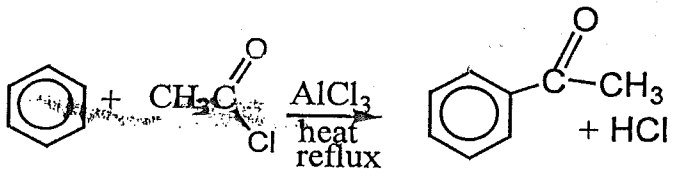


$$CH_3COOH + CH_3OH \overset{H_2SO_4}{\longleftrightarrow} CH_3COOCH_3 + H_2O_{(l)}$$

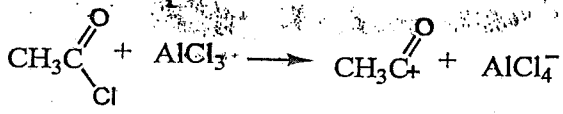
(d) (i)

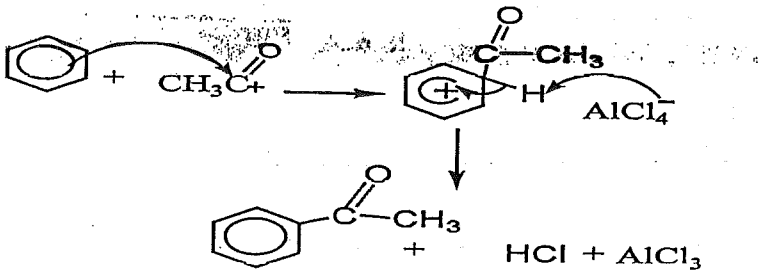


(ii)



(iii)





(e) (i)

$$CH_3CH_2CH_2I \xrightarrow[\text{heat under reflux}]{\text{dil. KOH or dil.NaOH}} CH_3CH_2CH_2OH + KI$$

(ii)

$$CH_3CH_2CH_2I \xrightarrow[\text{heat under reflux}]{\text{conc. KOH or conc.NaOH in ethanol(alcohol)}} CH_3CH{=}CH_2 + KI + H_2O$$

(f) (i)

$$CH_3CH_2CH_2I \xrightarrow[\text{heat under reflux}]{\text{Mg/dry ether}} CH_3CH_2CH_2MgI$$

Or

$$CH_3CH_2CH_2Br \xrightarrow[\text{heat under reflux}]{Mg/\text{dry ether}} CH_3CH_2CH_2MgBr$$

The magnesium, reagent and all the apparatus must be clean and dry.

SET 7: SECTION C (CGCEB 2015)

Organic Chemistry

5. (a)

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

(b). Total percentage of C and H

$48.7 + 8.1 = 56.8$

% of Oxygen $=100-56.8=43.2$

Element	C	H	O
	$\frac{48.7}{12}=4.1$	$\frac{8.1}{1}=8.1$	$\frac{48.7}{16}=2.7$
Mol ratio	$\frac{4.1}{2.7}=1.5$ $1.5\times2=3$	$\frac{8.1}{2.7}=3$ $3\times2=6$	$\frac{2.7}{2.7}=1.0$ $1\times2=2$
Empirical formula	$C_3H_6O_2$		

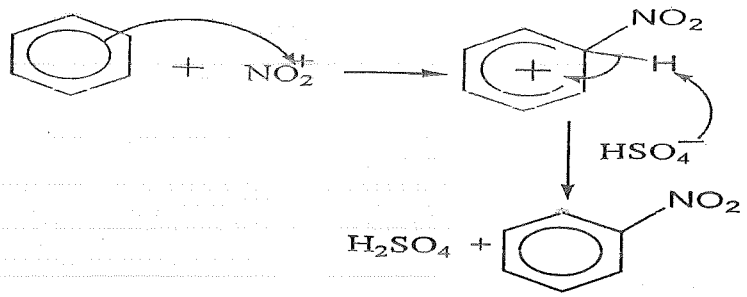
(c). Electrophile is an electron deficient species or a neutral molecule with an electron dcficient centre (empty orbital) e.g SO_3 or NO_2^+ or $AlCl_3$ or Br^+ etc while a nucleophile is an electron rich species or a neutral molecule with an electron rich centre e.g. OH^- or NH_3 or H_2O etc

(d). (i) Concentrated sulphuric acid (conc.H_2SO_4) and concentrated nitric acid (conc. HNO_3) OR conc.H_2SO_4/ conc. HNO_3

(ii). Temperature of 55°C-60°C. The acid must be concentrated.

(iii). Electrophilic substitution reaction

$$2H_2SO_4 + HNO_3 \rightarrow NO_2^+ + 2HSO_4^- + H_3O^+$$



(e). (i) Mixing of atomic orbitals to give an equivalent or a set of new bonding or hybrid orbitals

(ii). CH_4 is tetrahedral in shape while C_2H_4 is trigonal planar in shape. Or CH_4 the C-atom is SP^3 hybridised hence there is equal repulsion between the four hybrid orbitals while in C_2H_4 is SP^2 hybridised thus there is equal repulsion between the three hybrid orbital

---

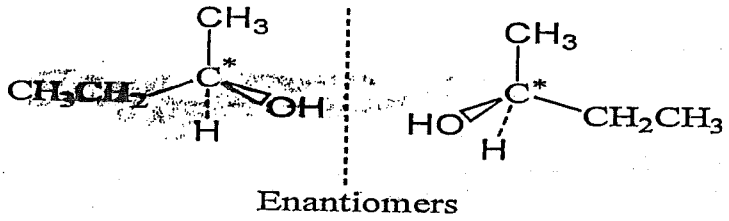
6. (a) (i) It is the existence of compounds with the same molecular formula but different structural properties or it is the existence of compound with the same molecular formula but different structural formulae or spatial arrangement of atoms in space.

(ii). A: Position isomerism

$CH_3CH_2CH_2CH_2OH$ and $CH_3CH_2CH(OH)CH_3$

B: Optical isomerism

$CH_3CH_2CH(OH)CH_3$



Enantiomers

C: Functional group isomerism

$CH_3CH_2CH(OH)CH_3$ and CH_3CH_2-O-CH_2CH_3

D: chain isomerism

$CH_3CH_2CH_2CH_2OH$ and CH_3CHCH_2OH (with CH_3 branch)

(iii). $CH_3CH_2CH(OH)CH_3$ gives a white fume of HCl wth PCl_5 while in CH_3CH_2-O-CH_2CH_3 there is no observable change with PCl_5.

(b). (i) B: phenylamine or aminobenzene

C: benzene dizonium chloride OR Phenydiazonium chloride

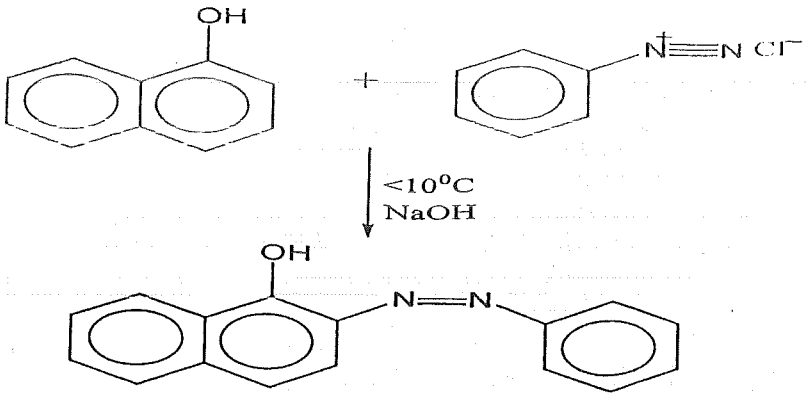
(ii). I Sn/conc. HCl /reflux

II $NaNO_2$ + HCl temperature <10°C

III CuBr/HBr /heat

IV CH_3Br/Na dry ether

(iii). By coupling with a solution of 2-naphthol or phenol in aqueous NaOH



(iv). By steam distillation.

SET 8: SECTION C (CGCEB 2016)

Organic Chemistry

5 (i)

C	H	O
$\frac{60}{12} = 5.000$	$\frac{4.4}{1} = 4.4.00$	$\frac{35.6}{16} = 2.225$
$\frac{5.000}{2.225} = 2.247$	$\frac{4.400}{2.225} = 1.978$	$\frac{2.225}{2.225} = 1$
$2.247 \times 4 = 8.988 \simeq 9$	$1.978 \times 4 = 7.9 \simeq 8$	$1 \times 4 = 4$
E.F=$C_9H_8O_4$		

(ii). $(C_9H_8O_4)n = 180$

$180n = 180$

⇨ $n=1$

⇨ MF = $C_9H_8O_4$

(iii) Mass spectroscopy

b) (i)

$CHCl_2CH_2CH_3$, $CHCCl_2CH_3$, $CH_3ClCHClCH_3$, $CH_2ClCH_2CH_2Cl$

(ii)

$CH_3ClCHClCH_3$

(c) (i)

A: $CH_3CH=CH_2$

B: CH_3CHCH_2Cl or $CH_3CH_2CH_2Br$ or $CH_2CH_2CH_2I$

C: $CH_3CH_2C\equiv N$

(ii) V: conc H_2SO_4, 170°C or Al_2O_3, 350°C W: $Br_{2(g)}$/ CCl_4 OR $Br_{2(g)}/FeBr_3$

X: $SOCl_2$ or PCl_3 or PCl_5 or PBr_3 or PI_3

Y: KCN or NaCN/ alcohol, reflux Z: $H_2O/H^+_{(aq)}$, heat

(d) (i) free radical substitution

(ii) Electrophilic substitution

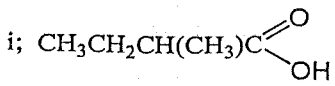
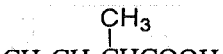
6) (a) (i) 2,2-dichloro-3-fluorobutan-1-ol

(ii) 3-methylbutanal

(iii) 2-phenylethanamide (phenylethanamide)

(iv) 2-aminopropanoic acid

(b)

i;  Or 

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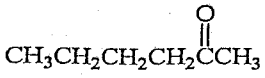

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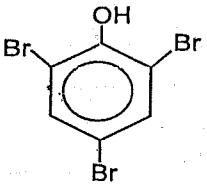
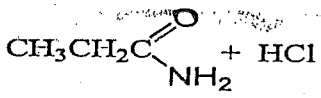


C) (i)

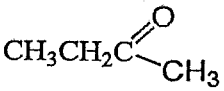
$CH_2=CHCH_2CH_3$ or $CH_3CH=CHCH_3$ + HBr

(ii)

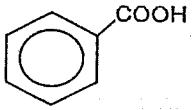
(iii)



(iv)



(v)



(d) (i) Neutral $FeCl_3$, gives a blue violet (purple) colouration with phenol but no observable change with benzene OR $Br_{2(l)}$ gives a white precipitate with phenol and no observable change with benzene

(ii) Ammonical silver nitrate gives a yellow or white precipitate with but-1-yne but not with but-2-yne (OR but-1-yne gives a reddish-brown precipitate with CuCl/NH_3 but-2-yne does not)

e) CH_3NH_2: EXPLANATION: The lone pair of electrons on nitrogen in phenylamine can be delocalized into the ring through resonance hence not readily available as in CH_3NH_2 where there is no resonance

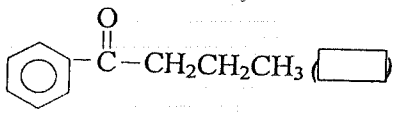
SET 9: SECTION C (CGCEB 2017)
ORGANIC CHEMISTRY

5a(i) C and D

(ii) D

(iii) C

b(i) Acid chlorides or acyl chlorides.

A:  or phenylbutanone

B: $CH_3CH_2CH_2CH_2OH$ or Butan-1-ol

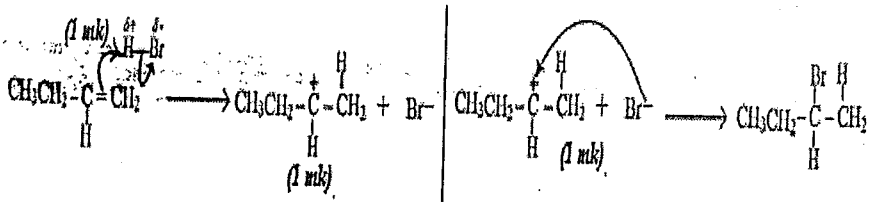
c(i) Functional group isomerism

(ii) When PCl_5, [or PCl_3 or $SOCl_2$] is added to A, it produces white fumes of HCl gas but no reaction with B Or use $H^+/KMnO_4$ or Na metal.

d(i)

Compound	Structure	Name
T	$CH_3CH_2CH(Br)CH_3$	2-bromobutane
U	$CH_3CH_2CH_2CH_3$	Butane
V	$CH_3CH_2CH(OH)CH_2OH$	Butane-1,2-diol
W	$CH_3CH_2CH(OH)CH_3$	Butan-2-ol

(ii) Electrophilic addition



(iii) Yes

V has two OH groups and thus forms more intermolecular hydrogen bonds than W with just one OH group and hence forms less intermolecular hydrogen bonds enabling V to have a higher boiling point.

6a(i)

C	H	O	
$\frac{66.7}{12}$	$\frac{11.1}{1}$	$\frac{22.2}{16}$	
5.56	11.1	1.39	(1 *mk*)
$\frac{5.56}{1.39}$	$\frac{11.1}{1.39}$	$\frac{1.39}{1.39}$	
3.99	7.99	1.39	
4.0	8.0	1.0	

$\Rightarrow$ Empirical formula = C_4H_8O (1 *mk*)

(ii) $(C_4H_8O)n = 72$

$72n = 72 \Rightarrow n = 1$ $\therefore$ Molecula formula = C_4H_8O

(iii) $CH_3CH_2CH_2CHO$, $CH_3COCH_2CH_3$ and $CH_3CH(CH_3)CHO$

Or $CH_2=CHCH_2CH_2OH$, $CH_3CH=CHCH_2OH$ and $CH_3CH_2CH=CH(OH)$

b(i) x: KOH(aq) / Alcohol under reflux

B: CH_3CH_2OH

(ii) c: P_2O_5/Heat

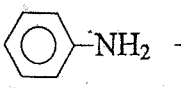
d: Br_2, conc. KOH/Warm

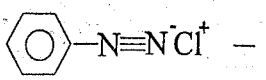
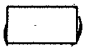
(iii) Y: No answer

e: $Cl_2/AlCl_3$

(iv) g: Excess conc. H_2SO_4/170 °C or Al_2O_3/350 °C or conc.H_3PO_4/210 °C

c(i) $CH_3CH_2NH_2$ – Ethylamine Or any other

(ii)  — Phenylamine  Or any other

(iii)  – Benzenediazonium chloride  Or any other

(iv) H_2N-CH_2-COOH - Aminoethanoic acid Or any other

(d) $ClCH_2COOH + 2NH_3 \xrightarrow[\text{Room temp (1 mk)}]{} H_2N\text{-}CH_2\text{-}COOH$ 

SET 10: SECTION C (CGCEB 2018)

Organic Chemistry

1. (a) (i) Carbon forms strong carbon – carbon bonds whereas the silicon – silicon bonds are weak. Carbon forms long chains and rings of identical atoms whereas silicon does not.

(ii) Ethene, sp^2 hydridisation and trigonal planar in shape.

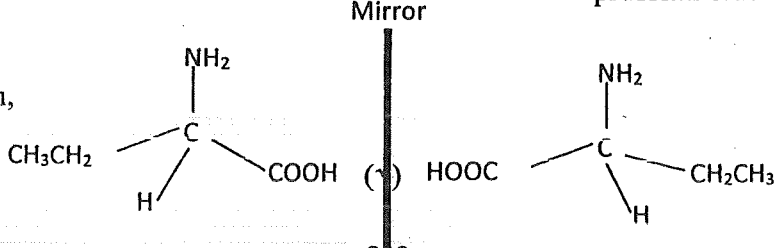
Ethyne, sp hydridisation and linear in shape.

(b) (i) Heat small sample of organic compound in test tube with molten sodium until it is red hot. Drop the test tube and it content in cold water. The test tube breaks and discharges its content into water. Filter and to a sample of the filtrate, add some iron (II) sulphate ($FeSO_4$) and boil. On cooling, add few drops of iron (III) chloride ($FeCl_3$) solution acidified with concentrated hydrochloric acid (HCl). The appearance of prussian blue colour indicates the presence of nitrogen in the organic compound.

$Fe^{2+}_{(aq)} + 6CN^-_{(aq)} \rightarrow [Fe(CN)_6]^{4-}$, $Fe^{3+}_{(aq)} + [Fe(CN)_6]^{4-} \rightarrow Fe[Fe(CN)_6]^-$.

prussian blue

(ii) Optical isomerism,



(c) (i) A: $CH_3COCH_3 + KCN/H_2SO_4 \rightarrow (CH_3)_2C(OH)CN$

$CH_3CHO + CH_3CH_2OH \rightarrow CH_3CHOH(OCH_2CH_3)$

$CH_3CHO + NaHSO_3 \rightarrow CH_3CHOH(SO_3Na)$ (Plus others)

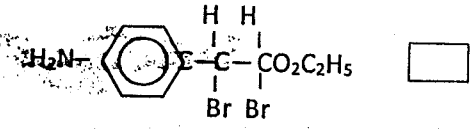
B: $CH_3-\overset{O}{\overset{\|}{C}}-H + H-\overset{H}{\underset{|}{N}}-OH \rightarrow CH_3-\overset{H}{\underset{|}{C}}=N-OH + H_2O$

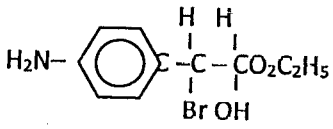
Alternatives to NH_2OH, are NH_2NH_2, 2,4 – DNPH, RNH_2

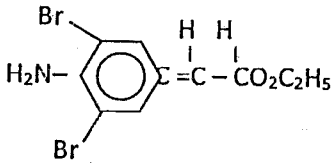
(ii) The positive inductive effect of the two alkyl groups in ketones makes the carbonyl carbon atom less electrophilic and less susceptible to nucleophilic attack than in aldehydes which have only one alkyl group attached to the carbonyl carbon.

OR The steric hindrance caused by two alkyl groups on the carbonyl carbon and impedes nucleophilic attack on the carbonyl carbon.

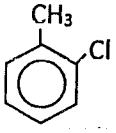
(d) (i) High C:H ratio **OR** presence or multiple bonds or benzene ring

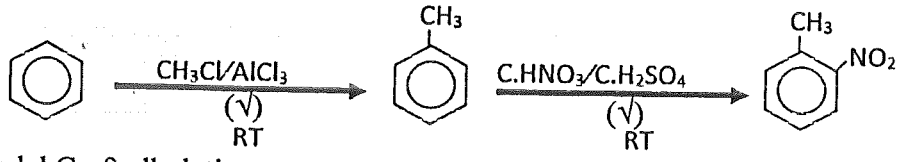
(ii) **A:** 

B: 

OR 

(iii) At a higher temperature >5°C the benzene diazonium salt gives a phenol by nucleophilic substitution.

(e) (i) 

(ii) 

(iii) Friedel Craft alkylation

2. (a) (i) $H^+/K_2Cr_2O_{7(aq)}$. or $H^+/KMnO_4$