Q. No. 2 Part (i) **Uses of Organic Compounds:**

The hydrocarbons and their **derivatives** known as organic compounds have following uses:

i. Methone (CH_4) is used as a fuel for burning.

ii. **Ethylene** (Ethene) is used as a starting material for many compounds like polyethylene, acetic acid, and ethylene glycol known as antifreeze.

iii. **Acetylene** (Ethyne) is used as oxy-acetylene for cutting and welding metals. It is also used to make PVC (polyvinyl chloride), polyvinyl acetate, rubber etc.

iv. Ethylene and Acetylene is used for ripening of fruits.

v. **Phenol** is used as antiseptic in hospital operating rooms and methanol is used as **solvent**.

Q. No. 2 Part (ii) **Aquatic Life Survival:**

Water has maximum density at 4°C. Water has an **anomalous behavior** in this regard. Density of most liquids and solids increase upon cooling and **decreases** upon heating. However, water behaves in another way. When water is cooled until 4°C, it contracts and density becomes maximum ($1 g cm^{-3}$). On further cooling, it **expands** and density decreases. Hence, "**ice floats on surface of water**." This makes survival of aquatic life possible. Ice being less dense forms on top of water and insulates the water beneath it. There may be freezing temperature outside but below the top layer of ice, aquatic life can easily survive.

Q. No. 2 Part (iii) **Homologus Series:**

Definition: "A series of related compounds from the same family in which the adjacent molecules differ in $-CH_2-$ group is called homologus series."

Due to this, these molecules have similar behavior only differ by mass 14 a.m.u and hence differ in physical properties. However, they have similar chemical properties and **some general formula.**

Example: Alcohols is a homologus series.

CH_3OH(methanol), CH_3CH_2OH(ethanol), $CH_3CH_2CH_2OH$(propanol)

All the above alcohols differ in $-CH_2-$ group, hence are homologues.

Q. No. 2 Part (iv) **Carbon monoxide:**

Production:

CO is produced due to incomplete combustion of fossil fuels in motor vehicles, factories, power stations etc. Also, produced due to wood burning in **limited supply of oxygen.**

$$2C_{(s)} + O_{2(g)}\ (\text{limited}) \longrightarrow 2CO_{(g)}$$

Effects: CO is colorless, odourless but **poisonous** gas.

(i) When inhaled it causes dizziness and head ache.

(ii) If inhaled for a long time, it may cause death.

(iii) It lessens the oxygen carrying capacity of haemo-globin. $Hb + CO \longrightarrow HbCO$

Q. No. 2 Part (v) **IUPAC Names :**

a. CH_4

Methone

b. $CH_3-CH_2-CH_3$

Propone

c. $CH_3-CH_2-CH_2-CH_3$

Butane

Q. No. 2 Part (vi) **Conditions for Equillibrium:**

Following conditions are necessary:

i. Reactants or Products must be pure.

ii. **System must be closed.** No substance is allowed to enter or leave.

iii. Concentrations of reactants or products should remain constant.

iv. **Temperature** of the system must remain constant.

v. Pressure or Volume should also remain same.

When reactants, products or their mixture is placed in **closed container**, equillibrium establishes and remains established until above conditions are observed.

Q. No. 2 Part (vii) **Reversible Reactions:**

a. $H_2 + I_2 \rightleftharpoons 2HI$

Forward Reaction : $H_2 + I_2 \longrightarrow 2HI$

Reverse Reaction : $2HI \longrightarrow H_2 + I_2$

b. $N_2O_4 \rightleftharpoons 2NO_2$

Forward Reaction : $N_2O_4 \longrightarrow 2NO_2$

Reverse Reaction : $2NO_2 \longrightarrow N_2O_4$

Q. No. 2 Part (viii) **Kc Expression:**

$$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$$

Rate of forward reaction $\propto [NO]^2[O_2]$

Rate of forward reaction $= K_f[NO]^2[O_2]$

Rate of reverse reaction $\propto [NO_2]^2$

Rate of reverse reaction $= K_r[NO_2]^2$

At equillibrium, rates are equal so,

$$K_f[NO]^2[O_2] = K_r[NO_2]^2$$

$$K_c = \frac{K_f}{K_r} = \frac{[NO_2]^2}{[NO]^2[O_2]} \quad \text{--- Kc expression.}$$

Unit: $Kc\ unit = \frac{[mol.dm^{-3}]^2}{[mol.dm^{-3}]^2[mol.dm^{-3}]} = mol^{-1}.dm^3$

Kc Units for this reaction is $mol^{-1}.dm^3$.

Q. No. 2 Part (ix) **Tetrachloroethane:**

Tetrachloroethane is prepared from ethyne by Addition of Halogens (Halogenation Reaction).

Reactants:

1. Ethyne 2. Chlorine

Reactions:

$$HC\equiv CH + Cl_2 \xrightarrow{CCl_4} \underset{\text{(1,2-Dichloroethene)}}{\overset{Cl\ \ Cl}{\underset{Cl\ \ Cl}{HC=CH}}}$$

$$\overset{Cl\ \ Cl}{\underset{Cl\ \ Cl}{HC=CH}} + Cl_2 \xrightarrow{CCl_4} \underset{\text{(1,1,2,2-Tetrachloro ethane)}}{\overset{Cl\ \ Cl}{\underset{Cl\ \ Cl}{HC-CH}}}$$

Net Reaction:

$$HC\equiv CH + 2Cl_2 \xrightarrow{CCl_4} \overset{Cl\ \ Cl}{\underset{Cl\ \ Cl}{HC-CH}}$$

Q. No. 2 Part (x) **Neutralization Reaction:**

Reaction of an acid with a base is called neutralization.

$$H_3PO_4(aq) + NaOH(aq) \longrightarrow Na(H_2PO_4)(aq) + H_2O(l)$$

$$Na(H_2PO_4)(aq) + NaOH(aq) \longrightarrow Na_2(HPO_4)(aq) + H_2O(l)$$

$$Na_2(HPO_4)(aq) + NaOH(aq) \longrightarrow Na_3PO_4(aq) + H_2O(l)$$

Net reaction:

Acid + Base → Salt + Water

$$H_3PO_4(aq) + 3\,NaOH(aq) \longrightarrow Na_3PO_4(aq) + 3H_2O(l)$$

This reaction gave 2 acidic but at last **neutral salt.**

Q. No. 2 Part (xi) **Bessemerization:**

Blister Copper is called so because it contains blister means small holes with entrapped SO_2 gas. It is 97 – 99% pure.

In bessemerization, hot air is passed through molten copper matte ($Cu_2S \cdot FeS$). Any remaining FeS is removed as slag ($FeSiO_3$).

$$2FeS_{(s)} + 3O_{2(g)} \rightarrow 2FeO_{(s)} + 2SO_{2(g)}$$

$$FeO_{(s)} + SiO_{2(s)} \rightarrow FeSiO_{3(s)}$$

Then, cuprous sulphide is first oxidized to cuprous oxide and reacts with remaining cuprous sulphide to form Cu (blister Cu).

$$2Cu_2S_{(l)} + 3O_{2(g)} \rightarrow 2Cu_2O_{(l)} + 2SO_{2(g)}$$

$$2Cu_2O_{(l)} + Cu_2S_{(l)} \rightarrow 6Cu_{(l)} + SO_{2(g)}$$

Use for rough work

Bronsted-Lowry Concept

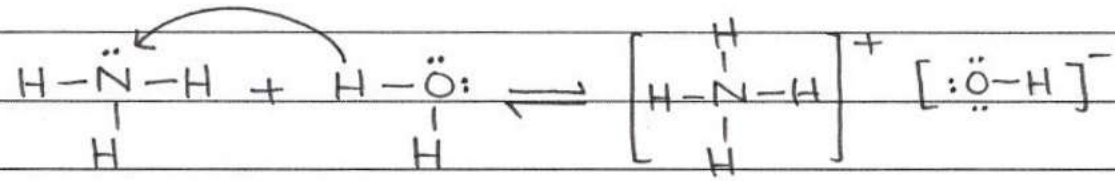
Definitions :

1. **Bronsted Lowry Acid :** Bronsted-Lowry acid is a proton (H^+) donor.
2. **Bronsted Lowry base :** Bronsted Lowry base is a proton (H^+) acceptor.

When bronsted lowry acid donates a proton to bronsted Lowry base, conjugate acid base pair is formed.

1. **Conjugate acid :** A specie formed after accepting proton.
2. **Conjugate base :** A specie formed after donating proton.

Reaction of NH_3 :

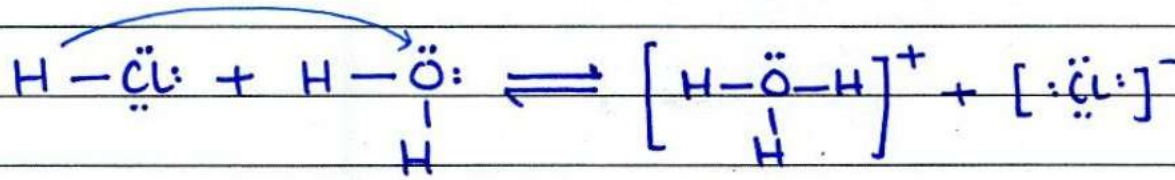


Base | Acid | Conjugate Acid | Conjugate Base.

In this reaction, Ammonia acts as a base and accepts H^+ from water which acts as acid and donates H^+.

Reaction of HCL :

HCl acts as acid and donates H^+ to water molecule which acts as base accepting H^+.



Acid Base Conjugate Acid Conjugate Base.

Behavior of H_2O :

In the reaction of H_2O with NH_3, water behaves as acid while in the reaction with HCl, it behaves as base. Hence **water has amphoteric nature.**

Amphoteric Substances : Those substances that behave as acid with base and as base with acid. Water is amphoteric.

Bronsted Lowry theory was proposed to overcome defects of Arrhenius theory.

Hardness of Water :

1. Definition :

"The water that forms little or no lather with soap and forms scum is called hard water."

2. Causes of hardness :

When rain falls through air, it dissolves CO_2.

$$H_2O_{(l)} + CO_{2(g)} \longrightarrow H_2CO_{3(aq)}$$

It forms carbonic acid. When water falls over rocks and soil, it dissolves certain substances.

$$CaCO_{3(s)} + H_2CO_{3(aq)} \longrightarrow Ca(HCO_3)_{2(aq)}$$

$$MgCO_{3(s)} + H_2CO_{3(aq)} \longrightarrow Mg(HCO_3)_{2(aq)}$$

Moreover, it sometimes dissolves gypsum ($CaSO_4 \cdot 2H_2O$) or anhydride ($CaSO_4$) and Kieserite ($MgSO_4 \cdot H_2O$). These dissolved ions make water hard.

3. Types of hardness :

There are 2 types of hardness :

1. **Temporary hardness :** It can be removed by boiling and is caused due to bicarbonates of **Ca and Mg.**
2. **Permanent hardness :** Can't be removed by boiling and caused due to chlorides and sulphates of **Ca and Mg.**

4. Methods to remove temporary hardness:

Principle : "Conversion of soluble bicarbonates to insoluble carbonates"

(i) By boiling:

The hard water is heated and the bicarbonates breaks down to insoluble carbonates that are then removed by **filtration**.

General Equation:

$$M(HCO_3)_{2(aq)} \xrightarrow{\Delta} MCO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$$

Example:

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

However, this method is expensive as heat is to be provided. An alternative method is used.

(ii) Clark's Method:

In this $Ca(OH)_2$ is added to Hard water that converts bicarbonates to insoluble carbonates.

$$Mg(HCO_3)_{2(aq)} + Ca(OH)_{2(s)} \longrightarrow CaCO_{3(s)} + MgCO_{3(s)} + 2H_2O_{(l)}$$

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

Depletion of Ozone:

1. Ozone: O_3 is an allotropic form of Oxygen which is present in **stratosphere** and protects us by screening harmful UV radiations from Sun.

2. Balance of Ozone:

Under natural phenomena, Ozone breaks and reforms as:

$$O_{3(g)} \xrightarrow{UV} O_{2(g)} + [O]_{(g)}$$

The atomic Oxygen is very reactive and again reacts with O_2 to form O_3.

$$[O]_{(g)} + O_{2(g)} \longrightarrow O_{3(g)}$$

3. Disturbance:

However, certain human activities have disturbed this balance and the ozone has started to deplete.

Ozone hole: The region where O_3 is present in less amount is called ozone hole. **Due to this UV radiations directly reach earth.**
It was first discovered over Antarctica, Oct, 1980.

4. Contribution of CFCs:

Chlorofluorocarbons (CFCs) are a group of chemically unreactive compounds that are used as solvents, in refrigeration, air conditioning units etc.

During manufacture, in use and after disposal, they diffuse into atmosphere.

1. In troposphere, they donot react with any compound.
2. They are easily then diffused into stratosphere.

In stratosphere, they are broken into free radicals by UV.

Example:

$$\underset{\text{(Freon)}}{CCl_3F_{(g)}} \xrightarrow{h\nu} \dot{C}Cl_2F_{(g)} + \dot{C}l_{(g)}$$

This $\dot{C}l$ acts as a catalyst and attacks ozone.

$$\dot{C}l_{(g)} + O_{3(g)} \longrightarrow Cl\dot{O}_{(g)} + O_{2(g)}$$

$$Cl\dot{O}_{(g)} + [O]_{(g)} \longrightarrow \dot{C}l_{(g)} + O_{2(g)}$$

$\dot{C}l$ converts O_3 to molecular oxygen and $Cl\dot{O}$ that further reacts with atomic oxygen and forms O_2.

Net reaction:

$$O_{3(g)} + [O]_{(g)} \xrightarrow{\dot{C}l} 2O_{2(g)}$$

The $\dot{C}l$ acts as catalyst and regenerated at the end, thus a single $\dot{C}l$ can destroy thousands of ozone molecules.

Importance of Water :

Water is an important substance that covers **71%** of total earths crust. It is a vital substance without which life would be impossible :

1. Biological Importance :

Water is used in the living organisms in many ways like :

1. Solvent for many biochemical reactions.
2. Helps in **digestion, moving food along alimentory canal.**
3. Saliva contains water that helps chewing, swallowing.

2. In Industries :

Water has high heat capacity and hence used as **coolent in different areas like :**

1. Water is used as coolent in motor vehicles.
2. Nuclear power plants.
3. Parts of heavy machinery.
4. Steel mills.

3. Agriculture :

Large amount of water is used for irrigation. of plants, crops etc.

4. Transport :

It is an important mean of transportation.

5. Climate Modification:

Water has high Latent heat of vaporization along with high heat capacity and thus moderates daily temperature variations and climate near water bodies.

It is cooler near water bodies in summer and warmer in winter.