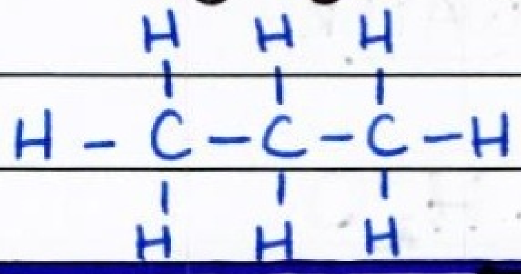
Q. No. 2 Part (i)

Names of Organic Compounds:

a) C_3H_8 → **PROPANE**

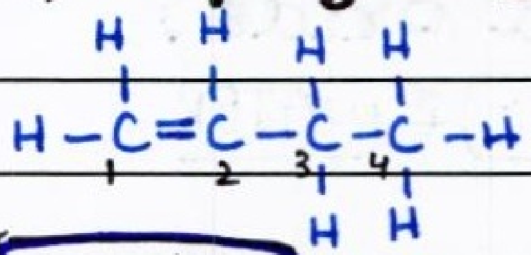
$C_nH_{2n+2} = C_3H_{2(3)+2}$
$= C_3H_8$



- Stem: Prop- (3 carbons)
- Class of Compound: Alkane

b) C_4H_8 → **BUTENE**

$C_nH_{2n} = C_4H_{2(4)}$
$= C_4H_8$

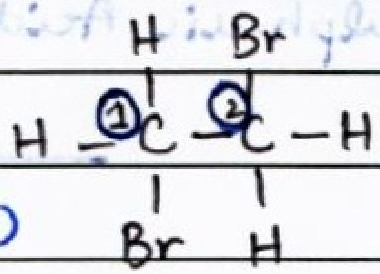


1 - Butene

- Stem: But- (4 carbons)
- Class of Compound: Alkene

c) $C_2H_4Br_2$ → **1,2-Dibrome Ethane**

C_nH_{2n+2}



- Stem: Eth-(2 carbons)
- Class of Compound: Alkane

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Q. No. 2 Part (ii) Raw Materials for Solvay Process:

Following RAW MATERIALS are used in solvay process for the manufacture of sodium carbonate (Na_2CO_3) :

1) Ammonia (NH_3)

2) Concentrated solution of NaCl (BRINE).

3) Calcium carbonate or Lime stone ($CaCO_3$) as source of carbondioxide (CO_2) and slaked lime $Ca(OH)_2$.

Q. No. 2 Part (iii) **Formation of Salts:**

a) Acid-Base Reaction

ACID + BASE ⟶ SALT + WATER

Example:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Hydrochloric Acid — Sodium Hydroxide — Sodium Chloride — water

b) Reaction of acid with metal oxide:

ACID + METAL OXIDE ⟶ SALT + WATER

Example:

$$H_2SO_4 + CaO \longrightarrow CaSO_4 + H_2O$$

Sulphuric Acid — Calcium Oxide — Calcium Sulphate — water

Q. No. 2 Part (iv) **Alkyl Radicals :**

a) **Ethane** (C_2H_6) ⟶ **ETHYL** (C_2H_5-)

- **n-ethyl :** CH_3-CH_2-

b) **Pentane** (C_5H_{12}) ⟶ **PENTYL** ($C_5H_{11}-$)

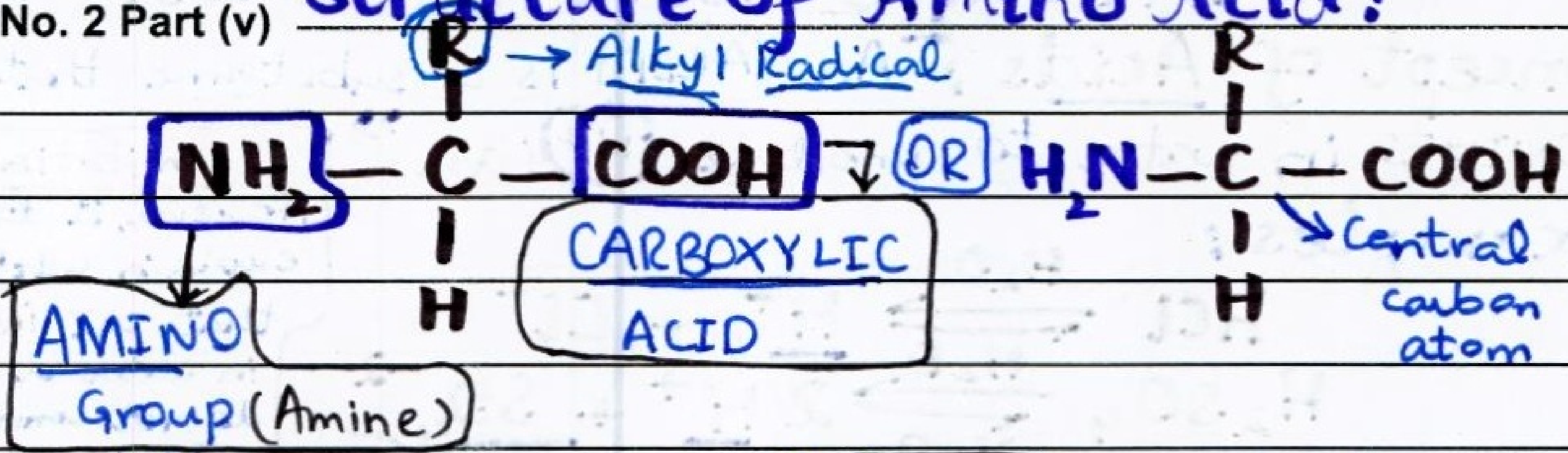
- **n-pentyl :** $CH_3-CH_2-CH_2-CH_2-CH_2-$
- **iso-pentyl :** $CH_3-\underset{|}{CH}-CH_2-CH_2-CH_3$

c) **Butane** (C_4H_{10}) ⟶ **BUTYL** (C_4H_9-)

- **n-butyl :** $CH_3-CH_2-CH_2-CH_2-$
- **iso-butyl :** $CH_3-\underset{|}{CH}-CH_2-CH_3$

Q. No. 2 Part (v)

Structure of Amino Acid:



Functional Groups: ① Amino Group / AMINE (H_2N-)

② Carboxylic Acid ($-COOH$)

Structure:

In structure of AMINO ACID, the aforementioned TWO functional groups are ATTACHED to the (central) carbon atom. An HYDROGEN atom is also attached to carbon along with an alkyl radical (R).

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Q. No. 2 Part (vi) **Roasting:**

DEFINITION: "Some METALS are converted to oxides by heating in the AIR at temperature below their melting point. This process is called ROASTING."

EXAMPLES:

① Roasting Reaction for Cinnabar (HgS):

$$HgS + O_2 \longrightarrow Hg + SO_2$$

Cinnabar Oxygen Mercury Sulphur dioxide

② Roasting Reaction for Copper Pyrite Ore ($CuFeS_2$):

$$2CuFeS_2 + O_2 \longrightarrow Cu_2S + 2FeS + SO_2$$

Copper Pyrite Ore — Cuprous Sulphide — Iron Sulphide — Sulphur Dioxide

⇒ In roasting, addition of OXYGEN (Oxidation) occurs and METAL OXIDES are formed at LOW TEMPERATURE.

Q. No. 2 Part (vii) **Arrhenius Acids and Bases:**

Concept of Acids: "An ACID is a substance that IONIZES in water to produce H^+ ions."

Limitation: However, it does NOT explain ~~substances~~ that are insoluble in water or that do not ~~convert to~~ contain H^+ or OH^- ions.

Examples:

$$HCl \xrightleftharpoons{H_2O} H^+ + Cl^-$$

$$H_2SO_4 \xrightleftharpoons{H_2O} 2H^+ + SO_4^{-2}$$

$$HNO_3 \xrightleftharpoons{H_2O} H^+ + NO_3^-$$

Concept of Bases: "A BASE is a substance that IONIZES in water to produce OH^- ions."

Examples:

$$NaOH \xrightleftharpoons{H_2O} Na^+ + OH^-$$

$$KOH \xrightleftharpoons{H_2O} K^+ + OH^-$$

$$Ca(OH)_2 \xrightleftharpoons{H_2O} Ca^{+2} + 2(OH^-)$$

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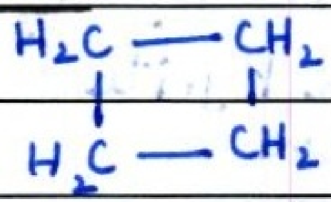
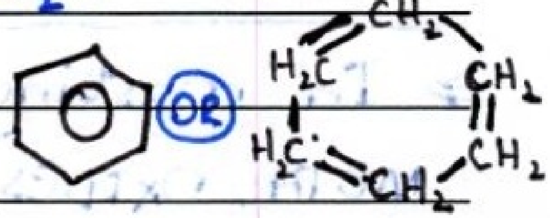
Q. No. 2 Part (viii)

Open Chain		Closed Chain
"Open chain compounds CONTAIN an open-ring of carban atoms."	**Definition**	"Those compounds which contain ANY number of carbon atoms joined with each other in a CHAIN or RING are called closed-chain compounds."
Acyclic compounds	**Other Name**	Cyclic compounds.
① Ethane (C_2H_6) → CH_3-CH_3 ② Butane (C_4H_{10}) → $CH_3-CH_2-CH_2-CH_3$ ③ Iso-Pentane (C_5H_{12}) → $CH_3-CH(CH_3)-CH_2-CH_3$	**Examples**	① Cyclo butane :  ② Benzene :  ③ Furan : 

Q. No. 2 Part (ix)

Preparation of Ethane:

1) By Hydrogenation of Alkenes and Alkynes:

Addition of HYDROGEN is called hydrogenation. Catalyst: Ni or Pt
Temperature: 200-300°C

① $HC \equiv CH + H_2 \xrightarrow[200-300^\circ C]{Ni} H_2C = CH_2$
Ethyne, Hydrogen, Ethene

② $H_2C = CH_2 + H_2 \xrightarrow[200-300^\circ C]{Ni} H_3C - CH_3$
Ethene, Hydrogen, **ETHANE**

} ADDITION Reaction

2) By the Reduction of Alkyl Halides:

Zn reacts with HCl or CH_3COOH (AQUEOUS ACID) to give NASCENT hydrogen. Addition of NASCENT hydrogen (reduction) reduces alkyl halide, forming ALKANE.

$H_3C - CH_2 - Cl + 2[H] \xrightarrow{Zn/HCl(aq)} H_3C - CH_3 + HCl$

Ethyl Chloride (↳ Alkyl Halide), Nascent Hydrogen, **ETHANE**, Hydrochloric Acid

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Q. No. 2 Part (x) **Ozone Layer Formation:** Ozone is the protective layer found in STRATOSPHERE which blocks HARMFUL ultraviolet radiation coming from the Sun.

Natural Balance: Naturally, OZONE formation and its DEPLETION ~~naturally~~, occur at the SAME rate and natural balance is maintained.

Ozone Depletion: $O_3 + O \longrightarrow 2O_2$

Ozone Reformation: $O_2 + O \longrightarrow O_3$

Molecular Oxygen — Atomic Oxygen — Ozone

($3O_2 \xrightarrow[\text{Discharge}]{\text{Electrical}} 2O_3$ Presence of OZONE felt near photocopier)

⇒ However, due to human activities like burning of FOSSIL FUELS, this NATURAL balance is DISTURBED.

⇒ Chlorofluorocarbons (CCl_3F) react with ozone to form CHLORINE FREE RADICALS ($\dot{Cl}$) which cause further thinning of ozone layer (OZONE HOLE).

Q. No. 2 Part (xi) **Global Warming:**

Definition: "The RISE in the natural TEMPERATURE of Earth due to human activities is called GLOBAL WARMING."

CAUSES:

1) Burning fossil fuels in AUTOMOBILES, POWER STATIONS, FACTORIES to provide energy.
2) DEFORESTATION i.e. CUTTING of trees.
3) Exhaust gases /fumes of HEAVY industrial units and MACHINERY.
4) All the above and various other NATURAL processes like forest fires, volcanoes emit LARGE AMOUNTS of GREEN HOUSE gases e.g. methane (CH_4), carbondioxide (CO_2) etc. which TRAP the heat emitted by surface of Earth and cause GREENHOUSE effect

⇒ INCREASING greenhouse effect is causing global warming which has serious consequences.

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Use for rough work

Q. No. 3 (Page 1)

LAW OF MASS ACTION

Discovery: In 1864, two chemists C.M. Guldberg and P. waage proposed Law of Mass Action to describe EQUILIBRIUM state.

Statement: Law of Mass Action states that,
"The rate at which a substance reacts is DIRECTLY PROPORTIONAL to its ACTIVE MASS. The rate at which the reaction proceeds is DIRECTLY PROPORTIONAL to the product of active masses of the reactants."

Active Mass: Active mass describes the CONCENTRATION of reactants and products in $mol\,dm^{-3}$ for a dilute solution and is represented in terms of (SQUARE) brackets [ ].

DERIVATION: Consider a hypothetical equation;-

$$aA + bB \rightleftharpoons cC + dD$$

⇒ According to the Law of Mass Action;

Rate of forward reaction $\propto [A]^a.[B]^B$

Rate of forward reaction (R_f) = $k_f [A]^a.[B]^b$

Also,

Rate of reverse reaction $\propto [C]^c.[D]^d$

Rate of reverse reaction (R_r) = $k_r [C]^c.[D]^d$

At EQUILIBRIUM,

Rate of forward reaction = Rate of reverse reaction

$$k_f [A]^a.[B]^b = k_r [C]^c.[D]^d$$

$$\frac{k_f}{k_r} = \frac{[C]^c.[D]^d}{[A]^a.[B]^b}$$

$\because \frac{k_f}{k_r} = K_c$

(A)

$$K_c = \frac{[C]^c.[D]^d}{[A]^a.[B]^b} = \frac{[Products]}{[Reactants]}$$

Here "K_c" is the equilibrium constant.

EQUILIBRIUM CONSTANT:

Definition: "Equilibrium constant is defined as the ratio of the concentration of PRODUCTS to the ratio of concentration of REACTANTS each raised to the (POWER) equal to the coefficient in its balanced chemical equation".

Dependence:

⇒ Equilibrium constant does NOT depend on the initial concentration of REACTANTS.

⇒ However, it DEPENDS on TEMPERATURE.

EQUILIBRIUM CONSTANT EXPRESSION:

Eq. (A) i.e.

$$K_c = \frac{[C]^c \cdot [D]^d}{[A]^a \cdot [B]^b} = \frac{[Products]}{[Reactants]}$$

is the REQUIRED equilibrium constant expression with C and D as PRODUCTS and A and B as REACTANTS.

Q. No. 4 (Page 1)

Soft Water:

Definition: "The water that gives LATHER with SOAP and does NOT form scum is called soft water."

For Example: DISTILLED water is soft water.

Methods to Remove Permanent Hardness:

Permanent Hardness: Permanent hardness is called so because it CAN NOT be removed by BOILING.

Caused By: Permanent hardness of water is CAUSED by:

1. Chlorides of CALCIUM and MAGNESIUM i.e. $CaCl_2$, $MgCl_2$
2. Sulphates of CACIUM and MAGNESIUM i.e. $CaSO_4$, $MgSO_4$

Methods:

Following TWO methods are used to remove permanent hardness of water;

1) By adding Washing Soda ($Na_2CO_3 . 10H_2O$):

⇒ On the LARGE scale, permanent hardness in water is removed by adding appropriate/estimated amount of WASHING SODA ($Na_2CO_3 . 10H_2O$).

⇒ Ca^{+2} and Mg^{+2} ions causing the HARDNESS are removed as INSOLUBLE carbonates i.e. $CaCO_3$, $MgCO_3$

⇒ Thus, water becomes soft.

General Equation:

$$M^{+2} + CO_3^{-2} \longrightarrow M^{+2}CO_3^{-2}$$

where $M = Ca^{+2}, Mg^{+2}$

Q. No. 4 (Page 2) **Specific Equations:**

① $Ca^{+2} + CO_3^{-2} \longrightarrow Ca^{+2}CO_3^{-2}$

② $Mg^{+2} + CO_3^{-2} \longrightarrow Mg^{+2}CO_3^{-2}$..

2) By Ion Exchange Resins: Permanent hard water is stored in a tank of suitable resin containing SODIUM ions. (ZEOLITE) is used as natural ion exchanger. SODIUM ZEOLITE is usually written as Na_2Z. Chemically, it is sodium aluminium silicate. It reacts with Ca^{+2} or Mg^{+2} ions causing the HARDNESS to form calcium zeolite or magnesium zeolite respectively and SODIUM IONS, thus REMOVING hardness.

Examples/Equations:

① $Ca^{+2} + Na_2Z \longrightarrow 2Na^+ + CaZ$

② $Mg^{+2} + Na_2Z \longrightarrow 2Na^+ + MgZ$

Sodium Zeolite

General Equation:

$$M^{+2} + Na_2Z \longrightarrow 2Na^+ + MZ$$

where $M = Ca^{+2}, Mg^{+2}$

⇒ Sodium zeolite can be (Regenerated) by reacting the formed (zeolites) with concentrated NaCl.

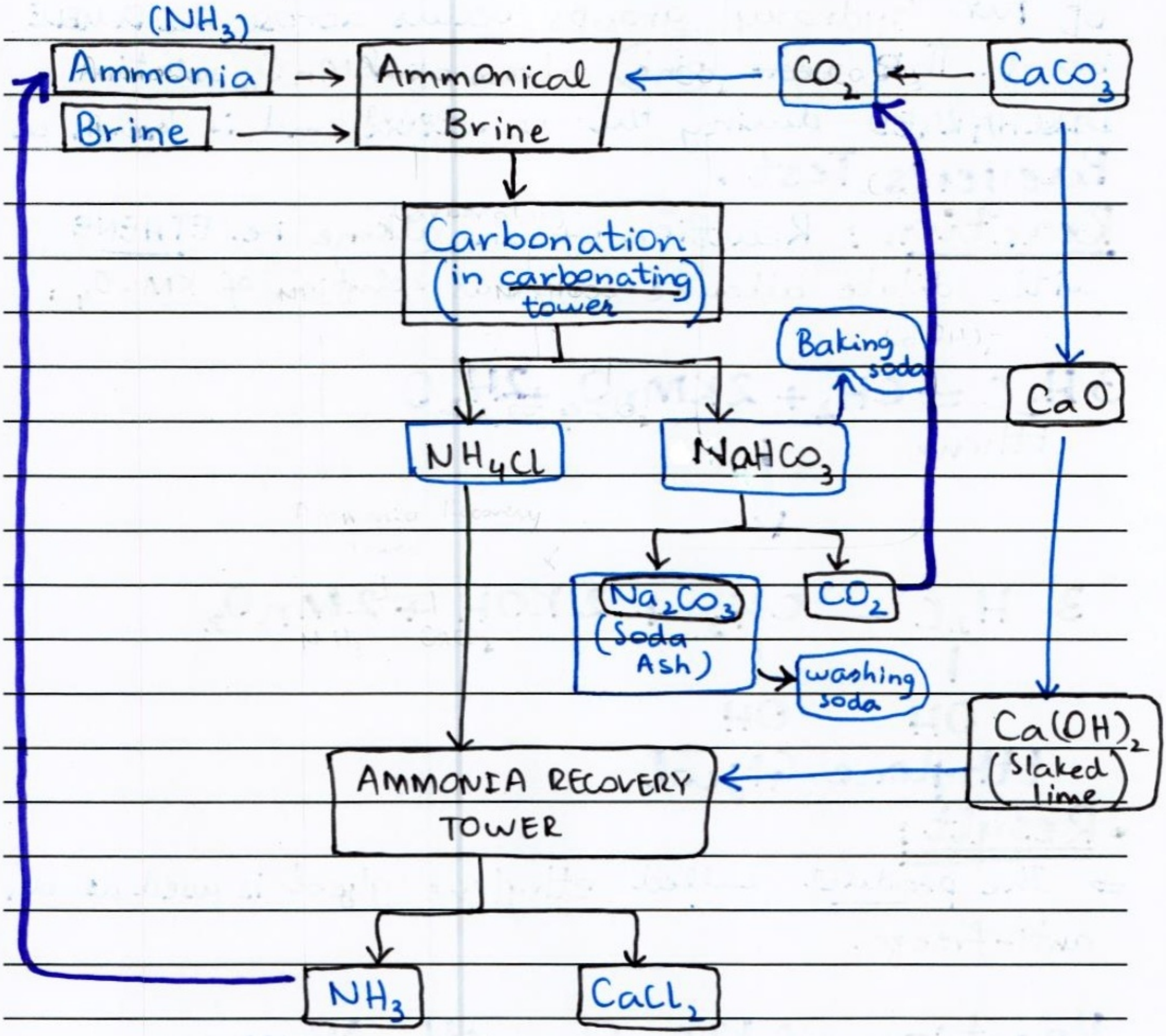
⇒ Thus, making the process (ECONOMICAL).

For Example:

$$CaZ + 2NaCl \longrightarrow Na_2Z + CaCl_2$$

Sodium Zeolite
↓
REGENERATED

Q. No. 5 (Page 1) **Flow Sheet Diagram of SOLVAY PROCESS :**



Q. No. 5 (Page 2)

Reaction of $KMnO_4$ with Alkenes:

Process: When an alkene is treated with dilute alkaline ageous solution of $KMnO_4$ (1%), addition of TWO hydroxyl groups occurs across the DOUBLE bond. The (pink) colour of $KMnO_4$ solution is DISCHARGED during the reaction and is known as **Baeyer's Test.**

Reaction: Reaction of an alkene i.e. ETHENE with dilute alkaline aqueous solution of $KMnO_4$:

$$3\,\underset{\text{Ethene}}{H_2C=CH_2} + 2KMnO_4 + 2H_2O$$

$$\downarrow$$

$$3\,\underset{\text{Ethylene Glycol}}{\underset{OH}{\underset{|}{H_2C}}-\underset{OH}{\underset{|}{CH_2}}} + 2KOH + 2MnO_2$$

• **Result:**

⇒ The product called ethylene glycol is used as an anti-freeze.

Reaction of $KMnO_4$ with Alkynes:

Process: Alkynes do NOT react with dilute alkaline solution of $KMnO_4$. However, they are oxidized by strong solution of $KMnO_4$ to give OXALIC ACID.

Reactions:

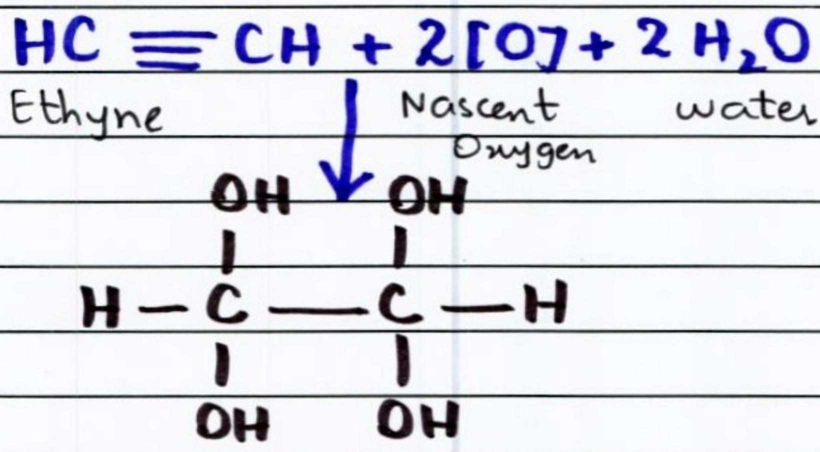
Q. No. 6 (Page 1)

First Step:

$$4KMnO_4 + 4KOH \longrightarrow 4K_2MnO_4 + 4[O] + 2H_2O$$

Second Step:

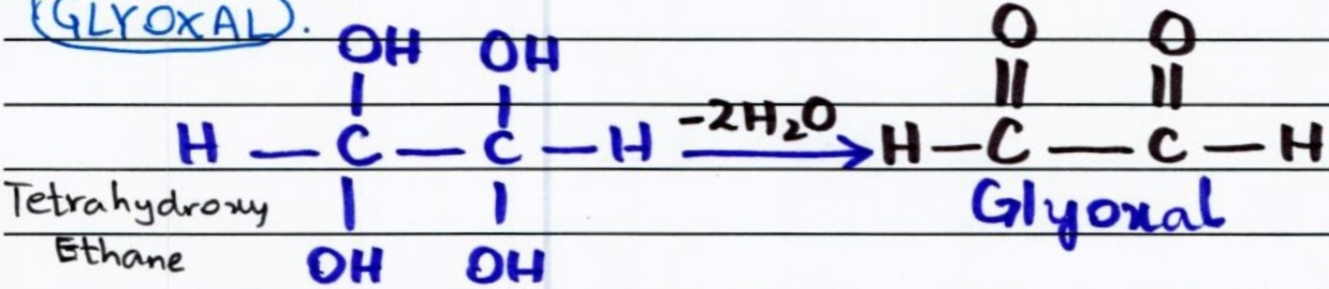
Secondly, four hydroxyl groups are added across the TRIPLE bond, to form tetrahydroxy ethane.



Tetrahydroxy Ethane

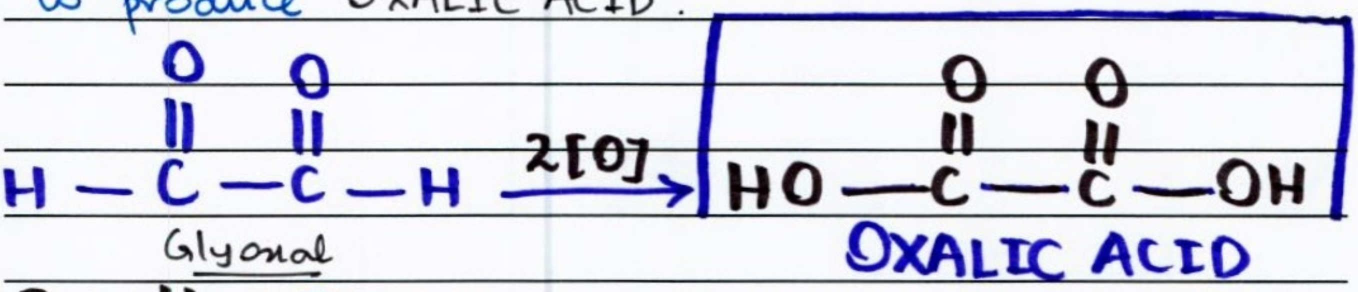
Third Step:

Tetrahydroxy ethane is an UNSTABLE compound. It loses TWO water molecules to form GLYOXAL.



Fourth Step:

Finally, Glyoxal is oxidized to produce OXALIC ACID.



- **Result:** Thus, OXALIC ACID is produced in this way by the REACTION of alkynes with $KMnO_4$.

Q. No. 6 (Page 2)