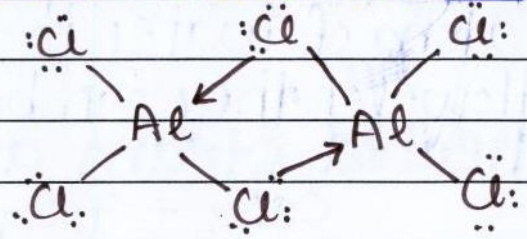
Q. No. 2 (i) Electrical conductivity is the property of an element or compound to conduct electricity by **free electrons and ions.** In case of **molten NaCl**, free ions are available as:

$$NaCl \xrightarrow{H_2O} Na^+_{(aq)} + Cl^-_{(aq)}$$

These ions conduct electricity. While in case of $AlCl_3$ **in solid state ions are not free to move** while in molten state at high pressure there are **no ions**. So it doesnot conduct electricity in either state.



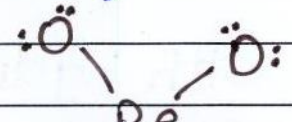
Q. No. 2 (ii) **a)** BeO is amphoteric in nature. It can react with both **acids and bases.**

$$\underset{(base)}{BeO} + \underset{(acid)}{2HCl} \longrightarrow \underset{(salt)}{BeCl_2} + H_2O$$

$$\underset{(acid)}{BeO} + \underset{(base)}{2NaOH} \longrightarrow Na_2BeO_2 + H_2O$$

sodium beryllate

b) BeO is covalent in nature but has high melting point because it is linked tetrahedraly with **4 oxygen atoms** thus higher temperature is required to break the bonds.



Q. No. 2 (iii) **a-** Group VI A elements show two oxidation states **+4 and +2.** Down the group stability of +2 oxidation state increases i.e. **$Pb^{+2} > Pb^{+4}$** That is why $PbCl_4$ in which Pb^{+4} ion is present is unstable while $PbCl_2$ is stable.

b- tetrahalides of carbon donot undergo hydrolysis because they belong to **2nd period** and **donot have vacant d orbitals** which can accept lone pair of oxygen atom of water to form intermediate complex. However they can be hydrolysed by **super heated steam as:**

$$CCl_4 + H_2O \xrightarrow{\text{super heated steam}} COCl_2 + 2HCl$$

(Phosgene gas)

.....

Q. No. 2 (iv) $[Cr(H_2O)_6]^{+3}$ can be oxidized to CrO_4^{-2} by following three reactions:-

- with few drops of base:-

$$[Cr(H_2O)_6]^{+3} + 3OH^- \longrightarrow [Cr(H_2O)_3(OH)_3] + 3H_2O$$

purple — **green ppt**

hexaaqua chromium (III) — triaquatrihydroxo chromium (III)

- with excess of base:

$$[Cr(H_2O)_3(OH)_3] + 3OH^- \longrightarrow [Cr(OH)_6]^{-3} + 3H_2O$$

green sol.

hexahydroxo chromate (III)

- reaction with hydrogen peroxide:

Q. No. 2 (v) Iron exists in two oxidation states Fe^{+2} and Fe^{+3}. It acts as a catalyst in the following reaction:-

$$S_2O_8^{-2} + 2I^- \longrightarrow 2SO_4^{-2} + I_2.$$

The reaction proceeds as:-

- $S_2O_8^{-2} + 2Fe^{+2} \longrightarrow 2SO_4^{-2} + 2Fe^{+3}$
- $2Fe^{+3} + 2I^- \longrightarrow I_2 + 2Fe^{+2}$

As Fe^{+2} is regenerated it acts as catalyst. If Fe^{+3} ion is present, 2nd reaction will proceed first.

.....

Q. No. 2 (vi) "Functional group refers to **atoms or group of atoms** which give a compound its characteristic properties." e.g. $-OH$, $-NH_2$, etc. The concept of functional group is important because:-

- It serves as a basis for **nomenclature** (naming of organic compounds).
- It serves as a basis for **classification of organic compounds**. Compounds belonging to same class have same functional groups.
- Functional group is the **site of chemical**

Q. No. 2 (vii)

STRUCTURAL ISOMERISM	STEREO ISOMERISM
• Compounds having same molecular formula but **different arrangement of atoms within molecule.**	• compounds having same molecular formula but **differ in orientation of atoms in space.**
• Same molecular formula and **different structural formula.**	• Same molecular and structural formula but **different configuration.**
• Types include, Chain isomerism, Position, Functional group, metamerism, tautomerism.	• Types include 1- optical isomerism 2- Geometrical

Q. No. 2 (viii)

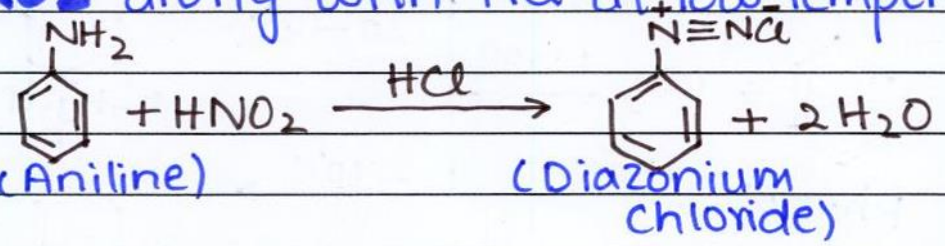
Q. No. 2 (ix) The trend of halide ions as reducing agent is **$I^- > Br^- > Cl^- > F^-$**. As we move down the group, **atomic size increases** thus hold of nucleus on outer electrons becomes weak. Thus, electrons can be easily lost. That is why I^- ion is most powerful reducing agent.
It reacts with H_2SO_4 as follows:-

$$4NaI + 2H_2SO_4 \longrightarrow 2Na_2SO_4 + 4HI$$
$$2\cancel{4}HI + H_2SO_4 \longrightarrow SO_2 + \cancel{2}I_2 + \cancel{3}H_2O$$

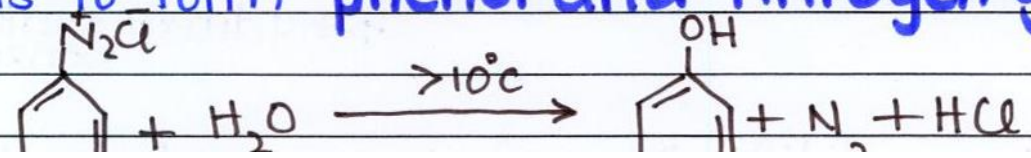
In this reaction I^- ion is reducing **sulphur in H_2SO_4 (+6) to +4 in SO_2** while is being oxidized itself.

.....

Q. No. 2 (x) Diazonium salts are compounds having nitrogen atoms joined by **triple bond (-N≡N-)**. It can be prepared by reacting **aniline with HNO_2** along with HCl at low temperature:-



At higher temperature **(above 10°C)** it hydrolysis to form **phenol and nitrogen gas:**



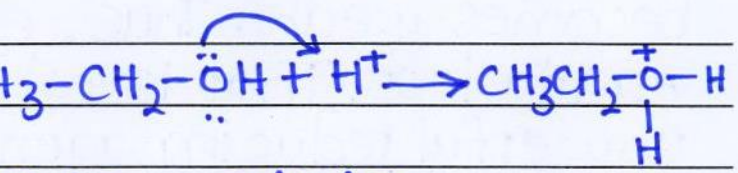
Q. No. 2 (xi) Dehydration of ethanol by conc. H_2SO_4 at 140°C produces **Diethyl ether.**

$$2\,CH_3CH_2OH \xrightarrow[140^\circ C]{conc.\ H_2SO_4} CH_3CH_2-O-CH_2CH_3 + H_2O$$

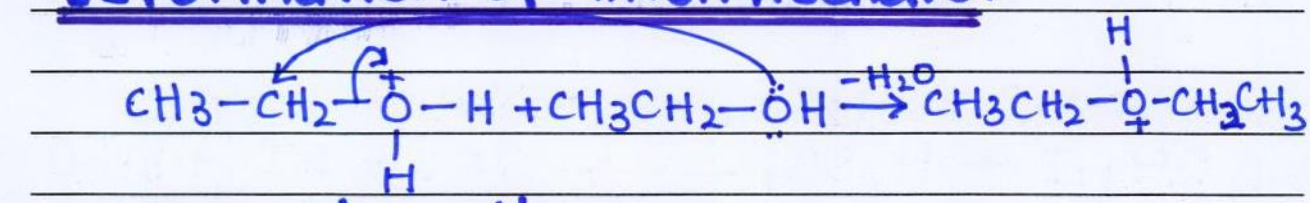
(ethanol) (diethyl ether)

MECHANISM:-

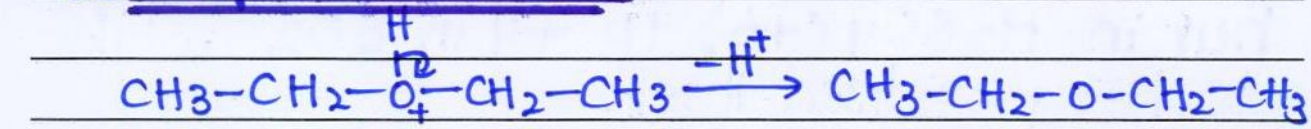
1- Protonation:



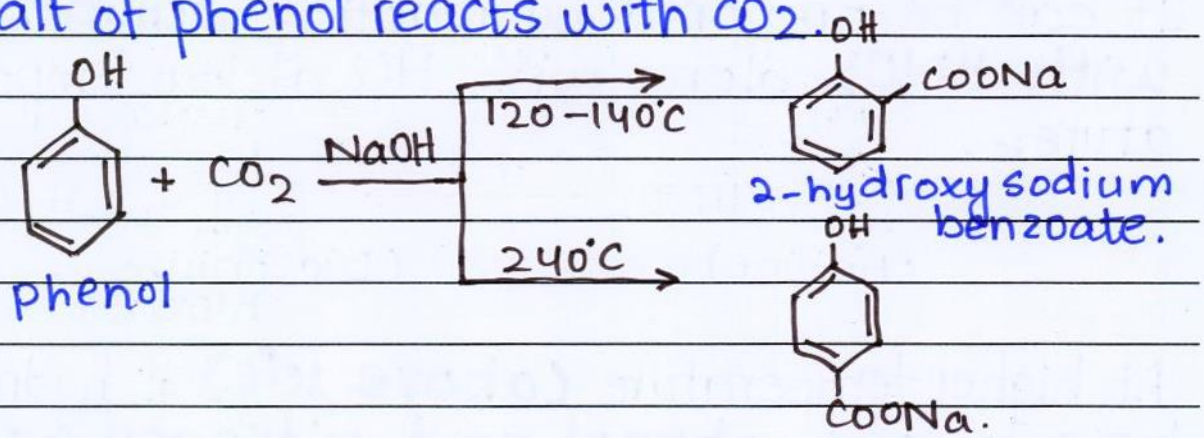
2- Formation of intermediate:



3- Deprotonation:



Q. No. 2 (xii) Kolbe-Schmitt reaction is the **carboxylation of phenol.** In this reaction sodium salt of phenol reacts with CO_2.



phenol

2-hydroxy sodium benzoate.

4-hydroxy sodium benzoate

Q. No. 2 (xiii) Aldehydes are **oxidized by mild oxidizing agents** e.g. Fehling's solution and Tollen's reagent while ketones donot give these reactions.

1- FEHLING'S SOLUTION TEST:

Fehling's solution is **alkaline solution of Cu^{+2} ions** along with sodium^x of^x potassium tartarate. Cu_2O **(red ppt)** is formed. or

$$CH_3CHO + Cu^{+2} + OH^- + \text{sodium tartarate} \rightarrow CH_3COO^- + Cu_2O + H_2O$$

Aldehyde is oxidized to CH_3COO^- and Cu^{+2} ons are reduced to Cu^{+1} ions.

2- TOLLEN'S TEST: Tollen's reagent (silver nitrate, ammonia and sodium hydroxide) react with aldehyde to form **silver mirror.**

$$CH_3CHO + 2[Ag(NH_3)]^+ + OH^- \rightarrow CH_3COO^- + 2Ag_{(s)}\downarrow + 2NH_3 + 2NH_4^+$$

Q. No. 2 (xiv) **a) By reduction:**

$$\underset{\text{(acetamide)}}{CH_3-\overset{O}{\overset{\|}{C}}-NH_2} + LiAlH_4 \longrightarrow \underset{\text{(ethyl amine)}}{CH_3-CH_2-NH_2}$$

b) Reaction with acetic acid (carboxylic acid):

$$\underset{\text{(acetyl chloride)}}{CH_3-\overset{O}{\overset{\|}{C}}-Cl} + \underset{\text{(acetic acid)}}{CH_3-\overset{O}{\overset{\|}{C}}-OH} \longrightarrow \underset{\text{acetic anhydride}}{CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3} + HCl.$$

c) By dry distillation:

Q. No. 2 (xv) **a) By reaction with CO_2:**

$$\underbrace{CH_3-Mg-Br}_{\text{(Grignard reagent)}} + O=C=O \xrightarrow{\text{ether}} O=C(CH_3)-OMgBr + H_2O \xrightarrow{H^+} CH_3-C(=O)-OH + MgBr(OH)$$

(acetic acid)

b) By ~~reduction:~~ hydrolysis:

$$(CH_3-C(=O)-)CH_3CN + H_2O \rightarrow CH_3-C(=O)-NH_2$$

methyl nitrile → acetamide

$$CH_3-C(=O)-NH_2 + H_2O \longrightarrow CH_3-C(=O)-OH$$

acetic acid.

c) By oxidation:

$$\text{ethyl alcohol } CH_3CH_2OH + [O] \xrightarrow[H_2SO_4]{KMnO_4} CH_3CHO \text{ (ethanal)}$$

$$CH_3CHO + [O] \xrightarrow[H_2SO_4]{KMnO_4} CH_3COOH.$$

Q. No. 2 (xvi)

DNA	RNA
• Stands for **deoxy ribonucleic acid.**	• Stands for **ribo nucleic acid.**
• Contains deoxyribose sugar.	• Contains ribose sugar.
• **Double stranded** structure.	• **Single stranded** structure.
• Contains nitrogeneous bases: Adenine (A), Guanine (G), Cytosine (C)	• Contains **Uracil (U)** instead of thymine.

Q. No. 2 (xvii) Petrochemical raw materials are classified into following three categories:

- **Olefins** including ethylene, propylene and butadiene. Ethylene and propylene are important chemicals involved in synthesis of **plastic products.** Butadiene is required for **rubber synthesis.**
- **Aromatics** including benzene, toulene and xylene. Produced during catalytic refining of oil and related processes.
- **Synthetic gas** which is a **mixture of CO and hydrogen gas** used to manufacture **ammonia and methyl alcohol.** urea fertilizer is produced from ammonia.

Q. No. 2 (xviii) "The separation of different miscible liquids on the basis of **difference in boiling points** by **evaporation and condensation** is refining of petroleum."

(Fractional Distillation.

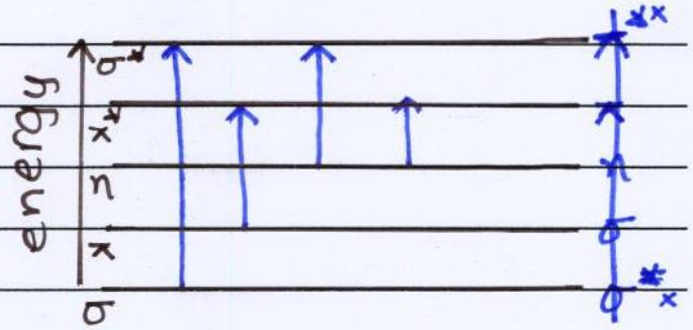
→ **PRINCIPLE:**

It is done in a large **fractionating tower**. The petroleum is heated under high pressure and high temperature **(≈400°c)**. The components with **low boiling point** and more volatile **boil out first** while the components with high boiling point and more ~~"val"~~ volatile boil out next. These components then **condense** according to their boiling points and are separately collected.

Q. No. 2 (xix) When an organic compound is subjected to visible radiations in the range of **200-800nm** electrons jump from **lower energy level to higher energy level** within the atom **(from HOMO to LUMO)**. This is known as **electronic spectroscopy** and is used to determine **the presence of unsaturation and extent of conjugation.**

Following transitions can occur:-

- σ to σ^*
- $n \rightarrow \sigma^*$
- $\pi \rightarrow \pi^*$
- $n \rightarrow \pi^*$



The energy required for various transitions:

$n \rightarrow \pi^* < \pi \rightarrow \pi^* < n \rightarrow \sigma^* < \sigma \rightarrow \sigma^*$

The relevant question should be answered only in the allotted space and inside the outer mark

Q. No. 2 (xx)

متعلقہ سوال کا جواب صرف مختص کردہ جگہ پر اور بیرونی نشان کے اندر دیا جائے۔

Q. No. 3 (Page 1/6)

The relevant question should be answered only in the allotted space and inside the outer mark

Q. No. 3 (Page 2/6)

متعلقہ سوال کا جواب صرف مختص کردہ جگہ پر اور بیرونی نشان کے اندر دیا جائے۔

Q. No. 3 (Page 3/6)

Q. No. 3 (Page 4/6)

متعلقہ سوال کا جواب صرف مختص کردہ جگہ پر اور بیرونی نشان کے اندر دیا جائے۔

Q. No. 3 (Page 5/6)

The relevant question should be answered only in the allotted space and inside the outer mark

Space for diagram/rough work

Q. No. 3 (Page 6/6)

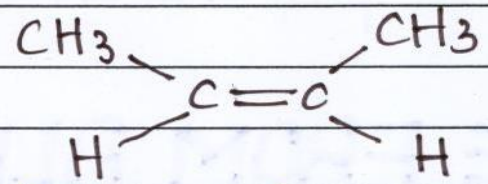
Q. No. 4 (Page 1/6)

a) GEOMETRICAL ISOMERISM

Geometrical isomerism or **cis-trans isomerism** results from **restriction in rotation** about double bond or about single bond in cyclic compounds.

→ CIS ISOMER:

Which contains **bulky groups on same side** of double bond e.g.

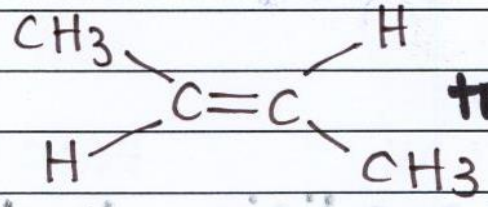


cis-2-butene

These are **less stable** due to steric effect.

→ TRANS ISOMER:

Which contains bulky groups on **opposite sides** of double bond e.g.



trans-2-butene

These are more stable.

Q. No. 4 (Page 2/6)

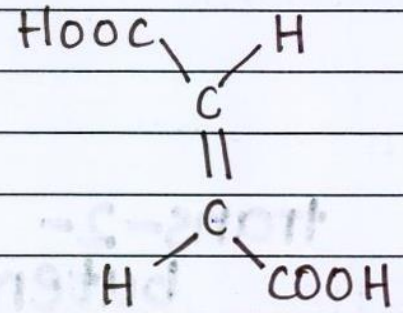
CONDITIONS :-

Not all alkenes show geometrical isomerism :-

- atleast one double bond must be present in alkenes and in case of single bond compound should be cyclic.
- Both double bonded carbons must be attached to **two different atoms or groups.**
- In cycloalkanes, two groups other than H must be present on **two carbon atoms.**

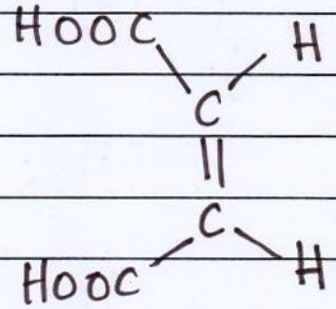
EXAMPLE FROM ALKENES

In alkenes, **Butenedioic acid** shows geometrical isomerism:-



trans-butenedioic acid

→ Fumaric acid



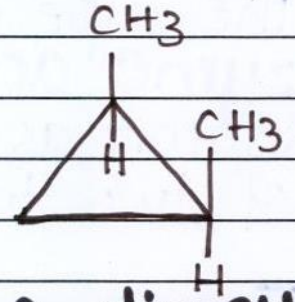
cis-butenedioic acid

→ Maleic acid

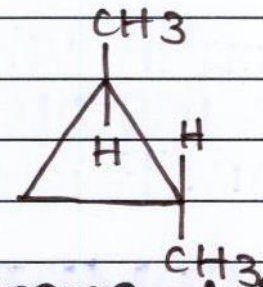
Q. No. 4 (Page 3/6)

EXAMPLE FROM CYCLOALKANES:-

In cycloalkanes, **1,2-dimethyl cyclo propane** shows geometrical isomerism.



cis-1,2-dimethyl cyclopropane



trans-1,2-dimethyl cyclopropane.

Geometrical isomers have **different physical and chemical properties** and are a type of **stereoisomers.**

b) ENZYME INHIBITION

"When a compound attaches with enzyme and **decreases its activity** it is known as enzyme inhibition."

Enzyme Inhibition is of the following two types on the basis of type of bond formed between enzyme and inhibitor.

1- IRREVERSIBLE:

Q. No. 4 (Page 4/6)

bonds are formed between the enzyme and inhibitor and **enzyme activity cannot be restored.**

2. REVERSIBLE:

The type of inhibition in which **enzyme activity can be restored** is known as reversible inhibition. It is further of two types:-

a) COMPETITIVE:

In competitive inhibition, the inhibitor is **structurally similar to substrate** and thus can **bind to active site.** When competitive inhibitor is present, the substrate can not bind to the active site and **reaction will not be catalyzed.** Competitive inhibition can be **overcomed** by **increasing the concentration of normal substrate.**

b) NON-COMPETITIVE:

The inhibitor attaches to enzyme other then the active. It binds to the **non-active site (allosteric site)** thus, changing

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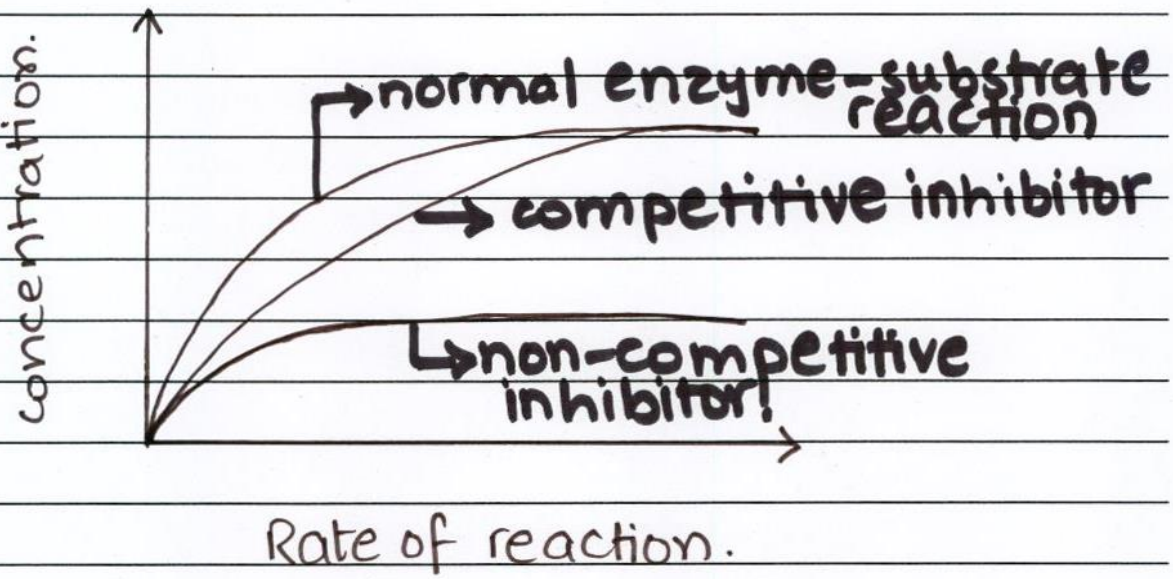
Q. No. 4 (Page 5/6)

cannot bind to the active site.



The relevant question should be answered only in the allotted space and inside the outer mark

Space for diagram/rough work

Q. No. 4 (Page 6/6)

Q. No. 5 (Page 1/6)

a) IODOFORM TEST

"**carbonyl compounds** containing CH_3CO- group react with I_2 in presence of an alkali to form yellow crystals of **iodoform.**"

GENERAL EQUATION:-

organic compound + I_2 + NaOH $\longrightarrow$ **CHI_3 + (yellow ppt)**

$RCOONa + NaI + H_2O$

(sodium salt of carboxylic acid).

ALCOHOLS:-

In case of **primary alcohols, only ethanol** will give this test positive.

$$\underset{\text{(ethanol)}}{CH_3-CH_2-OH} + 4I_2 + 6NaOH \rightarrow \underset{\text{(iodoform)}}{CHI_3} + \underset{\text{(sodium formate)}}{HCOONa} + 5NaI + 5H_2O.$$

In **secondary alcohols**, those containing **$CH_3-\underset{\underset{OH}{|}}{C}H-R$** group will give this test.

$$CH_3-\underset{\underset{OH}{|}}{C}H-CH_3 + 4I_2 + 6NaOH \rightarrow CHI_3 + CH_3COONa$$

Q. No. 5 (Page 2/6)

while tertiary alcohols will not give this test.

ALDEHYDES:

Only **acetaldehyde** will give iodoform test.

$$CH_3-\overset{O}{\overset{\|}{C}}-H + 3I_2 + 4NaOH \rightarrow CHI_3 + HCOONa + 3NaI + 3H_2O$$

acetaldehyde — iodoform (yellow ppt). — sodium formate

KETONES:

only methyl ketones will give this test positive.

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + 3I_2 + 4NaOH \rightarrow CHI_3 + CH_3COONa + 3NaI + 3H_2O$$

(acetone)

⇒ APPLICATIONS:-

- It can be used to **distinguish ethanol from methanol.**
- It can be used to **distinguish acetaldehyde (ethanal)** from other aldehydes.
- It can be used to distinguish **methyl ketones** from other ketones.

Q. No. 5 (Page 3/6)

b) OZONE HOLE

"Ozone hole is a region of ozone layer in the stratosphere where **ozone concentration has reduced** (ozone depletion)."

Scientists discovered it in the region of **Antarctica**. Due to absence of ozone, **harmful ultraviolet radiations** from the Sun **reach Earth**. The higher concentration of ozone in atmosphere is due to the fact that it is depleting in stratosphere.

FORMATION OF OZONE HOLE

Ozone depletion is caused by following three dominant factors:-

a) OXIDES OF NITROGEN:

Oxides of nitrogen destroy ozone to regenerate themselves. They cause **70% of ozone depletion**. Greater the concentration of oxides of nitrogen, greater will be ozone depletion.

$$NO + O_3 \longrightarrow NO_2 + O_2.$$

Q. No. 5 (Page 4/6)

b) NUCLEAR TESTS:

Nuclear tests being conducted throughout the world **generate high temperature.** At this high temperature, **N_2 and O_2** in the atmosphere **combine** to produce oxides of nitrogen which destroys ozone layer in the following way:-

$$NO + O_3 \longrightarrow NO_2 + O_2.$$

c) CHLOROFLOROCARBONS:

The major source of ozone depletion are chlorofluorocarbons **(CFCs)** like **Freon-1 ($CFCl_3$) and Freon-2 (CF_2Cl_2).** The are chemically inert and are used as **aerosals, refrigerants, in fire extinguishers and for cleaning electronic components.** They diffuse into stratosphere where by the action of UV light breakdown into **$Cl^{\bullet}$ (chlorine free radical)** which destroys ozone layer:

$$CF_2Cl_2 \xrightarrow{UV} \dot{C}FCl_2 + \dot{Cl}$$

$$\dot{Cl} + O_3 \longrightarrow \dot{Cl}O + O_2$$

$$\dot{Cl}O + O_3 \longrightarrow \dot{Cl} + 2O_2.$$

Q. No. 5 (Page 5/6)

PROTECTION OF OZONE LAYER

[USE OF HYDROFLUOROCARBONS]:-

Scientists are searching an alternative for CFCs and they have started using **HFCs or hydrofluoroalkanes.** These molecules **donot contain Cl-atom** which can form Chlorine free radical. Also **C-H bonds are reactive** and degenerate before reaching stratosphere, hence donot harm ozone layer.

The relevant question should be answered only in the allotted space and inside the outer mark

Space for Diagram/rough work

Q. No. 5 (Page 6/6)