Version No.			

ROLL NUMBER						

Answer Sheet No._____

Sign. of Candidate _____

Sign. of Invigilator _____

CHEMISTRY HSSC–II (3rd Set)

SECTION – A (Marks 17)

Time allowed: 25 Minutes

Section – A is compulsory. All parts of this section are to be answered on this page and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. **Do not use lead pencil.**

Q.1 Fill the relevant bubble for each part. Each part carries one mark.

(1) Predict the decomposition product which will give brown colored gas:

A. Na_2SO_4 ◯ B. $BaCO_3$ ◯

C. $Mg(NO_3)_2$ ◯ D. $CaSO_4$ ◯

(2) Li_2CO_3 is thermally unstable whereas other Group-I carbonates are stable. Predict the reason.

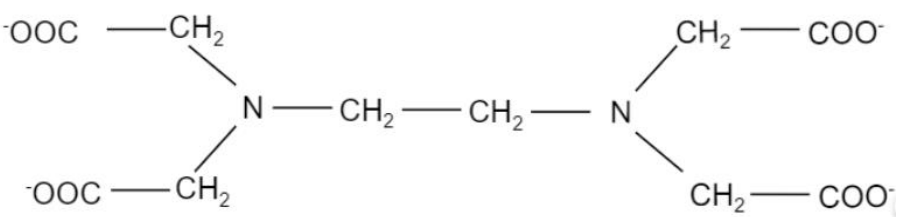
A. Li is less electropositive ◯

B. Li has low ionization potential ◯

C. Li^+ can effectively polarize CO_3^{-2} ion ◯

D. Li^+ cannot effectively polarize CO_3^{-2} ion ◯

(3) Identify the nature of the ligand



A. Monodentate ◯ B. Bidentate ◯

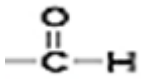
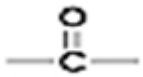
C. Tridentate ◯ D. Hexadentate ◯

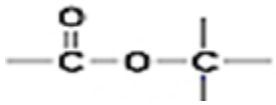
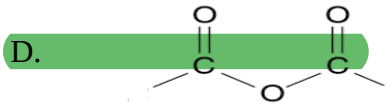
(4) Label the element in the first series of outer transition elements that has highest binding energy.

A. Titanium ◯ B. Vanadium ◯

C. Chromium ◯ D. Manganese ◯

(5) Identify the functional group present in the Anhydride.

A.  ◯ B.  ◯

C.  ◯ D.  ◯

(6) What is the IUPAC name of alkene which will give propanone and propanal on Ozonolysis?

A. 2-Butene ◯ B. 2-Methyl-2-Butene ◯

C. 2-Pentene ◯ D. 2-Methyl-2-Pentene ◯

(7) Propose the types of Isomerism shown by 1-Butanol.

A. Chain isomerism & Position isomerism ◯

B. Chain isomerism & Functional group isomerism ◯

C. Chain isomerism, Position isomerism & Functional group isomerism ◯

D. Position isomerism, Functional group isomerism & Metamerism ◯

(8) What is the name of Grignard Reagent that will give 2,2-Dimethyl Propanoic Acid on reaction with CO_2?

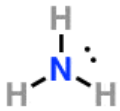
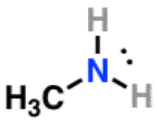
A. n-Propyl Magnesium Bromide ◯

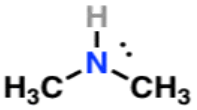
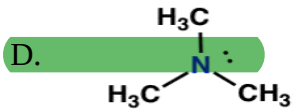
B. Iso-propyl magnesium Bromide ◯

C. N-Butyl Magnesium Bromide ◯

D. Neo-Butyl Magnesium Bromide ◯

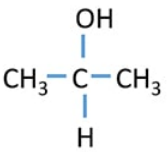
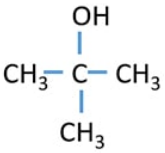
(9) Amines are basic in nature. Identify which one of the following is more basic?

A.  ◯ B.  ◯

C.  ◯ D.  ◯

(10) Identify the most reactive Alcohol with respect to the breakage of O-H bond.

A. CH_3-OH ◯ B. CH_3-CH_2 OH ◯

C.  ◯ D.  ◯

(11) Predict the product of acid hydrolysis of CH_3 -C≡C- CH_3 in the presence of $HgSO_4$ catalyst.

A. Acetaldehyde ◯ B. Propanal ◯

C. 2-Butanol ◯ D. Butanone ◯

(12) When secondary alcohol reacts with NaOH to produce yellow ppt, it is called:

A. Lucas test ◯ B. Benedict test ◯

C. Toulen test ◯ D. Iodoform test ◯

(13) Identify the name of the compound which will give acetamide on heating?

A. Ethyl amine ◯ B. Ethyl Nitrile ◯

C. Ethyl Diazonium Chloride ◯ D. Ammonium Acetate ◯

14. Predict which maltose is the disaccharide of

A.	Glucose only	◯	B.	Galactose only	◯
C.	Glucose & Fructose	◯	D.	Galactose & Fructose	◯

(15) Predict which one of the following substance is used as film forming agent in nail polish?

A.	Nitrocellulose	◯	B.	Ethyl acetate	◯
C.	Butyl stearate	◯	D.	Glycerol	◯

(16) Identify which one of the following water pollutant is Carcinogenic?

A.	Polycyclic hydrocarbons	◯
B.	Mineral acids	◯
C.	D.D.T	◯
D.	Nitrate fertilizers	◯

(17) Mass spectrum of Magnesium shows that it contains three isotopes. Mg-24 (78.70%), Mg-25 (10.13%) & Mg-26(11.17%). The average atomic mass of Mg is:

A.	24.32 amu	◯	B.	25.32 amu	◯
C.	26.32 amu	◯	D.	27.32 amu	◯

CHEMISTRY HSSC–II (3rd Set Solution)

SECTION – A (Marks 12)

Time allowed: 20 Minutes

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Key	C	C	D	C	D	D	C	D	D	A	D	D	D	A	A	A	A

SECTION-B

Q-No. 2

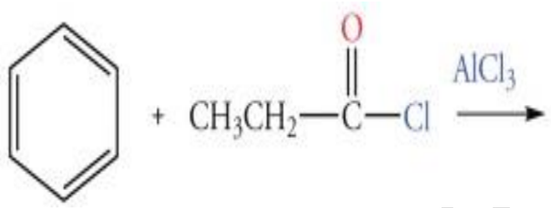
i. **List three raw materials of nail polish**.

Answer:

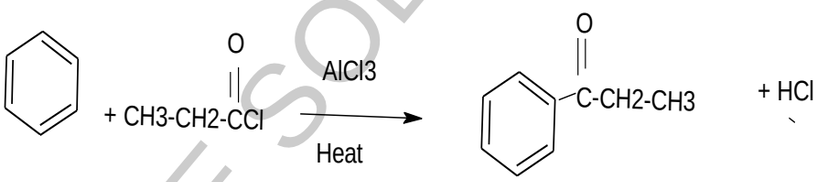
Three Raw materials of nail polish are :

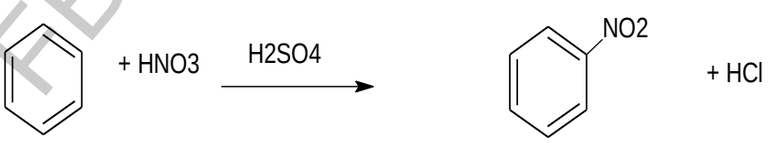
a. **Film Forming Agents** : e.g. Nitrocellulose
b. **Resins & Plasticizers** : e.g. Caster- oil , Amyl & Butyl stearate.
c. **Colouring agents** : e.g. Pearl or Fish scale

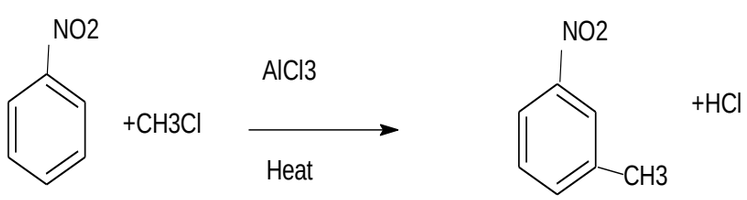
ii. Propose reaction mechanism of following.



Answer:







iii. **Describe the significance of catalytic converter and give reactions involved in it.**

Answer:

Catalytic converter is a device attached to the exhaust of automobile engine and contains Platinum as catalyst. Inside the catalytic converter, the exhaust gases consisting of un-burnt hydrocarbons, CO & NO are mixed with air and passed over Pt-catalyst at high temperature. The following reactions take place:

$2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$

$2\ CO + O_2 \rightarrow 2\ CO_2$

$2\ NO + 2\ CO \rightarrow N_2 + 2\ CO_2$

Significance: As a result of these reactions, the exhaust gases are converted into harmless N_2, CO_2 and H_2O vapours and help to reduce air pollution.

iv. Demonstrate reaction of 1-Butyne with ammonical silver nitrate and cuprous chloride.

Answer.

Reaction of 1- Butyne with Ammonical Silver Nitrate results in the formation of white ppt of Silver Butynide.

$CH_3\text{-}CH_2\text{-}C\equiv CH + AgNO_3 + NH_4OH \rightarrow CH_3\text{-}CH_2\text{-}C\equiv C\text{-}Ag + + NH_4NO_3 + H_2O$

(White ppt)

Reaction of 1- Butyne with Ammonical Cuprous Chloride results in the formation of red ppt of Copper Butynide.

$CH_3\text{-}CH_2\text{-}C\equiv CH + Cu_2Cl_2 + 2\ NH_4OH \rightarrow CH_3\text{-}CH_2\text{-}C\equiv C\text{-}Cu + + 2\ NH_4Cl + 2\ H_2O$

(Red ppt)

v. Illustrate one method of preparation of diazonium salt.

Answer.

Preparation of Diazonium Salt

When Ethyl amine is reacted with Nitrous acid in the presence of HCl at 0 ^oC , Ethyl diazonium chloride is produced.

$CH_3\text{-}CH_2\text{-}NH_2 + HNO_2 + HCl \rightarrow CH_3\text{-}CH_2\text{-}N\equiv N\text{-}Cl + 2\ H_2O$

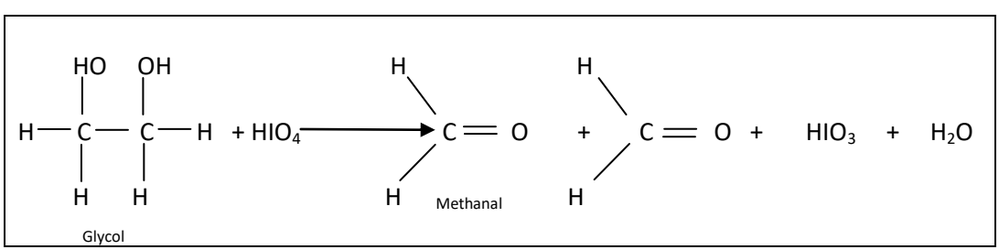
vi. Briefly describe contact adhesives

Answer.

Contact adhesives are applied to both the surfaces which are to be bound. The adhesive is allowed to stand for some time to dry and then two surfaces are pushed together. Some contact adhesives require 24 hours to dry before the surfaces are held together.

vii. Briefly describe the oxidative cleavage of 1,2 -diol. Give valid chemical reaction.

Answer.

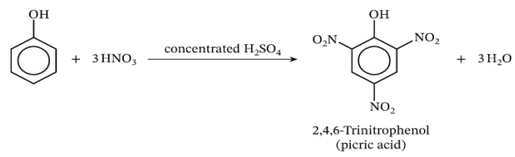
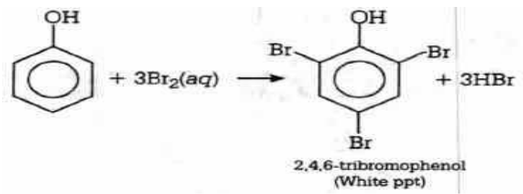


When Ethane – 1,2- diol (Glycol) is heated with Periodic acid , it is cleaved into to molecules of Formaldehyde. This reaction is specific test for 1,2- diols and is also known as oxidative cleavage.

viii. Differentiate between C_6H_5OH and $C_6H_{13}OH$ by chemical reaction

Answer.

Differentiation between Phenol (C_6H_5OH) & Hexanol ($C_6H_{13}OH$) by a Chemical reaction.

Phenol	Hexanol
Phenol reacts with Conc HNO_3 to produce yellow crystalline ppt of Picric acid.  2,4,6-Trinitrophenol (picric acid)	It does not react with Conc. HNO_3
Phenol reacts with Bromine water to produce white ppt of 2,4,6-Tribromo Phenol.  2,4,6-tribromophenol (White ppt)	Hexanol does not give this reaction.

ix. Demonstrate the oxidation of:

CH_3-CH_2-CH_2-CHO and CH_3-C($=O$)-CH_2CH_3 by chemical reactions.

Answer.

<u>Oxidation of Butanal</u> : Oxidation of aldehydes with acidified Potassium Dichromate gives Carboxylic acids.

$$CH_3\text{-}CH_2\text{-}CH_2\text{-}CHO + [O] \xrightarrow{K_2Cr_2O_7 / H_2SO_4} CH_3\text{-}CH_2\text{-}CH_2\text{-}COOH + H_2O$$

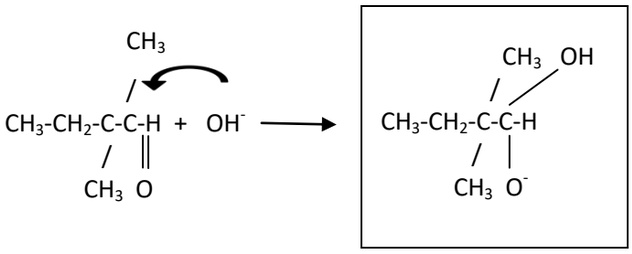
<u>Oxidation of Butanone :</u> Oxidation of Butanone with acidified Potassium Dichromate gives acetic acid.

$$CH_3\text{-}CO\text{-}CH_2CH_3 + [O] \xrightarrow{K_2Cr_2O_7 / H_2SO_4} 2\ CH_3\text{-}COOH$$

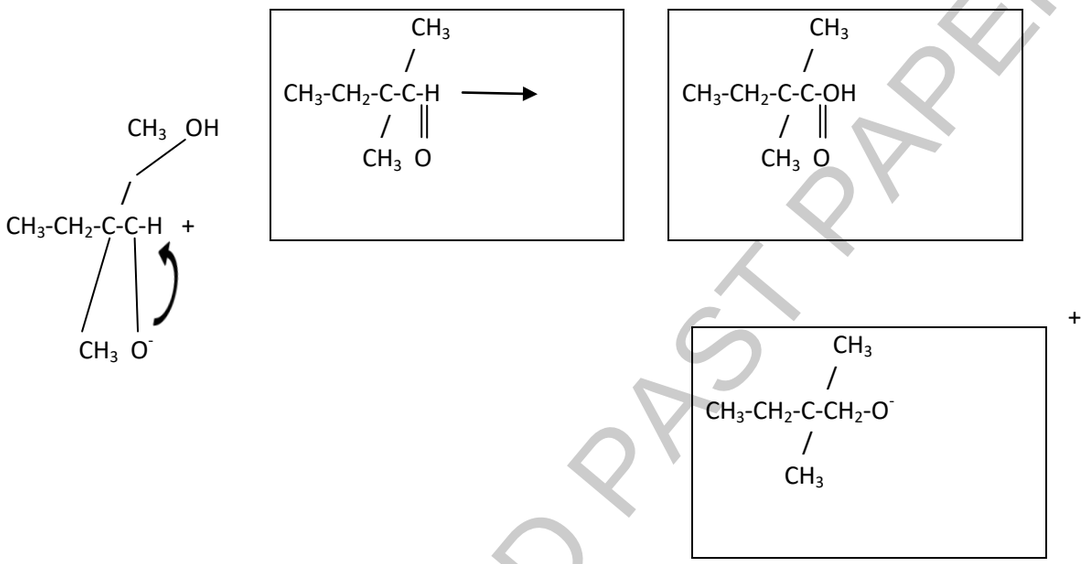
x. Propose reaction mechanism of 2,2 -Dimethyl butanal with sodium hydroxide.

Answer.

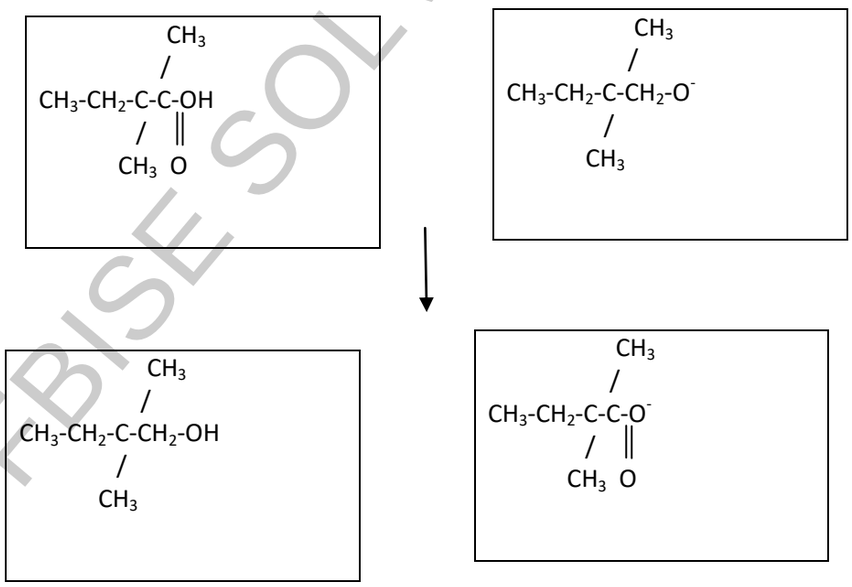
Step 1:



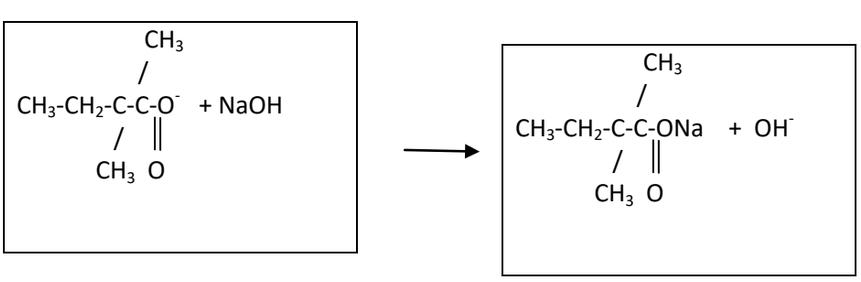
Step 2:



Step 3:



Step 4:



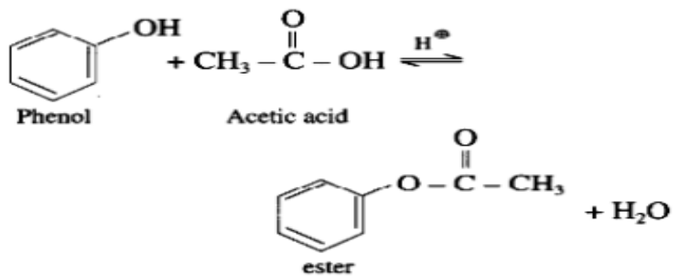
xi. Briefly discuss reactivity of Ethanoic acid with phenol.

Answer.

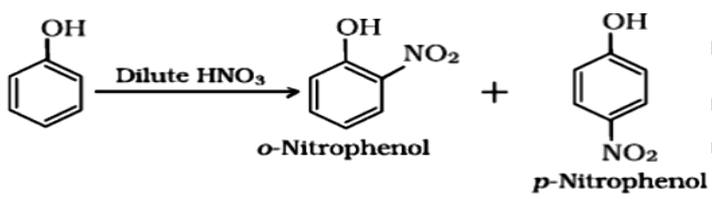
Phenol gives two types of reactions

(a) Reaction due to O-H bond breaking
(b) Reaction due to O-H benzene

(a) Ethanoic acid reacts with Phenol in the presence of Conc. H_2SO_4 to form Phenyl acetate, an ester.



(b) Reaction due to OH group on benzene will give ortho and para product



xii. Explain briefly the role of inhibitors in enzyme catalyzed reactions.

Answer.

A molecule which binds with enzyme and decreases its reactivity is known as Inhibitor. There are two types of enzyme inhibition.

Irreversible Inhibition:
In irreversible inhibition, the inhibitors form strong covalent bonds with active site of enzyme. This type of inhibition is stable and cannot be reversed.

Reversible Inhibition:
In reversible inhibition, the inhibitor forms weak bonds with active or non-active site of enzyme. The activity of enzyme can be restored in this process. The reversible inhibition is further divided into two types:

a. Competitive inhibition b. Non-competitive inhibition.

xiii. List down all the various raw materials for petrochemical industry.

Answer.

Raw Materials For Petrochemical Industry

The raw materials for petrochemical industry are classified into three types:

a. Olefins: It includes ethylene, propylene and Butadiene. Ethylene and Propylene are the major sources of industrial chemicals and plastic products. Butadiene is used in making synthetic rubber.

b. Aromatics: It includes Benzene, Xylene and Toluene. Aromatic hydrocarbons are produced by catalytic reforming in oil refineries.

c. Synthetic Gas: It is the mixture of Carbon monoxide and Hydrogen. It is used to make Ammonia and Methanol.

xiv. Recognize and briefly describe water pollutants.

Answer.

Water Pollution

The contamination of water with the substances which adversely effects humans, animals and plants is known as water pollution. It is caused by three types of water pollutants.

TYPES OF WATER POLLUTANTS:

1. Suspended Solids and Sediments

Examples: Oil spillage, Livestock waste, Industrial wastes, Leather tanneries.

2. Dissolved solids

Examples: Detergents, Pesticides

3. Heat (Thermal Pollution)

xv. State the regions electromagnetic spectrum used in IR and UV spectroscopy.

Answer.

Regions of Electromagnetic Spectrum used in IR Spectroscopy

There are two regions in Electromagnetic spectrum which are used in IR spectroscopy:

a. Functional Group Region: $1500 - 4000\ cm^{-1}$

b. Finger print Region : $626 - 1500\ cm^{-1}$

The radiations in these regions causes molecular vibration and rotation.

Regions of Electromagnetic Spectrum used in UV Spectroscopy

200 – 800 nm. This radiation causes the excitation of electrons from low energy level to high energy level.

xvi. Explain briefly the trends of oxidation states in groups IA, IIA, IVA, and VIIA of the periodic table.

Answer.

TRENDS IN OXIDATION STATES

Group –IA : Common oxidation state of all the elements : +1

Group – II A : Common oxidation state : +2

Group – IV A

Oxidation State of C , Si , Ge , Sn & Pb : +4

Oxidation states of Ge , Sn , Pb due to inert pair effect : +2

Stability of +4 Oxidation state : $Ge^{+4} > Sn^{+4} > Pb^{+4}$

Stability of +2 Oxidation state : $Ge^{+2} < Sn^{+2} < Pb^{+2}$

Group – VIIA

Oxidation state of F : - 1

Oxidation states of Cl , Br , I : -1 , +1 , +3 , +5 , +7

xvii. Demonstrate the reaction of potassium dichromate with oxalic acid by balanced chemical equation.

Answer.

Reaction of Potassium Dichromate with oxalic acid.

Acidified Potassium Dichromate acts as a strong oxidizing agent, It oxidizes Oxalic acid to CO_2 and is itself reduced to Chromium Sulphate.

$$K_2Cr_2O_7 + 4H_2SO_4 + 3H_2C_2O_4 \rightarrow Cr_2(SO_4)_3 + K_2SO_4 + 6CO_2 + 7H_2O$$

xviii. List three uses of plants as a source organic compound.

Answer.

Plants are the sources of following organic compounds

a. Carbohydrates (Cellulose , Starch , Sugars)

b. Fats / Oils (Palm oil , Cotton seed oil , Corn oil)

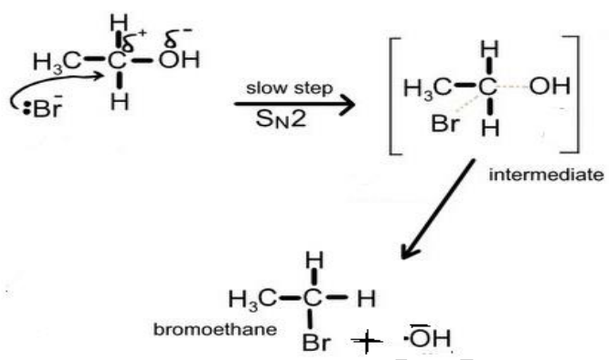
c. Alkaloids (Quinine , Morphine)

xix. Interpret why SN_2 mechanism is chosen rather than SN_1 in the preparation of primary alkyl halides?

Answer.

Primary Alkyl halides are prepared from primary alcohols by its reaction with HCl, HBr, PCl_3 etc. These reactions take place by SN_2 mechanism due to less stearic hindrance in primary alcohol.

Halide ion attacks the electrophilic carbon of Alcohol from the side opposite to the leaving group. The process of bond formation and bond breakage takes place simultaneously.



The reaction is supported by

a. Kinetic evidence which shows it to follow 2nd order Rate = k [Ethanol] $[Br^-]$

b. Stereo chemical evidence which shows the configuration of Alkyl halide as 100 % inverted.

xx. Identify 'A' and 'B' by completing reactions.

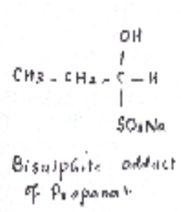
$CH_3CH_2CH_2OH$ $\xrightarrow{K_2Cr_2O_7/H_2SO_4}$ A $\xrightarrow{NaHSO_3}$ B

Answer.

$CH_3CH_2CH_2OH + [O] \xrightarrow{K_2Cr_2O_7/H_2SO_4} CH_3CH_2CHO + H_2O$

A

$_3CH_2CHO + NaHSO_3 \longrightarrow$



B

Bisulphite adduct of Propanal

SECTION – C (Marks 26)

Note: Attempt any **TWO** questions. All questions carry equal marks. (2×13 = 26)

Q.3 a. Propose reaction mechanism of free radical with ethane. (06)

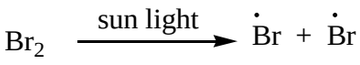
Answer:

Mechanism of free radical substitution in ethane.

To describe free radical substitution in ethane we take example of bromination. The overall reaction includes several separate steps.

Initiation Step. In this step, light energy breaks the Br-Br bond giving two separate bromine atoms (Br.).

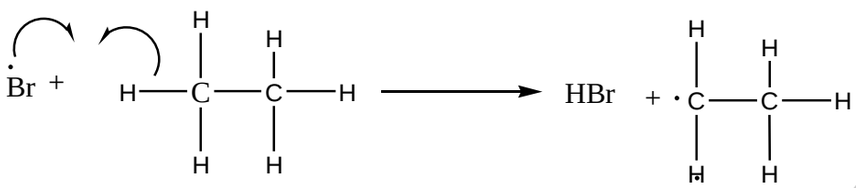
We call this type of bond breaking reaction, where a bonding electron pair divides equally between previously attached atoms, homolytic cleavage.



Step 1

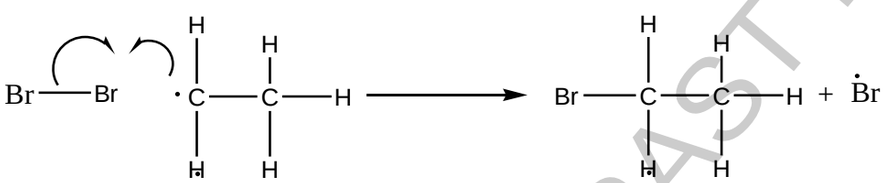
Propagation Steps.

Each Br. formed in Step 1 has the ability to abstract a H from ethane and forms H-Br in Step 2 and leaves behind a reactive molecular fragment (CH_3-CH_2.) called an ethyl radical (CH_3CH_2.)



Step 2

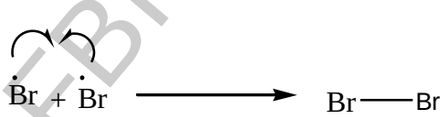
The ethyl radical is very reactive because of its unshared electron. The ethyl radical reacts with molecular bromine (Br_2) by abstracting a Br to form a C-Br bond.



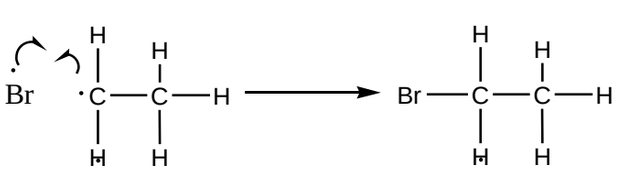
Step 3

Propagation Steps Repeat. The Br. that forms in Step 3 reacts with another ethane molecule in Step 2 and the resulting ethyl radical reacts with a new Br_2 in Step 3 to once again form Br. This cycle of Step 2 followed by Step 3 repeats many times giving high yields of the product CH_3CH_2Br from Step 3, and the product HBr from Step 2.
We call Steps 2 and 3 propagation reactions because in each of them, one radical species generates another radical keeping the "chain" alive.

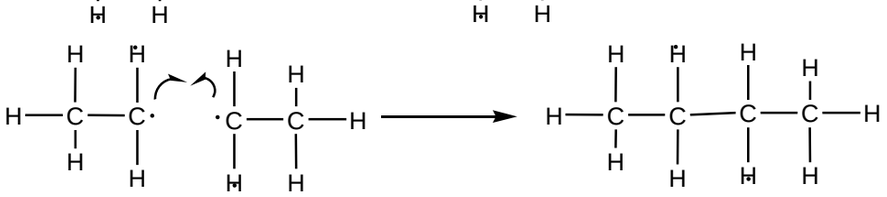
Termination Reactions
Since there are many radicals present at the same time, these radicals formed in initiation or in propagation reactions sometimes react with each other instead of reacting in the propagation steps. These reactions between two radicals lead to combination reactions that we collectively call termination reactions. Br. atoms and CH_3CH_2. radicals can combine with each other in the 3 ways



Step 4



Step 5



Step 6

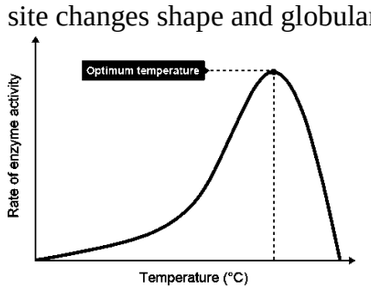
b. Identify factors that affect enzyme activity. Explain temperature and p^H. Describe the components of complex compounds. (2+2+3)

Answer:

Temperature:

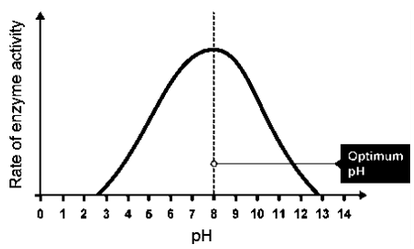
As the temperature increases so does the rate of enzyme activity. An optimum activity is reached at the enzyme's optimum temperature, where each enzyme works at its maximum rate.

A continued increase in temperature results in a sharp decrease in activity as the enzyme's active site changes shape and globular structure of it is lost. This is called denaturation of enzyme.



Effects of pH

Changes in pH also alter the shape of an enzyme's active site. Each enzyme work bests at a specific pH value, which is called the optimum pH for an enzyme. This optimum value of pH depends on where it normally works. For example, enzymes in the small intestine have an optimum pH of about 7.5, but stomach enzymes have an optimum pH of about 2.



Components of complex compounds:

A complex compound normally consists of three components.

1. A cation or anion which is not a complex.
2. A central metal atom or ion which is transition element.
3. Electron pair donor substances which are called ligands. These ligand can be negatively charged, positively charged or neutral.

   For example:

   $K_4[Fe(CN)_6]$

Q.4 a. Demonstrate by the balanced chemical reaction of potassium manganate (VII) with the following: (2+2+2)

(i) Ferrous Sulphate (ii) Oxalic acid (iii) Mohr's salt

Answer:

In these reactions Potassium manganate VII acts as oxidizing agent and ferrous sulphate, oxalic acid and Mohr's salt as reducing agents. These reactions take place in acidic conditions.

1. Potassium manganate VII with ferrous sulphate.

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$[2FeSO_4 + H_2SO_4 + [O] \longrightarrow Fe_2(SO_4)_3 + H_2O]x\ 5$$

$$2KMnO_4 + 3H_2SO_4 + 10FeSO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5Fe_2(SO_4)_3$$

2. Potassium manganate VII with Oxalic acid.

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

$$[H_2C_2O_4 + [O] \longrightarrow 2CO2 + H_2O]x\ 5$$

$$2KMnO_4 + 3H_2SO_4 + 5\ \underline{H_2C_2O_4} \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10\ CO_2$$

3. Potassium manganate VII with Mohr salt ($FeSO_4(NH_4)2SO_4.6H_2O$).

$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$

$[2FeSO_4(NH_4)_2SO_4.6H_2O + H_2SO_4 + [O] \longrightarrow Fe_2(SO_4)_3 + 2(NH_4)_2SO_4 + 13H_2O]$ x 5

$2KMnO_4 + 8H_2SO_4 + 10\ FeSO_4(NH_4)_2SO_4.6H_2O \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 68H_2O + 10(NH_4)_2SO_4$

b. Describe the trend in solubility of the hydroxides sulphates and carbonates of group IIA. (2+2+3)

Answer:

1. Solubility of the Hydroxides

Group II metal hydroxides become more soluble down the group because the lattice energy decreases down the group due to increase in size.

$Be(OH)_2$ are almost insoluble in water.

$Mg(OH)_2$ is insoluble and shows slightly alkaline nature in water. Suspension of $Mg(OH)_2$ is called Milk of magnesia. It is used to remove stomach acidity.

$Ca(OH)_2$ is slightly soluble in water. Its solution is called lime water.

$Ba(OH)_2$ is soluble enough to be able to produce a solution with a concentration of around 0.1 mol.dm-3 at room temperature.

2. Solubility of the Sulphates.

The sulphates become less soluble down the group. For example $BeSO_4$ and $MgSO_4$ are fairly soluble in water; calcium sulphate is sufficiently soluble in water while strontium and Barium sulphates are almost in soluble.

3. Solubility of the Carbonates

The carbonates tend to become less soluble as we go down the group. Carbonates are insoluble in water and therefore occur as solid rock minerals in nature. However they dissolve in water containing CO_2 due to the formation of bicarbonates

$CaCO_{3\,(s)} + CO_{2\,(g)} + H_2O_{(l)} \longrightarrow Ca(HCO_3)_{2\,(aq)}$

Q.5 a. Identify A and B compounds by completing the chemical reactions. Also write IUPAC names of A and B. (2.5+2.5+2)

(i) $CH_3\text{-}CH_2C(=O)\text{-}O\text{-}C(=O)\text{-}CH_2\text{-}CH_3 + CH_3\text{-}O\text{-}H \longrightarrow A+B$

(ii) $CH_3\text{-}CH_2C(=O)\text{-}O\text{-}C(=O)\text{-}CH_2\text{-}CH_3 + H_2O \longrightarrow A+B$

(iii) $CH_3\text{-}CH_2C(=O)\text{-}O\text{-}C(=O)\text{-}CH_2\text{-}CH_3 + CH_3\text{-}CH_2\text{-}NH_2 \longrightarrow A+B$

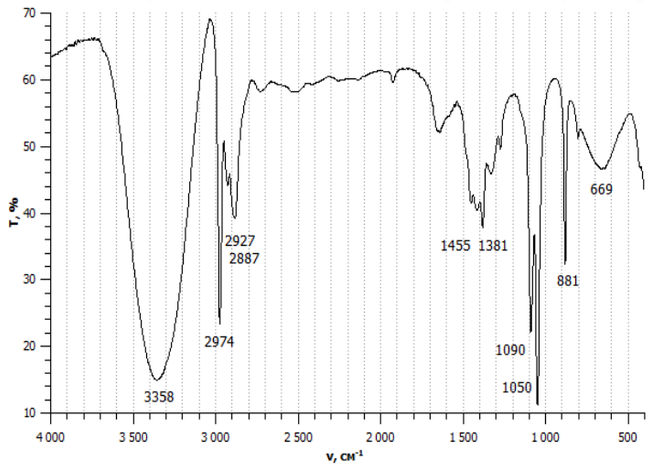
Answer:

(i) $CH_3\text{-}CH_2C(=O)\text{-}O\text{-}C(=O)\text{-}CH_2\text{-}CH_3 + CH_3\text{-}O\text{-}H \xrightarrow{\text{pyridine}} \underset{\text{Propanoic acid}}{CH_3\text{-}CH_2COOH} + \underset{\text{Methyl propanoate}}{CH_3\text{-}O\text{-}CO\text{-}CH_2\text{-}CH_3}$

(ii) $CH_3\text{-}CH_2C(=O)\text{-}O\text{-}C(=O)\text{-}CH_2\text{-}CH_3 + H_2O \xrightarrow{\text{Acid}} \underset{\text{Propanoic acid}}{CH_3\text{-}CH_2COOH} + \underset{\text{Propanoic acid}}{CH_3\text{-}CH_2COOH}$

(iii) $CH_3\text{-}CH_2C(=O)\text{-}O\text{-}C(=O)\text{-}CH_2\text{-}CH_3 + CH_3\text{-}CH_2\text{-}NH_2 \longrightarrow \underset{\text{Propanoic acid}}{CH_3\text{-}CH_2COOH} + \underset{\text{Propanamide}}{CH_3\text{-}CH_2CONH_2}$

b. Analyze the ethanol Infrared spectrum by using following data. (06)

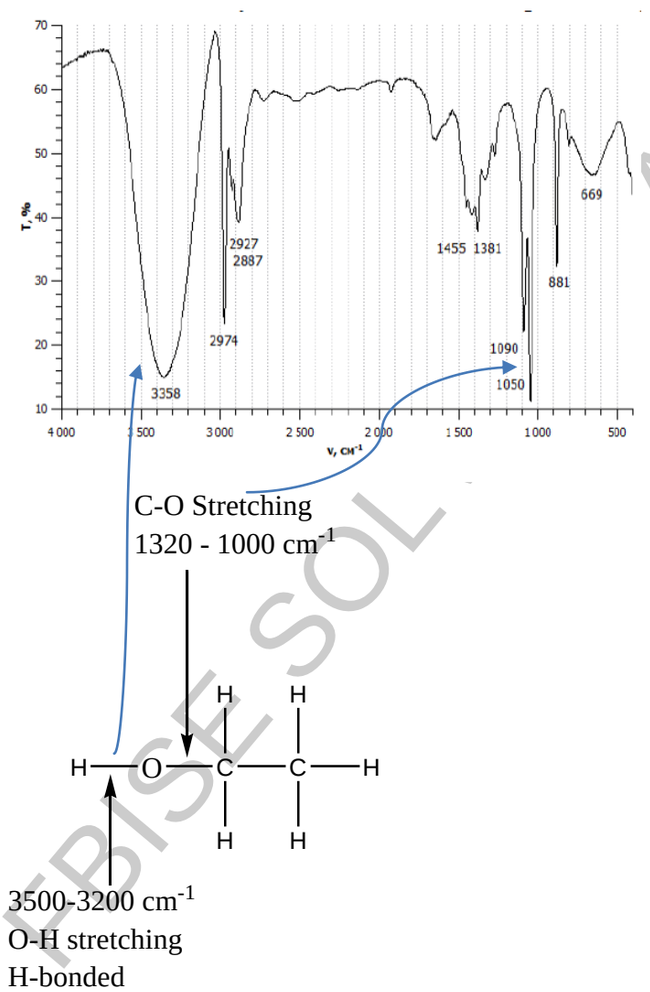


Wavenumber (cm^{-1})	Bond	Functional Group
3400–3250 (m)	N–H stretch	primary, secondary amines, amides
3500–3200 (s,b)	O–H stretch, H–bonded	alcohols, phenols
2260–2100 (w)	–C (triple bond) C– stretch	alkynes
1650–1580 (m)	N–H bend	primary amines
1300–1150 (m)	C–H wag (–CH_2X)	alkyl halides
1360–1290 (m)	N–O symmetric stretch	nitro compounds
1335–1250 (s)	C–N stretch	aromatic amines
1320–1000 (s)	C–O stretch	alcohols, carboxylic acids, esters, ethers

Answer:

The most distinct feature in the infrared spectrum of alcohols is the broad absorption band centered around wavenumbers 3550 to 3230 cm^{-1} due to O-H stretching vibrations, and broadened by intermolecular hydrogen bonding.

The C-O stretching band for primary alcohols is 1320 to 1000 cm^{-1}.



* * * * *