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CHEMISTRY

Class 10th (KPK)

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Unit 9

CHEMICAL EQUILIBRIUM

Exercise: Short Questions.

Q1. Define chemical equilibrium with two examples.

Ans: Definition: "The state of a reversible chemical reaction in which the rate of forward reaction becomes equal to the rate of backward reaction in called chemical equilibrium/Dynamic equilibrium". OR The state in which both reactants and products are presents in concentration in which no further tendency to change with time.

Examples

i. Change of a liquid to gas in a closed container:

when liquid water is placed in a closed container at constant temperature, part of liquid evaporates. As water begins to evaporate, at the same time, some of the vapours also begin to condense. Although in the beginning rate of evaporation is faster than the rate of condensation but with the passage of time the rate of evaporation becomes equal to the rate of condensation and thus a state of equilibrium is established

$$\text{Water} \underset{condensation}{\overset{evaporation}{\rightleftarrows}} \text{Vapours}$$

Equilibrium state is also in the following chemical reactions

ii. Reaction of sulphur dioxide with oxygen: $2SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3(g)}$

iii. Reaction of hydrogen with iodine:

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$.

Q2. How would you identify that dynamic equilibrium is established?

Ans: Chemical equilibrium/Dynamic equilibrium:

Definition:

"The state of a reversible chemical reaction in which the rate of forward reaction becomes equal to the rate of backward reaction and the concentrations of reactants and products remain constant is called chemical equilibrium/Dynamic equilibrium".

Explanation:

Consider a general chemical reaction in which reactant. A reacts with reactant B in gaseous state, in a closed container, to form products C and D.

$$A_{(g)} + B_{(g)} \rightleftharpoons C_{(g)} + D_{(g)}$$

The detail about this general reversible reaction is given below:

i. Concentrations at the start:

At the start of the reaction the concentrations of A and B are maximum while that C and D are zero.

ii. Concentrations after some time:

With the passage of time the concentrations of C and D gradually increase while that of A and B gradually decrease.

iii. Variation of rate of forward and backward reactions:

Change in concentrations of reactants or products per unit time is called rate of reaction.

In the beginning, the rate of forward reaction is maximum while rate of backward reaction is almost zero but as the time passes and sufficient amounts of C and D are formed then the rate of backward reaction increases while that of forward reaction decreases until rate of forward reaction becomes equal to the rate of backward reaction. Thus, a state of dynamic equilibrium is established.

iv. Concentration at equilibrium state:

The concentrations of reactants or products remain constant at equilibrium state. These concentrations are called equilibrium concentrations.

Q3. Compare the different macroscopic characteristics of forward and reverse reactions?

Forward reaction	**Reverse reaction**
It is defined as the conversion of reactants into products per unit time or the rate of chemical reaction taking place in forward rection,	It is defined as the conversion of products back into reactants per unit time or the rate of chemical reaction taking place in forward rection,
Characteristics	
i. It is a reaction in which reactants reacts to form product.	i. It is a reaction in which product reacts to form reactants.
ii. It takes place from left to right	ii. It takes place from right to left.
iii. At the beginning, rate of forward reaction is very fast.	iii. At the beginning, rate of reverse reaction is very slow.
iv. It slow down gradually	iv. It speeds up gradually...

Q4: **What information is required to predict the direction of chemical reaction?**

Ans: Prediction of direction of reaction:

The direction of reaction can be predicted by means of [product]/ [reactants] ratio.

$$Q_c = \frac{[initial\ concentration\ of\ products]}{[initial\ concentration\ reactions]}$$

By comparing the ratio with K_c we have three possibilities:

When the ratio is less than kc:

if the ratio is less then K_c. The system is not at equilibrium and more product is required to reach the equilibrium. Therefore, reaction will proceed in forward direction to form products.

When the ratio is greater than kc

If the ratio is greater than K_c The system is not at equilibrium and more reactant are required to reach the equilibrium. Therefore, the reaction will go in the reverse direction to form reactants.

When the ratio is equal to kc

If the ratio is equal to K_c then the reaction is at equilibrium i.e. rate of forward reaction is equal to the rate of reverse reaction.

Q5: Relate the active mass with the rate of chemical reaction?

Ans: Active mass:

Active masses are molar concentration of reacting substances. Molar concentration is the number of moles per dm^3 or litre.

Active mass and the rate of chemical reaction

The rate of a chemical reaction is directly proportional to the product of active masses of the reacting substances.

Which means when we increase the Molar concentration of reacting substances the rate of reaction also increases and vice versa.

Q6: At equilibrium a mixture of N_2, H_2, and NH_3 gas at 500°C is determined to consist of 0.602mol/dm^3 of N_2, 0.420mol/dm^3 of H_2 and 0.113mol/dm^3 of NH_3. What is the equilibrium constant for the reaction for the reaction at this temperature?

$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$

Given: Concentrations of Nitrogen (N_2) = 0.602mol/ dm^3

Concentration of hydrogen (H_2) = 0.420mol/ dm^3

Concentrations of NH_3 = 0.113mol/ dm^3

Required:

Value of K_c =?

Solution:

Writing equilibrium constant expression for the above reaction:

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$= \frac{[0.113mol\ dm^{-3}]^2}{[0.602mol\ dm^{-3}][0.420mol\ dm^{-3}]^3}$$

$$= \frac{[0.012769mol\ dm^{-3}]^2}{[0.602mol\ dm^{-3}][0.074088mol\ dm^{-3}]^3}$$

$$= \frac{[0.012769mol\ dm^{-3}]^2}{[0.602mol\ dm^{-3}][0.074088mol\ dm^{-3}]^3} = \frac{[0.012769mol\ dm^{-3}]^2}{[0.0446mol\ dm^{-3}]^4}$$

$= 0{,}28630[mol/dm^{-3}]^{-2}$

$0.28630mol^{-2}\ dm^6$

Q7: State conditions necessary for the chemical equilibrium.

Ans: Conditions necessary for equilibrium:

Followings are the conditions necessary for chemical equilibrium:

i. Closed container:

Equilibrium state can only be attained in closed container. It cannot be attained in open container because in open container the gaseous reactants and products will escape due to which there will be no possibility of equilibrium.

ii. Constant concentrations:

When equilibrium state is attained by a reaction in a closed container then the concentrations of various species in the reaction become constant. These concentrations are called equilibrium concentrations.

iii. Effect of catalyst on equilibrium:

A catalyst cannot change the equilibrium point, it only speedy up the rate forward and backward reactions. Thus, it helps to attain the equilibrium in short time.

Q8. Write equilibrium constant expression for the following reactions.

a. $N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$

K_c for this reaction is

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

b. $2H_2\,(g) + O_2\,(g) \rightleftharpoons 2H_2O\,(g)$ K_c for this reaction is:

$$\mathbf{K_c} = \frac{[H2O]^2}{H2]^2[O_2]}$$

c. $4NH_3 + 5O_2 \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$

K_c for this reaction is

$K_c = \frac{[NO]^4[H2O]^6}{[NH3]^4[O2]^5}$

Q9. A reaction between gaseous sulphur dioxide and oxygen gas to produce gaseous sulphur trioxide take place at 600^0C. At this temperature, the concentration of SO_2 is found to 1.50mol/dm^3. Using the balanced chemical equation, calculate the equilibrium constant for this system. **Ans: balanced chemical equation:**

$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_3$

Solution:

Concentration of SO_2 =1.50mol/dm^3

Concentration of O_2 =1.250mol/dm^3

Concentration of SO_3 =3.50mol/dm^3

Find K_c =?

Formula = $K_c = \frac{[SO_3]2}{[O_2][SO_2]^2}$

$= \frac{[3.50mol\ dm^{-3}]^2}{[1.250mol\ dm^{-3}][1.50mol\ dm^{-3}]^2}$

$= \frac{12.25[mol\ dm^{-3}]^2}{2.8125[mol\ dm^{-3}]^3}$

4.353[mol/dm^3]$^{-1}$

Q10: Describe the effect of temperature on equilibrium constant?

Ans: Effect of equilibrium constant:

Equilibrium constant is changed if we change the temperature of the system. For example, when the forward reaction is exothermic then increasing the temperature decreases the value of equilibrium constant. When the forward reaction is endothermic then increasing the temperature increases the value of equilibrium constant.

LONG QUESTIONS:

1. **$SO_{3\ (g)}$ decomposes to form SO_2 and $O_{2\ (g)}$. For this reaction write,**

i. Chemical equation

$2SO_3 \rightarrow 2SO_{2\ (g)} + O_{2\ (g)}$

ii. **K_c expression:** $K_c = \frac{[SO_2]2\ [O_2]}{[SO_3]^2}$

iii. **Unit of K_c** $= \frac{[mol\ dm^{-3}]^2\ [mol\ dm^{-3}]}{[mol\ dm^{-3}]^2}$

= mol/dm^3

Q2.a. Describe equilibrium state with the help of graph and an example.

Ans: Equilibrium state:

History:

Chemical equilibrium was first discovered by a French chemist Claude Louis Berthollet in 1803.

Definition:

"The state of a reversible chemical reaction in which the rate of forward reaction becomes equal to the rate of backward reaction in called equilibrium state.

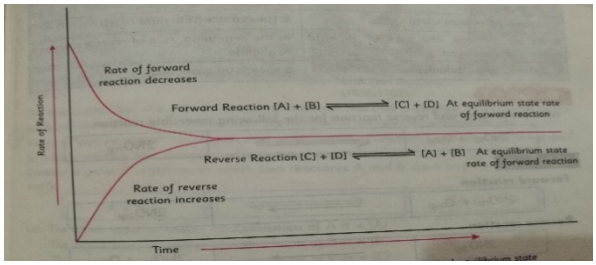
"The state of a reversible chemical reaction at which the reactants are continuously changing to products and the products are continuously changing to the reactants back but the concentrations of reactants and products remain constant is called chemical equilibrium/ equilibrium state.

Explanation:

i. Change of a liquid to gas in a closed container:

Consider a closed container which is partially filled with a liquid at a given temperature. At the start, and the vapour molecules are collected at the liquid surface. At the passage of time the collected gas molecules over the liquid surface converts to liquid back (condensation starts). In the beginning rate of evaporation is faster than the rate of condensation but with the passage of time the rate of evaporation becomes equal to the rate of condensation and thus a state of dynamic equilibrium is established.

v. Graphical representation:



b. Define law of mass action.

Ans: Law of mass action:

History:

This law was presented by two Norwegian chemists Cato Maximilian Guldberg and Peter Waage in 1864.

Definition/Statement:

"This law states that the rate of a chemical reaction is directly proportional to the product of active masses of the reacting substances".

Active masses:

The term active masses mean molar concentration of reacting substances. Molar concentration is the number of moles per dm^3 or litre. The molar concentration of reacting substances is expressed by enclosing their symbols or formulas in square brackets i.e. []

For example:

Consider the following general chemical equation.

$A+B \longrightarrow C+D$

Let, [A] and [B] = molar concentrations of A and B

And [C] and [C] = molar concentrations of C and D

Now according to law of mass action: rate of forward reaction is directly proportional to the concentration of the reactants A and B

$R_f \propto [A]\,[B] \longrightarrow$ R_f = forward

$\Longrightarrow R_f = K_f[A][B]$ ate

Where k_f is the rate constant for the forward rection.

Similarly, for rate of reverse *reaction*,

$R_r \propto [C]\,[D]$ R_r = reverse

$\Longrightarrow R_r = K_r[C]\,[D]$

Where K_r*is* the rate constant for the reverse reaction.

At equilibrium state,

Rate of forward reaction = rate of reverse reaction

Therefore, we can write,

$$R_f = R_r$$

$$K_f[A][B] = K_r[C][D]$$

Thus, it is clear that rate of reaction is proportional to the concentration of the reactants.

Q3. Derive an expression for the equilibrium constant and explain its units.

Ans: equilibrium constant:

The ratio of the mathematical product of the concentration of reacting substances called equilibrium constant". OR

"The ratio of the product of the concentration of the products to the product of the concentration of reactants at equilibrium is called equilibrium constant

Denotation

It is denoted by K_c where the subscript c indicates the equilibrium concentrations of various species in term of mole/om^3 or litre.

Derivation of expression for the equilibrium constant:

Consider the following general reaction

$$A+B \rightleftharpoons C+D$$

Then K_c for this reaction will be

$$\frac{Kf}{Kr} = \frac{[C][D]}{[A][B]} \frac{Kf}{Kr} = Kc$$

$$Kc = \frac{[C][D]}{[A][B]}$$

For more general reaction K_c is written as:

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

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

Where [A], [B],[C] and [D] represents molar concentration of reactants and products while a,b,c and d represent the number of moles from the balanced chemical equation.

Units of equilibrium constant:

The unit of equilibrium constant is independent of pressure, concentration and catalyst depends the equilibrium constant expression.

Q3.b How Can you predict direction of reaction for the K_c value.

Ans: Prediction of direction of reaction:

The direction of reaction can be predicted by means of [product]/ [reactants] ratio.

$$Q_c = \frac{[initial\ concentration\ of\ products]}{[initial\ concentration\ reactions]}$$

By comparing the ratio with K_c we have three possibilities:

When the ratio is less than Kc:

if the ratio is less then K_c. The system is not at equilibrium and more product are required to reach the equilibrium. Therefore, reaction will proceed in forward direction to form products.

When the ratio is greater than Kc

If the ratio is greater than K_c The system is not at equilibrium and more reactant are required to reach the equilibrium. Therefore, the reaction will go in the reverse direction to form reactants.

When the ratio is equal to Kc

If the ratio is equal to K_c then the reaction is at equilibrium i.e. rate of forward reaction is equal to the rate of reverse reaction.

Q4.(a). K_c has different units in different reaction. Prove it with suitable examples.

Ans: Units of equilibrium constant:

The unit of equilibrium constant depends on the equilibrium constant expression. We have two cases regarding the units of equilibrium constant:

Case-1:

It may have no units if the number of moles of reactants and products are equal in the balanced chemical equation.

Example:

$H_2(g) + I_2(g) \rightleftharpoons 2HI\ (g)$

K_c for this reaction is:

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{[mol\ dm^3]^2}{[mol\ dm^{-3}][mol\ dm^{-3}]} = \text{No units}$$

Case-2:

It may have units for the reaction in which the number of moles of product is greater than the reactants in a balanced chemical equation.

Example:

$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$

K_c for this reaction is:

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{[mol\ dm^{-3}]^2}{[mol\ dm^{-3}]}$$

$= mol.dm^{-3}$

Case-3:

It may have units for the reaction in which the number of moles of product is less than the reactants in a balanced chemical equation.

Example:

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3\ (g)}$

K_c for this reaction is:

$$K_c = \frac{[NH_3]^2}{[N_2][N_2]^3} = \frac{[mol\ dm^{-3}]^2}{[mol\ dm^{-3}][mol\ dm^{-3}]^3}$$

$$= \frac{[mol\ dm^{-3}]^2}{[mol\ dm^{-3}]^4} = \frac{1}{[mol\ dm^{-3}]^2} = \frac{1}{[mol^2\ dm^{-6}]}$$

Q4.(b). How can you predict the extent of reaction from the value of K_c value?

Ans: Extent of chemical reaction:

The value of K_c tells us about the extent of reaction from which quantities of reactants or products can also be predicted.

Consider the general reaction:

$aA + bB \rightleftharpoons cC + dD$

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

The extent of reaction depends upon the magnitude of K_c, so when

i. K_c value very small:

When the concentration of [A]and [B] is large and that of [C] and [D] is small, the equilibrium, mixture will contain large number of reactants and small number of products. It reflects that the reaction does not proceed appreciably in the forward direction.

ii. K_c value very large:

When the concentration of [A] and [B] is small and that of [C] and [D] is large, the equilibrium, mixture will contain large number of products and small number of reactants. It indicates that the reaction is completed in the forward direction

iii . K_c value neither very small nor very large (moderate):

If K_c value is neither very small nor very large then neither the forward nor the reverse reaction goes to completion. Thus, equilibrium mixture will contain appreciable amount of product and reactants.

Q5. (a). Kc expression for a reaction is given below,

$$K_c = \frac{[H_2O]^2[Cl2]^2}{[HCl]^4[O_2]}$$

For this reaction write,

i. Reactants and products ii. Derive the units of K_c

Ans: Reactants and products:

Reactants: $HCl_4 + O_2$

Products: $2Cl_2 + 2H_2O$.

ii. The units of K_c

$$K_c = \frac{[H_2O]^2[Cl2]^2}{[HCl]^4[O_2]}$$

$$K_c = \frac{[mol\ dm^{-3}]^2[mol\ dm^{-3}]^2}{[mol\ dm^{-3}]^4\ [mol\ dm^{-3}]}$$

$$K_c = \frac{1}{[mol\ dm^{-3}]}$$

Q5. (b). Explain the importance on the importance of equilibrium constant, support your answer with examples and reasons?

Ans: Importance/applications of equilibrium constant:

The value of equilibrium constant is specific and remains constant at particular temperature. The equilibrium constant can be used to predict:

i. The direction of chemical reaction.

ii. The extent of chemical reaction.

iv. The effect of change in conditions upon a chemical reaction in equilibrium state.

The detail is given below

1. Prediction of direction of reaction:

The direction of reaction can be predicted by means of [product]/ [reactants] ratio.

$$Q_c = \frac{[initial\ concentration\ of\ products]}{[initial\ concentration\ reactions]}$$

By comparing the ratio with K_c we have three possibilities:

When the ratio is less than kc:

if the ratio is less then K_c. The system is not at equilibrium and more product are required to reach the equilibrium. Therefore, reaction will proceed in forward direction to form products.

When the ratio is greater than kc

If the ratio is greater than K_c The system is not at equilibrium and more reactant are required to reach the equilibrium. Therefore, the reaction will go in the reverse direction to form reactants.

When the ratio is equal to kc

If the ratio is equal to K_c then the reaction is at equilibrium i.e. rate of forward reaction is equal to the rate of reverse reaction.

2. Extent of chemical reaction:

The value of K_c tells us about the extent of reaction from which quantities of reactants or products can also be predicted.

Consider the general reaction:

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

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

The extent of reaction depends upon the magnitude of K_c, so when

i. K_c value very small:

When the concentration of [A} and [B] is large and that of [C] and [D] is small, the equilibrium, mixture will contain large number of reactants and small number of products. It reflects that the reaction does not proceed appreciably in the forward direction.

ii. K_c value very large:

When the concentration of [A} and [B] is small and that of [C] and [D] is large, the equilibrium, mixture will contain large number of products and small number of reactants. It indicates that the reaction is completed in the forward direction

iii. K_c value neither very small nor very large (moderate):

If K_c value is neither very small nor very large then neither the forward nor the reverse reaction goes to completion. Thus, equilibrium mixture will contain appreciable amount of product and reactants.

3. The effect of change in external conditions:

Once a system has attained the equilibrium it will remain in the same state indefinitely, if the condition does not change. However, the equilibrium state of a system is disturbed if external conditions are changed i.e. concentration, pressure, temperature. Changing these conditions will disturb the equilibrium. Whenever the equilibrium is disturbed by changes in the external conditions, the system always tends to restore equilibrium.

Topic wise questions

Q1. What are irreversible and reversible reactions?

Ans: Irreversible reactions:

"Those chemical reactions which proceed in forward direction only are called irreversible reactions". Or"Those chemical reactions in which reactants are changed into products only and products are not changed to reactants are called irreversible reactions".

Characteristics of irreversible reactions:

Irreversible reactions have the following characteristics:

i. These reactions proceed in one direction only.

ii. They are represented by a single arrow sign (→)

iii. No equilibrium state is established in irreversible reactions.

iv. These reactions go to completion.

Example:

A few examples of irreversible reactions are given below:

i. Reaction of carbon with oxygen:

$$C_{(S)} + O_{2(g)} \longrightarrow C\,O_{2(g)}$$

Ii.Reaction of magnesium with HCl:

$$Mg_{(g)} + HCl_{(g)} \longrightarrow MgCl_{2(s)} + H_{2(g)}$$

Reversible reactions:

Those chemical reactions which proceed both in forward and backward directions are called reversible reactions".

Characteristics of reversible reactions:

A reversible reaction has the following characteristics:

i. These reactions proceed in two directions i.e. forward and backward.

ii. These reactions never go to completion i.e. the reactants are not fully converted into products.

iii. Their reversibility can exist in closed containers only.

iv. A state of dynamic equilibrium is established in all reversible reactions.

v. These reactions are represented by double arrow sign (⇌).

Examples:

Following are a few examples of reversible reactions:

i. Reaction of nitrogen with hydrogen:

$$N_{2\,(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

At the start reaction goes in forward direction but as soon as soon amount of ammonia is formed, the ammonia molecules dissociate to nitrogen and hydrogen. Thus, the reaction is reversed.

Some other examples are:

ii. Reaction of Sulphur dioxide with oxygen:

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$$

Q2.How can equilibrium constant be recognize:

Ans: in order to recognize the equilibrium constant of chemical reactions, following methods can be used:

I: Physical method: it includes Refractometry, polarimetry, Spectrophotometry **etc.**

ii. Chemical methods: such as titration.

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UNIT 10
ACIDS, BASES AND SALTS
SHORT QUESTIONS:

Q1. When a clear liquid is placed in a beaker. How can you identify whether it as an acid, base or neutral?

Ans: Different methods is used to determine the whether the given solution/ liquid is acidic, basic or neutral.

Litmus paper:

One of them is litmus paper test. In this method litmus paper is dipped in a beaker. If it turns the blue litmus paper to red then the given liquid will be acidic. If it turns red litmus paper then the given liquid will be basic. If the litmus paper remains unchanged it will be neutral liquid.

pH scale:

We can also use pH scale to measure the acidity or basicity of a solution. pH scale is a number from 0 to 14. From 0 to 7 are acids. From 7 to 14 are bases while if a liquid has a pH of 7. It will be neutral

Q2.justify H^+ ion as a Lewis acid?

Ans: H^+ ion as a Lewis acid:

According to Lewis concept a positively charged ions that can accept an e**lectron pair** can act as Lewis acid.

As H^+ is positively charged ion and it has tendency to accept lone pair of electrons so it acts as a Lewis acid.

$H^+ + :NH_3 \longrightarrow NH_4^+$

(Acid) (Base) (Ammonium ion)

Q3. Distinguish strong acids from weak acids? Give two example of each.

Strong acid:

Those acids which ionizes completely in aqueous solutions and give higher concentration of H^+ ions are called strong acids". A strong acid is strong electrolyte.

HCI, H_2SO_4 and HNO_3 are the examples of strong acids because they completely ionize in water.

$HCI_{(aq)} \longrightarrow H^+ + CI^-$

$H_2SO_{4\,(aq)} \longrightarrow H^+ + SO_4^-$

$HNO_{3\,(aq)} \longrightarrow H^+ + NO_3^-$

Weak acids:

"Those acids which do not completely ionize in aqueous solutions and give lower concentration of H^+ ions are called weak acids". A weak acid is weak electrolyte.

Examples:

$CH_3COOH\ (aq) \rightleftharpoons H^+ + CH_3COO^-$

Acetic acid (CH_3COOH) is a weak acid because when it is added into water, very few molecules of CH3COOH are dissociated. Some other weak acids are H_2S, H_2CO_3, H_2SO_3 and HNO_2 etc.

Q4. Compare the physical properties of acid and bases.

Ans:

Acids	Bases
i. Acids have sour taste	i. Base have bitter taste
ii. It turns blue litmus paper to red.	ii. It turns red litmus paper to blue
iii. Acids produce H^+ ions when dissolved in water.	iii. Base produces OH^- \ when dissolved in water.

iv.	Acids solution have P^H values less than 7.	**iv.**	Basics solution have P^H values greater than 7.

Q5 A carbonated drink has $[H^+] = 3.2 \times 10^{-3}$ M, classify the drink as neutral acidic or basic with reason.

Ans: Solution:

Data: hydrogen ion concentration = $[H^+] = 3.2 \times 10^{-}$M

Determination of P^H

$P^H = -\log [H^+]$

Putting the value of $[H^+]$ we get:

$P^H = -\log [3.2x10^{-3}]$

$=P^H=-(\log 3.2+\log 10^{-3})$ ∵ log mn = logm + logn

$=P^H=-[\log 3.2-\log 10^{-]3}$

$=P^H= -(0.5051) –(-3) \log 10$ ∵ $\log m^n = n \log m$

$=P^H = -0.5051 + 3\log 10$

$=P^H= -.0.5051 +3\ (1)$ ∵ log10=1

$=P^H= 0.5051 +3$

$=P^H= 2.49$

As the pH is less than 7 so the carbonated drink is acidic solution.

OR

We can also solve this problem by comparing the given $[H]^+$ of the solution with that of neutral water.

As we know that $[H]^+ = [OH]^- = 1\times10^{-7}$

If $[H]^+ > 1\times10^{-7}$ the solution will be acidic.

If $[OH]^{-} > 1\times10^{-7}$ the solution will be basic.

As in the given solution $[H] += 3.2\times10^{-3}$ M $> 1\times10^{-7}$ the solution is acidic.

Q6. Write the chemical name of an acid present in the following.

Ans: (a). Apple juice: Malic acid

(b).Grape: Tartaric acid

(c). Lemon juice: Citric acid

(d). Sour milk: Lactic acid.

Q7.What determine the strength of a base? Give one example of each solution of strongly acidic and weakly acidic.

Ans: Strong bases:

"Those bases which completely dissociate in aqueous solution and give a higher concentration of OH^- are called strong bases".

Strong bases completely ionize in water and almost no unionized molecule is left behind.

Examples:

Examples of some of the strong bases are given below:

$NaOH_{(aq)} \longrightarrow Na^+ OH^-$

$KOH_{(aq)} \longrightarrow K^+ + OH^-$

$LiOH_{(aq)} \longrightarrow Li + OH^-$

Weak bases:

"Those bases which do not dissociate completely in aqueous solution and give a lower concentration of OH^- are called weak bases".

Examples:

Some bases which do not completely ionize in water are given below:

$NH_4OH_{(aq)} \rightleftharpoons NH_4^+ + OH^-$

$Ba(OH)_{2(aq)} \rightleftharpoons Ba^{+2} + 2OH^-$

$Mg(OH)_{2(aq)} \rightleftharpoons Mg^{+2} + 20H^-$

Q8. Calculate the pH and pOH of O.5 M solution of HCl.

Calculate the P^H and P^{OH} of 0.5M HCL solution.

Given:

Molarity of hydrochloric acid (HCI) solution= 0.05M

Required:

To calculate the P^H and P^H

Solution:

Chemical equation for ionization of hydrochloric acid is:

$HCI \rightarrow H^+ + CI^-$

0.5M 0.05M

Hydrogen ion concentration $[H^+] = 0.5 = \frac{5}{10} = 5x10^{-1}$ M

Determination of P^H

$P^H = -\log [H^+]$

Putting the value of $[H^+]$ we get:

$P^H = -\log [5x10^{-1}]$

$=P^H=-(\log 5+\log 10^{-1})$ ∵ log mn = logm + logn

$=P^H=-\log 5-\log 10^{-1}$

$=P^H= -(.06989) - (-1) \log 10$ ∵ $\log m^n = n \log m$

$=P^H = -0.6989+1\log 10$

$=P^H= -.06989 +1\ (1)$ ∵ log10=1

$=P^H= -.06989 +1$

$=P^H= 0.301$

Determination of P^{OH}:

We know that:

$P^H + P^{OH} = 14$

$P^{OH} = 14 - P^H$

Putting the value of P^H we get:

$P^{OH} = 14-0.3o1$

$\Longrightarrow P^{OH} = 13.$

Result:

$P^H = 0.301$ and $P^{OH} = 13.69$

Q9. Calculate the P^H and P^{OH} of 0.005M H_2SO_4 solution.

Given:

Molarity of H_2SO solution= 0.005M

Required:

To calculate the P^H and P^H

Solution:

Chemical equation for ionization of nitric acid is:

$\mathbf{H_2SO} \rightarrow 2H^+ + \mathbf{SO_4^{-2}}$

0.005M 0.005M

Hydrogen ion concentration $[H^+]$:$0.005 = \frac{5}{1000} = 5x10^{-3}$ M

Determination of P^H

$P^H = -\log [H^+]$

Putting the value of $[H^+]$ we get:

$P^H = -\log [5x10^{-3}]$

$=P^H=-(\log5+\log10^{-3})$ ∵ log mn = logm + logn

$=P^H=-\log5-\log10^{-3}$

$=P^H= -(.06989) – (-3) \log 10$ ∵ $\log m^n = n \log m$

$=P^H = -0.6989+3og10$

$=P^H= -.06989 +3\ (1)$ ∵ log10=1

$=P^H= -.06989 +3$

$=P^H= 2.301$

Determination of P^{OH}:

We know that:

$P^H + P^{OH} = 14$

$P^{OH} = 14 - P^H$

Putting the value of P^H we get:

$P^{OH} = 14- 2.301$

$\Longrightarrow P^{OH} = 11.699$

Result:

$P^H = 2.301$ and $P^{OH} = 11.699$

10. Calculate the P^H of 0.2M NaOH solution?

Given:

Concentration of NaOH solution = 0.2M

Required:

P^{OH} =?

Solution:

Chemical equation for ionization of sodium hydroxide is:

$NaOH \rightarrow Na^+ + OH^-$

0.2M 0.2M

Hydroxide ion concentration $[OH^-]$: $0.2M = \frac{1}{10} = 10^{-1}M$

Determination of P^{OH}

$P^{OH} = -\log [OH^-]$

Putting the value of $[OH^-]$ we got:

$P^{OH} = -\log [2x10^{-1}]$

$P^{OH} =-(\log2+\log10^{-1})$ ∵ log mn = logm + logn

$P^{OH} =-\log5-\log10^{-3}$

$P^{OH} = -(0.301) –(-1) \log 10$ ∵ $\log m^n = n \log m$

$P^{OH} = -0.301+ 1 \log10$

$P^{OH} = -.0.301+1\ (1)$ ∵ log10=1

$P^{OH} = 0.699$

Determination of P^H:

We know that:

$P^H + P^{OH} = 14$

$P^H = 14 – P^{OH}$

Putting the value of P^H we get:

$P^H = 14 - 0.699$

$\Longrightarrow P^H = 13.301$

Result:

$P^H = 13.301$ and $P^{OH} = 0.699$

LONG QUESTIONS:

Q1, (a). What is salt?

Salt:

"The substance obtained due to neutralization reaction of an acid base reaction is called salt".

Composition of salt:

A salt consists of positive ions combined with negative ions. Positive ions come from a base while negative ions come from an acid i.e. In NaCI Na^+ is from NaOH while CI^- is from HCI.

Examples of some salts:

Examples of salts are given below:

ii. Silver bromide (AgBr)

iii. Potassium sulphate (K_2SO_4)

iv. Ferric phosphate ($FePO_4$).

Q1. (b). write down the different types of salts with example?

Ans: Types of salts:

There are three types of salts i.e. neutral salt, acidic salts and basic salts their detail is given below:

i. Neutral salts:

"The salts formed when hydrogen atom of an acid is completely replaced by a metal ion or group of atoms behaving like metal ion are called normal salts".

Neutral salts are formed when a strong acid react with strong base.

Examples:

$NaOH + HCI \rightarrow NaCI + H_2O$

Base Acid Normal Salt

Some other examples of normal salts are given below:

i. Potassium sulphate (K_2SO_4)

ii. Sodium phosphate (Na_3PO_4)

iii. Ammonium sulphate [$(NH_4)_2SO_4$]

iv. Sodium carbonate (Na_2CO_3)

ii. Acidic salts:

"The salts formed when hydrogen atom of a polyprotic acid is partially replaced by a metal ion or group of atoms behaving like metal ion are called acidic salts".

Examples:

$$H_2SO_4 + KOH \rightarrow KHSO_4 + H_2O$$

These acids can further react with bases forming neutral salt

$$KHSO_4 + KOH \rightarrow K_2SO_4 + H_2O$$

Some other examples of acidic salts are given below:

i. Ammonium bi phosphate [NH_4) H2PO4]

ii. Potassium bicarbonate ($KHCO_3$)

ii. Sodium bicarbonate [($NaHCO_3$] etc.

iii. Basic salts:

"The salts formed when hydroxide ions (OH^-) of a base are partially neutralized by an acids are called basic salts".

Basic salts are formed by poly acid bases only e.g.

Examples:

$Pb(OH)_2$, $Mg(OH)_2$, $AI(OH)_3$ etc.

$Pb(OH)_2 + HCI \rightarrow Pb(OH)CI + H_2O$.

Q2. (a). Define the auto-ionization of water. How can you find the pH of Water?

Ans: Auto-ionization of water:

The reaction in which two water molecules produce ions is called as the self-ionization or auto-ionization of water.

Explanation:

In order to understand the concept of self-ionization or auto ionization of water, we take one molecule of water and its dissociation at 25^0C, as

$H_2O_{(l)} \rightarrow H^+_{(aq)} + OH^-_{(aq)}$

Equilibrium constant expression for this reaction is:

$$K_c = \frac{[H^+][OH^-]}{[H_2O]}$$

As concentration of H_2O remains constant and the above equation can be written as:

$Kc\ [H_2O] = [H^+]\ [OH^-]$

$Kw = [H^+]\ [OH^-]$

where $Kw = Kc\ [H_2O]$

Dissociation constant of water (K_w):

K_w is called dissociation constant or ionization constant of water. It is defined as " the product of molar concentration of $H^+(H_3O^+)$ and OH^- ions is called dissociation constant of water". The value of K_w of water at 25^0C is $1.0x10^{-14}$ i.e.

$K_w = [H^+]\ [OH^-] = 1x10^{-14}$ mol/dm^3 of water at 25^0C

As one molecule of water produces one H^+ and oneOH^- ion on dissociation.

Therefore, we can say that,

$[H^+]\ [OH^-] = 1x10^{-14}$

$[H^+] = [OH^-]$

Or $[H^+]\ [H^+] = 1x10^{-14}$

$(H^+)^2 = 1x10^{-14}$

$(H^+)^2 = 1x10^{-14}$

Therefore

$(H^+) = 1x10^{-7}$

And $[OH^-] = 1.0\times 10^{-7}$

In water at 25^0C, $(H^+) = 1x10^{-7}$Mand $[OH^-] = 1.0\times 10^{-7}$M

$K_w = [H^+]\ [OH^-]$

$K_w = 1x10^{-7}M \times 1x10^{-7}M$

$K_w = 1x10^{-14}\ M^2$

pH Definition:

P^H can also be defined as:

"The negative logarithm of molar concentration of H^+ ions is called P^H".

$P^H = -\log [H^+]$

P^H of Water:

According to this scale, pH of water is calculated as,

$pH = -\log [H^+]$

putting values of $[H^+]$,

$pH = -\log[1.0\times 10^{-7}]$

$pH = -(-7.0) \log 10$ $\log 10 = 1$

$pH = 7.0$

Q.2(b). Why some acids are called monoprotic, diprotic and polyprotic acids. Explain your answer with suitable examples.

Ans: Acids can be classified in term of number of protons that can be given by per molecule of an acid when added to water. Acids are classified as,

i. Mono-protic acids

ii. Poly-protic acids

Monoprotic or monobasic acids:

"Those acids which give one proton per molecule are called monoprotic acids or monobasic acids".

Examples:

HCI, HNO_3, CH_3COOH, HBr, HCN etc are some of the examples of monoprotic acids because they give only one portion per molecule.

$HCI_{(aq)} \longrightarrow H^+ + CI^-$

$HNO_{3\,(aq)} \longrightarrow H^+ + NO^-$

$CH_3COOH_{(aq)} \longrightarrow H^+ + CH_3COO^-$

$HBr_{(aq)} \longrightarrow H^+ + Br^-$

$HCN_{(aq)} \longrightarrow H^+ + CN^-$

Polyprotic acids:

"Those acids which give more than one proton per molecule are called polyprotic acids or polybasic acids".

These are further divided into the following subgroups:

i. **Diprotic acids:**

"Those acids which give two protons per molecule are called diprotic acids or dibasic acids".

Examples:

$H_2SO_4H_2CO_3$ etc. are the examples of diprotic acids because they give two protons per molecule.

$H_2SO_{4\,(aq)} \longrightarrow 2H^+ + SO^{-2}$

$H_2CO_{3\,(aq)} \longrightarrow 2H^+ + CO_3^{-2}$

ii. **Triprotic acids:**

"Those acids that give three protons per molecule are called Triprotic acids or tribasic acids".

Example:

Phosphoric acid is an example of triprotic acid as clear from the following chemical equation:

$H_3PO_{4(aq)} \longrightarrow 3H^+ + PO_4^{-2}$

Q3. (a). Discuss the concept of lewis acids and bases with examples.

Ans: The Lewis concept:

Introduction:

G.N Lewis presented his own concept of acids and bases in 1923.

Definitions of acids and bases:

Acids:

According to this concept an acid is a species that can accept an election pair.

Base: Base is a species which can donate electron pair.

An acid is electrophile (electron loving) while a base is a nucleophile (nucleus loving).

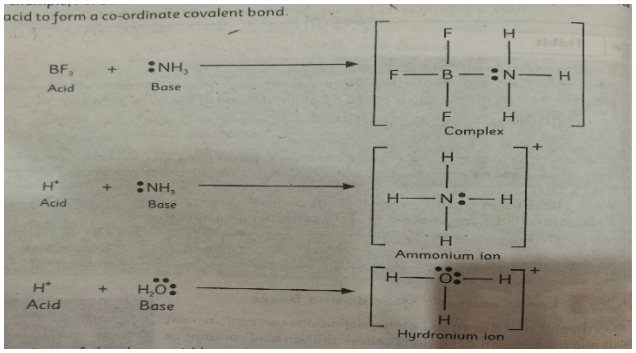
Species which acts as Lewis acids:

Those compound in which central atom has less than eight electrons in valance shell or positively charged ions that can accept an electron pair act as Lewis acids. e.g. BF_3, $AICI_3$,H^+ etc.

Species which acts as Lewis Base:

Those compounds in which central atom has lone pair of electrons in valance shell or negatively charged ions that can donate an electron pair can act as Lewis bases. act as Lewis bases e.g. NH_3, H_2O,CN^-,Cl^-

Example:



Q3. (b) Give the bronsted-lowery definition of acids and bases. Write equation that explain the definition.

Ans: Introduction:

Bronsted and Lowry presented a broader concept about acids and bases in 1923.

Definitions of acids and bases:

According to Bronsted-Lowry concept.

Acids: Acids are defined as the substances which donate or tend to donate protons (H^+ ions).

Bases: Bases are defined as the substances which accept or tend to accept protons.

Examples:

i. When ammonia (NH_3) is added to water, the following reaction occurs:

$$\mathbf{HCl_{(aq)} + NH3_{(aq)} \longrightarrow NH_{4(aq)}^{+} + Cl^-_{(aq)}}$$

(Acid) **(Base)**

In the above example the ammonia accepts a proton from HCI, therefore, it acts as a base while HCI donates a proton and therefore it acts as an acid.

ii. $\mathbf{HCl + H2O \longrightarrow H_3O^+ + Cl^-}$

Acid Base

In this example water act as a **bronsted-lowery** base and HCl act as **bronsted-lowery** acid?

iii. $\mathbf{H_2O_{(l)} + NH_3 \longrightarrow NH_{4(aq)}^{+} + OH}$

In the above example the ammonia accepts a proton from H_2O, therefore, it acts as a base while H_2O donates a proton and therefore it acts as an acid.

Q4. Below are two equations showing how two alkalis react with water.

$\mathbf{NaOH_{(aq)} + H_2O_{(i)} \rightleftharpoons Na^+_{(aq)} + OH^-}$

$\mathbf{NH_{3\,(aq)} + H_2O \rightleftharpoons NH_4^+{}_{(aq)} + OH_{-(aq)}}$

A). name both alkalis.

Ans: NaOH = sodium hydroxide

NH_3 = **a**mmonia

B. which is classified as weak alkali and why?

NaOH is a strong base while NH_3 is weak base.

c. What is the likely pH of each alkali?

PH of NaOH is13 while that of NH_3 is 11.6

Q5. Write the balanced neutralization reaction of,

i. Strong acid and strong base:

$HCl + NaOH \rightarrow NaCl + H_2O$
(Acid) (Base)

ii.Strong acid with weak base:
$HCl + NH_4OH \rightarrow NH_4Cl + H_2O$

iii.weak acid and strong base:
$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

iv.weak acid and weak base:
$CH_3COOH + NH_4OH \rightarrow CH_3COONH4 + H_2O$

Q5.(b). Define pH and pOH.
Ans: Meaning of P in pH and pOH
P stands for potenz (potential to be). Thus, P^H means potential of H^+ ions while pOH means potential of OH^+ ions while it denotes negative log i.e.=-log.
pH Definition:
P^H can also be defined as:
"The negative logarithm of molar concentration of H^+ ions is called P^H".
$P^H = -\log [H^+]$
According to this scale, pH of water is calculated as,
$pH = -\log [H^+]$
putting values of $[H^+]$,
$pH = -\log[1.0\times 10^{-7}]$
$pH = -(-7.0) \log 10$ $\log 10 = 1$
$pH = 7.0$
pH Definition:
pOH can also be defined as:
"The negative logarithm of molar concentration of OH^+ ions is called poH.
$pOH = -\log [OH^+]$
According to this scale, pOH of water is calculated as,
$pOH = -\log [OH^+]$
Putting values of $[OH^+]$,
$pOH = -\log[1.0\times 10^{-7}]$
$pOH = -(-7.0) \log 10$ $\log 10 = 1$
$pOH = 7.0$
Comparison of $_pH$ values:
A solution having P^H value of 7 is neutral, less than 7 is acidic while a solution having P^H value more than 7 is basic.
Q6. (a). According to your understanding which one is the three acid definitions is the broadest? Explain.
Ans: The three basic definitions of acid and bases are as follow;
1. The Arrhenius concept (The classical concept):
Introduction: The first concept about acids was presented by Arrhenius in 1884.
Definitions of acids: According to this concept acids are defined as follows:
Acid:" The compound which gives H^+ ions in water is called acid".

Examples of Arrhenius acids:

HCI, H_2SO_4, HNO_3, HBr, HI, CH_3COOH etc. are some of the examples of Arrhenius acids because when these are added to water, they ionize to give H^+ ions which react with water to form hydronium ions H_3O^+. The chemical equations for the ionization of some acids are as follows:

$HCI_{(aq)} + H_2O_{(I)} \longrightarrow H_3O^+_{(aq)} + CI_{(aq)}$

$HNO_{3(aq)} + H_2O_{(I)} \longrightarrow H_3O^+_{(aq)} + NO_3^-{}_{(aq)}$

Introduction:

Bronsted and Lowry presented a broader concept about acids in 1923.

Definitions of acid:

According to Bronsted-Lowry concept.

Acids: Acids are defined as the substances which donate or tend to donate protons (H^+ ions).

Examples:

i. When ammonia (NH_3) is added to water, the following reaction occurs:

$\mathbf{HCl_{(aq)}} + \mathbf{NH_{3(aq)}} \longrightarrow N\mathit{H}^+_{4(aq)} + \mathbf{Cl^-_{(aq)}}$

Proton donor Proton acceptor

(acid) (base)

In the above example the ammonia accepts a proton from HCI, therefore , It acts as a base while HCI donates a proton and therefore it acts as an acid.

The Lewis concept:

Introduction:

G.N Lewis presented his own concept of acids and bases in 1923.

Definitions:

According to this concept an acid is a species that can accept an election pair.

An acid is electrophile (electron loving)).

Species which acts as Lewis acids:

Those compound in which central atom has less than eight electrons in valance shell and positive ions act as Lewis acids i.e. they accept electron pair e.g. BF_3, $AICI_3$, H^+ etc.

Q6.(b). Write the uses of any three salts.

Ans: Uses of salts:

i. Sodium carbonate (Na_2CO_3):

Sodium carbonate (Na_2CO_3) is called soda ash or washing soda. It is used as cleaning agent in laundries and as water softener. It is also used as raw material in the manufacture of glass. It is also used in paper industry, leather industry and petroleum refining industry.

ii. Sodium bicarbonate ($NaHCO_3$):

It is also called as baking soda because it is used in baking of cakes and other confectionaries. It is also as antacids in medicines and in toothpastes etc.

iii. Copper sulphate ($CuSO_4.5H_2O$)(Blue vitriol):

It is used as electrolyte in copper electroplating process. It is also used to kill algae in water reservoirs and in agric substancriculture spray.

TOPIC WISE QUESTIONS

Q. What are amphoteric substances?

Ans: Amphoteric substances:

"Those substances which can act both as an acids and a base are called amphoteric substances".

Examples:

i. Water is amphoteric because it acts as a base with an acid while it acts as an acid with a base.

$HCI + H\text{-}OH \longrightarrow H_3O^+ + CI^-$

Acid Base conjugate acid conjugate base

$NH_3 + H_2O \longrightarrow NH^+ + OH^-$

Base Acid conjugate acid conjugate base

ii. During self-ionization of water some water molecules acts as an acid while some acts as a base:

$H_2O + H2O \longrightarrow H_3O^+ + OH^-$

Acid Base conjugate acid conjugate base.

Q. What is neutralization reaction?

Ans: Neutralization:

"The reaction of an acid with a base to form salt and water is called neutralization reaction".

Explanation with example:

For example, when HCL reacts with NaOH, NaCI and water and formed.

$HCI + NaOH \rightarrow NaCI + H_2O$

Acid base salt water

In order to understanding the process of neutralization, we need to write the acid, base and salt in their ionic forms.

$H^+ + CI^- + Na^+ + OH^- \rightarrow Na^+ + CI^- + H_2O$

In solution HCI exist as H^+ or H_3O^+ and CI^-, and NaOH exist as Na^+ and OH^-. In neutralization H^+ reacts with OH^- to form water, leaving Na^+ and CI^- ions in the solution which are present on both sides of the equation and they have not reacted. They are called spectator ions.

Thus, the net reaction of neutralization is the reaction of H^+ with OH^- to form water as given below:

$H^+ + OH^- \rightarrow H_2O$

The Na^+ and CI^- ions remain in the solution and can be obtained by evaporation the solution.

Q. Write down different method of preparation of salts?

Preparation of Salts:

Various preparation methods of salts are given below:

i. By neutralization reaction:

One of the most important and common method of preparation of salt is neutralization reaction in which an

acid reacted with a base to form salt and water

$NaOH + HCI \rightarrow NaCI + H_2O$

Base Acid salt water

ii. By the reaction of acid and metal (Direct displacement method:

In this method H^+ of an acid is replaced by the reactive metal to produce respective salt and hydrogen gas. For example, magnesium (Mg), Calcium (Ca), Zinc (Zn) etc

$2HCl_{(aq)} + Mg_{(s)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$

iii. By the reaction of acids with carbonates and bicarbonate

When an acid reacts with carbonate such as sodium carbonate (Na_2CO_3) or bicarbonate such as sodium bicarbonate ($NaHCO_3$) it produces salts e.g.

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$

$NaHCO_3 + HCl \rightarrow NACl + CO_2 + H_2O$

iv. By the reaction of an acid and metallic:

The metallic oxide such as copper oxide (CuO), Calcium oxide (CaO), react with acids to form salt and water.

$H_2SO_{4(aq)} + CaO_{(aq)} \rightarrow CaSO_{4(aq)} + H_2O_{(l)}$

Q.What are double salts?

Ans: Double salts:

Definition:

"The type of salts which consist of two specific salts containing water of crystallization are called double salts".

Preparation:

Double salts are formed by mixing the saturated solutions of two specific salts in a simple mole ratio, followed by crystallization. Double salts crystallize out containing water molecules in them. These water molecules are called water of crystallization.

Examples:

Following are some of the examples of double salts:

Salt name	Chemical formula
Potash alum	K_2SO_4, $AI_2(SO_4)_3$, $24H_2O$
Chrome alum	K_2SO_4, $Cr_2(SO_4)_3$, $24H_2O$
Ferric alum	$(NH_4)_2SO_4$,$Fe_2(SO_4)_3$, $24H_2O$

Q. Describe the uses of salts?

Ans: Uses of salts:

Salts have many different uses, ranging from household to big industries. Some important uses of different salts are given below:

i. Sodium chloride (NaCI):

It is daily used in our food to give it taste. It is used for seasoning and preserving food. In industry it is used as basic raw material for the extraction of sodium preparation of caustic soda (NaOH), washing soda etc. one of the major applications of sodium chloride is de-icing of roadways in sub-freezing weather.

ii. Calcium sulphate ($CaSO_4.2H_2O$):

It is also called gypsum. It is used as fertilizer in the preparation of plaster of Paris, and in cement industry.

iii. Sodium carbonate(Na_2CO_3):

Sodium carbonate (Na_2CO_3) is called soda ash or washing soda. It is used as cleaning agent in laundries and as water softener. It is also used as raw material in the manufacture of glass. It is also used in paper industry, leather industry and petroleum refining industry.

iv. Sodium bicarbonate ($NaHCO_3$):

It is also called as baking soda because it is used in baking of cakes and other confectionaries. It is also as antacids in medicines and in toothpastes.

v. Copper sulphate ($CuSO_4.5H_2O$) (Blue vitriol):

It is used as electrolyte in copper electroplating process. It is also used to kill algae in water reservoirs and in agriculture spray.

vi. Magnesium sulphate ($MgSO_4 7H_2O$) (Epsom Salt):

It is used as antacid and laxative in medicines. It is also used in dye industries.

vii. Potash alum ($K_2SO_4.AI_2 (AO_4)_3$, $24H_2O$):

It is used for water purification to remove suspended impurities. It is also used in textile industry and as blood coagulant in small injuries.

viii. Potassium nitrate (KNO_3):

It is used as a fertilizer and for the manufacture of flint glass.

ix. Calcium Carbonate ($CaCO_3$):

It is used in the preparation of cement and in ceramics industry.

x. Sodium sulphate:

It is used in the manufacture of paper, detergents and glass etc.

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CHEMISTRY

Class 10th (KPK)

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UNIT 11
ORGANIC CHHEMISTRY
SHORT QUESTIONS

Q1. Define functional group? Give example of functional groups containing oxygen.

Ans: Functional group:

A functional group is an atom or group of atoms attached with R that is responsible for the specific properties of an organic compound.

Explanation: A functional group is the active part of an organic compound. Most of the organic compounds consist of two parts i.e.

i. The hydrocarbon part which is an alkyl group/

ii. The functional group part.

For example:

In methanol (CH_3-OH),-CH_3 is the alkyl group (R) while –OH is the functional group part.

Example of functional groups containing oxygen:

Examples:

The functional groups containing oxygen are given in the table below:

Functional group	**Name of the classes**	**Examples**	**Name of compound**
-OH	Alcohols	CH_3-OH	Methyl alcohol
-CHO	Aldehydes	CH_3-CHO	Ethanal
-CO-	Ketones	CH_3-CO-CH_3	Propanone
-COOH	Carboxylic acids	CH_3-COOH	Ethanoic acid
-O-R	Ether	CH_3-O-CH_3	Di methyl ether

Q2. How can we obtain the organic compounds from natural sources?

Ans:

Q3. What are cycloalkanes?

Ans: Cyclic alkanes:

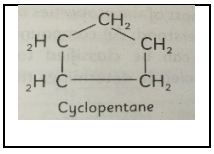
"The type of alkanes in which the carbon atoms are arranged in cyclic form are called cyclic alkanes or cyclo-alkanes**.**

General formula:

Cycloalkanes have two less hydrogen atoms than in corresponding alkanes.

These have the general formula similar to alkenes i.e. C_nH_{n2}

Examples:

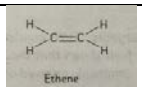
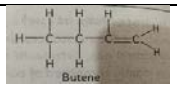
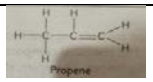


Q4. Write down examples of three unsaturated hydrocarbons with structural and condensed formulae?

Ans: Unsaturated hydrocarbons:

"The hydrocarbons containing at least one carbon-carbon double or triple bond are called unsaturated hydrocarbons".

Examples of unsaturated hydrocarbons:

Examples	Structural formulae	condensed formulae
1. Ethene		$CH_2 = CH_2$
2. Propene		$CH_2 = CHCH_3$
3. Butene		$CH_2 = CHCH_2CH3$

Q5. Define hydrocarbons, and briefly discuss their importance?

Ans: Hydrocarbons:

The compounds of carbon and hydrogen are called hydrocarbons".

Classification of hydrocarbons: Hydrocarbons are classified into two main groups:

Saturated hydrocarbons (alkanes)

Unsaturated hydrocarbons (alkenes and alkyne)

Importance of hydrocarbons:

Hydrocarbons are most important natural resources. They are used as electric and heat energy because they produce a large amount of heat when burned. Hydrocarbons are the main constituents of petroleum and natural gas. The gasoline that serves as fuel for automobiles consists of hydrocarbons. Natural gas mainly consists of methane and ethane and is used for heating and cooking purposes. Beside fuel hydrocarbons are also used as fragrances, detergents, medicines and many other things.

Q6. How alkyl radicals are formed. Discuss with examples.

Ans: Alkyl radical/group:

"A radical or group of atoms obtained by removing one hydrogen atom from an alkane is called alkyl group".

General formula: The general formula of alkyl radical is C_nH_{2n+1}, where n is the number of carbon atoms i.e. 1,2,3,4 etc

General Symbol: Alkyl radical are denoted by a general symbol-R.

Naming an alkyl radical: Alkyl radicals are named by replacing-ane of corresponding alkane by-yl.

Examples:

Number of C-atoms	Name of alkane	formula (C_nH_{2n+2})	Name of Alkyl Radical	formula (C_nH_{2n+1})
1	Methane	CH_4	Methyl	CH_3
2	Ethane	C_2H_5	Ethyl	C_2H_5
3	Propane	C_3H_8	Propyl	C_3H_7
4	Butane	C_4H_{10}	Butyl	C_4H_9

5	Pentane	C_5H_{12}	Pentyl	C_5H_{11}

Q7. List some uses of organic compounds.

Ans: Uses of organic compounds: The things we use in our daily life are mostly organic compounds such as the food we eat, the clothes we wear etc.

Our dependence on organic compounds is increasing day by day. It has changed our life style.

1: **Uses of as food**: The food we eat in our daily life such as milk,meat,egg,vegetables etc. consists of carbohydrates,proteins,vitamins,fats etc. Which are all organic compounds.

2: Uses as clothing: The clothes we wear are made up of fibres.These fibers are either natural such as cotton, silk, wool etc or synthetic fibers such as nylon, polyester and acrylic etc. All these are organic compounds.

3: Uses as medicine: Most of the medicines that we use are organic compounds. These are naturally synthesized from plants and are used as medicines. Most of the lifesaving drugs such as antibiotics, anti-inflammatory, anti-malarial etc. are synthesized in the laboratory.

4: Uses as fuel: The fuels which we use, such as petrol, diesel oil, compressed natural gas (CNG), coal and natural gas are organic compounds.

5: Uses as chemical materials: The chemicals that we use such as rubber, paper, ink, plastic, fibers, fertilizers, pesticides, insecticides, cosmetics, paints, detergents etc. are all organic compounds.

6: Uses as life molecules: Thousands of organic molecules are taking part in our body functions. There are four main groups of organic molecules that are carbohydrates, proteins, lipids and nucleic acid that combine to build cells and their parts. These molecules are called life molecules.

Q8: Give the general formula of the following homologues series?

Ans:

a. Alkanes	C_nH_{2n+2}
b. Alkenes	C_nH_{2n}
c. Alkynes	C_nH_{2n-2}

Q9. Why organic compounds are volatile in nature?

Ans: Organic compounds are volatile due to the following reason.

Reason: Volatile are those substances which easily evaporate and change into gaseous state at relatively low temperature. The volatility of a substance depends upon the strength of intermolecular attractive forces. Weaker the intermolecular attractive force more volatile will be the substance and vice versa.

Since organic compounds have generally weak inter molecular forces due to their nonpolar nature that is why organic compounds are volatile in nature.

Q10. The chemical properties of a homologous series are always the same?

Ana: The chemical properties of a homologous series are always the same due to the following reason:

Reason: The chemical properties of a homologous series depend on the functional group because it is the functional group which takes an active part in a chemical reaction.

As all the members (homologues) of a homologous series have the same functional group that is why chemical properties of a homologous series are always the same.

LONG QUESTONS

Q1.List the different characteristics of organic compounds.

Ans: Characteristic properties of organic compounds:

Organic compounds have the following general properties:

i. Origin: The main source of organic compounds is plants and animals.

ii. Composition: Carbon is an essential component of all organic compounds. However, beside carbon they also contain hydrogen as essential part. They may also contain some other elements like sulphur, nitrogen, oxygen and halogen.

iii. Thermal instability: Many organic compounds are thermally unstable and decompose to simple substances on heating. This property is of great commercial importance e.g. as in the cracking of petroleum.

iv. Low melting points and boiling points: Organic compounds have generally low melting points and boiling points due to weak intermolecular forces. They can be easily broken down and are generally volatile in nature.

v. Bonding: Organic compounds are generally covalent in nature.

vi. Solubility: As most of the organic compounds are non-polar therefore, they are soluble in non-polar solvent like benzene, acetone, and ether and less soluble or insoluble in polar solvents like water.

vii. Electrical conductivity: Most of the covalent compounds are non-polar therefore, poor conductors of electricity in molten or solution form.

viii. In flammability: Most of the organic compounds are inflammable. They burn out to give carbon dioxide, water vapours and energy.

ix. Reactivity: The reactions of organic compounds are much slower than the inorganic compounds.

x. Isomerism: The compounds having same molecular formula but different structures are called isomers and this phenomenon is called isomerism. Isomerism is common in most organic compounds. For example, butane has two isomers n-butane and iso-butane both have the molecular formula C_4H_{10} but they have different structures.

b. Which of these is not an unsaturated molecule?

i. C_6H_6 ii. C_6H_6 iii. C_8H_{18} iv. C_3H_6

c. Define destructive distillation of coal. Name the different types of products obtained by the destructive distillation of coal.

Ans: Destructive distillation:

The heating of a compound in the absence of air is called destructive distillation.

Destructive distillation of coal:

The process in which coal is heated in the absence of air is called destructive distillation of coal.

Products of destructive distillation of coal:

During this process, the coal is converted into coal gas, coke and coal tar and ammmonical liquior, which are the sources of other organic compounds.

Q2. What is catenation?

Ans: Catenation:

The self-linking ability of carbon atoms to covalently bond with other carbon atom to form straight chain, branched chain and rings is called catenation.

b. How does catenation contribution to the diversity of organic compound?

Ans: Catenation contribute to the diversity of organic compound by allowing carbon atoms to bond together in many possible arrangement .Due to catenation variety of molecules with different structures including chains and rings of many shapes and sizes are formed which have different properties.
Examples:

Q3. What information about a compound is provided by structural formula?

Ans: Structural formula:

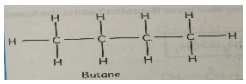
Structural formula of a compound is the arrangement of different atoms of various elements around the carbon atoms present in a molecule of a compound.

Importance:

A structural formula shows number and types of atoms present in a molecule and also shows the bonding arrangement of the atoms.

In structural formula, all the bonds are shown with their exact number. Single bonds are represented by a single line between the bonded atoms.

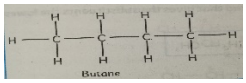
Example: Structural formula of butane C_4H_{10},



b. How are structural formula used in organic chemistry?

Ans: structural formula have particular importance in the study of organic chemistry. They show the arrangement of atoms in the molecules as far as which atoms are bonded to which and whether single, double, or triple bonds are used.

For example, the molecular formula C_4H_{10} does not tell which atoms are bonded to which other atoms but structural formula shows all arrangement. For example:



Q4. (A). what do term saturated and unsaturated mean when applied to hydrocarbons?

Ans: Hydrocarbons:

The compounds of carbon and hydrogen are called hydrocarbons".

Classification of hydrocarbons: Hydrocarbons are classified into two main groups:

i. Saturated hydrocarbons (alkanes)
ii. Unsaturated hydrocarbons (alkenes and alkynes)

i. Saturated hydrocarbons: "The hydrocarbons which contain all carbon-carbon single bonds are called saturated hydrocarbons or alkanes".

General formula: They have the general formula of C_nH_{2n+2}, where n is the number of carbon atoms.

Examples:

Methane (CH_4), Ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}) etc are the examples of saturated hydrocarbons.

ii. Unsaturated hydrocarbons: "The hydrocarbons containing at least one carbon-carbon double or triple bond are called unsaturated hydrocarbons". They are further classified to:

a. Alkenes: "The hydrocarbons which contain at least one carbon-carbon double bond are called alkenes".

General formula: They have the general formula of C_nH_{2n}, where n is the number of carbon atoms.

Example:

Ethene (C_2H_4), propene (C_3H_6), Butene (C_4H_8) and pentene (C_5H_{10}) are the examples of alkanes.

b. Alkyne: The hydrocarbons which contain at least on carbon─carbon triple bonds are called alkynes."

General formula: They have the general formula of C_nH_{2n-2}, where n is the number of carbon atoms.

Examples: Ethyne (C_2H_2), propyne (C_3H_4), butyne (C_4H_6), and pentyne (C_5H_8) etc are the examples of alkynes.

b. What other meanings do these term have in chemistry?

Ans: Saturated:

In chemistry term saturated also refer to chemical solutions. A solution which can't dissolve more solute is called saturated solution.

Unsaturated:

A solution which can dissolve further amount of solute to form a saturated solution is called Unsaturated solution.

c. Classify alkenes, alkanes, alkynes, and aromatic hydrocarbons as either saturated or unsaturated.

Ans: Alkanes: The hydrocarbons which contain all carbon-carbon single bonds are called saturated hydrocarbons. As alkanes contain all C-C singles bonds so alkanes are saturated hydrocarbons.

Unsaturated hydrocarbons: The hydrocarbons containing at least one carbon-carbon double or triple bond are called unsaturated hydrocarbons. Alkenes and alkynes contain double and triple bonds and aromatic hydrocarbons contain alternate single and double bonds. So, alkenes, alkynes and aromatic hydrocarbons are unsaturated.

Q5. Can you explain the term homologous series?

Ans: Homologous series :(Homo = same, logos = properties). "A serried of organic compounds having same chemical properties but each member differs from the adjacent member by methylene group (-CH_2-) is called homologous series while each member of homologous series is called homologue".

Properties of homologous series:

i. They have the same general formula.
ii. They have the same functional group.
iii. They have same chemical properties.
iv. Each member of homologous series differs from adjacent member by –CH_2- group.
v. They have the same general methods of preparations.

Examples:

There are seven homologous series of the organic compounds they are hydrocarbons, alcohols, carboxylic acids, carbonyl compounds (aldehydes and ketones), ethers, amines and alkyl halides.

b. How straight chain hydrocarbons are named.

Naming of alkanes (nomenclature): "The naming of alkanes under certain rules is called nomenclature".

Rules for naming alkanes (straight chain): Simple straight chain alkanes can be named by the following rules:

i. Count the number of carbon atoms in the formula of alkanes.
ii. Give prefixes meth for 1, eth for 2, prop for 3, but for 4 carbon atoms respectively etc.
iii. Add suffix-ane to the corresponding prefix. Thus, the full name of simple straight chain alkane is obtained.

Examples:

Chemical formula (C_nH_{2n+2})	Number of C-atoms	Greek numerals (Prefixes)	Full Name
CH_4	1	Meth-	Methane
C_2H_5	2	Eth-	Ethane
C_3H_8	3	Prop-	Propane
C_4H_{10}	4	But-	Butane
C_5H_{12}	5	Pent-	Pentane
C_3H_{14}	6	Hex-	Hexane
C_7H_{16}	7	Hept-	Heptane
C_8H_{18}	8	Oct-	Octane
C_9H_{20}	9	Non-	Nonage
$C_{10}H_{22}$	10	Dec-	Decane

C. name the straight chain alkane with the molecular formula C_8H_{18}.

Ans: As the number of carbon atom is eight and the prefix Greek numerals oct is used for 8. So, the name of given compound **C_8H_{18}** is octane.

TOPIC WISE QUESTIONS

Q1.What is vital force theory? Why it was rejected?

Ans: Vital force theory:

According to this theory organic compounds cannot be prepared in laboratory. They are only prepared in the bodies of living organisms under the influence of a supernatural force called vital force.

For example:

Urea (from urine), tartaric acid (from grapes), citric acid (from lemon) and sucrose (from cane sugar) are organic compounds.

Rejection of vital force theory:

In 1828, a German chemist Friedrich Wohler prepared an organic compound (urea) in the laboratory by heating ammonium connate and rejected the vital force theory.

Ammonium cynate is obtained by heating solid ammonium chloride with solid potassium cynate.

$NH_4CI_{(s)} + KCNO_{(s)} \rightarrow NH_4CNO_{(s)} + KCI_{(s)}$

$NH_4CNO_{(s)} \rightarrow H_2NCONH_2$ (urea)

Q2. Define organic compounds and organic chemistry?

Ans: Organic compounds:

"The compounds of carbon and hydrogen called hydrocarbons and their derivatives are called organic compounds".

Composition of organic compounds:

All organic compounds contain carbon and hydrogen as an essential ingredient beside these elements they may also contain halogens, sulphur, oxygen, nitrogen.

Derivatives of hydrocarbon:

When hydrogen atom of hydrocarbon is replaced by an atom or group of atoms then the resulting compound will be the derivate of that hydrocarbon.

For example:

If we remove one H from ethane C_2H_6 then ethyl group (C_2H_5) is obtained thus ethyl alcohol(C_2H_5OH), ethyl chloride (C_2H_5CI), ethyl bromide (C_2H_5Br) are the examples of derivatives of ethane.

Organic chemistry:

"The branch of chemistry which deals with the study of hydrocarbons and their derivatives is called organic chemistry". For example in this branch we study about alkanes like methane, alcohols like ethyl alcohol etc.

Q3. Define molecular, structural, condenced and dot and cross formula?

Ans: Molecular formula:

The formula which represents the actual number of atoms in one molecule of organic compound is called the molecular formula.

Example:

The molecular formula of propane is C_3H_8, and butane isC_4H_{10},

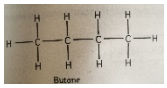
It shows that propane consists of three carbon and eight hydrogen atoms and

Structural formula:

The structural formula a compound is the arrangement of different atoms of various elements around the carbon atoms present in a molecule of a compound.

Example:

Structural formula of butane is.



Condensed formula:

The condensed formula of a molecule is the formula where the groups of atoms are shown in order as they appear in the structural formula with no bonds or dashes.

Example:

Hexane has six carbon and fourteen hydrogen atoms with molecular formula of C_6H_{14}. The condensed formula of hexane is $CH_3(CH_2)_4CH_3$.

Dot and cross formula:

A structural formula in which electrons are shown as dots and cross between various atoms in one molecule of a compound are called dot and cross formula**.**

Example:

In methane molecule, the four electrons of carbon is represented by dots (●) and cross **(×)** is used to represent the electrons of four hydrogen atoms. The molecules of methane and of propane is shown below.

Q4. Explain the classification of organic compound?

Ans: Classification of Organic compound: On the basis of structure of carbon chain, organic compound are classified into the following two groups:

i. Open chain alkanes

ii. Cyclic alkanes

i. Open chain organic compound or aliphatic organic compound: "The type of organic compound which consist of open chain of carbon atoms are called open chain or aliphatic organic compound". Open chain organic compound are further classified into two types which are given below:

a. Straight chain organic compound s: "The type of open chain organic compound which contain straight chain of carbon in their molecules are called straight chain organic compound".

A carbon atom in straight chain organic compound is not directly bonded to more than two carbon atoms. They are commonly named as n-alkanes (normal-alkanes).

Examples:

Some examples of straight chain alkanes are given below:

CH_3-CH_2-CH_2-CH_3 (n-butane)

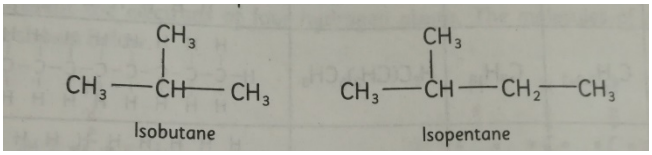
CH_3-CH_2-CH_2-CH_2- CH_3 (n-pentane)

CH_3-CH_2-CH_2-CH_2- CH_2-CH_3 (n-hexane)

b. Branched chain organic compound: "The type of open chain organic compound which do not contain straight chain of carbon in their molecules are called straight chain organic compound".

At least one carbon atom in branched chain alkanes is directly bonded to more than two carbon atoms. They are commonly named as iso-alkanes.

Examples:



ii. Cyclic alkanes: "The type of organic compound in which the carbon atoms are linked together to form a close chain structure

Are called cyclic alkanes or cyclo-alkanes".

These have the general formula similar to alkenes i.e. C_nH_{n2}

The closed chain alkanes are further divided into two groups. These are,

i. Homocyclic or Carbocyclic organic compound

ii. Heterocyclic organic compound

i. Homocyclic or Carbocyclic organic compound:

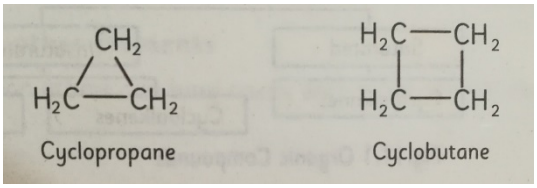
Organic compounds which are in close chain structure are called Homocyclic compounds. The ring is composed of only carbon atoms.
Homocyclicorganiccompound are further divided into two types.

a. Ali-cyclic organic compound
b. Aromatic organic compound

a.Ali-cyclic organic compound:

The cyclic organic compound which is composed of only carbon atom is called Ali-cyclic organic compound.
These organic compounds have properties similar to open chain organic compound but differ in their structure and formulae.

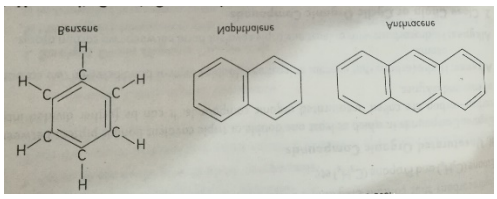
Example:



Aromatic organic compound:

The cyclic organic compound having alternate single and double bonds in its structure are known as aromatic organic compounds.

Examples:



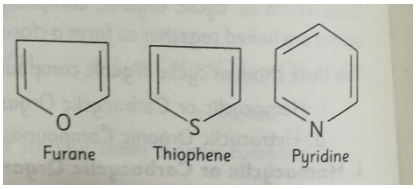
The important member of this class is benzene and the derivatives of benzene i.e. Naphthalene, Anthracene.

ii. Heterocyclic organic compound:

The organic compound which contain one or more atoms other than carbon such as sulphur, oxygen or nitrogen in the ring are called heterocyclic organic compound.

Example:

Examples are furan, thiophene and pyridine.



Q5. What are alkanes? Give examples.

Ans: Alkanes:

"The saturated hydrocarbons containing all carbon carbon single bonds are called alkanes or pyramids.

Reason of calling paraffin's: Paraffin is a Latin word meaning "little affinity". Since alkanes contain C-C and C-H single bonds, therefore they have little affinity towards chemical reactions that is why they are called paraffin's.

Reason of calling saturated hydrocarbons: Since in alkanes each carbon atom is bonded with four other atoms, therefore no further atom can be added to alkanes. Hence, they are called saturated hydrocarbons.

General formula: The general formula of alkanes is C_nH_{2n+2} where n is the number of carbon atoms e.g. if n=1 then the formula will be CH_4 which is called methane. Similarly, if n=2 then the formula will be C_2H_6 called ethane etc.

Example:

S. No.	Name of alkane	Chemical formula (C_nH_{2n+2})
1	Methane	CH_4
2	Ethane	C_2H_6
3	Propane	C_3H_8
4	Butane	C_4H_{10}
5	Pentane	C_5H_{12}

Q7. Describe the sources of organic compound?

Ans: Sources of organic compounds:

Sources of organic compounds may be natural or they may be prepared synthetically.

Natural sources of organic compounds: Coal, petroleum and natural gas are then main sources of large variety of organic compounds. They are called fossil fuels. Similarly, plants are also a source of organic compounds.

Formation of fossil fuels:

Coal, petroleum and natural gas are called fossil fuels because they are formed from the decay of plants and animals buried under ground. After a long period of time the plants and animals buried under ground. After a long period of time the plants and animals were changed to fossil fuels.

The detail of natural sources is given below:

i. Coal: Coal is a brown black solid mass and a major source of organic compounds.

Formation of coal: coal is formed from the remain of plants. Under the chemical and bacterial action on the remain of plants and trees, It is converted into peat. Peat under high temperature and pressure is converted into coal.

Coal as a source of organic compound:

Coal is a rich source of organic compounds. These organic compounds are obtained by the process of destructive distillation.

Destructive distillation of coal:

The process in which coal is heated in the absence of air is called destructive distillation of coal.

Products of destructive distillation of coal:

During this process, the coal is converted into coal gas, coke and coal tar and ammmonical liquior, which are the sources of other organic compounds.

Uses: Coal is a major source of organic compounds. It is used as a solid fuel.

ii.Petroleum:

Petroleum is the combination of two Latin words pet means rock, and oleum means oil.

Petroleum is also an important source of organic compounds. It may be defined as follows:

"A dark brown coloured and unpleasing smelling liquid that consists of mixture of various hydrocarbons, found in sedimentary rock of earth is called petroleum".

It is also called rock oil, crude oil and liquid gold.

Composition of petroleum: Petroleum consists of hydrocarbons majority of which are open and cyclic alkanes and aromatic compounds.

Uses: After refining petroleum is used as a fuel in the form of petrol, diesel, kerosene etc. It is also used for the production of useful products like synthetic rubber, plastics and explosives etc.

iii. Natural gas: It is also a natural source of organic compounds. It may be defined as:

"A flammable gaseous mixture consisting of low molecular hydrocarbons found naturally inside earth is known as natural gas". It is usually found together with petroleum.

Composition: Natural gas consists of low boiling point hydrocarbons. These hydrocarbons are 85% methane and 15% ethane, propane and butane. It may also contain small amounts of hydrogen sulphide (H_2S), nitrogen (N_2) and (CO_2) which are often removed during refining process.

Uses: Natural gas is used as fuel for domestic as well as industrial purposes. It is also used as a fuel in automobiles as compressed natural gas (CNG). It is also used for the preparation of carbon black and also as a basic raw material in the preparation of fertilizers.

iv.Plants: Plants are the main source of organic compounds. These compounds are mainly protein, carbohydrates, vitamins, fats and oils. these compounds are obtained from plants in the form of leaves, stems, fruits, flowers**,** seed sand roots etc. these compounds are called **Natural products.**

v. Animals: Animals are also good source of organic compounds. Most organic compounds such as protein, carbohydrates, vitamins, fats, etc are obtained from animals in form of milk, meat, butter and egg etc

Synthetic sources: Organic compounds are also prepared in laboratory and industries. In earlier times it was thought that organic compounds cannot be prepared in laboratory (Vital force theory) but after the synthesis of urea (H_2NCOH_2) from inorganic compound this theory was rejected and a large number of organic compounds were prepared in the laboratory and industries.

Q8. What is functional group? Explain with examples.

Ans: Functional group:

A functional group is an atom or group of atoms attached with R that is responsible for the specific properties of an organic compound.

Explanation: A functional group is the active part of an organic compound. Most of the organic compounds consist of two parts i.e.

i. The hydrocarbon part which is an alkyl group/

ii. The functional group part.

For example:

In methanol (CH_3-OH),-CH_3 is the alkyl group (R) while –OH) is the functional group part.

Classification of functional groups: Functional groups can be classified into following types:

i. Functional groups containing Carbon, Hydrogen and Oxygen:

Organic compounds containing carbon**,** hydrogen and oxygen as a functional groups are alcohols (-OH) Carbonyl compound which may be aldehydes or ketones (C=O), ethers (-O-) and carboxylic acids (-COOH) and the derivatives such as esters, acid halides and acid amides.

Examples:

Functional group	**General formula**	**Name of the classes**	**Examples**	**Name of compound**
-OH	R-OH	Alcohols	CH_3-OH	Methyl alcohol
-CHO	R/H- CHO	Aldehydes	CH_3-CHO	Ethanal

-CO-	R-CO-R	Ketones	CH_3-CO-CH_3	Propanone
-COOH	R-COOH	Carboxylic acids	CH_3-COOH	Ethanoic acid
-O-R	R-O-R	Ether	CH_3-O-CH_3	Di methyl ether

ii. **Functional groups containing C, H and N:** functional groups containing carbon hydrogen and nitrogen are called amines. Functional group of amines is -NH_2. The general formula is R-NH_2. For examples methyl-amine (CH_3-NH_2)

iii. **Functional groups containing C,H and X:**

Functional groups containing carbon hydrogen and halogens are called alkyl halides. Functional group of alkyl halides is halogens represented by 'X'. The general formula is R-X. X may be F, Cl, Br, or I for examples methyl-chloride (CH_3-Cl)

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Unit 12
HYDROCARBONS

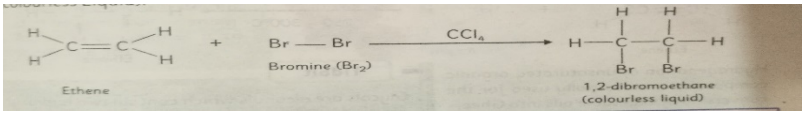
Short Questions:

Q1. How would you test that alkenes undergoes an addition reaction?

Ans: Addition reaction of alkenes: alkenes are unsaturated hydrocarbons and can be converted to saturated hydrocarbon. Addition reaction is **c**haracteristics properties of alkenes. One of the addition re action is addition of halogens (Halogenation).

Halogenation of alkene:

When bromine is added to ethene in the presence of an inert solvent like carbon tetra chloride (CCl_4), the double bond of it is converted into single bond. The red colour of bromine is disappear and produces 1, 2-dibromoethane.



Q2. Which one is more reactive between alkane and alkene? Explain.

Ans: Alkenes are more reactive than the corresponding alkanes due to the following reason:

Reason: Alkenes contain C-C double bonds and double bonds are weaker and can easily be broken. Therefore, alkenes are more reactive. On the other hand alkanes contain all C.C single bonds which are stronger and cannot be easily broken that is why alkenes are more reactive than the corresponding alkanes.

For example, ethane does not react with bromine solution while ethane reacts easily with bromine solution decolourizing its red colour.

Q3. Justify alkenes and alkynes as unsaturated hydrocarbons.

Ans: Unsaturated hydrocarbons:

The hydrocarbons containing at least one carbon-carbon double or triple bond are called unsaturated hydrocarbons. Alkenes contain C=C double and alkynes contains C≡C triple bonds. Therefore, alkenes and alkynes are termed as unsaturated hydrocarbons.

Q4. Why alkane is inert in nature?

Ans: Alkanes are chemically inert in nature due to the following reason:

Reason: Alkanes are chemically inert in nature because they contain carbon-carbon single bonds. The single bonds are very strong and stable and high energy is required to break them; therefore, alkanes are chemically inert as compared to alkynes and alkenes because they contain double or triple bonds which can easily be broken.

Q5. What happened when alkyl halide is reduced?

Ans: Reduction of alkyl halides:

Reduction means addition of hydrogen. Alkyl halides on reaction with nascent hydrogen in the presence of Zinc dust and HCl form the corresponding alkane's i.e. methyl halide will form methane, ethyl halide will form ethane etc.

General reaction of alkyl halide and nascent hydrogen to form alkane is:

$R{-}X + 2[H] \rightarrow R{-}H + HX$

Methyl iodide gives methane and hydrogen iodide HI.

$CH_3{-}I + 2[H] \rightarrow CH_3{-}H + HI$

Similarly, ethyl bromide gives ethane and hydrogen bromide HBr.

$CH_3{-}CH_2{-}Br + 2[H] \rightarrow CH3{-}CH_2{-}H + HBr$

Q6. Can you predict the products if $KMnO_4$ solution reacts with alkene?

Ans: Oxidation of alkanes by $KMnO_4$ (Baeyer's test):

Alkenes react with cold dilute potassium permanganate solution to form glycol. Glycols are the alcohols containing two hydroxyl groups (-OH) on two adjacent carbon atoms.

The reaction of potassium permanganate with ethane is given below:

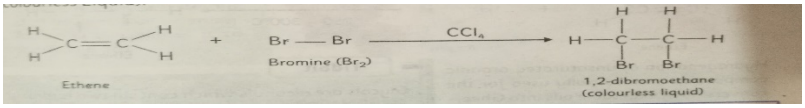
$$3CH_2{=}CH_2 + 2KMnO_4 + 4H_2O \rightarrow 3\underset{\vert\quad\vert}{CH_2\text{-}CH_2} + 2MnO_2 + 2KOH$$

OH OH

(Ethylene glycol).

Q7. Why colour of bromine water discharges on addition to ethene?

Ans: when bromine water having red brown colour is added to ethene in the presence of inert solvent like carbon tetra chloride, its colour is discharged. Because during this reaction bromine water reacts with ethene in carbon tetra chloride to form ethylene bromide which is colourless compound.



Q8. Compare the reactivity of alkane and alkene.

Ans: Alkenes are more reactive than the corresponding alkanes due to the following reason:

Reason: Alkenes contain C-C double bonds and double bonds are weaker and can easily be broken. Therefore, alkenes are more reactive. On the other hand, alkanes contain all C.C single bonds which are stronger and cannot be easily broken that is why alkenes are more reactive than the corresponding alkanes.

For example, ethane does not react with bromine solution while ethane reacts easily with bromine solution decolourizing its red colour.

Q9. Why addition reactions take place in ethane and ethyne but not in ethane?

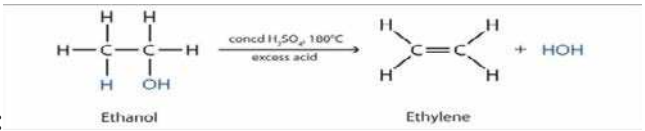
Ans: Addition reactions take place in ethane and ethyne but not in ethane due to the following reason.

Reason: Carbon atom has four electrons in its valance shell and it can directly for bond with maximum of four atoms.

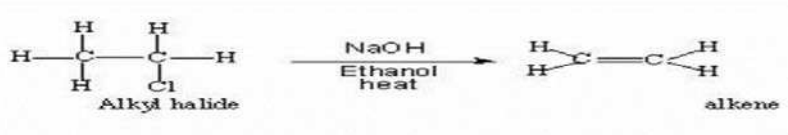
Ethane and ethyne are unsaturated hydrocarbons containing C-C double and triple bonds respectively. Therefore, the two carbon atoms of ethane and ethyne are directly bonded with less than 4 other atoms. Therefore, no further atoms can be added to it i.e. addition reaction does not occur only substitution reaction occur in ethane by the replacement of H-atoms.

Q10. Write equation for the preparation of ethene from ethyl alcohol and ethyl chloride.

Ans: Ethene from ethyl alcohol:



Ethene from ethyl chloride:



LONG QUESTIONS

Q1. (i). write down the equations for the preparation of alkanes, alkenes and alkynes.

Ans: Preparation of alkanes:

1. Hydrogenation of alkenes:

Alkanes can be prepared by the hydrogenation of alkenes**.** During this reaction alkenes are hydrogenated in the presence of Nickel (Ni) catalyst at 250- 300 ^{0}C temperature.

$H_2C{=}CH_2 + H{-}H \rightarrow H_3C{-}CH_3$

Ethene Ethane

2. Hydrogenation of alkynes:

Alkynes are hydrogenated to alkenes in the presence of Nickel (Ni) catalyst at 250- 300 ^{0}C temperature in the first step and in the second step, alkene is further hydrogenated and converted into alkanes.

$HC \equiv CH + H{-}H \rightarrow H_2C{=}CH_2$

$H_2C{=}CH_2 + H{-}H \rightarrow H_3C{-}CH_3$

3. Reduction of alkyl halides: Alkyl halides on reaction with nascent hydrogen in the presence of Zinc dust and HCl form the **corresponding** alkanes i.e. methyl halide will form methane, ethyl halide will form ethane etc.

General reaction of alkyl halide and nascent hydrogen to form alkane is:

$R{-}X + 2[H] \rightarrow R{-}H + HX$

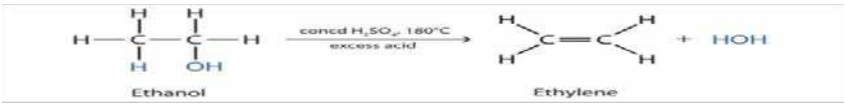
Methyl iodide gives methane and hydrogen iodide HI.

$CH_3{-}I + 2[H] \rightarrow CH_3{-}H + HI$

Preparation of alkenes:

1. Dehydrogenation of alcohols:

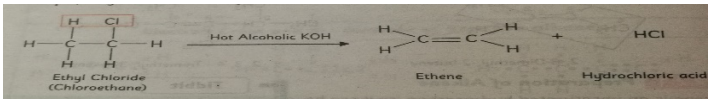
In this reaction water molecule is removed from alcohol and double bond is formed. This reaction is carried out in the presence of concentrated Sulphuric acid at 180^{o}C.



2. Dehydrohalogenation of alkyl halides:

When an alkyl halide is heated with alcoholic solution of potassium hydroxide (KOH) a molecule of hydrogen halide is removed and an alkene is formed. During this reaction hydrogen is removed from one carbon and halogen is removed from the other adjacent carbon atoms.

For example, ethyl chloride on dehydrohalogenation gives ethene and hydrogen chloride (HCl).



Preparation of alkynes:

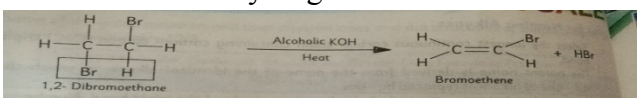
1. Dehalogenation of adjacent Dihalides:

The organic compound in which dihalides are attached to the adjacent carbon atoms are called vicinal dihalides.

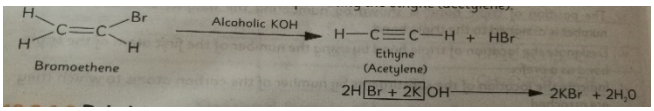
The reaction occurs in two steps.

Step 1.

Vicinal dihalides such as 1, 2-dibromoethanethane is heated with alcoholic potassium hydroxide solution, removal of hydrogen takes place from one carbon and bromine from other. It results in double bond and produces bromoethane and hydrogen bromide.

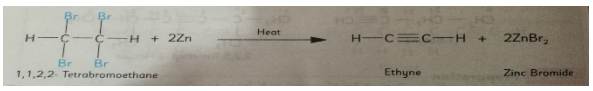


Step 2. In the next step another molecule of hydrogen bromide is removed and the double bond is converted into triple bond.



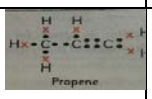
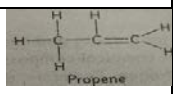
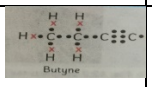
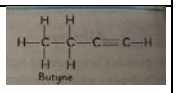
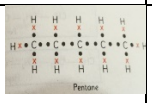
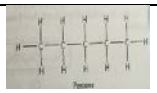
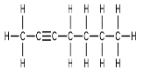
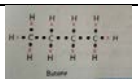
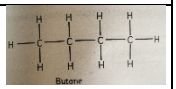
2. Dehalogenation of Tetra halide:

The compound contain four halogens atoms at two adjacent carbon atoms are called tetra halides. When alkyl tetra halides for example 1, 1, 2,2-tetrabromoethane is treated with reactive metal like zinc (Zn) dust. It eliminates two bromine and form triple bond, producing ethyne and zinc bromide ($ZnBr_2$).



Q1.(ii) Draw the molecular, dot, and cross, condensed and structural formula of each of the following.

Propene, Butyne, Pentane, Heptyne, butane.

s.no	Molecular formula	Condensed formula	Dot and cross formula	Structural formula
Propene	C_3H_6	CH_2CHCH_3		
Butyne	C_4H_6	CH_3CH_2CCH		
Pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$		
Heptyne	C_7H_{12}	$CH_3CH_2CH_2CH_2CH_2C{\equiv}CH$		
Butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$		

Q2. (i). the general formula of alkanes is C_nH_{2n+2}. Determine the general formula of cycloalkane?

Ans: **Cycloalnaes**: The alkanes in which carbon atoms are arranged in a ringorcyclic structure is called cycloalkanes. **The general formula of Cycloalnaes:** The general formula of cycloalkanes is C_nH_{2n}. Cycloalkanes have less than two hydrogen atom than in corresponding straight chain alkanes.

(ii). write a balanced equation for the complete combustion of each of the following.

a. **Methane b. Ethane c. Ethyne**

a.Combustion of Alkanes: Alkanes burn completely in the presence of excess of air (oxygen) to produce a lot of heat, carbon dioxide and water. The reaction is highly exothermic and thus alkanes is used as a fuel.

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + heat

Combustion of Alkenes: On complete combustion, alkenes produce carbon dioxide and water with the release of high amount of energy.

C$_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ + heat

C.Combustion of Alkynes: On complete combustion, alkynes produce carbon dioxide and water with the release of high amount of energy,

2C$_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$ + heat.

(iii). Explain briefly that why ethyne (a) undergoes addition rection in two steps?

Answer: In addition reaction of ethyne first triple bond is converted into double bond and then double bond is converted into single bond**.** That is the reason ethyne undergoes addition rection in two step.se

Example: hydrogenation of ethyne:
Step 1.$HC \equiv CH + H{-}H \rightarrow H_2C{=}CH_2$ **Step 2.** $H_2C{=}CH_2 + H{-}H \rightarrow H_3C{-}CH_3$.

Q3. (i). Give an example reaction of that would yield the following products. Name the organic reactants and products in each reaction.

Ans: a). Alkanes:

Hydrogenation of alkenes: alkanes can be prepared by the hydrogenation of alkenes**.** During this reaction alkenes are hydrogenated in the presence of Nickel (Ni) catalyst at 250- 300 ^{0}C temperature.

$H_2C{=}CH_2 + H{-}H \rightarrow H_3C{-}CH_3$
Ethene Ethane
b). Mon halogenated alkanes: Alkanes react with halogens in the presence of UV light and produce alkyl halide and hydrogen halide.

$H_3C{-}H + Cl{-}Cl \rightarrow H_3C{-}Cl + HCl$
Methane methyl chloride **c). Di halogenated alkanes:**

$Cl{-}CH_2{-}H + Cl{-}Cl \rightarrow Cl{-}CH_2{-}Cl + H{-}Cl$
methyl chloride Dichloromethane

d). Tetra halogenated alkanes:

$Cl_3C{-}H + Cl - Cl \rightarrow CCl_4 + H{-}Cl$

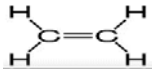
Dichloromethane tetrachloromethane

(ii). (a). Alkanes are unsaturated hydrocarbons. Explain the word unsaturated.

Ans: The word unsaturated means the organic compound having at least one carbon-carbon double or triple bond**.** The unsaturated hydrocarbons having hydrogen less than that of saturated hydrocarbons. Therefore, unsaturated hydrocarbons can easily undergo addition reaction.

(b). Describe the bonding between two carbon atoms in ethene.

Ans: bonding in ethene: Ethene is an unsaturated hydrocarbon containing two carbon atoms that are bonded to each other. With each carbon atom also bonded two hydrogen atoms.



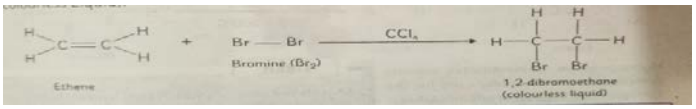
(c). which functional group is present in alkene?

Ans: In alkene C═C double bond functional group is present.

(d). Describe a simple chemical test to determine whether an unknown hydrocarbon is unsaturated. Describe the result if the test is positive.

Ans: The two widely used tests for determining the unsaturation in compound is bromine water test and Baeyer's test.

1. Bromine water test: add a few drops of bromine water to the substance under test and shake. If there are any carbon═ carbon double bonds then the red coloured bromine water will become colourless. The red colour of bromine is disappearing. During this test bromine water reacts with ethene to form ethylene bromide which is colourless compound.



2. Baeyer's test:

This test is used for determining the presence of double bond in compounds. Alkenes is reacted with acidified aqueous solution of potassium permanganate ($KMnO_4$) and form ethylene glycol (1, 2-ethanediol). During this reaction purple colour of $KMnO_4$.

$$3H_2C{=}CH_2 + 2KMnO_4 + 4H_2O \rightarrow 3H_2C{-}\underset{|\quad|}{CH_2} + 2MnO_2 + 2KOH$$
$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad OH\ OH$$

b

Q4. Using structural formula, give balanced equations for the following reactions.

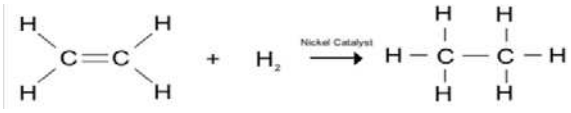
(a). Ethene with Chlorine:

Chlorine readily react with ethene in the presence of inert solvent carbon tetra chloride to form dichloro ethane.

(b). Ethene with hydrogen, name the catalyst used. Which industrial process uses a similar reaction?

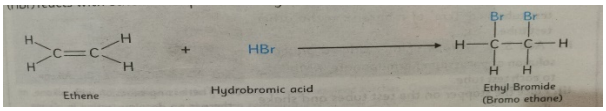
Hydrogenation of ethene:

When hydrogen (H_2) is added to ethene, the double bond is converted into single bond and produces ethane. The reaction occur in the presence of nickel as a catalyst at 250-300^{0}C.



(c). Ethene with hydrogen bromide:

The hydrogen (HBr) react with reacts with ethene and produces Ethyl bromide (Bromoethane).



(d). Ethene with $KMnO_4$:

Alkenes react with acidified aqueous solution of potassium permanganate ($KMnO_4$) to form glycol. Glycol are alcohols which contain two hydroxyl groups (-OH) on two adjacent carbons.

$$3H_2C{=}CH_2 + 2KMnO_4 + 4H_2O \rightarrow 3H_2C(OH){-}CH_2(OH) + 2MnO_2 + 2KOH$$

b

Q5. Illustrate the following accordingly has been instructed.

(A). Alkane from Alkyl Halide

Reduction of alkyl halides: Alkyl halides on reaction with nascent hydrogen in the presence of Zinc dust and HCl form the corresponding alkanes i.e. methyl halide will form methane, ethyl halide will form ethane etc. General reaction of alkyl halide and nascent hydrogen to form alkane is:R─X + 2[H] → R─H + HX Methyl iodide gives methane and hydrogen iodide HI.CH_3─I+ 2[H] → CH_3─H+ HI**(b). Bromoethane from Ethene:** When bromine is added to ethene in the presence of an inert solvent like carbon tetra chloride (CCl_4), the double bond of it is converted into single bond. The red colour of bromine is disappearing and produces 1, 2-dibromoethane.

(c) Ethylene glycol (1, 2-ethanediol) from Ethene:

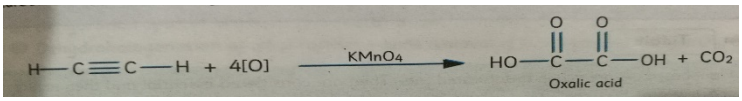
Alkenes react with acidified aqueous solution of potassium permanganate ($KMnO_4$) to form glycol. Glycol are alcohols which contain two hydroxyl groups (-OH) on two adjacent carbons.

$$3H_2C{=}CH_2 + 2KMnO_4 + 4H_2O \rightarrow 3H_2C(OH){-}CH_2(OH) + 2MnO_2 + 2KOH$$

b

(d). Oxalic acid from Acetylene:

The reaction of acetylene with potassium permanganate gives carboxylic acid and carbon dioxide on breaking the molecule of carbon─carbon triple bond.



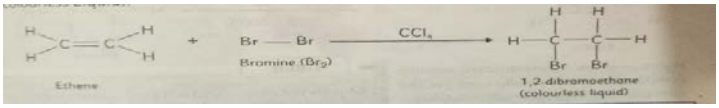
TOPIC WISE QUESTIONS

Q2. What are addition reaction?

Ans: Addition reaction: The reaction in which two or more substances react to form only one substance are called addition reaction.

With regard to organic compounds addition reactions can be defined as:

"the reaction in which molecules like H_2, Cl_2,HCl etc. are added to alkene and alkynesis called addition reaction. Addition reaction occur only in unsaturated hydrocarbons. During addition reaction unsaturated hydrocarbons are changed to saturated hydrocarbons



Q3. Write down the physical properties of Alkanes;

Ans: Physical properties:

i. Physical state: The first four members (methane, ethane, propane, butane) of alkane series are gases. Next thirteen members (from C_5H_{12} to $C_{17}H_{36}$) are colourless liquids and higher members of the series are solids.

ii. Solubility: Since alkanes are non-polar therefore, they are soluble in non-polar solvents like benzene, acetone, ether etc. However they are insoluble on polar solvents like water.

iii. Meting points and boiling points: The melting points and boiling points of alkanes increases with the increase in molecular masses because generally higher molecular masses alkanes have stronger intermolecular forces.

iv. Density: the density of alkanes increases regularly with increase in molecular mass.

V. viscous: Alkanes become more viscous as their molecular sizes increase.

vi. Flammable: Alkanes are flammable. With the increase of atomic mass the percentage of carbon in alkanes molecules also increases. As a result, alkanes become less flammable.

Q4. Give important chemical reactions of alkanes.

Ans: Chemical properties: As carbon atoms of alkanes are directly bonded with 4 other atoms therefore, only **Substitution** reaction reactions can occur in alkanes. Alkanes are chemically inert at room temperature due to all C-C and C-H single bonds presents in them. However at higher temperature, absorption of light etc the following reactions take place in them.

i. Halogenation: The substitution of hydrogen of an alkane by halogen is called halogenations.

Example: For example chlorine reacts with methane in the presence of diffused sunlight to form chloro-methane (methyl chloride).

$H_3C-H + Cl-Cl \rightarrow H_3C-Cl + HCl$

Methane methyl chloride

This reaction does not stop here. The remaining three hydrogen atoms are also replaced by chlorine atoms to form di, tri and tetra chloro-methane respectively

$Cl-CH_2-H + Cl-Cl \rightarrow Cl-CH_2-Cl + H-Cl$

methyl chloride Dichloromethane

$Cl-CH_2-Cl + Cl-Cl \rightarrow Cl_3CH + HCl$

Dichloromethane Chloroform (tri-Chloromethane)

$Cl_3CH + Cl-Cl \rightarrow CCl4$

Chloroform Carbon tetrachloride

ii. Combustion: Alkanes react with oxygen or air at higher temperature to form carbon dioxide, water vapours with evolution of large amount of heat.

Examples:

$$CH_{41g}+O_{21g} \rightarrow CO_{21g}+H_2Og+Heat$$

$$2C_2H +70_{21g}\ 4CO_{21g}+6HO_g+ Heat$$

In limited supply of oxygen, incomplete combustion of alkanes takes place and produce carbon monoxide, water and carbon.

$$3CH_{41g}+ 4O_{21g} \rightarrow 2CO+ 6H_2O + C$$

Q5. What is alkene? How it can be named?

Ans: Alkenes:

The unsaturated hydrocarbons containing at least one C-C double bond are called alkenes".

General Formula: They have the general formula of C_nH_{2n}

In alkenes all the carbon atoms are not bonded with 4 other atoms i.e. at least two carbon atoms are bonded with 3 other atoms. Addition reaction occur in alkenes.

Examples:

i. Methene (C_2H_4)4

ii. Propene (C_3H_6)

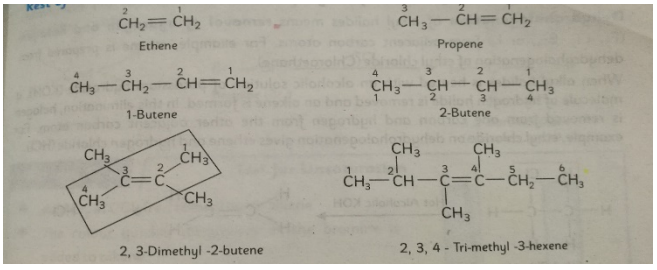
iii. Butene (C_4H_8)

iv. Pentene C_5H_{10}

Rules for naming alkenes:

The IUPAC rules for alkenes are as follow.

1. Select the longest continuous chain containing double bond (C═C) as the parent chain.
2. The parent name is derived from the named of the identical alkanes, in which the last –ane of alkanes is replaced –ene.
3. Number the chain so as to include both carbon atoms of the double bond. Numbering begins from the end which is nearer to the double bond.
4. The position of double is shown by numbering the alkene, so that minimum number is assigned to the double bond
5. Designate the location of the double bond by using the number of the first atom of the double bond as a prefix.
6. Indicate the location of the branches by numbers of the carbon atoms to which they are attached.



Q6. Write down physical and chemical properties of Alkenes.

Ans: Physical properties of alkenes:

i. Physical state: The first three members of alkene (ethene, propene, butene) are gases. Other members are liquids and higher are solids

ii. Solubility: alkenes are non-polar therefore, they are soluble in non-polar solvents like benzene, acetone, ether etc. However they are insoluble on polar solvents like water.

iii. Meting points and boiling points: The melting points and boiling points of alkenes increases with the increase in molecular masses because generally higher molecular masses alkenes have stronger intermolecular forces.

Chemical properties Alkenes:

Because of the unsaturated nature of alkenes, they easily undergoes addition reaction and in this way, they are converted into saturated compounds.

Important reaction of alkenes: Important reaction of alkenes include halogenation, addition of hydrogen halides, oxidation by $KMnO_4$, and hydrogenation. Theses reaction has already been discuss in exercise.

Q7. Define alkynes. Give the rules for naming of alkynes.

Ans: Alkynes:"

The hydrocarbons which contain at least on carbon─carbon which contain at least on carbon- carbon triple bonds are called alkynes."

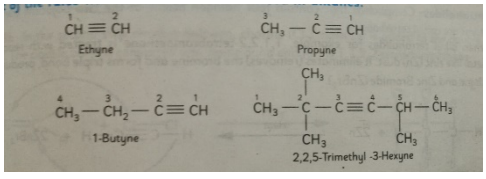
General formula: They have the general formula of C_nH_{2n-2}, where n is the number of carbon atoms.

Examples: Ethyne (C_2H_2), propyne (C_3H_4), butyne (C_4H_6), and pentyne (C_5H_8) etc are the examples of alkynes.

Rules for naming alkenes:

The IUPAC rules for alkenes are as follow.

1. Select the longest continuous chain containing carbon- carbon triple bond (C ≡ C) as the parent chain.
2. The parent name is derived from the named of the identical alkanes, in which the last –ane of alkanes is replaced –yne.
3. Number the chain so as to include both carbon atoms of the triple bond. Numbering begins from the end which is nearer to the triple bond.
4. The position of triple bond is shown by numbering the alkyne, so that minimum number is assigned to the triple bond
5. Designate the location of the double bond by using the number of the first atom of the triple bond as a prefix.
6. Indicate the location of the branches by numbers of the carbon atoms to which they are attached.



Q8. Write down physical and chemical properties of Alkynes.

Ans: Physical properties of alkynes:

i. Physical state: The first three members of alkyne (ethyne, propyne, butyne) are gases. Other members are liquids and higher are solids

ii. Solubility: alkynes are non-polar therefore, they are soluble in non-polar solvents like benzene, acetone, ether etc. However they are insoluble on polar solvents like water.

iii. Meting points and boiling points: The melting points and boiling points and density of alkynes increases with the increase in molecular masses because generally higher molecular masses alkenes have stronger intermolecular forces.

iv.Combustion: on complete combustion, they produce carbon dioxide and water with the release of high amount of energy,.

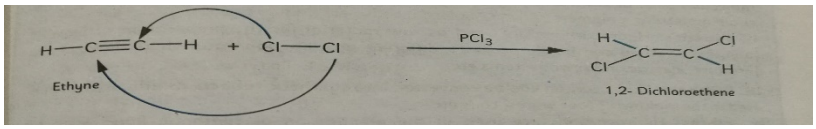
Chemical properties Alkynes:

Because of the unsaturated nature of alkynes, they easily undergoes addition reaction and in this way, they are converted into saturated compounds.

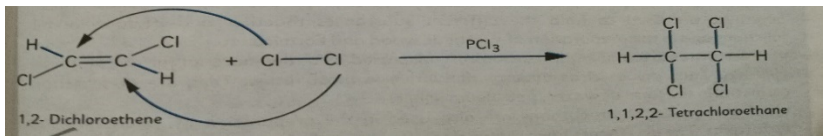
Important reaction of alkenes:

1. Halogenation: Alkynes react with halogens such as chlorine and bromine in the presence catalyst phosphorus trichloride (PCl_3). The addition of halogens take place in two steps.

Step 1. In the first step a halogen molecule, i.e. chlorine (Cl_2) or bromine (Br_2) is added to triple bond. Triple bond is converted into double bond and forms 1, 2-dichloroethene.

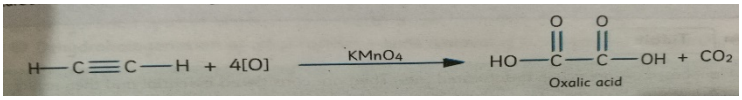


Step 2. In the second step another halogen molecule, i.e. chlorine (Cl_2) or bromine (Br_2) is added to double bond. thw double bond is converted into single bond and forms 1,1,2,2-tetra chloro ethene.



2. Oxidation with $KMnO_4$:

The oxidation of ethyne with potassium permanganate givs carboxylic acid and carbon dioxide on breaking the molecule at carbon – carbon triple bond.



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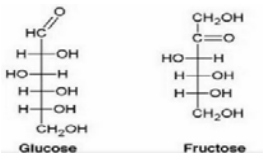
UNIT 13
BIOCHEMISTRY

Q1. Differentiate between glucose and fructose?

Ans: Difference between glucose and fructose:

Glucose and fructose are hexoses having same molecular formula $C_6H_{12}O_6$. The main difference between these two compounds is that glucose is pentahydroxy aldehyde having aldehydic functional group, while fructose is pentahydroxy ketone having ketonic functional group.



Q2. Write down four uses of lipidsAns: i. Source of energy:

Lipids are good source of energy. One gram of lipids contains approximately twice more energy than a gram of carbohydrates and protein.

Ii. As **a part of protoplasm:**

lipids are an important part of cell-protoplasm and plasma membrane.

iii. Act as a solvent:

lipids act as a solvent for some vitamin like A, D and E.

iv. Thermal insulator:

In mammals, a layer of fats is present under the skin. This layer acts as a thermal insulator. They insulate the body from excessive heat or cold.

Q3. How do you differentiate between simple and complex lipids?

Ans: Simple Lipids:

The type of lipids which produce fatty acids and alcohol upon hydrolysis are called simple lipids. They are also known as triglycerides.

Example: Fats, oils and waxes.

Complex Lipids:

The types of lipids which produce fatty acids, alcohols and some other substance upon hydrolysis are known as complex lipids.

Example: phospholipids, Glycolipids, Sullpholipids

Q4. What is meant by denaturing of protein?

Ans: Denaturing of protein: The process in which protein lose their natural structure by heat or some chemical substance is called\denaturing of protein.Due to denaturing the function of protein is disturbed and they cannot perform their normal function.

Example: When egg is heated its protein (albumin) becomes hard thus denaturing of its protein occurs.

Q5. How would you classify vitamins?

Ans:Classification of vitamins:

There are two types of vitamins.

i. Fats soluble vitamins ii. Water soluble vitamins

i.Fats Soluble Vitamins:

Vitamins which dissolve in fats are called fat soluble vitamins. These vitamins are a, D, E and K.

ii. Water Soluble Vitamins:

Vitamins which dissolve in water are called water soluble vitamins. These vitamins are B-complex and Vitamin c. Vitamin B–complex include eight vitamins i.e. B_1, B_2, B_3, B_5, B_6, Boltin, Folic acid and B_{12}.

Q6. Vitamin are vital for us?

Ans: Vitamins are vital for us because it plays an important role in the healthy development and growth of our body. Our body needs a small amount of vitamins and minerals every day to remain healthy, function properly and prevent in future from health problems. It also play important roles in bodily function such as metabolism, immunity and digestion.

Q7.Write down the of sucrose hydrolysis

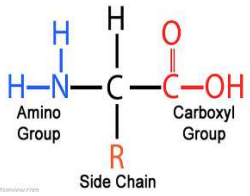
Ans: Hydrolysis of sucrose: On hydrolysis sucrose produce one unit of Glucose and one unit of Fructose.

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$

Sucrose + H_2O → Glucose + Fructose

Q8. Draw the general formula of amino acid. Identify the different parts and functional groups present in it.

Ans: General formula of amino acid: Amino acid is an organic compound having central carbon atom called alpha carbon, which is attached to basic amino group (NH_2), acidic carboxyl group (COOH), a side chain alkyl group (R) and hydrogen atom.



Q9. Briefly describe the sources and deficiency symptoms of Vitamin A.

Ans: Vitamin A.

Vitamin A is fat soluble which is important for growth, vision and immune system.

Sources:

Vitamin A is found in milk, butter, fish oils, eggs, fresh green vegetables and fruits.

Deficiency Symptoms: Deficiency of Vitamin A cause night blindness, dry skin, burning and irritation of eyes.

Q10. Identify the different sources of proteins? Also, list the four uses of protein?

Ans: Sources of proteins: There are two main sources of protein animal sources and plant sources.

i. Animal Sources of Protein:

Animal sources of proteins are fish, meat, eggs, milk cheese etc.

ii. Plant Sources of Proteins:

pulses and beans are the plant sources of proteicarn and are used as a food source.

Important function of protein: Some important function of protein are given below.

I. as Oxygen carrier: Haemoglobin is a protein which carries oxygen to all cells of body.

ii. Body structure: Skin, nail, hair, hoofs, horns and feather are composed of proteins.

iii. Growth: Proteins are essential for the physical and mental growth especially in children.

iv. Enzymatic action: Enzymes are proteins, which are produced by the cells of living organisms.

Enzymes catalyze the biochemical reactions going on in our bodies.

v. As Body regulators: Hormones and enzymes are the chemical regulators of the body.

vi. Body Defense System: The antibodies that help us to fight against diseases are large proteins molecules

LONG QUESTIONS

Q1. What function do carbohydrates perform in living organisms?

Ans: Function of carbohydrates:1. Source of energy:

Carbohydrates are used by our body as a rich source of energy.

2. Source of food:

Carbohydrates are used as a source of food. For example, many vegetables fruits and cereals contain carbohydrates. It is also used as a common sweetener for food.

3. Structural material:

Carbohydrates serves as a structural material in living organism. For example, plant cell wall is made up of cellulose similarly exoskeleton of insects is made up of chitin.

4. Energy reservoir:

Glucose is stored in animal muscles and liver cell in the form of glycogen. It serves as a long term energy reservoir in the body, converted back into glucose when needed. Plants store excess energy in the form of starch.

5. Medicinal Uses: Constipation and diarrhea are mainly controlled bythe use of carbohydrates fibers.

Q2. (a). Distinguish between monosaccharaides, disaccharides and polysaccharides and also give example of each one.

Ans: Carbohydrates:

Definition: "Polyhydroxy ketones or polyhydroxy aldehydes are called carbohydrates".

Polyhdroxy means having many hydroxyl groups.

Common name: Carbohydrates are commonly known as sugars.

Composition: Carbohydrates are poly functional (alcohol+aldehydes or ketones) organic compounds which mainly consist of carbon, hydrogen and oxygen some time along with nitrogen (chitin) or sulphur (keratin sulphate).

Classification of carbohydrates: Carbohydrates are classified into the following three groups:

1. Monosaccharides 2. Oligosaccharides 3. Polysaccharides

Their detail is given below:

1. Monosaccharides:

Definition: "The simplest carbohydrates which cannot be further hydrolyzed into smaller units are called monosaccharides".

General formula: They have the general formula of $C_n (H_2O)_n$ where n=3, 4, 5 and so on.

Composition: Monosaccharides are either aldoses having aldehydic functional group (for example glucose) or ketoses having ketonic functional group for examples glucose) or ketoses having ketonic functional group for example fructose.

These may be trioses ($C_3H_{12}O_6$), tetroses ($C_4H_8O_4$), pentoses ($C_5H_{10}O_5$) and hexoses ($C_6H_{12}O_6$).

General properties of monosaccharides: Some general properties of monosaccharides are:

i. Solubility: They are soluble in water.

ii. Physical state: They are crystalline solid at room temperature.

iii. Taste: They have sweet taste.

iv. Colour: They are colourless.

v. hydrolysis: They cannot be hydrolyzed further**.**

Examples: Some examples of carbohydrates along with their structures are given below:

In straight forms these structures can be written as following

2. Oligosaccharides: "Carbohydrates containing two to nine monosaccharide units are called oligosaccharides." OR
"The carbohydrates which yield two to nine monosaccharide units on hydrolysis in the presence of an acid or enzyme are called oligosaccharides."
Formation: They are formed when two to nine monosaccharide molecules combine with each other by the loss of water molecules. These molecules are bonded with each other through glycosidic linkage.
Types: Oligosaccharides have many types but two of them are described below:
a. Disaccharides: "Those oligosaccharides which consist of two monosaccharide units are called disaccharides."
Examples:

Disaccharides		**Monosaccharides**
Maltose	→	Glucose+Glucose
Lactose	→	Glucose+Galactose
Sucrose	→	Glucose+Fructose

b. Trisaccharides: "Those oligosaccharides which consist of three monosaccharide units are called trisaccharides."
Examples: Reffinose, kestose and maltotriose ($C_{18}H_{32}O_{16}$) etc.
General properties of oligosaccharides: Some general properties of oligosaccharides are:
i. Solubility: They are soluble in water.
ii. Physical state: They are crystalline solids.
iii. Taste: They are sweet taste.
iv. Colour: They are colourless.
v. Hydrolysis: They give two to nine monosaccharide units on hydrolysis.
3. Polysaccharides: "The biopolymers of monosaccharides which consist of 100 or more monosaccharide units joined together through glycosidic linkage are called polysaccharides." Polysaccharides have high molecular weight and they hydrolyzed to give many molecules of monosaccharides e.g.
General properties of polysaccharides:
i. Physical state: They are amorphous solids.
ii. Taste: They are tasteless and are called non-sugars.
iii. Solubility: They are insoluble in water.
iv. Hydrolysis: They give many molecules of monosaccharides on hydrolysis.
Examples: Cellulose, starch, dextrin and glycogen etc. are the examples of polysaccharides.
Function: Polysaccharides perform two main functions in animals and plants.
i. They are used as energy storage of cell.
ii. They are used as structural unit of cell

2. B. How carbohydrates are important to living organisms?
Ans: Importance of Carbohydrates: Carbohydrates are very important to living organism because they perform very important function in living organism such as,
1. Source of energy:
Carbohydrates are used by our body as a rich source of energy.
2. Source of food:
Carbohydrates are used as a source of food. For example many vegetables fruits and cereals contain carbohydrates. It is also used as a common sweetener for food.

3. Structural material:
Carbohydrates serves as a structural material in living organism. Forexample plant cell wall is made up of cellulose similarly exoskeleton of insects is made up of chitin.

4.

Energy reservoir:
Glucose is stored in animal muscles and liver cell in the form of glycogen. It serves as a long term energy reservoir in the body, converted back into glucose when needed. Plants store excess energy in the form of starch.

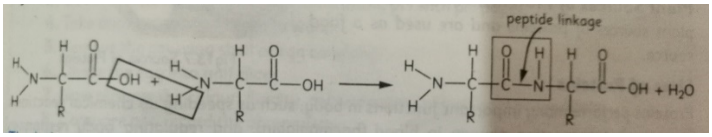
5. Medicinal Uses:
Constipation and diarrhea are mainly by the use of carbohydrates fibers.

Q3. a. How are proteins important to living organism?

Ans: Importance of proteins: Proteins are very important to living organisms because it performs many important function in body. Some important function of protein are given below.
i. As Oxygen carrier: Haemoglobin is a protein which carries oxygen to all cells of body.
ii. Body structure: Skin, nail, hair, hoofs, horns and feather are composed of proteins.
iii. Growth: Proteins are essential for the physical and mental growth especially in children.
iv. Enzymatic action: Enzymes are proteins, which are produced by the cells of living organisms. Enzymes catalyze the biochemical reactions going on in our bodies.
v. As Body regulators: Hormones and enzymes are the chemical regulators of the body.
vi. Body Defence System: The antibodies that help us to fight against diseases are large proteins molecules.

3. b. Explain the nature of bonding in protein?
Ans: Nature of bonding in Protein:
In protein three types of bonding may occur.

1. Peptide Bonding 2. Hydrogen bonding 3. Disulphide bridges
1. Peptide Bonding: The bonding between carbonyl group (-C=O) and NH group are called peptide bonding. Amino acid are linked together through peptide bonding to form proteins.



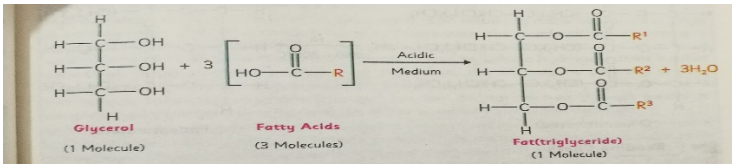
2. Hydrogen bonding:
The hydrogen bonding is formed between O of carbonyl group (-C=O) and h of –NH- group in proteins.

3. Disulphide bridges/bonding:
The disulphide bonds occur only in sulphur containg protein. In these –SH- group are bonded to form disulphide linkage,–H-S-S-H

Q4. a.Define the term Lipid?
Ans: Lipid:
Origin of word lipid: the word lipid is derived from Greek word lipose which means **fat**.
Definition: lipids are defined as biological molecules obtained from plant and animal tissue which are

not soluble in water but are soluble in non-polar organic solvents, such as alcohol, chloroform, ether etc.

Composition of lipids: lipids are generally composed of carbon, hydrogen and oxygen. Generally, lipids are esters of long chain fatty acids and alcohols. These esters are made up of three fatty acids, therefore they are called triglycerides.



4. b. Distinguish between fats and oils.

Ans:

Fats	Oils
Those triglycerides which contain higher proportion of saturated fatty acidscomponents are called fats.	Those triglycerides which contain higher proportion of unsaturated fatty acids components are called oils.
They are solid or semi-solid at room temperature	They are liquid at room temperature
Fats are mainly present in animals.	Fats are mainly present in plants and fish.
Fats have high melting point	Oils have low melting point

4 C. List four foods you eat that contain lipids.
Ans: Food that contain lipids:
foods that contain lipids are Milk, butter, Peanut, groundnut, walnut and coconut.

4. d. How lipids are important to our body?
Ans: Important functions of Lipids: lipids perform many important function in the body. Which are given below**;**

1. Source of energy: The most important function is the long-term storage of energy. One gram of fats contains approximately twice more energy than a gram of carbohydrates and protein.
2. Thermal insulator:
In mammals, a layer of fats is present under the skin. This layer acts as a thermal insulator. They insulate the body from excessive heat or cold.
3. Protective layer:
the fatty tissue in our body are made from lipids. A protective layer of fat around our heart, kidneys etc. reduces the impact of any external jerk or shock.
4. Regulatory hormone:
lipids such as Cholesterol etc. act as hormones to regulate body function.

Q4.a. how would you justify DNA as a genetic code of life?
Ans; DNA has the ability to store and transmit genetic information. The genetic information for the cell are present in DNA. The genetic information for the cell are present in the form of special codes.

These molecules are translated and expressed by synthesis of specific proteins. These proteins perform various function according to the direction which are given by the codes present in DNA.

4. b. Distinguish between DNA and RNA.
Ans:

DNA	RNA
DNA is double-stranded structure	RNA is single-stranded structure
In DNA the pentose sugar is deoxyribose	In RNA the pentose sugar is ribose
In DNA the nitrogen bases are adenine, cytosine, guanine and thymine	In RNA the nitrogen bases are adenine, cytosine, guanine and uracil

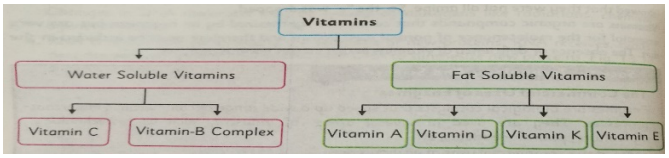
4. c. Explain the function of DNA.
Ans: Function Of DNA:
Genetic information: DNA has the ability to store and transmit genetic information. The genetic information for the cell are present in DNA. The genetic information for the cell are present in the form of special codes.

Protein synthesis: DNA also instructs how to synthesize a particular protein from a particular amino acids. These instruction are known as genetic code.

Mutation: Mutation is a sudden chemical change in a DNA molecule that can lead to the synthesis of protein with different amino acid sequence a DNA molecule that can lead to the synthesis of protein with different amino acid sequence. Changes in DNA molecules. Changes in DNA molecules may be caused by mutagens like radiations, chemical agents or viruses.

Q5.a. Define the term Vitamins and classify it.
Ans: Vitamins:
Origin of word vitamin: The word vitamin was originally vitamin, because the first one that was found was amine hence the name vital amine or vitamin, subsequently studies of other such substances showed that they were not all amine, so the “e” were dropped.
Definition of vitamin: Vitamins are organic compound that cannot be synthesized by an organism but are very essential for the maintenance of normal metabolism and therefore must be included in the diet.
Classification of vitamins:
There are two types of vitamins.
i. Fats soluble vitamins ii. Water soluble vitamins
i.Fats Soluble Vitamins:
Vitamins which dissolve in fats are called fat soluble vitamins. These vitamins are vitamins A, vitamins D, vitamins E and vitamins K.

ii. Water Soluble Vitamins:
Vitamins which dissolve in water are called water soluble vitamins. These vitamins are B-complex and Vitamin c. Vitamin B–complex include eight vitamins i.e. B_1, B_2, B_3, B_5, B_6, Boltin, Folic acid and B_{12}.



Q5.b.Explain the importance sources of vitamins.
Ans: Sources of different vitamins are given below.
Sources of vitamin A: Vitamin A is found in milk, butter, fish oils, eggs, fresh green vegetables and fruits.

Sources of vitamin B: Vitamin B is found in bread, rice, yeast, liver, milk, meat, fish, eggs, soybean oil, and fresh green vegetables.
Sources of vitamin C: Vitamin C is found in citrus fruits (oranges, lemons) tomatoes, fresh green vegetables.

Sources of vitamin D: Vitamin D is found in milk, butter, eggs, fish oils, vegetables.
Sources of vitamin E: Vitamin E is found in bread, rice, eggs, liver, butter, fresh green vegetables, and corn and soybean oil.
Sources of vitamin K: sources of vitamin K are fresh green vegetables, liver, egg yolk, meat and cheese.

Q5.c. Write down the names of five Vitamins and their importance.
Ans: Importance of vitamins:
there are different vitamins present in our body. Each vitamin plays an important role the development and growth of our body. Importance of different vitamins are given below.
Importance of vitamin A: Vitamin A is necessary for vision. It also keeps the cornea moist.
I**mportance of vitamin B:** Vitamin B helps to regulate nerve impulse transmissions.
Importance of vitamin C: Vitamin C is necessary for the formation of blood, improvement of the immune system and protection against illness, including the common cold.
Importance of vitamin D: Vitamin D regulates blood calcium, necessary for proper bones and tooth growth.

Importance of vitamin E: Vitamin E has been considered responsible for youth preserving and defender against the carcinogenic (cancer-causing) effects of certain chemicals.

TOPIC WISE QUESTIIONS

Q1. Write the sources of carbohydrates.
Ans: Sources of carbohydrates:
Carbohydrates are the most abundant class of Carbon, hydrogen, and oxygen containing compounds. It ranges from simple to complex units.They have varied sources**.**
Sources of monosaccharides: they are found in fruits, vegetables and cereals. They are also found in honey.

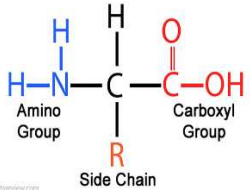
Sources of disaccharides: Sucrose are present in sugarcane, sugar beet, and fruits (mango, pineapple). Lactose are found in milk and dairy product and maltose are present in cereals.
Sources of Polysaccharides: Polysaccharides are cellulose and starch.
Cellulose is obtained from plants, for example, cotton is pure cellulose.
Starch is found in cereal crops, for example, potatoes, wheat, barely, maize, rice etc.

Q2. Define and explain term protein...Ans: Origin of word protein: The word protein is derived from Greek word "Proteios" which means of prime importance**,** because they are essential for the growth and maintenance of life.

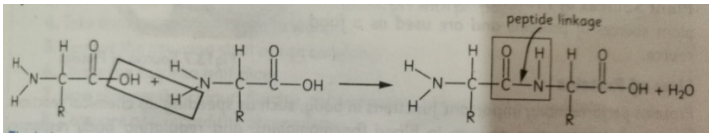
Definition: The complex nitrogenous compounds that are made up of amino acids present in all living organisms.

Composition of Protein: Proteins consist of carbon, hydrogen, oxygen, nitrogen and sometime consists of sulphur. About 50-55% of the dry weight of the cell is made up of proteins.

The building block of proteins:
The building block of proteins are amino acids.Amino acid is an organic compound having central carbon atom called alpha carbon, which is attached to basic amino group (NH_2), acidic carboxyl group (COOH), a side chain alkyl group (R) and hydrogen atom.



Amino acids are joined together by peptide linkage in protein polymer.



Q3. Write down the sources of Lipids. **Sources of Lipids:** Lipids obtained from animals, plants and marine organisms. For example, salmon and whales are rich source of cod liver oil.
Animal's sources: Milk is a rich source of animal fat from which butter, ghee, cheese etc. are obtained.

Plants Sources: seeds of many plants such as sunflower, corn, cotton, peanut, ground nut, walnut, coconut etc. are good source of lipids.

Q4. What is nucleic acid? Describe its composition, types and uses.

Ans: Nucleic acid:

Discovery: nucleic acid were first discovered in the nuclei of white blood cells in 1868 and in sperm head in 1872 by Johannes Friedrich Miescher, a Swiss physician and biologist.

Definition: Complex organic compound consisting of nucleotides which synthesize proteins and transmit characters from parents to offsprings are called nucleic acid.

Explanation: Nucleic acid are found in each and every living cell as well as in viruses. They are essential part of genes.

Composition of Nucleic acid: Nucleic acid are composed of units called nucleotides. These nucleotides are composed of three distinct parts:

i. Sugar: nucleotides consists of five carbon sugar which may be ribose (RNA) or deoxyribose (DNA).

ii. A nitrogen-containing bases of five types, uracil, cytocine, thymine, adenine and guanine.

iii. Phosphate group: Third part is phosphate group**.** .

Types of nucleic acid: Naturally occurring nucleic acid are of two types.

i. Deoxyribonucleic acid (DNA) ii. Ribonucleic acid (RNA)

i. Deoxyribonucleic acid (DNA):

Discovery: DNA was first discover by Watson and Crick in 1953.

Definition: DNA is a double-stranded structure composed of deoxyribose sugar, phosphate group and four nitrogenous bases. The four nitrogenous bases present in DNA are adenine, cytocine, thymine, and guanine.

Explanation: pentose sugar and phosphate group make the back bone of each strand. Two strand are linked together through bases. The strands are held together by hydrogen bonds.

Function of Nucleic acid:

Function of DNA:

Genetic information: DNA has the ability to store and transmit genetic information. The genetic information for the cell are present in DNA. The genetic information for the cell are present in the form of special codes.

Protein synthesis: DNA also instructs how to synthesize a particular protein from a particular amino acids. These instruction are known as genetic code.

Mutation: Mutation is a sudden chemical change in a DNA molecule that can lead to the synthesis of protein with different amino acid sequence a DNA molecule that can lead to the synthesis of protein with different amino acid sequence. Changes in DNA molecules. Changes in DNA molecules may be caused by mutagens like radiations, chemical agents or viruses.

Function of RNA:

RNA is responsible for directing the synthesis of new proteins**.** RNA receives, reads, decodes and uses genetic information from DNA to synthesize

Q5. Briefly describe the sources and deficiency symptoms of Vitamin A.

Ans: Vitamin A.

Vitamin A is fat soluble which is important for growth, vision and immune system.

Sources:

Vitamin A is found in milk, butter, fish oils, eggs, fresh green vegetables and fruits.

Deficiency Symptoms:
Deficiency of Vitamin A cause night blindness, dry skin, burning and irritation of eyes.

Vitamin B Complex.
Vitamin B Complex is water soluble and consist of Vitamin B_1, B_2, B_3, B_5, B_6, Boltin, Folic acid and B_{12}. They are important for energy production, nerves and cells,
Sources: Vitamin B is found in bread, rice, yeast, liver, milk, meat, fish, eggs, soybean oil, and fresh green vegetable.
Deficiency Symptoms:
Deficiency of Vitamin B cause skin diseases, tongue/lips inflammation, anemia, bleeding gums and beriberi.

Vitamin C.
Vitamin C is water soluble which is important for blood vessels, gums, healing wounds and preventing cold.
Sources:
Vitamin C is found in citrus fruits (oranges, lemons) tomatoes, fresh green vegetables
Deficiency Symptoms:
Deficiency of Vitamin C scurvy and pain in joints.
Vitamin D.
Vitamin D is fat soluble which is important for bones and teeth.
Sources:
Vitamin D is found in milk, butter, eggs, fish oils, vegetables.
Deficiency Symptoms:
Deficiency of Vitamin D cause Rickets, osteomalacia.
Vitamin E.
Vitamin E is fat soluble which acts as an antioxidant.
Sources:
Vitamin E is found in bread, rice, eggs, liver, butter, fish, soybean oil, and fresh green vegetables.
Deficiency Symptoms:
Deficiency of Vitamin E causes anemia and sterility.
Vitamin K.
Vitamin K is fat soluble which is important for blood clotting.
Sources:
Vitamin K is found in liver, egg yolk, meat, cheese, fresh green vegetables.
Deficiency Symptoms:
Deficiency of Vitamin D cause Rickets, osteomalacia.

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CHAPTER 14

ENVIRONMENTAL CHEMISTRY

Q1: How ozone layer is depleted in the atmosphere?

Ans: **Ozone layer depletion:**

Ozone is present in the stratosphere layer helps to absorb ultraviolet ray. when ozone depleting substance such as chlorofluorocarbons (CFCs), Hydro chlorofluorocarbons (HCFCs) and volatile organic compound goes to stratosphere layer react with uv-ray .This reaction breakdown the depleting substances and release the free cl atom. This free cl atom reacts with ozone gas and deplete the ozone layer.

Q2: Differentiate between primary and secondary pollutant. Write the name and sources of greenhouse gases to atmosphere.

: Primary pollutant	**Secondary pollutant**
Primary pollutant is an air pollutant which are released directly into air**.**	Secondary pollutant is not produced directly. Secondary pollutant are formed from primary pollutants.
Example: The gases like SO2 released from burning fossil fuel. Carbon Ammonia etc	**Example:** Photochemical oxidants, secondary particulate matter
The product which escape from the chimney of industrial unit**.** Exhaust of automobiles.	Acid rain, like SO2 mix with water in atmosphere and cause acid rain. Nitrogen oxide and hydrocarbon react with sunlight cause ozone

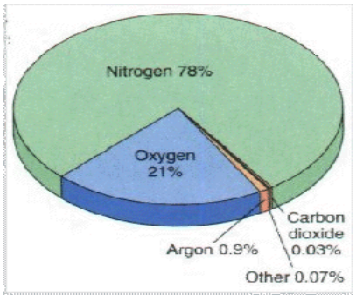
Greenhouse gases name:
The greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone.
Sources: The main sources of greenhouse effect is human activities. The main human sources of greenhouse gas emissions are, fossil fuel, Deforestation, intensive livestock farming, use of synthetic fertilizers and industrial processes, natural processes like animal and plant respiration.

Q3. Define Environmental Chemistry and atmosphere.

Ans: Environmental Chemistry:
The branch of chemistry which deal with the study of environment and the changes occurring in it, is called environmental system.
Atmosphere: the thick protective blanket of air or gases around the earth, which helps to sustain life, is called atmosphere.
Composition: The major constituents of atmosphere are N_2 and O_2. Its minor constitutions are CO_2, Noble gases and some trace gases.

Q4. Sketch and briefly discuss the composition of atmosphere, by mentioning the percentage of each component.

Ans: Sketch of atmosphere:



Percentage of each component:

Element	Chemical Formula	Percentage
Nitrogen	**N_2**	**78.084**
Oxygen	**O_2**	**20.95**
Argon	**Ar**	**0.93**
Water	**H_2O**	**0.0 - 0.4**
Carbon dioxide	**CO_2**	**0.00397**
Neon	**Ne**	**0.0018**
Helium	**He**	**0.000524**
Ozone	**O_3**	**0.00006**
Krypton	**K_r**	**0.000114**
Hydrogen	**H_2**	**0.01**

Q5. How the acid rain effect the building material or statues?

Ans: Acid rain: The rain having PH less than 5.6is **c**alled acid rain**.**

Effect of acid rain on building materials: Acid rain damages building material such as steel, paint, plastic, cement sculptural work, material especially of marble and limestone.

$CaCO3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$

The calcium sulphate is soluble in water and washed away with rain water.

The historical statues in Greece and Italy and The Taj Mahal in India were damaged due to acidic rain.

Q6: Increase in concentration of CO_2 cause greenhouse effect, justify it.

Ans: As we know that CO2 is produced by burning fuels like oil, natural gas , diesel and organic petroleum.CO2 is released to the atmosphere where it remain for many years. This leads to an increasing concentration of CO2 in our atmosphere. Which in turn cause average temperature on earth to raise. The CO2 is greenhouse gas which emission causes global warming.

Q7: Briefly discuss how the acid rain affect the aquatic life.

Ans: Effect of Acid rain on aquatic life:

The rain which PH is less than 5.6 is called acid rain. The aquatic life like fish, plants and microorganism are very sensitive to acidity .i.e. at PH-5, most fish eggs cannot hatch. Some adult fish die. Ia fish or animal survive in acidic water but food they eat might not be available as food. i.e., frog can tolerate the condition at around PH-4 but mayflies the food of frog are more sensitive and not survive below PH-5.6.

Q8: List the sources which produce CO and CO2 to the atmosphere.

Ans: The following are sources which produced CO and CO2 to atmosphere.

CO: **Natural sources:** CO is one of the gaseous pollutant .its natural sources are Volcanic eruption, Natural gas emission and forest fires. .

Anthropogenic sources: Most of carbon monoxide released to atmosphere by human activities. Automobile release 75% of CO to the environment. Besides this incomplete combustion of fossil fuels, smoking, forest fires and steel industries are the main sources of carb on monoxide.

Sources of CO_2:

the main sources of carbon dioxide gas emission are our everyday activities such Cooking and baking etc. vehicle and industrial emission, petroleum production and thermal power plant are also the source of CO.

Q9: what are the adverse effects of global warming?

Ans: Global Warming: The gradual increase in the average temperature of the earth due to emission of greenhouse gases is called global warming

Effect of Global warming:

Global warming is a phenomenon of climate change characterized by general increase in average temperature. It is adversely effecting sea level, ozone layer, crop yield, precipitation (rain and snow fall) and health.

Global warming is harming the environment in several ways include

Desertification increase in temperature around the world changes the water cycle and rainfall patterns which causes desertification of certain areas.

Increases melting of ice and snow:

Snow and ice are melting at a faster pace due to increase in temperature.

Sea level rise:

Increase in temperature cause ocean waters to expand on other hand glaciers and ice are melting due to rise in temperature which rise the sea level.

Strong storms and cyclone:

Rise of temperature also increase the frequency of strong cyclone and strong storms

Q10:What is the importance of ozone?

Ans: Ozone : Ozone is an allotropic form of oxygen, consisting of three chemically bonded oxygen atoms

Importance of ozone:

The ozone acts as a protective layer in the atmosphere. it save earth and living thing from harmful UV rays from sun.it also helps to remove the pollutant from the surface of the earth.

Long questions

Q1: Sketch and identify the different layer of atmosphere.

A: Definition:

The layer of gases surrounding the earth is called atmosphere.it extends up to about 500km from the earth's surface.

Layers of Atmosphere:

The atmosphere is divided into four layers based on the variation in temperature in each layer.

(i) Troposphere

(ii) Stratosphere

(iii) Mesosphere

(iv) Thermosphere / Ionosphere

Troposphere :

The first layer of the atmosphere which is closest to Earth's surface is called troposphere .we live in this layer.it contains approximately 75% of atmosphere mass and 99% of total mass of water vapor aerosol**.**

Characteristics of Troposphere :

The few characteristics of Troposphere are given below**:**

a. Height:

The average height of this layer from the earth's surface is about 11km.It height is depends upon the latitude and season and pressure. It is lowest over the poles and highest at equator and by season it is lower in winter and higher in summer. The pressure, moisture content, density of air also decrease with height

b. Main components:

The major components of this layer are N2, O2, and water vapours.70 to75% of the atmosphere gases are present in this layer. Dust, particles are also present here.

phenomenon occurring in Troposphere:

All the weather phenomenon like cloud formation, winds, rainfall, snowfall takes place in this layer.

Lapse rate:

The change in temperature of atmosphere with increase in height is called lapse rate. It may be positive or negative

Positive lapse rate:

If the temperature increase with height it is called positive lapse rate.

Negative lapse rate:

If the temperature decrease with height it is called negative lapse rate**.**

The air of this layer is warmer than other layers because it is heated from the earth's surface below.

D. Temperature:

The temperature range of this layer is from 15℃to -56. ℃. It shows negative laps rate.

ii. Stratosphere:

The layer which is above the Troposphere is called Stratosphere.

It is second layer of the atmosphere. It is warmer at top than bottom. The lower portion has nearly constant temperature with height but upper part temperature increase with latitude.

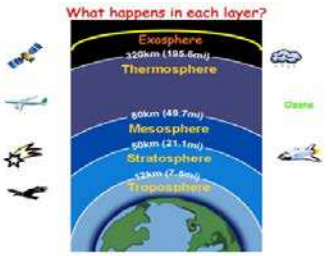
Characteristics of Stratosphere

a. Height:
The height of this layer is from 11km to 50 km.
b. Temperature:
The temperature of this layer is increases from -56℃ to -2℃ with height**.**
c. Main component:
The major component of this layer is ozone O3.
Ozonosphere:
Stratosphere contains ozone, at height of about 30 km, therefore it is called ozonosphere.
Production of ozone:
when the oxygen molecules absorbs ultraviolet radiation, it decompose to form oxygen atom. This oxygen atom react with another oxygen and ozone is produced.

$O_{2(g)} + O^{\bullet}_{(g)} \rightarrow O_{3(g))}$

Phenomenon occurring in Stratosphere:
The ozone layer is present in this layer which absorbs harmful UV radiation .Thus protects the living organism from harm full UV radiation.

The CFCs and ultra violet radiation from the sun, break down the Ozone molecule into mono atomic oxygen and diatomic oxygen, resulting in damage to ozone layer.
$O_{3(g))} \rightarrow O_{2(g)} + O^{\bullet}_{(g)}$



b. Differentiation between Troposphere and Stratosphere?

Ans:

Troposphere	**Stratosphere**
The main component of this layer is N_2, O_2 andCO2and water vapor	The main component of this layer is ozone.
It is warmer than Stratosphere	It is colder than troposphere.
The air density is more in this laye	The air is less dense in this layer.
Clouds formation, rain, snowfall, and winds occur here.	No clouds formation, rain, snowfall and wind
The temperature is from 15 to -56.	The temperature is from -56 to -2

Q2.a.Air is polluted in the big cities of Pakistan, justify the statement.

Ans: Air pollution: According to world health organization (WHO), air pollution is defined as: the substances released to air either by human activities or by natural activities, in sufficient concentration to cause harmful effects to human beings, plants and other living thing is called Air pollution.

Explanation: Air pollution change the physical, biological and chemical characteristics of airthat cause adverse effects on human and other organism.
Air pollution in Pakistan: The big cities of Pakistan like Karachi, Lahore, Faisalabad and Islamabad faces the air pollution due to following reasons.

1. Urbanization and population growth
2. Increase in number of vehicles used daily
3. Deforestation for making house and other uses.
4. Inefficient use of energy
5. Burning of garbage and plastic increase the smog and other air pollution due to worst air quality.
Q2.b.Enlist the main source of air pollution.
Ans: Pollutants: The substances that are responsible for causing air pollution are called air pollutant.
Sources of air pollution:
A: There are two main sources of air pollution.
i. Nature sources
ii. Anthropogenic/ man made sources
Natural sources: Natural sources of air pollutants are as follow,
A. **Particulate**:
The particulate pollutant is produced naturally by volcanic eruption, soil erosion by wind, dust storms , natural forest fires and salts spray from oceans . The contribution of the natural sources towards the particulate emission is greater than man made sources. It has been estimated that natural sources releases millions of tones particulate matter in to air.
B. Oxides of carbon (Coax):
CO and CO2 are the oxides of carbon.
I. **Carbon monoxide;**
The natural concentration of carbon monoxide in air is around 0.2 parts per million (ppm), and that amount is not harmful to humans. Natural sources of carbon monoxide include volcanic eruption, decomposition of organic matter, and electrical discharge during storms, seed germination and natural gas emission etc.
ii. Carbon dioxide:
The natural sources of CO_2 are animal and plants respiration, decomposition of organic matter, forest fires and emissions from volcanic eruption.
iii. Oxides of nitrogen (NOx)
Bacteria and microorganisms are the main sources for emission of oxides of nitrogen into air. They convert nitrates present in soil into oxides of nitrogen. Nitrogen oxides are produced naturally by lightning, and atmospheric nitrogen gas into oxides of nitrogen and ammonia.
Iv. Oxides of Sulphur dioxides
The major oxides of Sulphur are Sulphur dioxide and Sulphur trioxide. They are produced by volcanic eruptions, rock weathering and biological activities.
v. volatile organic compound:
Volatile organic compounds or VOCs, are chemicals that have a strong tendency to vaporize from liquids or solids into gaseous states e.g. Methane. Wetlands are the largest natural source of methane.

They contribute 78% of natural methane in the environment. Animals like sows, sheep and goats during their normal digestion process produce large amount of methane.

Anthropogenic/man made sources:

The burning of different types of fuels by man that produced air pollution is called Anthropogenic /man made sources.

I. Particulates:

Particulate matter is the sum of all solid and liquid particles suspended in air. The man-made sources of particulate matter are combustion of fuels wood burning, construction, mining and industrial process. **ii.**

Oxides of carbons;

a. Carbon dioxide:

Carbon dioxide is also added to the atmosphere through human activities, such as the burning of fossil fuels and forests and the production of cement. Also thermal power generation and our everyday activities such as cooking and baking released CO2.

Carbon monoxide:

CO is produced by incomplete combustion, i.e. when there isn't enough oxygen to make CO2, Automobiles exhausts, smoking forest fires and steel industries are also the main sources of CO gas.

Oxides of nitrogen (NOx):

Automobiles exhausts, industrial activities, furnaces, thermal power generation. , jet airplanes are the main sources of nitrogen oxides.

Sulphur oxides (SOx):

Burning of fossil fuels such as coal, oil and natural gas are the main source of Sulphur dioxide emissions. Coal fired power stations, in particular, are major sources of Sulphur dioxide, other sources of Sulphur dioxide are industrial processes and transportation.

Volatile organic compounds (VOCs):

Volatile organic compound e.g. methane is produced by burning fossil fuel.

Common sources of these organic compounds are:

Furniture polish and other wood finishing products

Solvents and thinners, e.g. nail polish remover with acetone or paint thinner.

Aerosols, such as air fresheners and other cleaners

Smoke from burning stoves or candle, as well as cigarettes.

Automobile exhaust and factories are also the main sources of VOCs.

Chlorofluorocarbons (CFCs) :

It is anthropogenic compounds that have been released into the atmosphere from various applications such as in air-conditioning, refrigeration, blowing agents in foams, insulations and packing materials.

Q2.c. Prove that oxides of nitrogen and Sulphur cause air pollution.Oxides of Sulphur:

The major oxides of Sulphur are SO2 and SO3.

These oxides are produced by the burning of Sulphur containing fossil fuel**.** Sulphur dioxide is a gas. It is invisible and has a nasty, sharp smell. It reacts easily with other substances to form harmful compounds, such as sulfuric acid, sulphurous acid and sulphate particles. The main source of Sulphur dioxide in the air is industrial activity e.g. the generation of electricity from coal, oil or gas that contains sulphur. Sulphur dioxide is also present in motor vehicle emissions and air become polluted.When sulphur dioxide combines with water and air, it forms sulfuric acid, which is the main component of acid rain. Acid rain can:

Cause deforestation.

Effect the aquatic life and other organism life.

Corrode building materials and paints.

Oxides of Nitrogen (NOx): Nitrogen dioxide and nitric oxide are oxides of nitrogen (NOx). When nitrogen is released during fuel combustion it combines with oxygen atoms to create nitric oxide (NO). This further combines with oxygen to create nitrogen dioxide (NO2). Nitric oxide is not considered to be hazardous to health, but nitrogen dioxide is danger gas. NOX react with water, oxygen and other chemicals to form nitric acids. It mix with water and other materials before falling to the ground and cause acid rain NOx gases react to form smog.

2.d. Enlist the effects of air pollution.

Effects of air pollution: A variety of air pollutants have harmful effects such as;

i. carbon monoxide:

carbon monoxide reduce the amount of oxygen carried by hemoglobin around the body in red blood cells. The result is that vital organs, such as the brain, nervous tissues and the heart, do not receive enough oxygen to work properly. Breathing CO can cause headache, dizziness, vomiting, and nausea.

ii. Carbon dioxide: carbon dioxide in the atmosphere increases the greenhouse effect. More thermal energy is trapped by the atmosphere, causing the planet to become warmer than it would be naturally. This increase in the Earth's temperature is called global warming

.iii. Sulphur dioxide: Sulphur dioxide affects human health when it is breathed in. It irritates the nose, throat, and airways to cause coughing, wheezing, shortness of breath, or a tight feeling around the chest .it reduced the productivity of plants and yellowing it.SO2 also damages the stone and marble.

iv. Nitrogen dioxide: NOx gases react to form smog and acid rain as well as being central to the formation of fine particles (PM) and ground level ozone, both of which are associated with adverse health effects. It reduces plant growth.it also effect the heart, respiratory system, skin and eyes.

V. Chlorofluorocarbons (CFCs): chlorofluorocarbons (CFCs) destroy the earth's protective ozone layer, which shields the earth from harmful ultraviolet (UV) rays generated from the sun.

vi. Particulate matter:

It is toxic matter and affect both our lungs and heart.

Q3.what would be the result if rainwater is acidic?

Ans: Normal rainwater has a pH of 5.6 to 6. As we know that the air is polluted with the oxides of nitrogen and Sulphur. When rainwater is exposed to the carbon dioxide and oxides of nitrogen and Sulphur present in the atmosphere it become acidic and cause the acid rain. Acidic rain has a PH low than normal rain. It has harmful effects on human, plants and materials. 5.6.Acid rain damages building such as steel, paint , plastic ,cement sculptural work ,material especially of marble and limestone.

For example

$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$

The calcium sulphate is soluble in water and washed away with rain water.

The historical statues in Greece and Italy and The Taj Mahal in India were damaged due to acid rain.

(iii)

Q3.b.What could be done to minimize the formation of acid rain?

There are several solutions to stopping manmade acid rain

Energy conservation: The biggest step that we can take to prevent acid rain is to decrease our energy consumption. Close the lights when we leave the room. Whenever we're not using an electrical appliance, simply shut it off to conserve energy

Transportation: Because cars are a major contributor to acid rain pollution, it's important to find alternate modes of transportation. By using public transit, carpools, bikes and even your feet, we're

helping reduce auto emissions...

Alternative fuels: An excellent way to prevent acid rain is to stop using non-renewable fuels and switch over to renewable sources of energy, such as solar, wind and water energy. As the technology for these alternative energies increases, they will become more accessible to the public. A great way to reduce acid rain is to produce energy without using fossil fuels.

Q3.C. write down the effect of acid rain on,

i. Human (ii) Plants (iii) Soil (IV) Materials

i Human: The acid rain damages the, skin and hair of human beings. It also encourages lungs problems, like asthma and bronchitis. Acid rain increases the acidity of water and cause the waterborne diseases. **(ii)**

Plants: Acid rain removes the minerals and nutrients from the soil which is important for plant growth. Young rootlets and leaf shoots are very sensitive to low PH at high altitudes acid fog and clouds decrease the nutrients from trees and plant and their leaves become brown or dead. They are unable to absorb sunlight and week to survive at freezing point.

Soil: Acid rain increase the acidity of soil and increase the amount of aluminium in soil which effect the plant growth.

(iv).Material: The rain which have PH 5.6 is called normal rain. Acid rain have PH less than**.**

Q4.a. Explain ozone layer depletion.

Ans Ozone depletion: The decrease in the concentration of the ozone in stratosphere below its normal level is called ozone depletion**.**

Occurrence of ozone : ozone is present in the stratosphere layer helps to absorb ultraviolet ray. When ozone depleting substance such as chlorofluorocarbons (CFCs), Hydro chlorofluorocarbons (HCFCs) and volatile organic compound goes to stratosphere layer react with uv-ray. This reaction breakdown the depleting substances and release the free cl atom. This free cl atom reacts with ozone gas and deplete the ozone layer.

Q4.B. Where does ozone layer lie in the atmosphere?

An ozone layer is mainly found in the lower portion of the stratosphere, from approximately 30 kilometers above Earth, although its thickness varies seasonally and geographically**.**

Ozonosphere:. The stratosphere contain ozone layer so it is also called ozonosphere.

Q4.C. what evidence can you find that depletion of ozone occurs in the atmosphere?

Chlorofluorocarbons are the main class of chemical that depleted the ozone layer in the stratosphere. Measurements reveal that emissions of these compounds are rising, .CFCs are highly stable, synthetic chemicals that were used in various applications from the 1930s onwards — for example, as propellants in aerosol sprays, solvents and refrigerants. CFCs could be destroyed naturally only in the stratosphere, in a process that releases chlorine atoms. Each of these atoms would be able to destroy many ozone molecules and severe ozone depletion was found over Antarctica alone, thus posing a threat to the ozone layer.

$O_2 (g) + O' \rightarrow O_3$

Q4.D. recommend few ways to protect ozone layer.

Protection of ozone

Avoid the consumption of gases dangerous to the ozone layer.

Minimize the use of cars and use public transport

do not use cleaning products that are harmful to the environment and to us.

Buy local products.

Maintain air conditioners

Q5. Summarize the components of stratosphere and troposphere?

Main components of Troposphere:

The major components of this layer are N2, O2, and water vapours.70 to75% of the atmosphere gases are present in this layer. Dust particles are also present here

Main component of stratosphere:

The major component of this layer is ozone O3.

Ozonosphere:

Stratosphere has ozone layer, at a height of 30 km, therefore it is called ozonosphere.

B. Describe ozone formation.

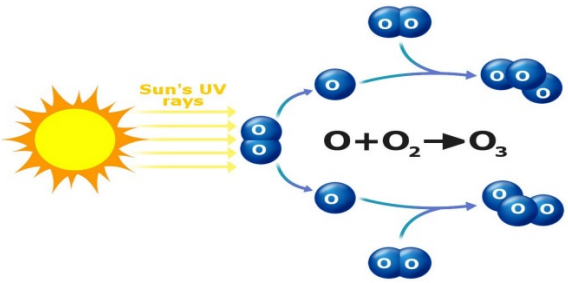
Ans. formation of ozone: ozone is formed naturally by chemical reactions involving solar ultraviolet radiation (sunlight) and oxygen molecules.

$3O2(g) \rightarrow 2O3(g)$

First step: solar ultraviolet radiation breaks apart one oxygen molecule (O2) to produce two oxygen atoms (2 O**)**

$O2(g) \rightarrow 2O(g)$

Second step: Each of these highly reactive atoms combines with an oxygen molecule to produce an ozone molecule (O3). These reactions occur continually whenever solar ultraviolet radiation is present the stratosphere. As a result, the largest ozone production occurs in the tropical stratosphere.



C. Greenhouse effect is good or bad for us, explain it.

Ans:Greenhouse effect is good: The greenhouse effect is essential for humanity to survive, without it the earth would be far colder. This is because if there will be no greenhouse effect then harmful solar radiations will destroy habitat on earth. Some greenhouse gases like carbon dioxide, water vapor and ozone absorb those radiations, they repel harmful radiations back to space and distribute good radiations in all directions. This effect also maintain the temperature on earth.

Greenhouse effect is bad: When greenhouse gases cause an increase in temperature by stopping out-going radiation from leaving the Earth. This causes an imbalance between in-coming and out-going radiation and leads to warming. This effect is responsible for change in climate, so if carbon dioxide (a greenhouse gas) will be emit as it is emitting now then there will be disturbance in climate. This may also result in rise in temperature and possibly melt glaciers which will increase water level on earth, this is so dangerous for us.

Predict the outcomes of global warming.

Rising seas and increased coastal flooding: Global warming increases the temperature of earth. As temperatures increase, more rain take place, increasing the risk of flooding events.

Longer and more damaging wildfire seasons: wildfires are increasing and wildfire season is getting as temperatures rise. Higher spring and summer temperatures and earlier spring snow-melt result in forests that are hotter and drier for longer periods of time.

More frequent and intense heat waves: Dangerously hot weather is already occurring more frequently than it did 60 years ago heat waves to become more frequent and severe as global warming intensifies. This increase in heat waves creates serious health risks, and can lead to heat exhaustion and heat stroke. An **increase in extreme weather events**: Global warming is increasing certain types of extreme weather events, including heat waves, coastal flooding, extreme precipitation events, and more severe.

Topic wise:

Q: What are the effect of ozone layer depletion?
Effect of ozone layer depletion:
Ozone layer depletion increases the amount of UV radiation that reaches the Earth's surface. Ultraviolet (UV) radiation from the Sun can cause a variety of health problems in humans, including skin cancers, eye cataracts and a reduction in the ability to fight off disease. Furthermore, UV radiation can be damaging to microscopic life in the surface oceans which forms the basis Some of its major impacts on living things are given below:
Skin cancer: Exposure to UV rays from sun can lead to increased risk for developing of several types of skin cancer due to damages of skin tissue. In minor cases, it causes sun burn.
Eye damage: UV rays are harmful for our eyes too. Direct exposure to UV rays can lead to Cataract problems.
Damage to Immune system: Our immune system is also highly unsafe to UV rays. Increased exposure to UV rays can lead to weakening of the response of immune system and even impairment of the immune system in

Aging of skin: Exposure to UV rays can lead to acceleration of the aging process of our skin. We look older than our actual age. It can also lead to photo allergy that result in outbreak of rashes in fair skinned people.

Other effect on human: In humans, exposure to UV rays can also lead to difficulty in breathing, chest pain, and throat irritation and can even lead to curb of lung function.

Effect on amphibians: UV rays affect other life forms too. It adversely affects the different species of amphibians and is one of the prime reasons for the declining numbers of the amphibian species. It affects them in every stage of their life cycle; from hampering the growth extreme cases.
and development in the larvae stage, deformities and decreases immunities in some species.
Effect on marine life: UV rays also have adverse effect on the marine ecosystem. It adversely affects the planktons which plays a vital role in the food chain and oceanic carbon cycle. Affecting phytoplankton will in turn affect the whole ocean ecosystem.
Effect on plants: UV rays will also affect the plants. UV radiations can alter the time of owering in some plant species. It can also directly affect the plant growth by altering the physiological and developmental processes of fl the plants.
Effect on material:Ozone depletion will cause many materials to degrade faster. These materials include PVC (used in window and doorframes, pipes and gutters), nylon and polyester.

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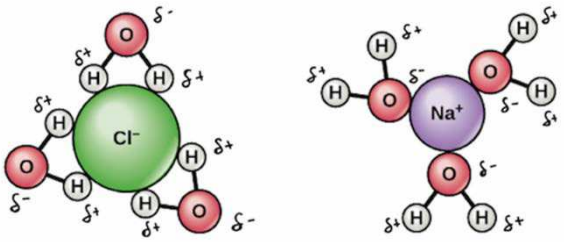
UNIT: 15

ENVIRONMENTAL CHEMISTRY II:WATER
SHORT QUESTIONS: -

Q: Identify the factor which are responsible for dissolving polar substance in water?
A: Factors affecting solubility:
Water because of its polarity and ability to form hydrogen bonds, water makes an excellent solvent, meaning that it can dissolve different kinds of molecules.
Explanation: Water molecules have a polar arrangement of the oxygen and hydrogen atoms—one side (hydrogen) has a positive electrical charge and the other side (oxygen) had a negative charge. This allows the water molecule to become attracted to many other different types of molecules. Water can become so heavily attracted to a different molecule, like salt ($NaCl$) that it can disrupt the attractive forces that hold the sodium and chloride in the salt molecule together and, thus, dissolve it.



2: Explain why it is advisable to drink boiled water?
A: Water treatment process improves the quality of water. In the treatment process, the removal of suspended and dissolved solids and kills the harmful bacteria and microbes, makes the water clean and safer for drinking. If we drink the untreated or contaminated water, there is a great risk of being seriously ill. Boiling water is a safe precaution to prevent waterborne diseases like diarrhea, Dysentery cholera, and Typhoid fever etc. So it is always advisable to drink treated or boiled water.
3: Why ice floats on the surface of water?
A: The density of most of the solids and liquids increases with decrease in temperature. However, water shows a unique behavior in this regard because of hydrogen bonding. A water molecule is made from one oxygen atom and two hydrogen atoms strongly joined to each other. Water molecules are also attracted to each other by weaker chemical bonds (hydrogen bonds) between the positively-charged hydrogen atoms and the negatively charged oxygen atoms of neighboring water molecules. As the water cools below 4 C, the hydrogen bonds adjust to hold the negatively charged oxygen atoms

apart. This produces a crystal lattice, which is commonly known as ice. When water is cooled down below 4°C, its density decreases. At 0°C, the density of water becomes 0.91 g/cm. Thus, ice is lighter than liquid water and therefore floats on the surface of water.

4: Explain the importance of water and its quality?

A: Water is an important requirement in our life. After air, the importance of water takes the second place for survival on earth. Earth is the only planet in the solar system that contains water. It is very difficult to survive even a few days without drinking water.

Water quality: It describes the condition of the water, including chemical, physical, and biological characteristics. Water quality is measured by several factors, such as the concentration of dissolved oxygen, bacteria levels, the amount of salt or the amount of material suspended in the water .it saves us from many waterborne diseases. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well.

5: What is eutrophication? How does it pollute water?

A: Eutrophication: The excessive amount of nutrients such as nitrogen, phosphorous, nitrates etc. in water bodies is called eutrophication. Eutrophication can have serious effects, like algal blooms that block light from getting into the water and harm the plants and animals that need it. If there's enough overgrowth of algae, it can prevent oxygen from getting into the water and creating a dead zone where no organisms can survive. Hence this results in the death of aquatic animals.

6: How chemistry helps to maintain clean swimming pools?

A: Chemistry helps to maintain a clean swimming pool by killing bacteria and other microorganisms by using chlorine based disinfectants. It can be easily applied, measured and controlled. It is fairly persistent and relatively cheap. Chlorine itself does not kill when it is added into water, but it reacts with water to form hypochlorous acid (HOCl) and hydrochloric acid (HCl). $\mathbf{Cl_{2(g)} + H2O_{(l)} \rightarrow HOCl_{(aq)} + HCl_{(aq)}}$ Both kill microorganisms and bacteria by attacking the lipids in the cell walls and destroying the enzymes and structures inside the cell, makes them harmless. HOCl is unstable and produce atomic oxygen (O) which bleach the dyes and kill the germs by oxidations. Hypochlorous acid is able to oxidize the organisms in several seconds.

$\mathbf{HOCl_{(aq)} \rightarrow HCl_{(aq)} + [0]}$

7: Make the distinction between soft and hard water?

Soft water: Soft water contains fewer minerals such as Sodium. The formula is H_2O.Soft water is that water, which easily produces good lather and does not scum with soap because it has less minerals than hard water

Hard water: Hard water contains more minerals such as Calcium bicarbonate, Magnesium bicarbonate, Calcium Sulphate, Magnesium Sulphate, Calcium Chloride and Magnesium Chloride. The formula is D_2O. Hard water is that water, which produces little lather and forms scum with soap. Because of the high mineral quantity in hard water it leaves residue on things Due to the minerals counteracting the soap particles will not forming the foaming.

8: Why water is universal solvent?

A: Water is called the universal solvent because more substances dissolve in water than in any other chemical. This is due to polarity of each water molecule. The hydrogen side of water molecule carries slight positive charge, while oxygen side carries slight negative charge. This helps water dissociate ionic compounds into positive and negative ions. The positive part of ionic compound is attracted to oxygen side of water while negative part is attracted to hydrogen side of water. For example, consider what happens when salt dissolves in water. Salt is sodium chloride($NaCl$). The sodium portion of the

compounds carries a positive charge, while the chlorine part carries a negative charge. The two ions are connected by an ionic bond. The hydrogen and oxygen in the water, on the other hand, are connected by covalent bonds. Hydrogen and oxygen atoms from different water molecules are also connected via hydrogen bonds. When salt is mixed with water, the water molecules orient so that the negative charge oxygen anions faces the sodium ion, while the positive-charged hydrogen cations face the chloride ion. Although ionic bonds are strong, the net effect of the polarity of all the water molecules is enough to pull the sodium and chlorine atoms apart. Once the salt is pulled apart, its ions become evenly distributed, forming a homogeneous solution.

9: Give some of the disadvantages of the detergents?

A: Disadvantages:
1).The major disadvantage of detergent is that they are non - biodegradable. Microorganisms like bacteria cannot decompose detergent, while these microorganisms can easily decompose soap.
2) They causes soil and water pollution
3) Excessive alkalis used in some detergent can damage the fabric.
4) Colour may run out while using cheaper variety of detergent.
5) More amount of water is required for rinsing to remove foam, otherwise it will damage the fabric

10: Identify the different toxic substances in household wastes?

A: Household waste products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be "household hazardous waste". It is hazardous to human health and the environment. The following are the toxic household waste substances: Aerosols, Batteries, Automotive, Chemicals, Fertilizer, Fluorescent light bulbs, Hair color, Kerosene, Lawn and garden pesticides Nail polish, Shampoo and Thermometers with mercury

LONG QUESTIONS:

1a): Enlist the main sources of water?

A: Water is one of the most abundant natural resources present on earth. There are two main sources of water;

1**. Oceans (97.5%)**

2. Fresh water (2.5%) Fresh **water is further subdivided into:**

Lakes
Rivers
Ground water
Glaciers and ice caps.

The distribution of water on the Earth's surface is extremely uneven. Only 2.5% of water on the surface is fresh; the remaining 97.5% resides in the ocean. Of freshwater, 69% resides in glaciers, 30% underground, and less than 1% is located in lakes, rivers, and swamps. Only one percent of the water on the Earth's surface is usable by humans, and 99% of the usable quantity is situated underground.

b): How would you categorize physical properties of water?

A: Physical properties of water:

Pure water is colourless, odourless and a tasteless liquid.
Water exists in nature in all the three states i.e. solid, liquid and gas.
Freezing point of water is 0°C and boiling point is 100°C.
Pure water is neutral to litmus. It does not change the colour of the litmus.
Pure water has minimal electrical conductivity, but it's conductivity increases as electrolyte dissolved in it. Water is a polar molecule.
It has heat capacity of 4.18J/g℃ Water conduct heat and have high surface tension.

C): Predict the product of reaction, (i). K (ii). Cl_2 (iii). CaO (iv). CH_3CHOOH (v). C, with water?

A: Reaction With Alkali Metals: Potassium (K) react with water forming potassium hydroxide (KOH), and produce Hydrogen gas. $2K_{(s)} + 2H_2O_{(l)} \rightarrow 2KOH_{(aq)} + H_2(g)\uparrow$

Reaction with Chlorine: Chlorine gas reacts with water to produce hydrochloric acid (HCl) and hypochlorous acid (HOCl). It produces atomic oxygen which can killed the germs by oxidation.

$Cl_{2(g)} + H_2O_{(g)} \rightarrow HCl + HOCl_{(aq)}$ $HOCl_{(aq)} \rightarrow HCl_{(aq)} + [O]$

Reaction with Calcium Oxide: Water reacts with calcium oxide (quicklime) forming calcium hydroxide (slaked lime).$CaO_{(s)} + H_2O_{(aq)} \rightarrow Ca(OH)_{2(aq)}$

Hydrolysis Reaction: It is defined as the reaction in which H-OH bond of water molecule is broken down by the action of salt with water. When salt is added into water the solution becomes basic or acidic due to hydrolysis reaction. In this reaction water splits into H+ and OH- ions $CH_3COONa_{(aq)} + H_2O_{(l)} \rightarrow CH_3COOH_{(aq)} + NaOH_{(aq)}$ (Salt of weak acid) (weak acid)(Strong Base)**Reaction with Carbon:** When steam is passed over a red-hot carbon, a mixture of hydrogen and carbon monoxide, known as water gas is produced.

$C_{(s)} + H_2O_{(g)} \rightarrow CO_{(s)} + H_2(g)\uparrow$

Red hot carbon Water Gas

2: Water is an excellent solvent. Explain how this property is beneficial for life but sometimes harmful for us?

A: Water is the best-known solvent. It can dissolve more substances than any other solvent. Due to this fact, it is termed as a universal solvent. This property is very beneficial for us but sometimes become harmful for us, because mostly salts (pollutants) dissolve in water and cause water pollution. This characteristic property of water is due to the following reasons;

i: Polarity of water molecules

ii: Hydrogen bonding in water

iii: Dielectric constant

i: Polarity of water molecules: The water molecule has polar structure. The hydrogen on one end of the water molecule is partially positive.while the oxygen on the other end is partially negative. It is due to the electronegativity difference between oxygen (O=3.5) and hydrogen (H=2.1) atoms. When an ionic compound is added into water, oppositely charged ions are surrounded by water molecules. These oppositely charged ions of ionic compounds are pulled by the water molecules and it becomes soluble in water. For example,$NaCl$,KCl, are soluble in water. When an ionic compound such as sodium chloride ($NaCl$) is added to water, the sodium ion (Na^+) of NaCl is attracted towards the partial negative pole (O-δ) of water molecule while the chloride ion (Cl^+) is attracted towards the partial positive pole ($H^+\delta$) of water molecule. The ionic bond break down in NaCl, which causes the sodium chloride to split in water and dissolves. The water molecules orient in such a way that the negative poles are towards the positive ions. Similarly, the positive poles of water molecules orient themselves around the negative ions. A hydration shell is formed around the ions, which prevents Na^+ and Cl^- from attracting each other.

ii: Hydrogen bonding in water: Water molecule is composed of oxygen and hydrogen atoms. The hydrogen on one end of the water molecule is partially positive .while the oxygen on the other end is partially negative. Because of the presence of two nonbonding electrons (lone pairs of electrons) on oxygen, water molecule forms four hydrogen bonds with other H_2O molecule. These water molecules are arranged in a tetrahedral manner. Hydrogen bonding makes water unique. Covalent compounds, which have polar ends also form hydrogen bond with water. This behavior enables water to dissolve some of the covalent compounds having hydroxyl group (OH^-) very easily. For example, sugar ($C_{12}H_{22}O_{11}$), alcohol like methyl alcohol (CH_3OH) etc. will dissolve easily. **iii: Dielectric constant:** Dielectric constant is based on the coulomb law in which the force of attraction between two oppositely charged bodies “x” and “y” is directly proportional to the product of charges and inversely proportional to the square of distance between them r^2 .**Mathematically it can be written as:**

$\boldsymbol{Force} \infty \frac{(x)(y)}{r2}$ $\boldsymbol{Foece} = \frac{(x)(y)}{Dr2}$Where D is the proportionality constant and is called the dielectric constant of water. Greater the value of D the smaller will be the force of attraction and vice versa. Water has a high dielectric constant of 80 at 18℃. Thus, the positive and negative ions of a polar salt dissolved in water will have less force of attraction and would remain soluble, while other liquids have small value of dielectric constant compared to water and therefore, these are not good solvents.**3a): Classify temporary hard water and permanent hard water?**

A: There are two types of hard water;

1: Temporary hard water2: Permanent hard water

1: Temporary hard water: The temporary hardness of water is due to the dissolved Calcium bicarbonate and Magnesium bicarbonate. These salts are soluble in water and are present in the form of

positive and negative ions as shown below:
$Ca(HCO_3)_{2(aq)} \rightarrow Ca^{2+}((aq0 + 2HCO_3^-{}_{(aq)}\ Mg(HCO_3)_{2(aq)} \rightarrow Mg^{2+}{}_{(aq)} + 2HCO_3^-{}_{(aq)}$ **2: Permanent hard water:** The permanent hardness of water is due to the presence of chlorides (Cl-) or sulphates (SO_4^{-2}) of calcium and magnesium i.e. $MgCl_2$, $MgCO_3$ and $CaCl_2$. These salts are soluble in water and produce the respective ions in water. Simple boiling of the water cannot decompose these salts.$CaCl_{2(aq)} \rightarrow Ca^{2+} + 2Cl^-{}_{(aq)} MgCl_{2(aq)} \rightarrow Mg^{2+} + 2Cl^-{}_{(}CaSO_{4(aq)}) \rightarrow Ca^{2+}((aq) + SO_4{}^{-2}{}_{(aq)}$ $MgSO_4 \rightarrow Mg^{2+} + SO_4{}^{-2}{}_{(aq)}$**b): What methods could be adopted to remove the temporary hardness of water? A: Methods for Removal of Temporary Hardness:**
i: By boiling the temporary hard water: Temporary hardness of water can be easily removed by simple boiling the water. This hardness is caused by the presence of dissolved calcium bicarbonate, $Ca(HCO_3)_2$, which decomposes on heating. The calcium carbonate ($CaCO_3$) is formed. The calcium carbonate is insoluble and settles down as precipitate at the bottom. , $Ca(HCO_3)_{2(aq)} \rightarrow CaCO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$ **ii: Clark's Method**: This method is used to remove the temporary hardness of water on a large scale. This is a chemical method. A calculated amount of slaked lime, (Ca(OH)2) is added to the temporary hard water. The soluble bicarbonate ions (HCO3-) of calcium and magnesium present in temporary hard water are converted into their carbonate ions(CO3-2). The carbonates of calcium and magnesium are soluble in water and settles down at the bottom. $Ca(HCO_3)_{(aq)} + Ca(OH)_2 \rightarrow 2CaCO_{3(s)} + 2H_2O_{(l)}$White ppt $Mg(HCO_3)_{2(aq)} + Ca(OH)_2 \rightarrow MgCO_{3(s)} + CaCO_{3(s)} + 2H_2O_{(l)}$White ppt**C): What methods could be adopted to remove the permanent hardness of water? A: Methods for removal of Permanent Hard:** Permanent hardness of water can only be removed by using chemicals, which convert soluble salts into insoluble salts on precipitation. **i: By using washing soda:** The washing soda ($NaCO_3$) removes the permanent hardness of water. The washing soda reacts with the soluble calcium and magnesium chloride and sulphate and converts them into insoluble calcium and magnesium carbonate respectively
$Na_2CO_{3(aq)} + CaCl_{2(aq)} \rightarrow CaCO_{3(s)} + 2NaCl_{(aq)}\ Na_2CO_{3(aq)} + MgCl2(aq) \rightarrow MgCO_{3(a)} + 2NaCl_{(aq)} Na_2CO_{3(aq)} + CaSO4(aq) \rightarrow CaCO_{3(s)} + Na_2So_{4(aq)}\ Na_2CO_{3(aq)} MgSO4(aq) \rightarrow MgCO_{3(s)} + Na_2SO_{4\ (aq)}$**ii: Ion exchange method**: Zeolite is an ion exchange resin which is integral part in the water treatment process in both consumer and industrial settings. Zeolite is naturally occurring sodium aluminum silicates. It can also be prepared artificially. This resin is commonly known as sodium zeolite. When hard water is passed through the resin, the sodium ions will go into the solution while the unwanted calcium and magnesium ions take their place in the resin.
$CaSO_{4(aq)} + Na2\text{-}Zeolite \rightarrow Ca\text{-}Zeolite + + Na_2SO_{4(aq)}$ Soluble Insoluble
$MgSO_{4(aq)} + Na_2\text{-}Zeolite \rightarrow Mg\text{-}Zeolite + Na_2SO_{4(aq)}$ Soluble InsolubleWhen the Na-zeolite is used up and becomes inactive then it can be regenerated by treating it with a strong solution of common salt(NaCl).
$Ca\text{-}Zeolite_{(S)} + 2NaCl_{(aq)} \rightarrow Na_2\text{-}Zeolite_{(S)} + CaCl_{2(aq)}$**4a): Why water is important for us?**
A: Water is an important requirement in our life. After air, the importance of water takes the second place for survival on earth. Water is important for us because;
Water is vital for maintaining life. The reactions, which take place in our body and keep us alive occur in the presence of water.
Water regulates the temperature of earth.
Water is a universal solvent, as many substances dissolve in it.
Water serves as a medium for transportation, as ships and boats move on water.
Water enables our body to excrete waste during perspiration and urination.

The kidneys and liver use it to help flush out these wastes from our body.
Water is used in cooking and washing.
Running water is used to generate electricity.
Water in lakes, rivers and oceans are used as a means of transportation.
Fish and other aquatic animals and many plants live in water.
Agriculture needs large amount of water, to cultivate fruits, vegetables, and other food.
It is required for irrigating crops, as seeds cannot germinate without water.
Many industries such as petroleum, fertilizers, dye and drugs industries require large quantities of water for various processes.

b): Write the disadvantages of hard water?

A: The following are the disadvantages of hard water;
Hard water consumes large amount of soap in washing process.
Hard water is unfit to use in steam engines and boilers. When hard water is used in the boiler, calcium and magnesium salts settles down at the bottom as hard insulating scale. As a result, more fuel is consumed in producing steam. If these are not removed, they block the tubes, which lead to the engines. These make a constant threat to the explosion of boiler. This deposition of scales inside the boiler causes overheating and reduces the life of boiler.
Use of hard water for drinking purposes for a long time causes dysentery, intestinal and stomach diseases. If magnesium sulphate is present in the hard water, it weakens the stomach function.

c): Enlist the advantages of wastewater treatment?

A: Wastewater treatment is defined as the process of removing any harmful contaminants from water no longer needed

Advantages of wastewater treatment:

1)It prevents disease:
It removes harmful bacteria and chemicals from water that cause disease. Thus makes the water safe for living organisms.
It provides clean water: It filtering out harmful contaminants, and leaving a water source clean and safe for everyone. This removes the fear of droughts, water shortages.

5a): How would you evaluate the effects of water pollution?

A: Effects of water pollution:
The effects of water pollutants are not only disturbing to people but also to plants, animals, fishes and birds. Polluted water is unsuitable for drinking, agriculture and industry.
The major effect of water pollutants are as under;
i: Infectious disease: Water pollution is the major cause of infectious diseases in human beings. These diseases include typhoid, cholera, dysentery, amoebiasis, ascariasis and hepatitis etc.
ii: Nutrient pollution: Nutrient pollution is a form pf water pollution. In this process, large amount of nutrients such as nitrogen, phosphorus, nitrates etc. become part of water as a runoff from agricultural fields or weathering of rocks. The enrichment of nutrients in water bodies is called eutrophication. These excessive amounts of nutrients create problems such as excessive growth of algae, decrease in dissolved oxygen in water etc. This in turn, can kill fish, carbs, oysters, and other aquatic animals.
iii: Chemical contamination: Some of the major effects of chemical contamination are as under;
Pesticides affect and damage the nervous system, liver, reproductive system, endocrine glands and DNA etc.
Oil and petrochemical can alter the ecology of aquatic habitats and the physiology of marine organisms. In human beings, it causes gastro-intestinal irritation, liver and kidney damage and nervous system effects. Mercury and its compounds are used in many industries. It finds its way into

the water bodies primarily through air pollution and industrial wastes. Mercury gets into the body through food especially seafood. In children, it causes brain damage, learning defects and incomplete mental development. In adults, mercury causes Parkinson's disease, Alzheimer's disease etc.

iv: Thermal water pollution: Hot water from industrial processes is directly allowed to become the part of the environment. This hot water effects the aquatic life in two ways;

a. The hot water decrease the solubility of oxygen as a result aquatic organisms will die due to the shortage of oxygen. Many aquatic animals especially young cannot survive in water above 30℃ and will die.

b.Explain how industrial wastes pollute environment?

A: Industrial wastes such as hot water, chemicals and solid materials pollute our environment in the following ways;

Most of the industries have been started without proper planning and waste treatment plants. They just dispose off untreated toxic wastes into nearby drains, canals or rivers. Industries produce lots of wastes. These wastes are highly toxic due to the presence of compounds like mercury, calcium, lead, chromium, arsenic, acids such as hydrochloric acid (HCl), sulphuric acid (H_2SO_4), nitric acid (HNO_3), oils, grease, dyes and may also contain gases in dissolved form.

Water used in industries as a coolant or for cleaning purposes dissolves all the chemicals and detergents and causes water pollution when discharge from industries. These industrial wastes also pollute ground water. The compounds which are discharged from industries gets into the body through edible substances and cause different diseases.

Radioactive wastes that may leak from nuclear power stations also create many problems to the living organisms.

c): Support the view that domestic wastes cause pollution?

A: Domestic Wastes: Domestic waste is also called solid waste or urban waste. It is either in solid or semisolid form. It contains food, newspaper, glass bottles, cans, metals etc. Today, many people dump their garbage into streams, lakes, rivers and seas. When rainwater or other forms of water come in contact with these materials, it removes or extracts chemicals from these solid wastes. This process is called leaching and the resulting mixture is called leachate. Leachate either seeps into the soil and pollutes underground water or finds its way to rivers and streams through rainwater.

d): How would you relate the agricultural wastes and water pollution?

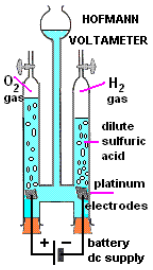
A: Agricultural Wastes: Agricultural wastes are wastes produced as a result of various agricultural activities. Agricultural wastes include both natural and synthetic wastes. Natural (organic) wastes include manure and other wastes from farming, harvesting, poultry and slaughter houses etc. whereas, synthetic wastes consists of fertilizers in run-off water from fields, pesticides, insecticides and herbicides that enter into water, air or soils and salt and slit drained from fields.

Topic wise:

Composition of water: water is a compound of hydrogen and oxygen. Henry Cavendish proved that water is a compound. Composition of water can be determined,

1) Volume 2) Mass .

Composition of water by volume: Water molecule composed of two Hydrogen atoms and one Oxygen atom. Its molecular formula is H_2O.Composition of water can be determined by using an apparatus called "Hofmann voltammeter". When an electric current is passed through water containing a little salt, water decomposes into hydrogen gas and oxygen gas.it shows that water composed of two volumes of hydrogen and one volume of oxygen.



Composition of water by mass: Water is composed of one part of hydrogen to eight parts of oxygen by mass. Joseph Proust determined the ratio of water by mass I.e. 1:8.

Explanation: One mole of H_2O is made up of 2 moles of Hydrogen atoms and 1 mole of Oxygen atom

Mass of 1 mole of Hydrogen atoms= 1 g /mol

Mass of 1mole of Oxygen atoms = 16 g/mol

Mass of two moles of Hydrogen atoms = 2x 1 g/mol = 2 g/mol.

Mass of one mole of Oxygen atoms = 1 x 16 g /mol

Mass of one mole of water = 2 g/mol + 16 g/mol = 18 g/mol.

% of hydrogen = molecular mass of hydrogen / molecular mass of H_2O ×100

%of hydrogen= 2/18 ×100=11.11

% of oxygen = Atomic mass of oxygen/molecular mass of H_2O ×100

% of oxygen = 16/18=88.88

Ratio = 1 : 8

Water pollution:

Definition: water pollution occurs when undesirable foreign substance are introduced into natural water**.** The substances that cause water pollution is called pollutants**.** Water pollution is one the main environmental issues that we are facing, as more than 70% of the Earth's surface is water-covered.

Sources of water pollution: The major sources of water pollution are following**;**

Industrial waste: waste from factories, refineries, waste treatment plants etc. that emit fluids of varying quality directly into urban water supplies cause water pollution sources include contaminants that enter the water supply from soils/groundwater systems and from the atmosphere via rain water. Soils and groundwater contain the residue of human agricultural practices (fertilizers, pesticides, etc.) and improperly disposed of industrial wastes. Atmospheric contaminants are also derived from human practices (such as gaseous emissions from automobiles, factories and even bakeries).

Waterborne diseases: The diseases that spread due to polluted water or eating those foods that are prepared from polluted water are called waterborne diseases. They bacterial, parasitic or viral diseases.

(1)Bacterial infections:

cholera: The symptoms are watery diarrhea and vomiting. It effects intestine and causes dehydration**.**

Dysentery: It is the large intestinal disease, causing abdominal cramp, anal pain and bloody stool.
Typhoid: it is bacterial disease and person is suffer from typhoid fever.
(2) Viral infections:
Hepatitis A and E: Hepatitis-A virus infection (HAV) and Hepatitis E virus infection (HEV) are due to contaminated water: it attack liver and cause jaundice.
Polio: Polio, also called poliomyelitis or infantile paralysis, is an infectious disease caused by the poliovirus.The polio virus usually enters the environment in the feces of someone who is infected. In areas with poor sanitation.
Protozoal infections: In this disease Amoeba enters through unsanitary food or contaminated water effect the gastrointestinal illness.
Parasitic infections: Guinea worm and pinworm infection are common parasitic infection. In contaminated water the egg of these worms are swallowed cause ulcers, fever, and vomiting.
Arsenicosis and fluorosis:
Fluorosis: It is an abnormal condition caused by excessive intake of water having fluorine.it effects the bones and teeth.
Arsenicosis: Drinking water rich in arsenic over a long period leads to arsenic poisoning or arsenicos is Most waters in the world have natural arsenic concentrations of less than 0.01 mg/dm^3.The symptoms of this disease are excess of saliva, vomiting, nausea and blood in urine.

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UNIT 16

EXERCISE

SHORT QUESTIONS

Q1. How could you convert $NaHCO_3$ into Na_2CO_3?

Ans: Calcination: sodium bicarbonate ($NaHCO_3$) is converted into sodium carbonate (Na_2CO_3) by the process called calcination, in this process $NaHCO_3$ is heated in rotatory funnel call calcinatory, to give anhydrous sodium carbonate.

$$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2\,(g)} + H_2O$$

Q2. Enlist the different uses of urea?

Ans: Uses of urea:

it is a white crystalline organic compound. It is important due to the following usage.

1. Fertilizer: about 86% of urea is used as solid fertilizer.

2. Resins: Urea-formaldehyde resins are used as a polywood adhesive/glues.

3. Use as explosive: Urea can be used to make urea nitrate, which is highly explosive.

4. Chemical Industry: Urea is used as a raw material for manufacture of many important chemical compounds like plastics, resins, and various adhesives etc.

6. Flame proofing agent: Urea is used as a flame proof in agent.

7. Cosmetics:it is used as an ingredient in hair conditioners, facial cleaners and lotions.

8.Repellent to Corrosion:It is used as an alternative to rock salt in the deicing roadways and runways. It does not promote metal corrosion to extent that salt does.

9. Cigarette: It is also used as flavor enhancing additive for cigarette.

10. Medicinal uses:urea containing creams are used as tropical dermatological products to promote rehydration of skin.

Q3. Differentiate between minerals and ore.

Ans: Minerals: The naturally combined state of metal is called is called mineral.

Ores: An aggregate of mineral and other impurities is known as ore.

Q4. What is metallurgy? What are its types?

Ans: Metallurgy: The art and science of making of making metals and alloys from their ores with properties suitable for practical uses is called metallurgy. OR

The science that deals with the procedures used in extracting metals from their ores, purifying**,** alloying metal sand creating useful objects from metal is called metallurgy.

Types of metallurgical operations: In metallurgy the ores are mined and subjected to various mechanical and chemical processes. There is no single method for extracting metals from their ores, But certain basic operation are , required that is,

i. Concentration of ores

ii. Extraction of metal (roasting and reduction)

iii. Refiningof metal**.**

Q5. What is the function of forth floatation?

Ans: Forth floatation: A separating method of the mineral particles of ore from the gangue that depends on the wetting of the minerals pieces.

Function of forth floatation: It is a process for selectively separating hydrophobic materials from hydrophilic. In this process the ore is wetted with water. And the water insoluble impurities float on the surface and thus separated from the ore.

Q6. On what basis the different fraction of petroleum are separated?

Ans: Fractional distillation: The type of distillation in which different fractions of petroleum are separated according to difference in their boiling point is called Fractional distillation.

Basic principle of Fractional distillation: The fractions are separated according to difference in their boiling point. The substances having less boiling points boils out first leaving behind others.

Q7. What is slaked lime? How slaked lime is produced.

Ans: Slaked lime: Slaked lime is calcium hydroxide $Ca(OH)_2$.

Preparation: when quick lime (CaO) and water are mixed together in calculated amount and the mixture is heated, slaked lime is produced.

$CaO + H_2O \rightarrow Ca(OH)_2$

Q8. Assess the composition of urea and calculate the percentage of nitrogen in it.

Ans: Composition of urea**:** urea is one of the most important nitrogenous fertilizers. Its chemical formula is NH_2CONH_2. The formula shows that urea is composed of nitrogen, hydrogen. Carbon and oxygen. **Percentage of nitrogen in urea:**

Percentage of an element in a compound can be calculated by using following formula:

$$\text{Percentage of element} = \frac{Atomic\ masss\ of\ element \times no.of\ aatoms\ in\ compoun}{molecular\ mass\ of\ the\ compound} \times 100$$

Molecular formula of Urea = N_2H_4CO

Molecular mass of urea $= 14\times2 + 1\times4 + 12 + 16 =$

$= 28+ 4+ 12 + 16 = 60$g/mol.

Q9. What is gangue and where it is found?

Ans: Gangue: The earthy material like sand, rock, clay, lime stone, etc. attached with ores are called gangue. Gangue are the impurities mostly found in ores

Q10. How blistered copper is purified?

Ans: Purification of blistered copper: The blistered copper is purified/refined by electrolytic process.

Electro-refining of Copper: the process of electro refining of copper involves following steps.

Construction:i. Anode: a large plate of blistered copper is made anode.

ii. Cathode: a thin sheet of pure copper is made cathode.

iii. Electrolyte: The solution of copper sulphate ($CuSO_4$) and dil. Sulphuric acid (H_2SO_4) solution is used as an electrolyte.

Working: During electrolysis, pure copper is deposited on the cathode.

The impurities (Ag, Au and Pt. along with Cu_2O) in the anode and settle s\down at the bottom and are

removed as anode mud. The copper obtained by this method is 99.9% pure.
Reaction at anode: $Cu_{(s)} \rightarrow Cu^{+2}_{(aq)} + 2e^-$

Reaction at Cathode: $Cu^{+2}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

LONG QUESTIONS

Q1. How could you convert the concentration ore to its oxide?
Ans: Concentration ore to its oxide: Following methods are used to convert the concentration ore to its oxide form.

1. **Roasting:** It is the process in which concentrated ore is heated alone or in the presence of some other materials in excess of air in a process.
   Procedure: the ore of metals such a copper and nickel when roasted in a furnace in the presence of air between 5000^0C and 7000^0C are converted into their oxide i.e.
   $CuCO_{3(s)} \rightarrow CuO_{(s)} + CO_{2\,(g)}$
   $Cu\,(OH)_{2(s)} \rightarrow CuO_{(s)} + H_2O_{\,(g)}$
   $2CuFeS_{2(s)} \rightarrow Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2\,(g)}$
2. **Smelting:** It is the process in which the oxide ore in the fused state is reduced with reducing agents such as coke to get the metal is called roasting.
   Procedure: The roasted ore is mixed with coke and sand and smelted into blast furnace. During smelting iron sulphide (FeS) get oxidized to iron oxide (FeO). The iron oxide then react with silica (SiO_2) forming iron silicate ($FeSiO_3$).
   $2FeS_{(s)} + 3O_{2\,(g)} \rightarrow 2FeO_{(s)} + 2SO_{2\,(g)}$
   $FeO_{(s)} + SiO_{2(s)} \rightarrow FeSiO_3$
   Cuprous sulphide (Cu_2S) is also oxidizes and form copper oxide (Cu_2O).
   $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_{2\,(g)}$
   Cu_2O then reacts with un-reacted FeS and form Cu_2S and FeO.
   $Cu_2O_{(s)} + FeS_{(s)} \rightarrow Cu_2S_{(s)}\ FeO_{(s)}$
   The$Cu_2S$and FeS is called matte and is removed through slag hole.
3. **Bessemerization:**
4. **History:** Bessemer process was invented by Henry Bessemer.

Bessemer converter: This process is carried out in a special kind of egg shaped or pear shaped furnace. This furnace is called Bessemer.
Procedure: In Bessemerization matte is reacted with sand. Iron sulphide (FeS) oxidized to Iron oxide (FeO). This iron oxide (FeO) reacts with sand (SiO_2) forming ($FeSiO_3$), slag which is float on the surface.

$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$
$FeO + SiO_2 \rightarrow FeSiO_3$

Similarly Cuprous sulphide (Cu_2S) is converted to cuprous oxide (Cu_2O). This Cu_2O reacts with Cu_2S to produce copper (Cu) in molten form and sulphur dioxide (SO_2). This copper is known as blister copper (95-97% pure).

$2Cu_2S + 3O_2 \rightarrow 2Cu2O + 2SO_2$
$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

Q1. b. How would you use the roasting in extraction of copper?
Ans: Roasting: It is the process in which concentrated ore is heated alone or in the presence of some other materials in excess of air in a process.
Procedure: The concentrated ore of copper when roasted in a furnace between 5000^0C and 7000^0C in the presence of air are converted into their oxide i.e.
$CuCO_{3(s)} \rightarrow CuO_{(s)} + CO_{2\,(g)}$ $Cu(OH)_{2(s)} \rightarrow CuO_{(s)} + H_2O_{(g)}$ $2CuFeS_{2(s)} \rightarrow Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2\,(g)}$

Q1.c. What inference can you make of smelting in extraction of copper?
Ans: Smelting: It is the process in which the oxide ore in the fused state is reduced with reducing agents such as coke to get the metal is called roasting.
Procedure: The roasted ore is mixed with coke and sand and smelted into blast furnace. During smelting iron sulphide (FeS) get oxidized to iron oxide (FeO). The iron oxide then react with silica (SiO_2) forming iron silicate ($FeSiO_3$).

$2FeS_{(s)} + 3O_{2(g)} \rightarrow 2FeO_{(s)} + 2SO_{2(g)}$ $FeO_{(s)} + SiO_{2(s)} \rightarrow FeSiO_3$
Cuprous sulphide (Cu_2S) is also oxidizes and form copper oxide (Cu_2O).
$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_{2\,(g)}$
Cu_2O then reacts with un-reacted FeS and form Cu_2S and FeO.
$Cu_2O_{(s)} + FeS_{(s)} \rightarrow Cu_2S_{(s)}$ $FeO_{(s)}$
The$Cu_2S$and FeS is called matte and is removed through slag hole.

Q1. D. can you elaborate the reason of electro-refining of copper?
Ans: Purpose of electro-refining of copper: The blistered Copper is 95-97% pure copper, beside, this it contains iron (Fe), manganese (Mn), silver (Ag), gold (Au) etc. copper when used for electrical industries must be highly pure. Therefore in order to purify the blistered copper the electro-refining of copper is done.

Q2. A. List the raw materials used in Solvay process?
Ans: Solvay process: Sodium carbonate which is also known as soda ash is commercially prepared by a process known as Solvay process.
Raw materials used in Solvay process: Raw materials used for the manufacture of sodium carbonate are:

- Sodium chloride (NaCl)
- Lime stone ($CaCO_3$)
- Ammonia (NH_3)
- Water (H_2O)

Q2.b. What basic reaction would you use to support the manufacture of soda ash?
Ans: Basic reaction:
Solvay process consists of following steps.
1. Preparation of Brine solution: At first step, a saturated solution of sodium chloride is prepared which is known as brine.
2. Preparation of ammoniacal Brine: In this step, saturated brine solution is allowed to flown down in ammoniating tower, where ammonia is dissolved in brine.
3. Preparation of carbon dioxide and Slaked lime: Carbon dioxide is produced by heating limestone in lime kiln. $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2\,(g)}$
Carbon dioxide is fed into the carbonating tower from top. Calculated amounts of quick lime (CaO)

and water mixed to produce slaked lime Ca (OH) $_{2\,(aq)}$

$CaO_{(s)} + H_2O \rightarrow Ca\,(OH)_{2(aq)}$

4. Carbonation of Ammoniacal brine: in this step, ammoniacal brine is allowed to enter the carbonating tower, where ammoniacal brine is mixed with carbon dioxide gas, carbon dioxide reacts with ammoniacal brine to form ammonium carbonate $(NH_4)_2CO_3$

$2NH_{3(g)} + CO_2 + H_2O \rightarrow (NH_4)_2CO_{3(aq)}$

Ammonium carbonate reacts with sodium chloride and form sodium bicarbonate ($NaHCO_3$) and ammonium chloride (NH_4Cl).

$(NH_4)_2CO_{3\,(aq)} + NaCl \rightarrow NaHCO_{3(s)} + NH_4Cl\,_{(aq)}$

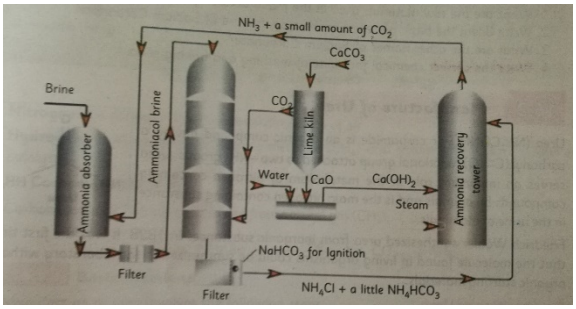
5.Filtration: The precipitate of sodium bicarbonate ($NaHCO_3$) is separated from the solution by filtration. It is used as baking soda.

6. Calcination: dry sodium bicarbonate ($NaHCO_3$) is heated in rotatory funnel call calcinatory, to give anhydrous sodium carbonate.

$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2\,(g)} + H_2O$

7. Recovery of Ammonia: Ammonia is recovered from ammonia chloride solution and slaked lime. Slaked lime is heated with ammonium chloride to form ammonia and calcium chloride which is the by product.

$2NH_4Cl_{(s)} + Ca\,(OH)_{2(aq)} \rightarrow CaCl_{2\,(aq)} + 2NH_{3\,(g)} + 2H_2O_{\,(l)}$



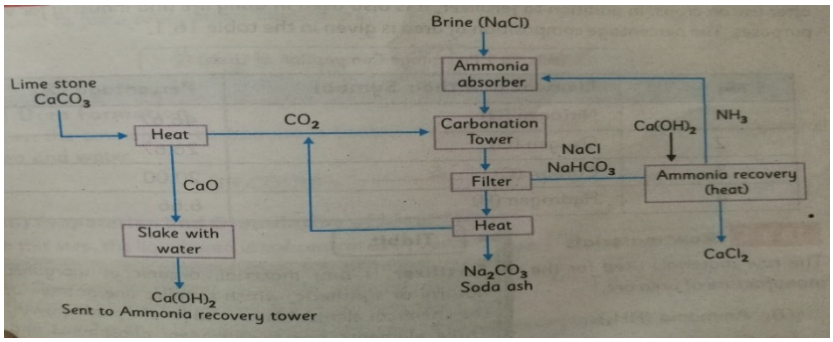
Q2.c. predict the by-products in the Solvay process.

Ans: By-products in the Solvay process:

the by-products of Solvay process is calcium chloride.

Q2.d. sketch the flow sheet diagram of the Solvay process.

Ans:



Q3.a. Enlist raw material used in the manufacture of urea?

Ans: Urea: Urea is an organic compound having a carbonyl (C═O) functional group attached to two –

NH_2. . Urea is one of the most important nitrogenous fertilizers. Its chemical formula is NH_2CONH_2. The formula shows that urea is composed of nitrogen, hydrogen. Carbon and oxygen.

Raw material used in the manufacture of urea material used in the manufacture of urea are following.

- Ammonia (NH_3)
- Carbon dioxide (CO_2)

Ammonia (NH_3): ammonia is prepared by Haber process. In this process, nitrogen and hydrogen react when they are passed over iron catalyst at 450^0C and 200 atmosphere pressure. It produces ammonia.
$N_{2\,(g)} + 3H_{2\,(g)} \rightarrow 2NH_{3\,(g)}$**Carbon dioxide:** it can be prepared from natural gas (CH_4).
$CH_{4\,(g)} + H_2O_{\,(g)} \rightarrow CO_{2\,(g)} + 4H_{2\,(g)}$

Q3.b. What basic reactions would you use to support the manufacture of urea?
Ans: Basic reaction:
Manufacture of urea involves the following steps.

1. Reaction of Ammonia and carbon dioxide: ammonia and carbon dioxide are heated at 17o – 200^0C and 100-200 atmospheric pressure to form ammonium carbamate.

$2NH_{3\,(g)} + CO_{2\,(g)} \rightarrow NH_2COONH_4$
2.Urea formation: when ammonium carbamate is heated it decomposes and produce water and urea.

$NH_2COONH_4 \rightarrow NH_2CONH + H_2O$

3. Evaporation and granulation of liquid: in this step, liquid urea is concentrated in vacuum evaporators. It is sprayed from top of tower under pressure and hot current of air in introduced from the bottom in opposite direction. It evaporates water from urea. It is rapidly cooled and sent to the granules. This urea is stored to be marketed.

Q3.c. What is the advantage of recycling of untreated compound in manufacture of urea?

Ans: Advantages of Recycling: manufacture urea contain untreated ammonia and carbon dioxide and ammonium carbamate. Ammonium carbamate is removed by reduction the pressure. When heating ammonia and carbon dioxide is separated. The advantage of this process is that ammonia and carbon dioxide can be recycle back to the process. Which increases urea yield.

Q3.d. Sketch the flow sheet diagram of urea manufacture process.

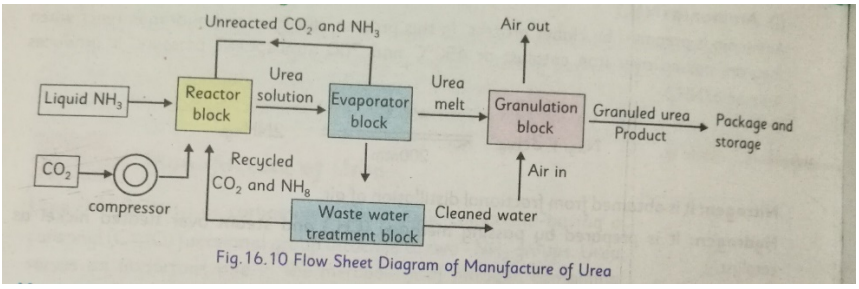


Fig.16.10 Flow Sheet Diagram of Manufacture of Urea

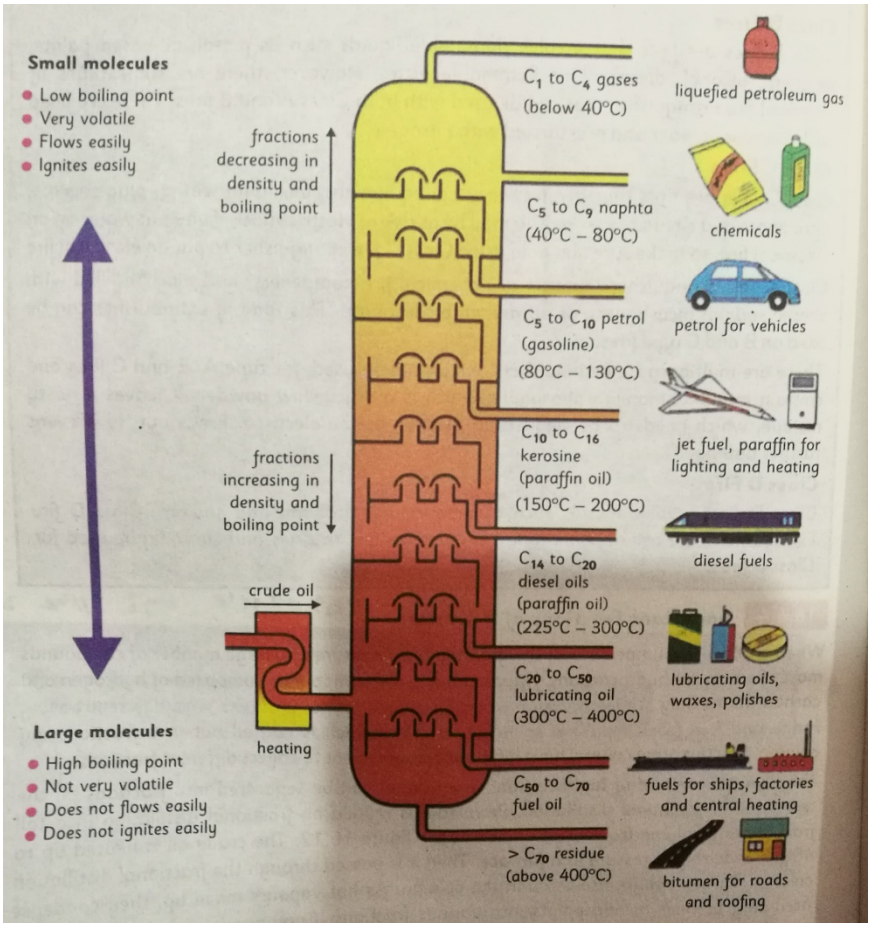
Q4.a.Define refining of petroleum. Describe the composition of petroleum?
Ans: Refining of petroleum:
the conversion of crude oil into useful products with different boiling range and d free from impurities is called refining of petroleum.

Composition of petroleum: petroleum is the mixture of various hydro carbons. It includes petroleum gas such as methane, ethane, propane and butane, naphtha petrol which range from $C_4 – C_1$. Kerosene oil ranges from $C_{12} – C_{16}$, diesels oils from $C_{14} – C_{25}$, lubricating oil $C_{20} – C_{70}$ and residue which is above C70.

Q4.b. What are the two theories about origin of petroleum?
Ans: There are two theories about origin of petroleum.
Inorganic origin: This theory was put forward by Russian chemist Mendeleev. He proposed that steam reacted with metallic carbides at high temperature and pressure under the surface of the earth produced petroleum. This theory did not gain popularity. According to this theory petroleum is originated from non-living source.

Organic origin: according to this theory, the remain of plants and animals were buried under the soil millions of year ago. These dead organic matter were converted into petroleum by the action of bacteria under the influence of temperature and pressure of the earth. These deposits trapped between the layers of nonporous rocks. The oil and gas thus formed could not come out and collected underground. This theory gain popularity.

Q.4.c. write a detail note on fractional distillation of petroleum.
Ans: Fractional distillation: The type of distillation in which different fractions of petroleum are separated according to difference in their boiling point is called Fractional distillation.
Basic principle of Fractional distillation: The fractions are separated according to difference in their boiling point. The substances having less boiling points boils out first leaving behind others.
Fractional Column: Fractional distillation is carried out in fractionating column. It has different compartment to collect different fractions**.**
Fractional distillation of petroleum: First of all crude oil is heated up to 400^0C under high pressure in a furnace. The heated mixture then passed through the fractional distillation column. The fractionating g column is divided into different compartment. Each compartment has definite range of temperature as hot vapours move up, they condense according to their boiling point into various fractions. Compound with high boiling point will condense first near bottom, while those compounds having low boiling points move to the top of column. Thus crude oil is separated into different fractions.



S.No	Fraction	Number of carbon atoms per molecule	BoilingPoint	Uses
1	Refinery Gas	$C_1 – C_4$	Below 40^0C	Methane (CH_4) coking, ethane another gaseous fuel, carbon-3 and carbon-4 as portable energy source and butane for camping gas
2	Naphtha-petrol (gasoline)	$C_4 – C_{12}$	40^0C - 130^0C	Naphtha used as a solvent and important chemical and as light engine oil

3	Kerosene (paraffin oil)	$C_{12} – C_{16}$	150^0C - 200^0C	Less volatile, less flammable than petrol, used for domestic heating fuel (paraffin), aircraft jet fuel (kerosene)
4	Diesel Oils	$C_{14} – C_{225}$	225^0C - 300^0C	Less volatile than petrol, used as a fuel in large vehicle such as trucks, trains etc.
5	Lubricating oil	$C_{20} – C_{70}$	300^0C - 400^0C	Viscous and used as lubricating oil and greases
6	Residue (bitumen/ Asphalt)	Above C_{70}	Above 400^0C	Used on roads as it forms a thick, black, tough and resistant adhesive surface on cooling, also used as a roofing water proofing material

Q5.a. write a detail note metallurgical operations.

Ans: Metallurgy: The art and science of making of making metals and alloys from their ores with properties suitable for practical uses is called metallurgy. OR
The science that deals with the procedures used in extracting metals from their ores, purifying**,** alloying metal sand creating useful objects from metal is called metallurgy.
Basic metallurgical operations: In metallurgy the ores are mined and subjected to various mechanical and chemical processes. There is no single method for extracting metals from their ores, But certain basic operation are required that is,
i. Concentration of ores
ii. Extraction of metal (roasting and reduction)
iii. Refining of metal**.**
1. Concentration of ore: the removal of useless rocky portion of the ore is called concentration of ore.

Explanation: Ore is impure metal containg large amount of sand and rocky material. These impurities must be removed from the ore before the extraction of metal.

Crushing and grinding: Huge lumps of ores are broken down into small pieces and then reduced to fine powder with the help of ball mill or stamp mill. This process is called pulverization.

Method used: there are mostly physical methods of concentration and also some chemical methods.

1. Hand picking: in this method the ores are concentrated to sufficient degree of purity by simple picking it with hand and breaking the rock stones with hammer.

2. Hydraulic washing:
Basis: This method is based on difference in densities of the ore and gangue.
Procedure: In this process, the ore particles are poured over a hydraulic classifier which is vibrating inclined able with grooves and a jet of water is allowed to flow over it. The denser are settled in the grooves while the lighter gangue particles are washed away.

Forth floatation: A separating method of the mineral particles of ore from the gangue that depends on the wetting of the minerals pieces.
Function of forth floatation: It is a process for selectively separating hydrophobic materials from hydrophilic. In this process the ore is wetted with water and pine oil. And the water insoluble impurities float on the surface and thus separated from the ore.
Steps:
1. Floatation tank: concentration of copper ore is carried out in floatation tank.
2. Crushing and grinding: In this step the ore is reduced to fine powder through crushing and grinding.

3. Froath formation: the powdered ore is suspended in water, soap or pine oil is added and a blast of air is bubbled through the suspension to produce froth.
4. Particle of ore: the particle are wetted by oil and float at the top of the mixture in container from which it is collected.
5. Concentrated Ore: the froth is washed with water and then filtered to obtain concentrated ore. While undissolved particles settle down at the bottom.
ii. Extraction of metal (roasting and reduction)

See L.Q 1 (part b and c).

iii. Refining of metal.

See L.Q 1 part d.

Q5.b. Explain the process of smelting and Bessemerization with reference to copper extraction.
Ans: Smelting: It is the process in which the oxide ore in the fused state is reduced with reducing agents such as coke to get the metal is called roasting.
Procedure: The roasted ore of copper is mixed with coke and sand and smelted into blast furnace. During smelting iron sulphide (FeS) get oxidized to iron oxide (FeO). The iron oxide then react with silica (SiO_2) forming iron silicate ($FeSiO_3$).

$2FeS_{(s)} + 3O_{2(g)} \rightarrow 2FeO_{(s)} + 2SO_{2(g)}$
$FeO_{(s)} + SiO_{2(s)} \rightarrow FeSiO_3$
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Cu_2O then reacts with un-reacted FeS and form Cu_2S and FeO.
$Cu_2O_{(s)} + FeS_{(s)} \rightarrow Cu_2S_{(s)}$ $FeO_{(s)}$
The$Cu_2S$and FeS is called matte and is removed through slag hole.

Bessemerization:
History: Bessemer process was invented by Henry Bessemer.
Bessemer converter: This process is carried out in a special kind of egg shaped or pear shaped furnace.
This furnace is called Bessemer.

Procedure: In Bessemerization matte is reacted with sand. Iron sulphide (FeS) oxidized to Iron oxide (FeO). This iron oxide (FeO) reacts with sand (SiO_2) forming ($FeSiO_3$), slag which is float on the surface.

$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$
$FeO + SiO_2 \rightarrow FeSiO_3$

Similarly Cuprous sulphide (Cu_2S) is converted to cuprous oxide (Cu_2O). this Cu_2O reacts with Cu_2S to produce copper (Cu) in molten form and sulphur dioxide (SO_2). This copper is known as blister copper (95-97% pure).

$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$
$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

Q.5.c. Enlist the different uses of urea.
Ans: Uses of urea:
it is a white crystalline organic compound. It is important due to the following usage.
1. Fertilizer: about 86% of urea is used as solid fertilizer.
2. Resins: Urea-formaldehyde resins are used as a poly-wood adhesive/glues.

3. Use as explosive: Urea can be used to make urea nitrate, which is highly explosive.
4. Chemical Industry: Urea is used as a raw material for manufacture of many important chemical compounds like plastics, resins, and various adhesives etc.

5. Flame proofing agent: Urea is used as a flame proof in agent.
6. Cosmetics: it is used as an ingredient in hair conditioners, facial cleaners and lotions.
7. Repellent to Corrosion: It is used as an alternative to rock salt in the deicing roadways and runways. It does not promote metal corrosion to extent that salt does.

8. Cigarette: It is also used as flavor enhancing additive for cigarette.
9. Medicinal uses: urea containing creams are used as tropical dermatological products to promote rehydration of skin.

TOPIC WISE QUESTIONS

Q2. What is drilling of petroleum?

Ans: Drilling of petroleum: the process by which petroleum is taken out from the earth by the use of various equipment is called drilling of petroleum.
Naturally: petroleum usually occurs at the depth of 500 feet of more. Crude oil is often associated with natural gas which exerts pressure on the oil surface and drives it out through natural opening of earth.

Artificially: in case of artificial mining, mines are bored. If the natural gas is present with the petroleum its pressure forces the petroleum to come out. If there is no natural gas then the air pressure is applied to force the oil from the well.