Unit 09

Chemical Equilibrium

Long Answer Questions

Q.1 Describe a reversible reaction with the help of an example and graph.

Ans. Reversible Reaction

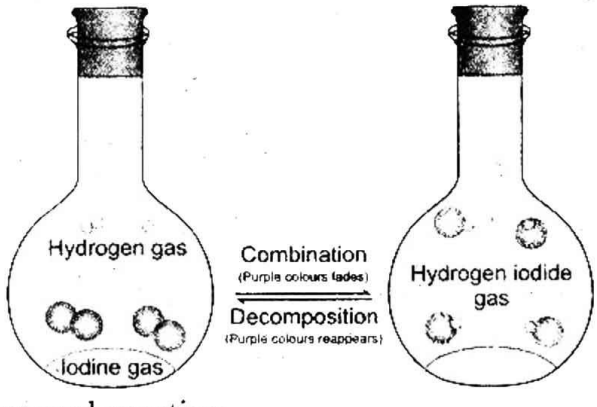
The reaction in which the products can recombine to form reactants, are called reversible reactions. These reactions never go to completion. They are represented by a double arrow ($\rightleftharpoons$) between reactants and products. These reactions proceed in both ways, i.e., they consist of two reactions; forward and reverse. So, a reversible reaction is one which can be made to proceed in either direction depending upon the conditions.

Example:

The reaction between hydrogen and iodine. Because one of the reactant, iodine is purple, while the product hydrogen iodide is colourless, proceedings of the reaction are easily observable. On heating hydrogen and iodine vapours in a closed flask, hydrogen iodide is formed. As a result purple colour of iodide fades as it reacts to form colourless hydrogen iodide, as shown in figure.

$$H_{2(g)} + \underset{\text{Purple}}{I_{2(g)}} \xrightarrow{\Delta} \underset{\text{Colourless}}{2HI}$$

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



This reaction is called as forward reaction.

On the other hand, when only hydrogen iodide is heated in a closed flask, purple colour appears because of formation of iodine vapours. Such as

$$\underset{\text{Colourless}}{2HI_{(g)}} \xrightarrow{\Delta} H_{2(g)} + \underset{\text{Purple}}{I_{2(g)}}$$

In this case hydrogen iodide acts as reactant and produces hydrogen and iodine vapours. This reaction is reverse of the above. Therefore, it is called as reverse reaction.

When both of these reactions are written together as a reversible reaction, they are represented as:

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

Chemical Equilibrium State

When we think of the term equilibrium, the first word that usually comes to mind is "balance". However, the balance may be achieved in a variety of ways.

Thus, when the rate of the forward reaction takes place at the rate of reverse reaction, the composition of the reaction mixture remains constant, it is called a chemical equilibrium state. At equilibrium state there are two possibilities

(i) When reaction ceases to proceed, it is called static equilibrium. This happens mostly in physical phenomenon. For example a building remains standing rather than falling down because all the forces acting on it are balanced. This is an example of static equilibrium.

(ii) When reaction does not stop, only the rates of forward and reverse reactions become equal to each other but take place in opposite directions. This is called dynamic equilibrium state. Dynamic means reaction is still continuing. At dynamic equilibrium state:

Rate of forward reaction = Rate of reverse reaction

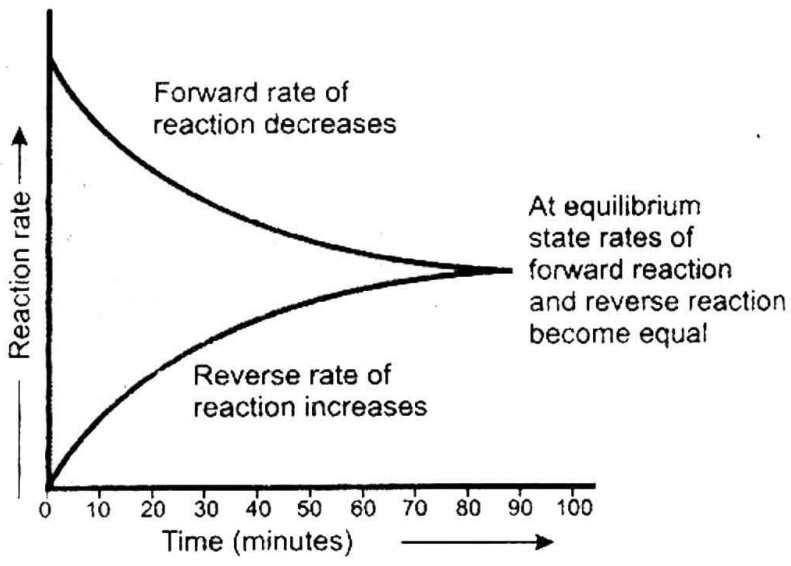
In a reversible reaction, dynamic equilibrium is established before the completion of reaction. It is represented graphically in figure.

At initial stage:

At initial stage the rate of forward reaction is very fast and reverse reaction is taking place at a negligible rate.

By passing time:

But gradually forward reaction slows down and reverse reaction speeds up. Eventually, both reactions attain the same rate, it is called a dynamic equilibrium state.



Q.2 Define chemical equilibrium state. Describe it with examples.

Ans. Chemical Equilibrium state:

When the rate of the forward reaction takes place at the rate of reverse reaction, then the composition of the reaction mixture remains constant, it is called a chemical equilibrium state.

At equilibrium state:

Rate of forward reaction = Rate of reverse reaction

Example 1:

Our existence based on the equilibrium phenomenon taking place in atmosphere. We inhale oxygen and exhale carbon dioxide, while plants consume carbon dioxide and release oxygen. This natural process is responsible for the existence of life on the Earth.

Many other environmental systems depend for their existence on delicate equilibrium phenomenon.

Other examples from nature:

- The lives of aquatic plants and animals are indirectly related to concentration of dissolved oxygen in water.
- Concentration of gases in lake water is governed by the principles of equilibrium.

Example 2:

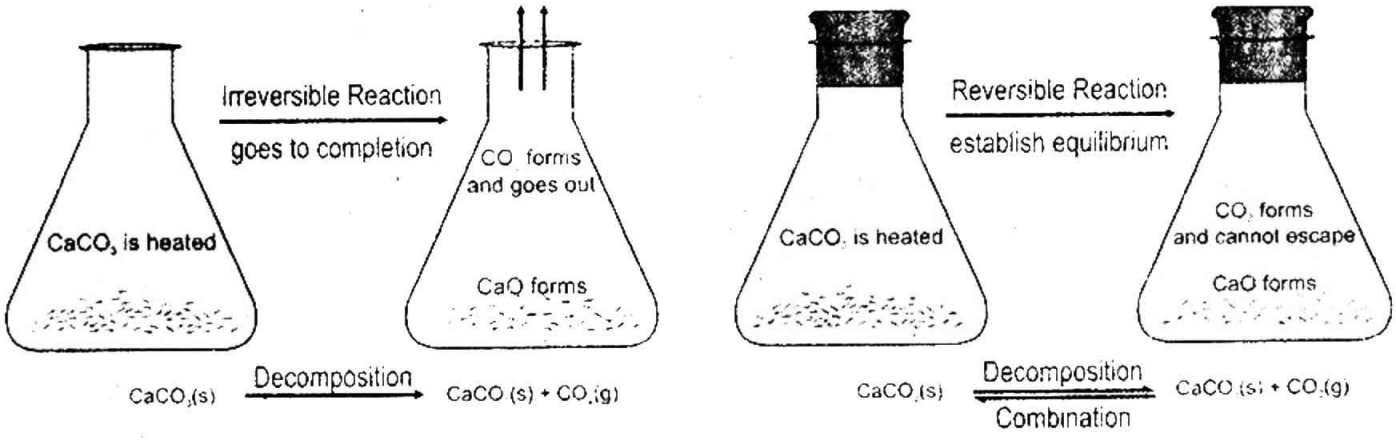
When calcium oxide and carbon dioxide react, they produce calcium carbonate.

$$CaO_{(s)} + CO_{2(g)} \longrightarrow CaCO_{3(g)}$$

On the other hand, when $CaCO_3$ is heated in an open flask, it decomposes to form calcium oxide and carbon dioxide. CO_2 escapes out and reaction goes to completion.

$$CaCO_{3(s)} \longrightarrow CaO_{(s)} + O_{2(g)}$$

$$CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}\uparrow \quad \text{(decomposition)}$$



In these two reactions, decomposition is reverse to combination or vice versa. When calcium carbonate is heated in a closed flask, so that CO_2 can't escape out as shown in figure. For some time only decomposition goes on (forward reaction) but after a while CO_2 starts combining with CaO to form $CaCO_3$.

In the beginning, forward reaction is fast and reverse reaction is slow. But eventually the reverse reaction speeds up and both reactions go on at the same rate. At this stage decomposition and combination take place at the same rate but in opposite directions, as result amounts of $CaCO_3$, CaO and CO_2 do not change. It is written as:

$$CaCO_{3(s)} \overset{\Delta}{\rightleftharpoons} CaO_{(s)} + CO_{2(g)}$$

This is the chemical equilibrium state of this reaction.

Q.3 Write macroscopic characteristics of forward and reverse reactions.

Ans. Macroscopic characteristics of forward and reverse reactions:

Forward Reaction	Reverse Reaction
i) It is a reaction in which reactants react to form products.	It is reaction in which products react to produce reactants.
ii) It takes place from left to right	It takes place from right to left.
iii) At initial stage the rate of forward reaction is very fast.	In the beginning the rate of reverse reaction is negligible.
iv) It slows down gradually.	It speeds up gradually.

Q.4 Write down macroscopic characteristics of dynamic equilibrium.

Ans. Macroscopic characteristics of dynamic equilibrium:

A few important characteristic features of dynamic equilibrium are given below:

(i) An equilibrium is achievable only in a closed system (in which substances can neither leave nor enter)

(ii) At equilibrium state a reaction does not stop. Forward and reverse reactions keep on taking place at the same rate but in opposite direction.

(iii) At equilibrium state, the amount (concentration) of reactants and products do not change. Even physical properties like colour, density, etc. remain the same.

(iv) An equilibrium state is attainable from either way, i.e. starting from reactants or from products.

(v) An equilibrium state can be disturbed and again achieved under the given conditions of concentration, pressure and temperature.

Q.5 State the law of mass action and derive the expression for equilibrium constant for a general reaction

Ans. Law of mass action:

Guldberg and Waage in 1869 put forward this low. According to this law "The rate at which a substance reacts is directly proportional to its active mass and the rate of reaction is

directly proportional to the product of the active masses of the reacting substances". Generally an active mass is considered as the molar concentration in units of mol dm^{-3}, expressed as square brackets [ ].

Derivation of the expression for equilibrium constant for general reaction

Let us apply the law of Mass Action for a general reaction. According to this law, the rate of a chemical reaction is directly proportional to the product of the molar concentrations of its reactants raised to power equal to their number of moles in the balanced chemical equation of the reaction.

Let us first discuss the forward reaction. A and B are the reactants whereas 'a' and 'b' are their number of moles.

The rate of forward reaction according to law of Mass Action is

$$R_f \propto [A]^a [B]^b$$
$$R_f = K_f [A]^a [B]^b$$

Where K_f is the rate constant for the forward reaction. Similarly, the rate of the reverse reaction R_r, is directly proportional to the product of $[C]^c$ $[D]^d$, where 'c' and 'd' are the number of moles as given in the balanced equation. Thus,

$$R_r \propto [C]^c [D]^d$$
$$R_r = k_r [C]^c [D]^d$$

Where Kr is the rate constant for the reverse reaction. We know that at equilibrium state the rate of both the reactions are equal to each other.

The rate of forward reaction = The rate of reverse reaction

$$R_f = R_r$$

And putting the values of R_f and R_r

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

By taking the constants on one side and the variable on other side of the equation, the above equation turns into;

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

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

Where, $K_c \left(K_c = \frac{k_f}{k_r} \right)$ is called equilibrium constant. So

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

Q.6 Define equilibrium constant. Also describe its unit.

Ans. Equilibrium constant is a ratio of the product of concentration of products raised to the power of coefficient to the product of concentration of reactants raised to the power of coefficient as expressed in the balanced chemical equation.

Formula:

$$K_c = \frac{\text{Product of concentration of products raised to the power of coefficients}}{\text{Product of concentration of reactants raised to the power of coefficients}}$$

It is conventional to write the product side numerator and the substances on the reactant side as denominator. By knowing the balanced chemical equation for a reversible reaction we can write the equilibrium expression. Thus we can calculate the numerical value of K_c by putting actual equilibrium concentrations of the reactants and products into equilibrium expression. The value of K_c depends only on temperature, it does not depend on the initial concentrations of the reactants and products. A few problems have been solved to make the concept understandable.

K_c has no units in reactions with equal number of moles on both sides of the equation. This is because concentration units cancel out in the expression for K_c, e.g., for the reaction

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

$$Kc = \frac{[HI_{(g)}]^2}{[H_{2(g)}][I_{2(g)}]} \qquad \text{Units} = \frac{\cancel{(\text{mol dm}^{-2})}}{\cancel{(\text{mol dm}^{-3})}\ \cancel{(\text{mol dm}^{-3})}} = \text{no units}$$

For reactions in which the number of moles of reactants and product are not equal in the balanced chemical equation, K_c of course, have units, e.g., for the reaction

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

$$Kc = \frac{[NH_3]^2}{[N_{2(g)}][H_{2(g)}]^3} = \frac{(\text{mol dm}^{-3})^2}{(\text{mol dm}^{-3})\ (\text{mol dm}^{-3})^3} = \frac{1}{(\text{mol dm}^{-3})^2} = \text{mol}^{-2}\ \text{dm}^6$$

Q.7 How can you predict the direction of a reaction by using the equilibrium constant?

Ans. Knowing the numerical value of equilibrium constant of a chemical reaction, direction as well as extent of the reaction can be predicted.

(i) Predicting Direction of Reaction

Direction of a reaction at a particular moment can be predicted by inserting the concentration of the reactants and products at that particular moment in the equilibrium expression. Consider the gaseous reaction of hydrogen with iodine.

$$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)} \qquad K_c = 57.0 \text{ at } 700\,K$$

We withdraw the samples from the reaction mixture and determine the concentrations of $H_{2(g)}$, $I_{2(g)}$ and $HI_{(g)}$. Suppose concentrations of the components of the mixture are:

$$[H_2]_t = 0.10\,mol\,dm^{-3},\ [I_2]_t = 0.20\,mol\,dm^{-3} \text{ and } [HI]_t = 0.40\,mol\,dm^{-3}$$

The subscript 't' with the concentration symbols means that the concentrations are measured at some time t, not necessarily at equilibrium. When we put these concentrations into the equilibrium constant expression, we obtain a value called the reaction quotient Qc. The reaction quotient for this reaction is calculated as:

$$Q_c = \frac{[HI]_t^2}{[H_2]_t[I_2]_t} = \frac{(0.40)^2}{(0.10)(0.20)} = 8.0$$

As the numerical value of Qc (8.0) is less than Kc(57.0), the reaction is not at equilibrium. It requires more concentration of product. Therefore, reaction will move in the forward direction.

The reaction quotient Q_c is useful because it predicts the direction of the reaction by comparing the value of Q_c with K_c.

Thus, we can make the following generalization about the direction of the reaction.

If $Q_c < K_c$ the reaction goes from left to right, i.e, in forward direction to attain equilibrium.

If $\mathbf{Q_c > K_c}$ of a reaction is more than K_c, the reaction goes from right to left, i.e. in reverse direction to attain equilibrium.

If $\mathbf{Q_c = K_c}$, forward and reverse reactions take place at equal rates i.e, equilibrium has been attained

Q.8 How can you predict the extent of reaction by using equilibrium constant?

Ans. Predicting extent of a reaction

Numerical value of the equilibrium constant predicts the extent of a reaction. It indicates to which extent reactants are converted to products. In fact, it measures how far a reaction proceeds before establishing equilibrium state.

In general there are three possibilities of predicting extent of reactions as explained below.

(a) Large numerical value of K_c

The large value of K_c indicates that at equilibrium position the reaction mixture consists of almost all products and reactants are negligible. The reaction has almost gone to completion. For example, oxidation of carbon monoxide goes to completion at 1000 k.

$$2CO_{(g)} + O_{2(g)} \rightleftharpoons 2CO_{2(g)} \qquad K_c = 2.2\times10^{22}$$

(b) Small numerical value of K_c

When the K_c value of reaction is small it may indicate the equilibrium has established with a very small conversion of reactants to products. At equilibrium position almost all reactants are present but amount of products is negligible. Such type of reaction never goes to completion, for example,

$$2NH_{3(g)} \rightleftharpoons N_{2(g)} + 3H_{2(g)} \qquad K_c = 3.0\times10^{-9}$$

(c) Numerical value of K_c is neither small nor large

Such reactions have comparable amounts of reactants and products at equilibrium position. For example:

$$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)} \qquad K_c = 0.211$$

Solved Book Examples

Example 1:

When hydrogen reacts with iodine at 25°C to form hydrogen iodide by a reversible reaction as follows:

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

The equilibrium concentrations are:

$[H_2]$ = 0.05 mol dm^{-3} ; $[I_2]$ = 0.06 mol dm^{-3} and [HI] = 0.49 mol dm^{-3}

Calculate the equilibrium constant for this reaction?

Solution:

Given equilibrium concentrations are;

$[H_2]$ = 0.05 mol dm^{-3} ; $[I_2]$ = 0.06 mol dm^{-3} and [HI] = 0.49 mol dm^{-3}

Write the equilibrium constant expression as

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

Now put the equilibrium concentration values in the equilibrium expression

$$K_c = \frac{[0.49]^2}{[0.05][0.06]} = \frac{0.2401}{0.0030} = 80$$

Examples 2:

For the formation of ammonia by Haber's process hydrogen and nitrogen react reversibly at 500°C as follows

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

The equilibrium concentrations of these gases are: nitrogen 0.602 mol dm^{-3}; hydrogen 0.420 mol dm^{-3} and ammonia 0.113 mol dm^{-3}. What is value of K_c.

Solution:

The equilibrium concentrations are

$[N_2]$ = 0.602 mol dm^{-3}, $[H_2]$ = 0.420 mol dm^{-3} and $[NH_3]$ = 0.113 mol dm^{-3}

The equilibrium constant expression for this reaction is:

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

Now put the equilibrium concentration values into the equilibrium expression

$$K_c = \frac{[0.113]^2}{[0.602][0.420]^3} = 0.286\,mol^{-2}\,dm^6$$

Example 3:

For a reaction between PCl_3 and Cl_2 to form PCl_5, the equilibrium constant is 0.13 mol^{-1} dm^3 at a particular temperature. When the equilibrium concentrations of PCl_3 and Cl_2 are 10.0 and 9.0 mol dm^{-3} respectively, what is the equilibrium concentration of PCl_5.

Solution:

$[PCl_3]$ = 10 mol dm^{-3} $\quad$ $[Cl_2]$ = 9.0 mol dm^{-3}

K_c = 0.13 mol^{-1} dm^{-3} $\quad$ $[PCl_5]$ = ?

Now write the balanced chemical equation and equilibrium constant expression

$$PCl_{3(g)} + Cl_{2(g)} \rightleftharpoons PCl_5$$

$$K_c = \frac{[PCl_5]}{[PCl_3][Cl_2]}$$

Now put the known values in above equation and rearrange

$$0.13 = \frac{[PCl_5]}{(10.0)(9.0)}$$

$$[PCl_5] = 0.13 \times 10.0 \times 9.0 = 11.7 \text{ mol dm}^{-3}$$

Numericals

1. For the decomposition of di-nitrogen oxide (N_2O) into nitrogen and oxygen reversible reaction take place as follows:

$$2N_2O_{(g)} \rightleftharpoons 2N_{2\,(g)} + O_2$$

The concentration of N_2O , N_2 and O_2 are 1.1mol.dm^{-3}, 3.90 mol dm^{-3} and 1.95 mol dm^{-3}, respectively, at equilibrium. Find out K_c for this reaction.

Ans.

Data:

The concentration of

N_2O = 1.1 mol dm^{-3}
N_2 = 3.90 mol dm^{-3}
O_2 = 1.95 mol dm^{-3}
K_c = ?

Solution

The equilibrium constant expression for this reaction is

$$K_c = \frac{[N_2]^2[O_2]}{[N_2O]^2}$$

$$K_c = \frac{[3.90]^2[1.95]}{[1.1]^2}$$

$$K_c = \frac{[15.21]\ [1.95]}{[1.21]^2}$$

$$K_c = 24.51 \text{ mol dm}^{-3} \text{ Ans.}$$

2. Hydrogen iodide decomposes to form hydrogen and iodine. If the equilibrium concentration of HI is 0.078 mol dm^{-3}, H_2 and I_2 is same 0.011 mol dm^{-3}. Calculate the equilibrium constant value for this reversible reactions.

Ans.

Data:

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

The equilibrium concentration of

$$\begin{aligned} HI &= 0.078\ \text{mol dm}^{-3} \\ H_2 &= 0.011\ \text{mol dm}^{-3} \\ I_2 &= 0.011\ \text{mol dm}^{-3} \\ K_c &= ? \end{aligned}$$

Solution

The equilibrium constant expression for this reaction is

$$K_c = \frac{[H_2]\ [I_2]}{[HI]^2}$$

$$K_c = \frac{[0.011]\ [0.011]}{[0.078]^2}$$

$$K_c = 0.019 \quad \text{Ans.}$$

3. For the fixation of nitrogen following reaction takes place

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

When the reaction takes place at 1500 K, the K_c for this is 1.1×10^{-5}. If equilibrium concentration of nitrogen and oxygen are 1.7×10^{-3} mol dm^{-3} and 6.4×10^{-3}mol dm^{-3}, respectively, how much NO is formed?

Ans.

Data:

Temperature = 1500 K

$$\begin{aligned} K_c &= 1.1\times10^{-5} \\ N_2 &= 1.7\times10^{-3}\ \text{mol dm}^{-3} \\ O_2 &= 6.4\times10^{-3}\ \text{mol dm}^{-3} \\ NO &= ? \end{aligned}$$

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

Solution:

The equilibrium constant expression for this reaction is

$$K_c = \frac{[NO]^2}{[N_2][O_2]}$$

$$1.1\times10^{-5}=\frac{[NO]^2}{[1.7\times10^{-3}][6.4\times10^{-3}]}$$

$$[NO]^2=1.1\times10^{-5}\times1.7\times10^{-3}\times6.4\times10^{-3}$$

$$[NO]^2=11.96\times10^{-11}$$

$$[NO]^2=1.196\times10^{-10}$$

Taking square root on both sides

$$\sqrt{[NO]^2}=\sqrt{1.196\times10^{-10}}$$

$$NO = 0.09\times10^{-5}\,mol\,dm^{-3}$$

4. When nitrogen reacts with hydrogen to form ammonia, the equilibrium mixture contains 0.31 mol dm^{-3} and 0.50 mol dm^{-3} of nitrogen and hydrogen respectively, if the K_c is 0.50 mol^{-2} dm^6, what is the equilibrium concentration of ammonia?

Ans.

Data:

$$[N_2] = 0.3\,mol\,dm^{-3}$$
$$[H_2] = 0.50\,mol\,dm^{-3}$$
$$K_c = 0.50\,mol^{-2}\,dm^6$$
$$[NH_3] = ?$$

Solution:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The equilibrium constant expression for this reaction is

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

$$K_c = \frac{[NH_3]^2}{[0.3][0.50]^3}$$

$$[NH_3]^2 = 0.50\times[0.3][0.50]^3$$

taking sq. root on both sides

$$\sqrt{[NH_3]^2}=\sqrt{0.01875}$$

$$[NH_3] = 0.136\,mol\,dm^{-3}$$

Short Answer Questions

Q.1 Why at equilibrium state reaction does not stop?

Ans. At equilibrium state the reaction does not stop because the rate of forward reaction is exactly equal to the reverse reaction but in opposite direction.

Q.2 Why equilibrium state is attainable from either way?

Ans. Equilibrium state is attainable from either way because a reversible reaction proceeds in both way.

Equilibrium state is attained when a reaction moves forward as well as reaction moves back ward.

$$\text{Reactants} \rightleftharpoons \text{Products}$$

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

Q.3 What are the characteristics of a reaction that establishes equilibrium state at once?

Ans. The reactions which attain the equilibrium are called reversible reactions.

(i) In these reactions dynamic state of equilibrium is established in which

Rate of forward reaction = Rate of reverse reaction

(ii) These reaction does not go to stop.

(iii) These can be proceed in both directions.

(iv) For these reactions value of K_c is neither too large nor too small.

Q.4 Which natural process is responsible for existence of life on earth?

Ans. We inhale oxygen and exhale carbon dioxide while plants consume carbon dioxide and release oxygen. This natural process is responsible for existence of life on earth.

Q.5 Differentiate between reactants and products.

Ans.

Reactants	Products
In a chemical reaction the substances that combine are called reactants	In a chemical reaction, reactants combine to form new substances which are called products

Q.6 Differentiate between irreversible reaction and reversible reaction.

Ans.

Irreversible reaction	Reversible reaction
i. The reactions in which products do not recombine to form reactants	**i.** The reaction in which products react to produce reactants are called reversible reactions
ii. They are supposed to complete	**ii.** These reactions never go to completion
iii. These are represented by a single arrow ($\rightarrow$) between reactants and products	**iii.** They are represented by a double arrow ($\rightleftharpoons$) between reactants and products

Q.7 What is static equilibrium state?

Ans. When reaction ceases to proceed. It is called static equilibrium.

Example:

A building remains standing rather than falling down because all the forces acting on it are balanced.

Q.8 What is dynamic equilibrium state?

Ans. When reaction does not stop only the rate of forward and reverse reaction become equal to each other but take place in opposite directions. This is called dynamic equilibrium state.

Q.9 What is equilibrium constant?

Ans. Equilibrium constant is a ratio of the product of concentration of products raised to the power of coefficient to the product of concentration of reactants raised to the power of coefficient as expressed in the balance chemical equation.

$$K_c = \frac{\text{Product of conc. of products raised to the power of coefficient}}{\text{Product of conc. of reactants raised to power of coefficients}}$$

Q.10 Why the reaction mixture does not have 50% reactants and 50% products at equilibrium position?

Ans. At equilibrium state the conc. of reactants and products are constants so it is not necessary that the reactants and products are in 50% ratio.

Q.11 If a reaction has large value of K_c, will it go to completion and why?

Ans. The large value of Kc indicates that at equilibrium position the reaction mixture consists of almost all products and reactants are negligible the reaction has almost gone to completion.

Q.12 What do you mean by the extent of reaction?

Ans. Extent of reaction means the degree of completion of a chemical reaction. It also tells stability of reactants and products.

Q.13 Why the reversible reaction does not go to completion?

Ans. The reversible reaction does not go to completion because, it proceeds in both directions. After the equilibrium attained the product start to convert back into the reactants at this state the composition of reaction mixture remains constant.

Q.14 What are irreversible reactions? Give few characteristics of them?

Ans. The reactions in which products do not recombine to form reactants are called irreversible reactions.

i. In the reversible reaction static equilibrium is attained or established.

ii. These are represented by a single arrow ($\rightarrow$) between reactants and products.

iii. Irreversible reactions go to completion and 100 % conversion of reactants to products take place.

Q.15 Define chemical equilibrium state.

Ans. When the rate of the forward reaction takes place at the rate of reverse reaction, the composition of the reaction mixture remains constant, it is called a chemical equilibrium state.

Q.16 What is relationship between active mass and rate of reaction?

Ans. According to Guldberg and Waage's law the rate of reaction is directly proportional to the product of the active masses of the reacting substances.

Q.17 Derive equilibrium constant expression for the synthesis of ammonia from nitrogen and hydrogen.

Ans. For the reaction of nitrogen with hydrogen to form ammonia, the balanced chemical equation is

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

For the reaction

The rate of forward reaction $R_f = k_f [N_2] [H_2]^3$

The rate of reverse reaction $R_r = k_r [NH_3]^2$

The expression for the equilibrium constant for this reaction is:

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

Q.18 Write the equilibrium constant expression for the following reactions:

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

ii. $CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$

Ans. The equilibrium constant expression for these reactions

i. $Kc = \frac{[HI]^2}{[H_2][I_2]}$

ii. $Kc = \frac{[CH_4][H_2O]}{[CO][H_2]^3}$

Q.19 How direction of reaction can be predicted?

Ans. Direction of a reaction at a particular moment can be predicted by measuring reaction quotient Q_c. The reaction quotient Q_c is useful because it predicts the direction of the reaction by comparing the value of Q_c with K_c. If Q_c is less than K_c the reaction is forward.

Q.20 How can you know that a reaction has achieved an equilibrium state?

Ans. If $Q_c = K_c$, forward and reverse reactions takes place at equal rates i.e equilibrium has been established.

Q.21 If reaction quotient Q_c of a reaction is more than K_c. What will be the direction of the reaction?

Ans. If Q_c of a reaction is more than K_c the reaction goes from right to left, i.e. in reverse direction to attain equilibrium.

Q.22 What are the uses of atmospheric gases in the manufacture of chemicals?

Ans. The two major components of atmospheric are nitrogen and oxygen gases. Both of these gases constitute 99% of the atmosphere.

These gases are being used to manufacture chemicals since the advent of 20th century. Nitrogen is used to prepare ammonia, which is further used to manufacture nitrogenous fertilizers.

Oxygen is used to prepare sulphur dioxide which is further used to manufacture king of chemicals sulphuric acid.

Q.23 Define the law of Mass Action.

Ans. The rate at which a substance reacts is directly proportional to its active mass and the rate of a reaction is directly proportional to the product of the active masses of the reacting substances.

Q.24 How the active mass is represented?

Ans. An active mass is considered as the molar mass concentration in unit of mol dm^{-3}, expressed as square brackets [ ]

Q.25 How dynamic equilibrium is established?

Ans. In a reversible reaction, dynamic equilibrium is established before the completion of reaction. At initial stage the rate of forward reaction is very fast and reverse reaction is taking place at a negligible rate. But gradually forward reaction slows down and reverse reaction speeds up. Eventually, both reactions attain the same rate and dynamic equilibrium state is established.

Q.27 Point out the coefficient of each in the following hypothetical reactions.

(a) $2A+3B \rightleftharpoons 4C+2D$

(b) $4x \rightleftharpoons 2Y+3Z$

(c) $2M+4N \rightleftharpoons 5O$

Ans. (a) Coefficients of this reactions are (a) 2, 3, 4, 2

(b)4, 2, 3

(c) 2, 4, 5

Q.27 An industry was established based upon a reversible reaction. It failed to achieve products on commercial level. Can you point out the basic reasons of its failure being a chemist?

Ans. In a reversible reaction, the amounts of reactants and products remain same when the equilibrium state is achieved. If industry is based on reversible reaction, it cannot achieve desired commercial product and its required amount because expected yield is not achieved and industry fails.

Q.28 Write the importance of equilibrium constant.

Ans. (i) It is used to predict the direction of reaction.

(ii) It is used to predict the extent of reaction, means how much reactants are converted into products.

Q.29 Which physical factor effects the value of K_c?

Ans. Temperature highly effect the numeric value of K_c. Temperature change will effect both equilibrium position and equilibrium constant.

Q.30 Write the names of two chemicals in which nitrogen is used?

Ans. (i) Urea (ii) Nitric Acid

Q.31 What is the proportion of oxygen and nitrogen in our atmosphere?

Ans. In our atmosphere, the total proportion of O_2 and N_2 is 99%.

Nitrogen = 78% Oxygen = 21%

Multiple Choice Questions

1. The reaction in which the products do not recombine to form reactants are called;

(a) Irreversible reactions
(b) Reversible reactions
(c) Decomposition (d) Addition

2. The reaction in which the products can recombine to form reactants are called;

(a) Irreversible reactions
(b) Reversible reactions
(c) Decomposition (d) Addition

3. The colour of iodine is;

(a) purple (b) Black
(c) red (d) Pink

4. The colour of hydrogen iodide is;

(a) colourless (b) black
(c) red (d) pink

5. When the rate of the forward reaction takes place at the rate of reverse reaction the composition of the reaction mixture remains constant it is called;

(a) Chemical equilibrium
(b) Dynamic equilibrium
(c) Static equilibrium
(d) all

6. When the reaction ceases to proceed, it is called;

(a) Chemical equilibrium state
(b) static equilibrium
(c) Dynamic equilibrium
(d) all

7. Guldberg and waage put forward law of mass action in;

(a) 1860 (b) 1869
(c) 1870 (d) 1879

8. The % age of nitrogen and oxygen in our atmosphere is;

(a) 80 (b) 90
(c) 95 (d) 99

9. Which gas is used to prepare ammonia?

(a) N_2 (b) O_2
(c) Cl_2 (d) S

10. Which gas is used to manufacture king of chemicals sulphuric acid?

(a) N_2 (b) O_2
(c) Cl_2 (d) S

11. Equilibrium constant has no unit when number of moles of reactants and products are;

(a) same (b) different
(c) both a & b (d) none

12. For reactions having large Kc value, the reaction proceeds to;

(a) completion
(b) equilibrium state
(c) back ward (d) None

13. The characteristics of reversible reactions are the following except;

(a) products never recombine to form reactants
(b) they never complete
(c) they proceed in both ways
(d) they have a double arrow between reactants and products

14. In the lime kiln, the reaction $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$ **goes to completion because;**

(a) of high temperature
(b) CaO is more stable than $CaCO_3$
(c) CO_2 escapes continuously
(d) CaO is not dissociated

15. For the reaction, $2A_{(g)} + B_{(g)} \rightleftharpoons 3C_{(g)}$ **the expression for the equilibrium constant is:**

(a) $\frac{[2A][B]}{[3C]}$ (b) $\frac{[A]^2[B]}{[C]^3}$
(c) $\frac{[3C]}{[2A][B]}$ (d) $\frac{[C]^3}{[A]^2[B]}$

16. When a system is at equilibrium states?

(a) the concentration of reactants and products becomes equal
(b) the opposing reactions (forward and reverse) stop
(c) the rate of the reverse reaction becomes very low
(d) the rates of the forward and reverse reactions becomes equal.

17. Which one of the following statements is not correct about active mass?

(a) rate of reaction is directly proportional to active mass.
(b) active mass is taken in molar concentration
(c) active mass is represented by square brackets
(d) active mass means total mass of substances

18. When the magnitude of K_c is very large it indicates;

(a) reaction mixture consists of almost all products
(b) reaction mixture has almost all reactants
(c) reaction has not gone to completion
(d) reaction mixture has negligible products

19. When the magnitude of K_c is very small it indicates;

(a) equilibrium will never establish

(b) all reactants will be converted to products

(c) reaction will go to completion

(d) the amount of products is negligible

20. Reactions which have comparable amounts of reactants and products at equilibrium state have;

(a) very small K_c value

(b) very large K_c value

(c) moderate K_c value

(d) none of these

21. At dynamic equilibrium;

(a) the reaction stops to proceed

(b) the amounts of reactants and products are equal

(c) the speed of the forward is reverse reactions are equal

(d) the reaction can no longer be reversed

22. In an irreversible reaction dynamic equilibrium;

(a) never establishes

(b) establishes before the completion of reaction

(c) establishes after the completion of reaction

(d) establishes readily

23. A reverse reaction is one that;

(a) which proceeds from left to right

(b) In which reactants react to form products

(c) which slows down gradually

(d) which speeds up gradually

24. Nitrogen and hydrogen were reacted together to make ammonia

$N_2 + 3H_2 \rightleftharpoons 2NH_3 \qquad K_c = 2.86\,mol^{-2}\,dm^6$

What will be present in the equilibrium mixture?

(a) NH_3 only

(b) N_2, H_2 and NH_3

(c) N_2 and H_2 only

(d) H_2 only

25. For a reaction between PCl_3 and Cl_2 to form PCl_5, the units of K_c are;

(a) mol dm^{-3} (b) mol^{-1} dm^{-3}

(c) mol^{-1} dm^3 (d) $moldm^3$

26. The two major components of Atmosphere are

(a) carbon and nitrogen

(b) Nitrogen and oxygen

(c) oxygen and chlorine

(d) None of these

27. Which type of reactions do not go to completion?

(a) Irreversible reaction

(b) Reversible reactions

(c) Addition reactions

(d) Decomposition reactions

28. Which type of reactions speed up gradually?

(a) Irreversible reactions

(b) Reversible reactions

(c) Forward reactions

(d) Decomposition reactions

29. Which type of reactions take place in both directions?

(a) addition reactions

(b) reversible reactions

(c) irreversible reactions

(d) decomposition reactions

30. In a chemical reaction, the substance that combine are called;

(a) reactant

(b) products
(c) mass
(d) material

31. When a reaction ceases to proceed further, it is called;

(a) chemical states
(b) static state
(c) physical state
(d)dynamic equilibrium state

32. Dynamic means, reaction is:

(a) in forward direction
(b) stop
(c) in reverse direction
(d) still continuing

33. The forward reaction takes place:

(a) right to left
(b) left to right
(c) only to right
(d) only to left

34. The units of molar concentration:

(a) $mol.dm^{-2}$
(b) $mol.\ dm^{-1}$
(c) mol. dm
(d) $mol.dm^{-3}$

35. Equilibrium constant value "K_c" is equal to;

(a) K_f/K_r
(b) K_r/K_f
(c) K_c/Q_c
(d) Q_c/K_r

36. Which chemical is called king of chemicals?

(a) KNO_3
(b) H_2SO_4
(c) HCl
(d) NHO_3

Answer Keys

1.	a	**2.**	b	**3.**	a	**4.**	a	**5.**	b
6.	b	**7.**	b	**8.**	d	**9.**	a	**10.**	b
11.	a	**12.**	a	**13.**	a	**14.**	c	**15.**	d
16.	d	**17.**	d	**18.**	a	**19.**	d	**20.**	c
21.	c	**22.**	a	**23.**	d	**24.**	b	**25.**	a
26.	b	**27.**	b	**28.**	b	**29.**	b	**30.**	a
31.	b	**32.**	d	**33.**	b	**34.**	d	**35.**	a
36.	b								

Unit 10

Acids, Bases and Salts

Long Answer Questions

Q.1 Define an acid and base according to Arrhenius concept with the help of examples.

Ans. Arrhenius Acid

According to Arrhenius concept (1787)

Acid is a substance which dissociates in aqueous solution to give hydrogen ions (H^+).

Examples:

HCl, HNO_3, CH_3COOH, H_2SO_4, H_3PO_4, HCN etc are acids because they ionize in aqueous solution to provide H^+ ions.

In general the ionization of acids takes place as follows:

$$HA_{(aq)} \overset{water}{\rightleftharpoons} H^+_{(aq)} + A^-_{(aq)}$$

$$HCl_{(aq)} \overset{water}{\rightleftharpoons} H^+_{(aq)} + Cl^-_{(aq)}$$

$$HNO_{3(aq)} \overset{water}{\rightleftharpoons} H^+_{(aq)} + NO^-_{3(aq)}$$

$$CH_3COOH_{(aq)} \overset{water}{\rightleftharpoons} CH_3COO^-_{(aq)} + H^+_{(aq)}$$

Arrhenius Base

Base is a substance which dissociates in aqueous solution to give hydroxide ions (OH^-).

Examples:

The substances such as NaOH, KOH, NH_4OH, $Ca(OH)_2$ etc are bases because they provide OH^- ions in aqueous solution.

In general the ionization of bases take place as follows:

$$BOH_{(aq)} \overset{water}{\rightleftharpoons} B^+_{(aq)} + OH^-_{(aq)}$$

$$NaOH_{(aq)} \overset{water}{\rightleftharpoons} Na^+_{(aq)} + OH^-_{(aq)}$$

$$Ca(OH)_{2(aq)} \overset{water}{\rightleftharpoons} Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$$

Neutralization reactions according to Arrhenius concept

Acids give H^+ ions in water, bases give OH^- ions in water.

Q.2 Write down limitations of Arrhenius Concept.

Ans. Limitations of Arrhenius concept

(i) This concept is applicable only in aqueous medium and does not explain nature of acids and bases in non-aqueous medium.

(ii) According to this concept, acids and bases are only those compounds which contain hydrogen (H^+) and hydroxyl (OH^-) ions, respectively. It can not explain the nature of compounds like CO_2, NH_3 etc., which are acid and base, respectively.

Although this concept has limited scope yet, it led to the development of more general theories of acid-base behaviour.

Q.3 Describe Bronsted-Lowry concept about acids and bases with examples.

Ans. In 1923, the Danish chemist Bronsted and the English chemist Lowry independently presented their theories of acids and bases on the basis of proton transfer. According to this concept.

Bronsted-Lowry Acid

An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance e.g HCl.

Bronsted-Lowry Base

A base is a substance that can accept a proton (H^+) from another substance e.g NH_3.

Explanation

HCl acts as an acid while NH_3 acts as base:

$$\underset{\text{Acid}}{HCl_{(aq)}} + \underset{\text{Base}}{NH_{3(aq)}} \rightleftharpoons NH^+_{4(aq)} + Cl^-_{(aq)}$$

Similarly, when HCl dissolved in water; HCl acts as an acid and H_2O as a base.

$$\underset{\text{Acid}}{HCl_{(aq)}} + \underset{\text{Base}}{H_2O} \rightleftharpoons \underset{\text{Conjugate acid}}{H_3O^+_{(aq)}} + \underset{\text{Conjugate base}}{Cl^-_{(aq)}}$$

It is a reversible reaction. In the forward reaction HCl is an acid as it donates a proton, whereas H_2O is a base as it accepts a proton. In the reverse reaction Cl^- ion is a base as it accepts a proton from acid H_3O^+ ion. Cl^- ion is called a conjugate base of acid HCl and H_3O^+ ion is called a conjugate acid of base H_2O. It means every acid produces a conjugate base and every base produces a conjugate acid such that there is conjugate acid-base pair. Conjugate means joined together as a pair.

Conjugate Acid

A conjugate acid is a specie formed by accepting a proton by a base.

Conjugate Base

A conjugate base is a specie formed by donating a proton by an acid.

Thus, conjugate acid-base pair differs from one another only by a single proton.
Similarly,

$$\underset{\text{Acid}}{CH_3COOH_{(aq)}} + \underset{\text{Base}}{H_2O_{(aq)}} \rightleftharpoons \underset{\text{Conjugate acid}}{CH_3OO^-_{(aq)}} + \underset{\text{Conjugate base}}{H_3O^+_{(aq)}}$$

Limitations of Bronsted-Lowry concept

It has been observed that there are certain substances which behave as acids though they do not have the ability to donate a proton, e.g., SO_3. Similarly, CaO behaves as a base but it cannot accept a proton. These observations prove the limitations of Bronsted-Lowry concept of acids and bases.

Conjugate acid-base pairs of common species.

Acid		Base		Conjugate acid		Conjugate base
$HNO_{3(aq)}$	+	$H_2O_{(l)}$	$\rightleftharpoons$	$H_3O^+_{(aq)}$	+	$NO^-_{3(aq)}$
$H_2SO_{4(aq)}$	+	$H_2O_{(l)}$	$\rightleftharpoons$	$H_3O^+_{(aq)}$	+	$HSO^-_{4(aq)}$
$HCN_{(aq)}$	+	$H_2O_{(l)}$	$\rightleftharpoons$	$H_3O^+_{(aq)}$	+	$CN^-_{(aq)}$
$CH_3COOH_{(aq)}$	+	$H_2O_{(l)}$	$\rightleftharpoons$	$H_3O^+_{(aq)}$	+	$CH_3COO^-_{(aq)}$
$H_2O_{(l)}$	+	$NH_{3(aq)}$	$\rightleftharpoons$	$NH^+_{4\,(aq)}$	+	$OH^-_{(aq)}$
$H_2O_{(l)}$	+	CO^{2-}_3	$\rightleftharpoons$	$HCO^-_{3(aq)}$	+	$OH^-_{(aq)}$
$HCl_{(l)}$	+	HCO^-_3	$\rightleftharpoons$	$H_2CO_{3(aq)}$	+	$Cl^-_{(aq)}$

Q.4 Define an acid and a base according to Bronsted-Lowry concept and justify with examples that water is an amphoteric compound.

Ans. In 1923, the Danish chemist Bronsted and the English chemist Lowry independently presented their theories of acids and bases on the basis of proton transfer. According to this concept.

Bronsted-Lowry Acid

An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance e.g HCl.

Bronsted-Lowry Base

A base is a substance that can accept a proton (H^+) from another substance e.g NH_3.

Water as an amphoteric compound

According to Bronsted-Lowry concept, an acid and a base always work together to transfer a proton. That means, a substance can act as an acid (proton donor) only when another substance simultaneously behaves as a base (proton acceptor). Hence, a substance can act as

an acid as well as a base, depending upon the nature of the other substance. For example, H_2O acts as a base when it reacts with HCl and as an acid when it reacts with ammonia such as

Water acting as an acid:

$$\underset{\text{Acid}}{H_2O_{(l)}} + \underset{\text{Base}}{NH_{3(aq)}} \rightleftharpoons NH^+_{4(aq)} + OH^-_{(aq)}$$

Water acting as a base:

$$\underset{\text{Acid}}{HCl_{(aq)}} + \underset{\text{Base}}{H_2O_{(l)}} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$$

Amphoteric

Such a substance that can behave as an acid, as well as, a base is called **amphoteric.**

Q.5 Explain Lewis Concept of Acids and Bases with example.

Ans. The Arrhenius and Bronsted-Lowry concepts of acids and bases are limited to substances which contain protons. G.N. Lewis (1923) proposed a more general and broader concept of acids and bases. According to this concept.

Lewis Acid

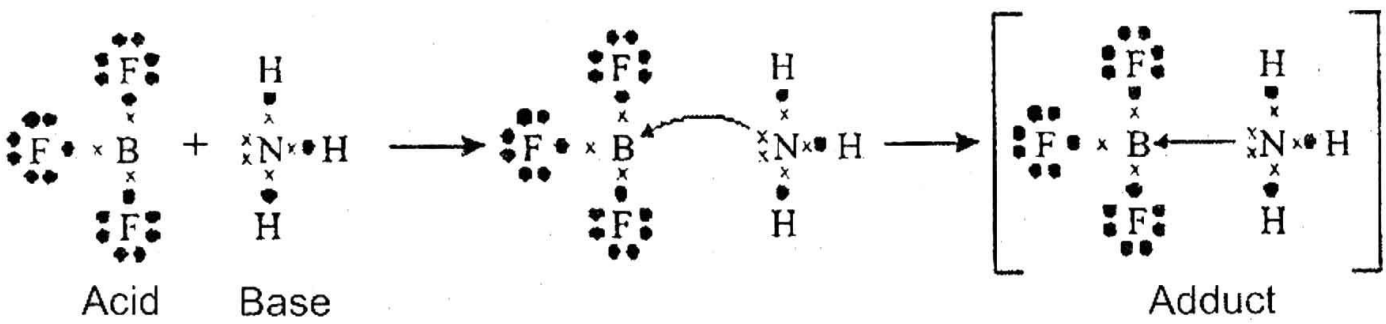
An acid is a substance (molecule or ion) which can accept a pair of electrons.

Lewis Base

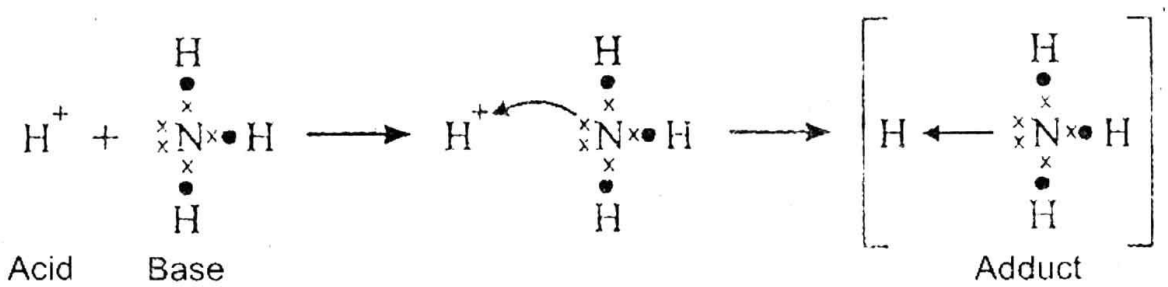
A base is a substance (molecule or ion) which can donate a pair of electrons.

Explanation

A reaction between ammonia and boron trifluoride takes place by forming a coordinate covalent bond between ammonia and boron trifluoride by donating an electron pair of ammonia and accepting that electron pair by boron trifluoride.



The cations (proton itself or metal ions) act as Lewis acids. For example a reaction between H^+ and NH_3, where H^+ acts as an acid and ammonia as a base.



Adduct

The product of any Lewis acid-base reaction is a single specie, called an adduct.

Neutralization

A neutralization reaction according to Lewis concept is donation and acceptance of an electron pair to form a coordinate covalent bond in an adduct.

Conclusion

Acids are electron pair acceptors while bases are electron pair donors. Thus, it is evident that any substance which has an unshared pair of electrons can act as a Lewis base while a substance which has an empty orbital that can accommodate a pair of electrons acts as Lewis acid.

Q.6 Describe characteristics of Lewis Acids and Bases.

Ans. Characteristics of Lewis Acids:-

According to Lewis concept, the following species can act as Lewis acids.

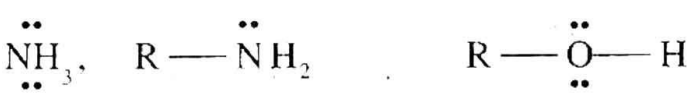
(a) Molecules in which the central atom has incomplete octet. For example, in BF_3, $Fecl_3$, $AlCl_3$, the central atom has only six electrons around it, therefore, these can accept an electron pair.

(b) Simple cations can act as Lewis acids. All cations act as lewis acids since they are deficient in electrons. However, cations such as Na^+, K^+, Ca^{2+} ions, etc., have a very little tendency to accept electrons. While the cations like H^+, Ag^+ ions, etc., have a greater electron accepting tendency therefore, act as Lewis acids.

Characteristics of Lewis Bases

According to Lewis concept, the following species can act as Lewis bases:

(a) Neutral species having at least one lone pair of electrons. For example, ammonia, amines, alcohols etc., act as Lewis bases because they contain a lone pair of electrons:



(b) Negatively charged species or anions. For example, chloride, cyanide, hydroxide ions, etc., act as Lewis bases:

CN^-, Cl^-, OH^- etc,

Q.7 Explain the chemical properties of acids.

Ans (i) Reaction with metals

Acids react explosively with metals like sodium, potassium and calcium. However dilute acids (HCl, H_2SO_4) react moderately with reactive metals like:
Mg,Zn,Fe and Al to form their respective salts with the evolution of hydrogen gas.

$$Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}\uparrow$$

$$2Al_{(s)} + 6HCl_{(aq)} \longrightarrow 2AlCl_{3(aq)} + 3H_{2(g)}\uparrow$$

(ii) Reaction with Carbonates and Bicarbonates

Acids react with carbonates and bicarbonates to form corresponding salts with the evolution of carbon dioxide gas.

$$CaCO_{3(aq)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)}\uparrow + H_2O_{(l)}$$

$$2NaHCO_{3(aq)} + H_2SO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + 2CO_{2(g)}\uparrow + 2H_2O_{(l)}$$

(iii) Reaction with bases

Acids react with bases (oxides and hydroxides of metal and ammonium hydroxide) to form salts and water. This process is called neutralization.

$$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

$$CuO_{(aq)} + H_2SO_{4(aq)} \longrightarrow CuSO_{4(aq)} + H_2O_{(l)}$$

(iv) Reaction with Sulphites and Bisulphites

Acids react with sulphites and bisulphites to form salts with liberation of sulphur dioxide gas.

$$CaSO_{3(aq)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + SO_{2(g)}\uparrow + H_2O_{(l)}$$

$$NaHSO_{3(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + SO_{2(g)}\uparrow + H_2O_{(l)}$$

(v)Reaction with Sulphides

Acids react with metal sulphides to liberate hydrogen sulphide gas.

$$FeS_{(aq)} + H_2SO_{4(aq)} \longrightarrow FeSO_{4(aq)} + H_2S_{(g)}\uparrow$$

Q.8 Write down the uses of Acids

Ans Uses of Acids

(i) **Sulphuric acid** is used for manufacture of fertilizers, ammonium sulphate, calcium superphosphate, explosives, paints, dyes, drugs it is also used as an electrolyte in lead storage batteries, and other chemicals.

(ii) **Nitric acid** is used for manufacturing of fertilizer (Ammonium nitrate), explosives, paints and drugs. Etching designs on copper plates.

(iii) **Hydrochloric acid** is used for cleaning metals, tanning and in printing industries.

(iv) **Benzoic acid** is used for food preservation.

(v) **Acetic acid** is used for flavouring food and food preservation. It is also used to cure the sting of wasps.

Q.9 Explain chemical properties of bases.

Ans. **Chemical Properties of Bases**

(i) Reaction with acids

Bases react with acids to form salt and water. It is a neutralization reaction.

$$2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + H_2O_{(l)}$$

(ii) Reaction with Ammonium Salts

Alkalis react with ammonium salts to liberate ammonia gas

$$NH_4Cl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + NH_{3(g)}\uparrow + H_2O_{(l)}$$

$$(NH_4)_2SO_{4(aq)} + Ca(OH)_{2(aq)} \longrightarrow CaSO_{4(aq)} + 2NH_{3(g)}\uparrow + 2H_2O_{(l)}$$

(iii) Precipitation of Hydroxides

Alkalis precipitate insoluble hydroxides when added to solutions of salts of heavy metals such as copper, iron, zinc, lead and calcium.

$$CuSO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Cu(OH)_{2(aq)} + Na_2SO_{4(aq)}$$

Blue ppt.

$$ZnCl_{2(aq)} + 2NaOH_{(aq)} \longrightarrow Zn(OH)_{2(aq)} + 2NaCl_{(aq)}$$

White ppt.

$$FeCl_{3(aq)} + 3NaOH_{(aq)} \longrightarrow Fe(OH)_{3(s)} + 3NaCl_{(aq)}$$

Brown ppt.

$$Pb(NO_3)_{2(aq)} + 2NaOH_{(aq)} \longrightarrow Pb(OH)_{2(s)} + 2NaCl_{(aq)}$$

White ppt.

$$CaCl_2 + 2NaOH \longrightarrow Ca(OH)_{2(s)} + 2NaNO_{3(aq)}$$

White ppt.

$$FeSO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Fe(OH)_{2(s)} + Na_2SO_{4(aq)}$$

Dirty Green.

Q.10 Write down the uses of bases.

Ans. Uses of Bases

(i) **Sodium hydroxide** is used for manufacturing of soap, artificial silk, in textile and paper industries and as a laboratory reagent.

(ii) **Calcium hydroxide** is used for manufacturing of bleaching powder, softening of hard water and neutralizing acidic soil and lakes due to the acid rain.

(iii) **Potassium hydroxide** is used in alkaline batteries and shaving cream.

(iv) **Magnesium hydroxide** is used as a base to neutralize acidity in the stomach. It is also used for the treatment of bee's stings.

(v) **Aluminium hydroxide** is used as foaming agent in fire extinguishers.

(vi) **Ammonium hydroxide** is used to remove grease stains from clothes.

Q.11 What is auto-ionization of water? How it is used to establish the pH of water.

Ans. Concentration of hydrogen ion $[H^+]$ in pure water is the basis for the pH scale. Water is a weak electrolyte because it ionizes very slightly into ions in a process called auto ionization or self ionization;

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

The equilibrium expression of this reaction may be written as

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

As concentration of water (H_2O) is almost constant. The above equation may be written as

$$K_c[H_2O] = [H^+][OH^-]$$

A new equilibrium constant known as ionic product constant of water 'K_w' is used instead of product of equilibrium constant and $[H_2O]$. Therefore,

$$K_w = [H^+][OH^-] = 1.0 \times 10^{-14} \text{ at } 25^\circ C$$

As we know, one molecule of water produces one H^+ ion and one OH^- ion on dissociation. So

$$[H^+] = [OH^-] \quad \text{or} \quad [H^+]^2 = 1.0 \times 10^{-14}$$

$$[H^+] = \sqrt{1.0 \times 10^{-14}}$$

Therefore, $[H^+] = 1.0 \times 10^{-7}$ M at $25^\circ C$

As it is difficult to deal with such small figures having negative exponents, so it is convenient to convert these figures into a positive figure using a numerical system. It is taking the common (base-10) logarithm of the figure and multiplying it with -1. 'p' before

the symbol H means' negative logarithm of H^+. On this scale pH is the negative logarithm of molar concentration of the hydrogen ions. That is,

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

So, according to this scale, pH of water is:

$$pH = -\log (1.0 \times 10^{-7}) = 7$$

Similarly $pOH = -\log (1.0 \times 10^{-7}) = 7$

$$pOH = -\log[OH^-]$$

pH value normally varies from 0 to 14. therefore;

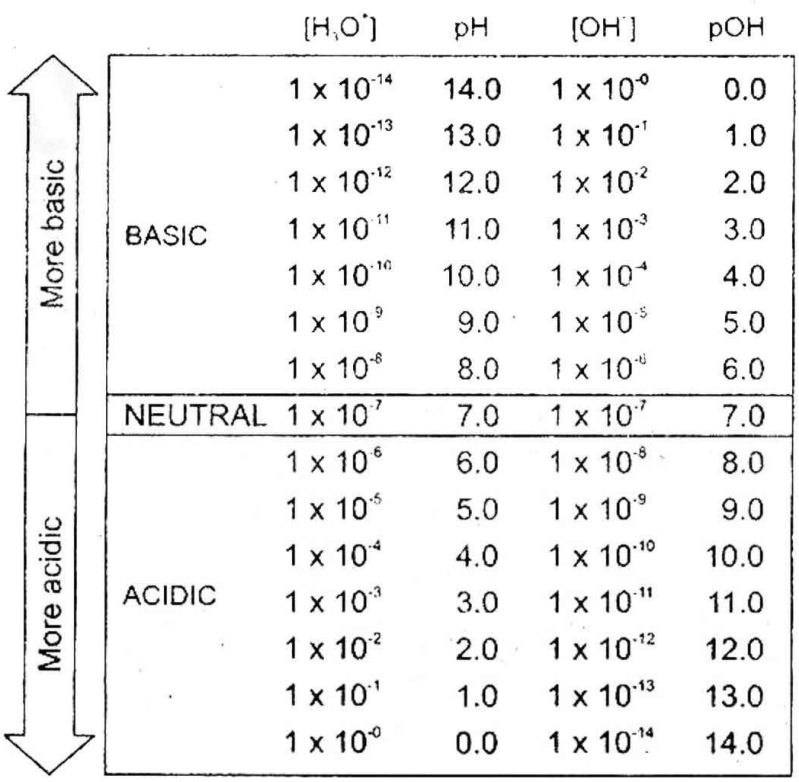
$$pH + pOH = 14$$

So, the sum of the pH and pOH of the solution is always 14 at 25°C.

Identification of acids and bases by pH scale

	Highly acid				Slightly acid			Neutral	Slightly basic					Highly basic	
pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
pOH	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

A solution or compound of pH 7 or pOH 7 is considered a neutral solution. Solutions of pH less than 7 are acidic and more than 7 are basic as are also shown in fig.



	$[H_3O^+]$	pH	$[OH^-]$	pOH
BASIC	1×10^{-14}	14.0	1×10^{0}	0.0
	1×10^{-13}	13.0	1×10^{-1}	1.0
	1×10^{-12}	12.0	1×10^{-2}	2.0
	1×10^{-11}	11.0	1×10^{-3}	3.0
	1×10^{-10}	10.0	1×10^{-4}	4.0
	1×10^{-9}	9.0	1×10^{-5}	5.0
	1×10^{-8}	8.0	1×10^{-6}	6.0
NEUTRAL	1×10^{-7}	7.0	1×10^{-7}	7.0
ACIDIC	1×10^{-6}	6.0	1×10^{-8}	8.0
	1×10^{-5}	5.0	1×10^{-9}	9.0
	1×10^{-4}	4.0	1×10^{-10}	10.0
	1×10^{-3}	3.0	1×10^{-11}	11.0
	1×10^{-2}	2.0	1×10^{-12}	12.0
	1×10^{-1}	1.0	1×10^{-13}	13.0
	1×10^{0}	0.0	1×10^{-14}	14.0

Since the pH scale is logarithmic, a solution of pH 1 has 10 times higher concentration of $[H^+]$ than that of a solution of pH 2, 100 times than that of a solution of pH 3 and so on.

Hence, low pH value means strong acid while high pH value means a strong base and vice versa.

Conclusion

(i) pH of a neutral solution is always 7.

(ii) Acidic solution has pH less than 7

(iii) Basic solution has pH value greater than 7

(iv) pH and pOH values range from 0 to 14.

Q.12 Write an note on the followings

(i) Indicators (ii) Universal indicators (iii) pH meter

Ans. Indicators

Indicators are the organic compounds. they have different colours in acidic and alkaline solutions. Litmus is a common indicator. It is red in acidic solutions and blue in alkaline solutions.

- Each indicator has a specific colour in acidic medium which changes at a specific pH to another colour in basic medium. For example, phenolphthalein is colourless in strongly acidic solution and red in strongly alkaline solution. It changes colour at a pH of about 9. This means phenolphthalein is colourless in a solution with pH less than 9. If the pH is above 9, phenolphthalein is red as is shown in figure.

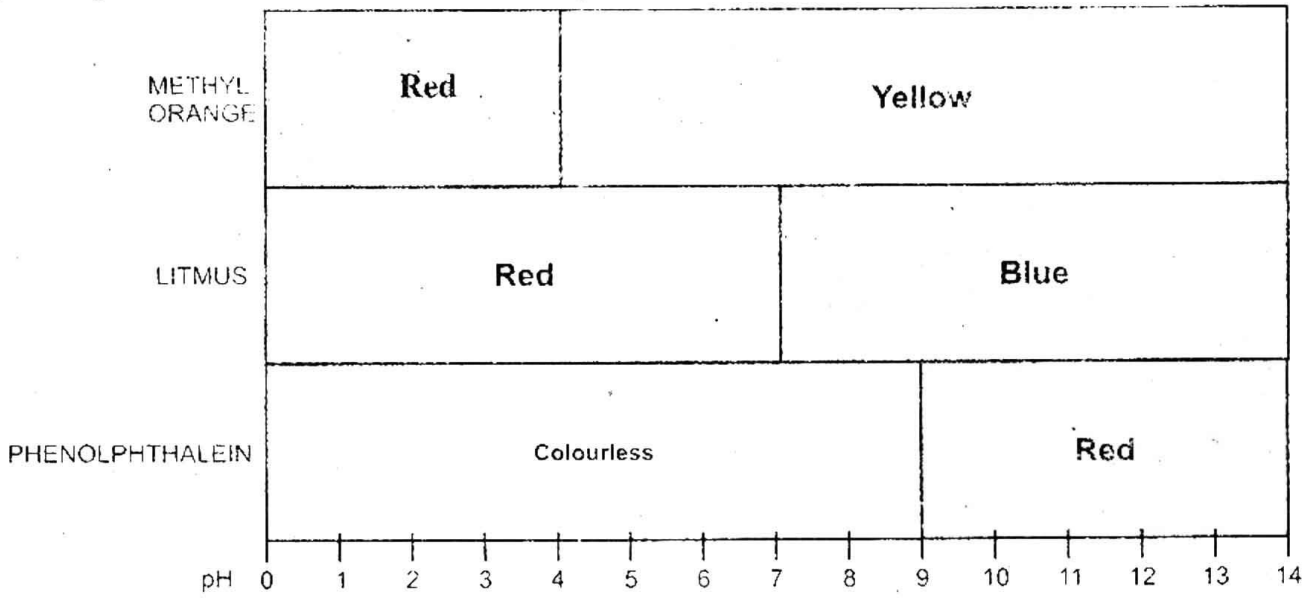


Fig: Colours of indicators at different pH solutions

A few commonly used indicators in titrations are given in Table:

Table : Few important indicators

Indicator	Colour in strongly acidic solution	pH at which colour changes	Colour in strongly alkaline solution
Methyl orange	red	4	yellow
Litmus	red	7	blue
Phenolphthalein	colourless	9	red

(i) Universal Indicator

Some indicators are used as mixtures. The mixture indicators give different colours at different pH values. Hence, it is used to measure the pH of a solution. Such a mixed indicator is called Universal Indicator or simply pH indicator. The pH of solution can be measured by dipping a piece of Universal Indicator paper in the solution. The pH is then found by comparing the colour obtained with a colour chart as shown in figure.

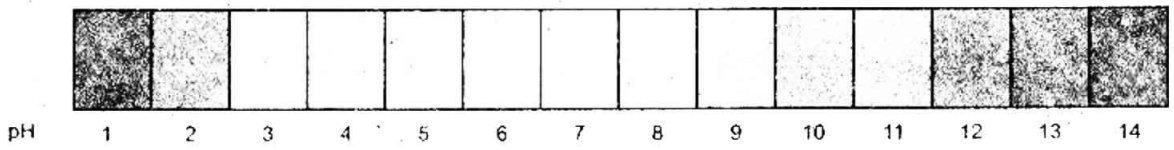
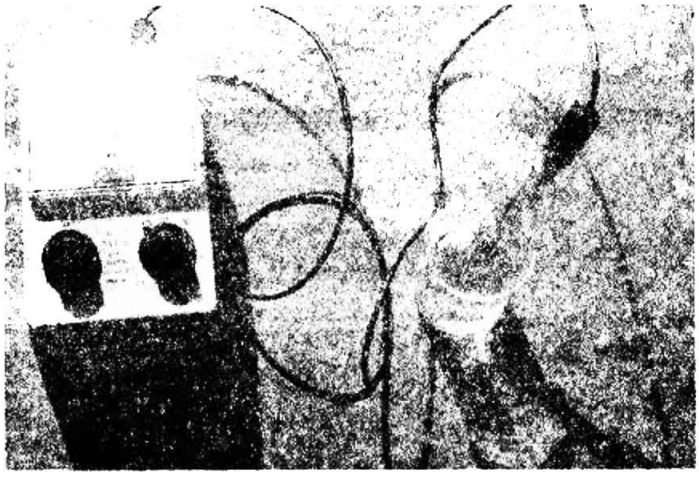


Fig: Colours of universal indicator

(ii) The pH Meter

The pH of a solution can be measured with a pH meter. It consists of a pH electrode connected to a meter. The electrode is dipped into the solution and the meter shows the pH either on a scale or digitally. It is much more reliable and accurate method of measuring pH than Universal Indicator paper, though the latter is often more convenient.

Figure



pH meter

Q.13 What are salts? Write down the characteristic properties of salts.

Ans: Salts are ionic compounds generally formed by the neutralization of an acid with a base.

Acidic and Basic radicals

Salts are made up of positive ions (cations) and negative ions (anions). A cation is metallic and derived from a base, therefore, it is called basic radical. While anion is derived from acids therefore it is called acid radical.

Salt Names

A salt gets its name from the names of the metal and the acid as shown in table

Metal	Acid	Salt Name
Sodium (Na)	Hydrochloric acid (HCl)	Sodium chloride (NaCl)
Potassium (K)	Nitric acid (HNO_3)	Potassium nitrate (KNO_3)
Zinc (Zn)	Sulphuric acid (H_2SO_4)	Zinc sulphate ($ZnSO_4$)
Calcium (Ca)	Phosphoric acid (H_3PO_4)	Calcium phosphate $Ca_3(PO_4)_2$
Silver (Ag)	Acetic acid (CH_3COOH)	Silver acetate ($CH_3COO\ Ag$)

Characteristic properties of salts:

(i) Salts are ionic compounds found in crystalline form.

(ii) They have high melting and boiling points.

(iii) Most of the salts contain water of crystallization which is responsible for the shape of the crystals. Number of molecules of water are specific for each salt and they are written with the chemical formula of a salt. For example,

Copper sulphate $CuSO_4.5H_2O$; Calcium sulphate $CaSO_4.2H_2O$

(iv) Salts are neutral compounds. Although, they do not compose of equal number of positive and negative ions, but have equal number of positive and negative charges.

Q.14 Explain with examples that how soluble salts are prepared?

Ans: Salts may be water soluble or insoluble. The methods used for the preparation of salts are based on their solubility in water.

General Methods for the preparation of Salts

There are five general methods for the preparation of salts. Four methods, make soluble salts but one prepares insoluble salts.

(i) Preparation of soluble salts

Soluble salts are often prepared in water. Therefore, they are recovered by evaporation or crystallization.

(a) By the reaction of an acid and a metal: (direct displacement method)

This is direct displacement method in which hydrogen ion of acid is replaced by a reactive metal. Such as, calcium, magnesium, zinc and iron, e.g,

Acid + Metal $\longrightarrow$ Salt + Hydrogen gas

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

(b) By th reaction of an acid and a base: (Neutralization method)

It is a neutralization reaction in which acid and base react to produce a salt and water.

Acid	+	Base	⟶	Salt	+	Water
$HCl_{(aq)}$	+	$NaOH_{(s)}$	⟶	$NaCl_{(aq)}$	+	$H_2O_{(l)}$

(c) By the reaction of an acid and metallic oxide:

Mostly the insoluble metallic oxides react with dilute acids to form salt and water.

Acid	+	Metallic oxide	⟶	Salt	+	Water
$H_2SO_{4(aq)}$	+	$CuO_{(aq)}$	⟶	$CuSO_{4(aq)}$	+	$H_2O_{(aq)}$

(d) By the reaction of an acid and carbonate:

Dilute acids react with metallic carbonates to produce salts, water and carbon dioxide gas.

$$2HNO_{3(aq)} + Na_2CO_{3(s)} \longrightarrow 2NaNO_{3(aq)} + CO_{2(g)} + H_2O_{(l)}$$

Q.15 Write note on types of salts.

Ans: Following are the main classes of salts

(i) Normal salts **(ii)** Acidic salts

(iv) Basic salts **(v)** Double salts

(v) Mixed salts **(vi)** Complex salts

(i) Normal or Neutral salts:

A salt formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion or NH^+_4 ion is called normal or neutral salt. These salts are neutral to litmus, that is,

$HCl_{(aq)}$	+	$KOH_{(aq)}$	⟶	$KCl_{(aq)}$	+	$H_2O_{(l)}$
$H_2SO_{4(aq)}$	+	$ZnO_{(aq)}$	⟶	$ZnSO_{4(aq)}$	+	$H_2O_{(l)}$
$H_3PO_{4(aq)}$	+	$3NaOH_{(aq)}$	⟶	$Na_3PO_{4(aq)}$	+	$3H_2O_{(l)}$
$HNO_{3(aq)}$	+	$NH_4OH_{(aq)}$	⟶	$NH_4NO_{3(aq)}$	+	$H_2O_{(l)}$

(ii) Acidic Salts

These salts are formed by partial replacement of a replaceable H^+ ions of an acid by a positive metal ion.

$H_2SO_{4(aq)}$	+	$KOH_{(aq)}$	⟶	$KHSO_{4(aq)}$	+	$H_2O_{(l)}$
$H_3PO_{4(aq)}$	+	$NaOH_{(aq)}$	⟶	$NaH_2PO_{4(aq)}$	+	$H_2O_{(l)}$

These salts turn blue litmus red.

Acidic salts react with bases to form normal salts.

$KHSO_{4(aq)}$	+	$KOH_{(aq)}$	⟶	$K_2SO_{4(aq)}$	+	$H_2O_{(l)}$
$NaH_2PO_{4(aq)} + 2NaOH_{(aq)}$			⟶	$Na_3PO_{4(aq)}$	+	$H_2O_{(l)}$

(iii) Basic Salts

Basic salts are formed by the incomplete neutralization of a polyhydroxy base by an acid

$Al(OH)_{3(aq)} + HCl_{(aq)} \longrightarrow Al(OH)_2Cl_{(aq)} + H_2O_{(l)}$

$Pb(OH)_{2(aq)} + CH_3COOH_{(aq)} \longrightarrow Pb(OH)CH_3COO_{(aq)} + H_2O_{(l)}$

$Zn(OH)_{2(aq)} + HNO_{3(aq)} \longrightarrow Zn(OH)\,NO_{3(aq)} + H_2O_{(l)}$

These salts further react with acids to form normal salts.

$Al(OH)_2Cl_{(aq)} + HCl_{(aq)} \longrightarrow Al(OH)Cl_{2(aq)} + H_2O_{(l)}$

$Al(OH)Cl_{2(aq)} + HCl_{(aq)} \longrightarrow AlCl_{3(aq)} + H_2O_{(l)}$

$Pb(OH)\,CH_3COO + CH_3COOH_{(aq)} \longrightarrow Pb(CH_3COO)_{2(aq)} + H_2O_{(l)}$

$Zn(OH)NO_{3(aq)} + HNO_{3(aq)} \longrightarrow Zn(NO_3)_{2(aq)} + H_2O_{(l)}$

(iv) Double Salts

Double salts are formed by two normal salts when they are crystallized from a mixture of equimolar saturated solutions. The individual salt components retain their properties. The anions and cations give their respective tests. Mohr's salt $FeSO_4.(NH_4)_2\ SO_4.6H_2O$; Potash Alum $K_2SO_4.Al_2(SO_4)_3\ .\ 24H_2O$; Ferric alum $K_2SO_4.\ Fe_2(SO_4)_3\ .\ 24H_2O$, are examples of double salts.

(v) Mixed Salts

Mixed salts contain more than one basic or acid radicals. Bleaching powder Ca(OCl) Cl, is an example of mixed salts.

(vi) Complex Salts

Complex salts on dissociation form a simple cation and a complex anion or vice versa. Only the simple ion yields the characteristics test for cation or anion. Examples are as follow:

Potassium ferrocyanide $K_4\ [Fe(CN)_6]$ gives on ionization, a simple cation K^+ and complex anion $[Fe(CN)_6]^{-4}$

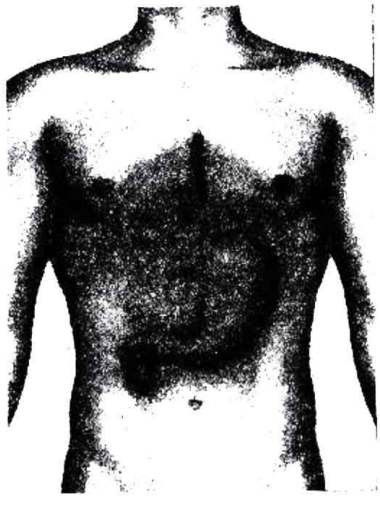
Q.16 Write down uses of salts.

Ans. Salts have vast applications in industries and in our daily life. Some common salts and their uses are given in Table

Name of salts	Common and industrial Uses
Sodium Chloride (NaCl)	It is commonly used as a table salt and for cooking purposes. It is also used for de-icing roads in winter and for the manufacture of sodium metal, caustic soda, washing soda.

Sodium carbonate (Na_2CO_3) soda ash	It is used for the manufacture of glass, detergents, pulp and paper and other chemicals.
Sodium carbonate ($Na_2CO_3.10H_2O$) Washing soda	It is used as cleaning agent for domestic and commercial purposes, for softening of water, in manufacture of chemicals like caustic soda (NaOH), borax, glass, soap and paper.
Sodium sulphate (Na_2SO_4)	It is used for the manufacture of glass, paper and detergents.
Sodium silicate (Na_2SiO_3)	It is used for the manufacture of detergents, cleaning agents and adhesives.
Sodium chlorate (Na_2ClO_3)	It is used for manufacture of explosives, plastics and other chemicals.
Sodium tetraborate ($Na_2B_4O_7.10H_2O$)	It is used for manufacture of heat resistance glass (pyrex), glazes and enamels, in leather industry for soaking and cleaning hides.
Calcium Chloride ($CaCl_2$)	It is used for de-icing roads in winter, as a drying agent of chemical reagents and as a freezing agent.
Calcium oxide (CaO) quick lime	It is used as drying agent for gases and alcohol and in steel making, water treatment and other chemicals like slaked lime, bleaching powder, calcium carbide. For purification of sugar, a mixture of CaO and NaOH called soda lime is used to remove carbon dioxide and water vapours from atmosphere.
Calcium sulphate ($CaSO_42H_2O$)	Gypsum is used as fertilizer, to prepare plaster of paris which is used for making statues, casts etc.
Potassium Nitrate (KNO_3)	It is used as fertilizer and for the manufacture of flint glass.

Q.17 Explain the Stomach acidity.



Ans. Stomach secretes chemicals in a regular way to digest food. These chemicals mainly consist of hydrochloric acids along with other salts. Although hydrochloric acid is highly corrosive, but stomach is protected from its effects because it is lined with cells that produce a base. The base neutralizes stomach acid. The important function of this acid is to break down chemical bonds of foods in the digestion process. Thus, big molecules of food are converted into small ones. It also kills the harmful bacteria of certain foods and drinks.

However, sometimes stomach produces too much acid. It

causes stomach acidity also called **hyperacidity**. **Symptoms** of this disease are feeling burning sensation throughout the gastro intestinal track. These feelings sometimes extend towards the chest, that is called **heart burning**.

Prevention from Hyperacidity

(i) Avoiding over-eating and staying away from fatty acids and spicy foods.

(ii) Simple and regular eating, remaining in an upright position for about 45 minutes after taking a meal.

(iii) Keeping the head elevated while sleeping.

Q.18 Explain the Process of Etching in Art and Industry.

Ans. The process of etching on glass is carried out by using a wax stencil. Stencil is placed on areas of glass or mirror that are to be saved from acid. The glass or mirror is dipped into hydrofluoric acid. The acid dissolves the exposed part of the glass thus etching it. This process has been very dangerous because the acid would damage the skin and tissue of artist's body. Although it is dangerous to deal with acid, yet etching done with acid is very attractive as compared to using other chemicals.

Q.19 Describe Preservatives in food.

Ans. Chemicals used to prevent food spoilage are called preservatives. Food spoiling may be due to microbial actions or chemical reactions. So preservatives serve as either anti-microbial or anti-oxidants or both.

Manufactures add preservatives mostly to prevent spoiling during transportation and storage of foods for a period of time.

Natural food preservatives are salts, sugar, alcohol, vinegar, etc. they efficiently control the growth of bacteria in food. They are used to preserve meat, fish, etc.

Solved Book Examples

10.1

(i) What are conjugate bases of each of the following?

$HS^-, H_3O^+, H_2PO_4^-, HSO_4^{-2}, HF, CH_3COOH, [Al(H_2O)_6)]^{3+}$

(ii) Give the conjugate acids of the following:

$OH^-, HCO_3^-, HPO_4^{2-}, CH_3NH_2, CO_3^{2-}, CH_3COOH$

(ii) Which of the following behave both as Bronsted acids and Bronsted bases?

$H_2O, HCO_3^-, H_2SO_4, H_3PO_4, HS^-$

Solution

(a)	Conjugate bases	(b)	Conjugate acids
HS^-	: S^{2-}	OH^-	: H_2O
H_3O^+	: H_2O	HCO_3^-	: H_2CO_3
H_2PO4^-	: HPO_4^{2-}	HPO_4^{2-}	: $H_2PO_4^-$
HSO_4^-	: SO_4^{2-}	CH_3NH_2	: $CH_3NH_3^+$
HF	: F^-		
CH_3COOH	: CH_3COO^-	CO_3^{2-}	: CHO_3^-
$[Al(H_2O)_6]3^+$	: $[Al(H_2O)_5 OH]_2^+ CH_3COOH$		: $CH_3COOH_2^+$

(c) Bronsted acids, as well as, bases are: H_2O, HCO^-_3, HS^-

10.2. A solution of hydrochloric acid is 0.02M. What is its pH value?

Solution

Hydrochloric acid is a strong acid so it ionized completely. That is

$$HCl_{(aq)} \longrightarrow H^+_{(aq)} + Cl^-_{(aq)}$$

So, its solution also contains 0.01M H^+ ions, i.e., 10^{-2}M.

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

By putting the values of H^+ ions in the above equation:

$$pH = -\log 10^{-2}$$

$$pH = 2$$

10.3. Find out the pH and pOH of 0.001M solution of KOH?

Solution

Potassium hydroxide solution is a strong base. It ionizes completely such that one mole of KOH gives one mole of OH^- ions.

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

Therefore, 0.001M solution of KOH produces 0.001M OH^- ions.

$[OH^-] = 0.001M \quad or\ 10^{-3}\ M$
$pOH = -\log 10^{-3} = 3$
$pH = 14-3 = 11$

10.4. Find the pH of 0.001M sulphhuric acid:

Solution

Sulphuric acid is a strong dibasic acid. It ionizes completely and its one mole produces 2 moles of hydrogen ions as presented in equation.

$H_2SO_{4(aq)} \longrightarrow 2H^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$

Therefore, 0.01M sulphuric acid will produce 2×0.01M hydrogen ions. Hence, hydrogen ions concentration is

$[H^+] = 2\times10^{-2}M$
$pH = -\log(2\times10^{-2}) = -(\log 2+\log 10^{-2})$
$pH = -\log 2-\log 10^{-2}$ as $-\log 10^{-2}=2$
$pH = 2-\log 2$ $pH = 2-0.3=1.7$

Numericals

1. Calculate the pH and pOH of 0.2M H_2SO_4?

Solution

Ionization of H_2SO_4 in aqueous solution is as

$H_2SO_{4(aq)} \rightleftharpoons 2H^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$

Therefore, 0.2M sulphuric acid will prooduce 2×0.2M hydrogen ions
Hence Hydrogen ions conc.is

$[H^+] = 2\times2\times10^{-1}\ M$
$pH = -\log(4\times10^{-1})$
$pH = -(\log 4+\log 10^{-1})$
$pH = -\log 4-\log 10^{-1}$
$pH = -0.6+1$
$pH = 0.4$
$pOH = 14-0.4$
$= 13.6$

2. Calculate the pH of 0.1M KOH?

Solution

Ionization of KOH in aqueous solution is as

$$KOH \rightleftharpoons K^+ + OH^-$$

Therefore, 0.1M KOH produces 0.1 M OH^- ions.

$[OH^-] = 0.1M \text{ or } 1 \times 10^{-1} M$

$pOH = -\log[OH^-]$

$pOH = -\log[10^{-1}]$

$pOH = -\log 10^{-1}$

$pOH = 1$

$pH = 14 - 1$

$pH = 13$

3. Calculate the pOH of 0.004M HNO_3.

Solution

Ionization of HNO_3 in aqueous solution is as

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

Therefore, 0.004M HNO_3 will produce 0.004 M H^+ ions

$[H^+] = 0.004M \text{ or } 4 \times 10^{-3} M$

$pH = -\log[4 \times 10^{-3}]$

$pH = -(\log 4 \times \log 10^{-3})$

$pH = -\log 4 - \log 10^{-3}$

$pH = -0.602 + 3$

$pH = 3 - 0.602$

$pH = 2.4$

$pOH = 14 - 2.4$

$pOH = 11.6$

4. Complete the following table

Solution

(i) 0.15 M HI

$$HI \rightleftharpoons H^+ + I^-$$

0.15 M hydrogen iodide (HI) releases H^+ ions as ....

$[H^+] = 1 \times 0.15$ M or

$\boxed{H^+ = 15 \times 10^{-2}}$ M

$pH = -\log (15 \times 10^{-2})$

$\boxed{pH = 0.82}$

$pOH + pH = 14$

$pOH = 14 - 0.82$

$\boxed{pOH = 13.12}$

(ii) 0.040 M KOH

KOH is a strong base. It ionized completely. One mole of KOH produce one OH^- ion as shown in balanced chemical equation.

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

Therefore concentration of OH^- ions is as

$[OH^-] = 1 \times 0.040M$

$[OH^-] = 4.0 \times 10^{-2}M$

$pOH = -\log (4.0 \times 10^{-2})$

$\boxed{pOH = 1.40}$

$pOH + pH = 14$

$pH = 14 - pOH$

$pH = 14 - 1.40$

$\boxed{pH = 12.60}$

(iii) 0.020 M $Ba(OH)_2$

$$Ba(OH) \longrightarrow Ba^+ + 2OH^-$$

$Ba(OH)_2$ releases two OH^- ions as shown in equation. Therefore concentration of OH^- ions is as

$[OH^-] = 2 \times 0.020M$

$\boxed{[OH^-] = 4 \times 10^{-2}}\ M$

$pOH = -\log (OH^-)$

$pOH = -\log (4 \times 10^{-2})$

$\boxed{pOH = 1.40}$

$pH + pOH = 14$

$pH = 14 - pOH$

$pH = 14 - 1.40$

$\boxed{pH = 12.6}$

(iv) 0.00030 M $HClO_4$

$HClO_4$ release one H+ ion as

$$HClO_4 \longrightarrow H^+ + ClO_4^-$$

Therefore concentration H^+ ions in the solution will be as

$[H^+]= 1 \times 3.0 \times 10^{-4}$M

$\boxed{[M^+]= 3.0 \times 10^{-4}}$ M

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

$pH = -\log [3.0 \times 10^{-4}]$

$\boxed{pH = 3.52}$

$pOH = 14 - 3.52$

$= 10.48$

(v) 0.55 M NaOH

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

NaOH releases one OH^- ion as

$\boxed{[OH^-] = 55.0 \times 10^{-2}}$ M

$pOH = -\log [OH^-]$

$pOH = -\log (55 \times 10^{-2})$

$\boxed{pOH = 0.26}$

$pH + pOH = 14$

$pH = 14 - pOH$

$\boxed{pH = 13.74}$

(vi) 0.55 M HCl

$$HCl \longrightarrow H^+ + Cl^-$$

HCl releases one H^+ ion as....

$[H^+]= 1 \times 0.55$ M

$[H^+]= 55 \times 10^{-3}$ M

$pH = -\log(55\times10^{-3})$

$\boxed{pH = 1.26}$

$pH + pOH = 14$

$pOH = 14 - pH$

$=14 - 1.26$

$= 12.74$

(vii) 0.55 M $Ca(OH)_2$

$Ca(OH)_2 \longrightarrow Ca^+ + 2OH^-$

$Ca(OH)_2$ releases two (OH^-) ions as .....

$[OH^-] = 2 \times 0.055M$

$\boxed{[OH^-] = 0.11}$ or 11×10^{-2} M

$pOH = -\log (11 \times 10^{-2})$

$\boxed{pOH = 0.96}$

$pH + pOH = 14$

$pH = 14 - pOH$

$pH = 14 - 0.96$

$= 14 - 0.96$

$\boxed{pH = 13.04}$

Solution	$[H^+]$	$[OH^-]$	pH	pOH
(i) 0.15 M HI	15×10^{-2}	—	0.82	13.12
(ii) 0.040 M KOH	—	4×10^{-2}	12.6	1.4
(iii) 0.020 M $Ba(OH)_2$	—	4×10^{-2}	12.6	1.4
(iv) 0.00030 M $HClO_4$	3×10^{-4}	—	3.52	10.48
(v) 0.55 M NaOH	—	55×10^{-2}	13.74	0.26
(vi) 0.055 M HCl	55×10^{-3}		1.26	12.74
(vii) 0.055 M $Ca(OH)_2$	—	11×10^{-2}	13.04	0.96

Short Answer Questions

Q.1 What is meant by Acid?

Ans. The acid is derived from the Latin word "Acidius" meaning sour. Acid is a substance which has sour taste and turns blue litmus red.

Q.2 Write down characteristic properties of Acids and bases

Ans. Properties of acids and bases

Acids	Bases
1) Acids have sour taste for example unripe citrus fruits or lemon Juice.	**1)** Bases have bitter taste and feel slippery for example soap is slippery to touch.
2) They turn blue litmus red.	**2)** They turn red litmus blue.

3) They are corrosive in concentrated form.	3) They are non corrosive except concentrated forms of NaOH and KOH.
4) Their aqueous solutions conduct electric current.	4) Their aqueous solutions conduct electric current.

Q.3 Define Arrhenius acid. Give example?

Ans. According to Arrhenius concept acid is a substance which dissociates in aqueous solution to give hydrogen ions. For example HCl is an acid because it ionizes in aqueous solution to provide H^+ions.

Q.4 Define Arrhenius base. Give example.

Ans. According to Arrhenius concept base is a substance which dissociates is aqueous solution to give hydroxide ions. For example the substance NaOH is a base because it ionizes in aqueous solution to provide OH^- ions.

Q.5 Define Bronsted and Lowry acid.

Ans. An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance. e.g HCl and CH_3COOH

Q.6 Define Bronsted Lowry base.

Ans. A base is a substance that can accept a proton (H^+) from another substance. e.g H_2O and NH_3.

Q.7 Define conjugate acid and base.

Ans. Conjugate acid

A conjugate acid is a specie formed by accepting a proton by a base. e.g., H_3O^+

Conjugate base

A conjugate base is a specie formed by donating a proton by an acid. e.g., Cl^-

Q.8 Define amphoteric.

Ans. A substance that can behave as an acid as well as a base is called amphoteric. For example water is an amphoteric compound.

Q.9 Write down limitations of Bronsted Lowry concept.

Ans. It has been observed that there are certain substances which behave as acids though they do not have the ability to donate a proton e.g SO_3. Similarly CaO behaves as a base but

it cannot accept a proton. These observations prove the limitations of Bronsted Lowry concept of acids and bases.

Q.10 Define Lewis-base. Give example.

Ans. A base is substance (molecule or ion) which can donate a pair of electrons. e.g NH_3.

Q.11 Define Lewis acids. Give example.

Ans. An acid is a substance (molecule or ion) which can accept a pair of electrons. e.g $AlCl_3$ and BF_3.

Q.12 Define Adduct.

Ans. The product of any Lewis acid-base reaction is a single specie called an adduct

Q.13 Write down the names of three mineral acids.

Ans. Following acids are called mineral acids. Hydrochloric acid (HCl)
Sulphuric acid (H_2SO_4) and nitric acid (HNO_3).

Q.14 Write down uses of sulphuric acid.

Ans. It is used to manufacture fertilizers, ammonium sulphate, calcium super phosphate, explosives, paints, dyes and drugs. It is also used as an electrolyte in lead storage batteries.

Q.15 Write down uses of nitric acid.

Ans. It is used in manufacturing of fertilizer (ammonium nitrate), explosives, paints, drugs and etching designs on copper plates.

Q.16 Write down uses of hydrochloric acid.

Ans. It is used for cleaning metals, tanning and in printing industries.

Q.17 Write down uses of benzoic acid.

Ans. It is used for food preservation

Q.18 Write down uses of sodium hydroxide.

Ans. It is used for manufacturing of soap, artificial silk, as laboratory reagent in textile and paper industries.

Q.19 Write down uses of calcium hydroxide.

Ans. It is used for manufacturing of bleaching powder, softening of hard water and neutralizing acidic soil and lakes due to acid rain.

Q.20 Write down uses of potassium hydroxide.

Ans. It is used in alkaline batteries.

Q.21 Write down uses of magnesium hydroxide.

Ans. It is use as a base to neutralize acidity in the stomach. It is also used for treatment of bees stings.

Q.22 Write down uses of Aluminium hydroxide.

Ans. It is used as foaming agent in fir extinguishers

Q.23 Write down uses of ammonium hydroxide.

Ans. It is used to remove grease stains from clothes.

Q.24 Define pH. Write down its formula.

Ans. pH is the negative logarithm of molar concentration of the hydrogen ions

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

Q.25 Write down uses of pH.

Ans. i) It is used to determine acidic or basic nature of a solution

ii) It is used to produce medicines, culture at a microbiological particular concentration of H^+ ion.

iii) It is used to prepare solutions of required concentrations necessary for certain biological reactions.

Q.26 What are indicators. Give example?

Ans. Indicators are the organic compounds. They have different colours in acidic and alkaline solutions. Litmus is a common indicator. It is red in acid and blue in alkaline solutions.

Q.27 What are universal indicators?

Ans. Some indicators are used as mixture. The mixture indicators give different colours at different pH values. Hence it is used to measure the pH of a solution. Such a mixed indicator is called universal indicator.

Q.28 Who are analytical chemists?

Ans. Analytical chemists examine substances qualitatively and quantitatively. They indentify substances and evaluate their properties.

Q.29 Define salts.

Ans. Salts are inorganic compounds generally formed by neutratization of an acid with a base. e.g., sodium chloride (NaCl)

Q.30 What is acid and basic radical?

Ans. Salts are made up of positive ions (cotions) and negative ions (Anions). A cation is metallic and derived from a base therefore it is called **basic radical**. While anion is derived form acids therefore it is called **acid radical.**

Q.31 Write down any two characteristics of salts.

Ans. salts are ionic compounds found in crystalline form. They have high melting and boiling points.

Q.32 Define normal or neural salts.

Ans. A salt formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion or NH_4^+ ions is called normal or neutral salt. e.g NaCl

Q.33 Define Acidic salt.

Ans. These salts are formed by partial replacement of H^+ ions of an acid by a positive metal ion. e.g $KHSO_4$

Q.34 Define basic salt.

Ans. Basic salts are formed by the incomplete neutralization of a polyhydroxy base by an acid. **e.g $Al(OH)_2$ Cl**

Q.35 Define double salt. Give example.

Ans. Double salts are formed by two normal salts when they are crystallized from a mixture of equimolar saturated solutions. The individual salt components retain their properties. For example Mohr's salt $FeSO_4$. $(NH_4)_2$ SO_4. $6H_2O$.

Q.36 Define Mixed salt. Give example.

Ans. Mixed salts contain more than one basic or acid radicals. Bleaching powder Ca(OCl) Cl, is an example of mixed salts.

Q.37 Define Complex salt. Give example?

Ans. Complex salt on dissociation provides a simple cation and a complex anion or vice verse. Only simple ions yields the characteristics test for cation or anion. E.g., potassium ferrocyanide $K_4\,[Fe(CN)_6]^-$

Q.38 Define neutralization reaction. Give example

Ans. A reaction between an acid and a base is called a neutralization reaction. It produces a salt and water.

$$\text{Acid} + \text{Base} \longrightarrow \text{Salt} + \text{Water} \quad \text{(Neutralization)}$$
$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Q.39 Name three common household substances having

a) pH values greater than 7

1) Soap
2) Detergent
3) Shampoo

b) pH values less than 7

1) vinegar
2) Citrus fruits
3) Butter

c) pH values equal to 7

1) Water
2) NaCl
3) Sugar

Q.40 Define a base and explain all alkalis are bases, but all bases are not alkalis.

Ans. A base is a substance which turn red litmus to blue and having pH value greater than 7. Water soluble base is called alkali but some bases are not soluble in water, so all alkalis are bases but all bases are not alkalis.

Q.41 Define Bronsted-Lowery base and explain with an example that water is Bronsted-lowery base.

Ans. Bronsted-Lowery base is a substance(molecule or ion) which can accept a proton (H^+) from another substance. For example, when HCl dissolves in water, HCl acts, as an acid and H_2O act as a base because it accepts a proton.

$$HCl_{(aq)} + H_2O_{(aq)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(eq)}$$

Acid **base**

Q.42 How can you justify that Bonsted –Lowery concept of acid and base is applicable to non aqueous solutions?

Ans. According to Bronsted-Lowry concept:

"An acid is a compound which donates a proton (H^+)."

"A base is a compound which accepts a proton (H^+)."

So, the compounds which have H^+ ions also act as acids in addition to water e.g., CH_3COOH while the compounds which have not OH^- ions also act as base e.g., NH_3.

Q.43 Which kind a bond forms between Lewis acid and base?

Ans. Coordinate covalent bond forms between Lewis acid and base.

Q.44 Why H^+ ion acts as a Lewis acid?

Ans. Because it has an empty orbital that can accommodate a pair of electrons.

Q.45 Name two acids used in the manufacture of fertilizers.

Ans. Sulphuric acid and nitric acid both are used in the manufacture of fertilizers.

Q.46 Define pH. What is the pH of pure water?

Ans. pH is the negative logarithm of molar concentration of the hydrogen ions. that is, $pH = -\log [H^+]$. The pH value of pure water is 7.

Q.47 How many times a solution of pH 1 will be stronger than that of a solution having pH 2?

Ans. Because the pH scale is logarithmic, a solution of pH 1 has 10 times higher concentration of $[H^+]$ than that of a solution of pH2.

Q.48 Na_2SO_4 is a neutral salt while $NaHSO_4$ is an acidic salt justify.

Ans. Because in Na_2SO_4 there is total replacement of ionizable H^+ ions. While in $NaHSO_4$ the partial replacement of a replaceable H^+ ions of an acid takes place by a positive metal ion. It turns red litmus to blue.

Q.49 Give few characteristics of salts.

Ans. There are following characteristics of salt.

1) Salts are ionic compounds found in crystalline form.
2) They have high melting and boiling point.

Q.50 How the soluble salts are recovered from water?

Ans. Soluble salts are recovered by evaporation or crystallization.

Q.51 How the insoluble salts are prepared?

Ans. In this method, usually solutions of soluble salts are mixed. During the reaction exchange of ionic radicals(i-e metallic radicals exchange with acidic radicals) takes place to produce two new salts. One of the salt is insoluble and other is soluble. The insoluble salt precipitates(solidify in solution) e.g.,

$$AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow AgCl_{(s)} + NaNO_{3(aq)}$$

$$Na_2CO_{3(aq)} + CuSO_{4(aq)} \longrightarrow CuCO_{3(s)} + Na_2SO_{4(aq)}$$

Q.52 Why a salt is neutral, explain with an example?

Ans. A salt is formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion or NH_4^+ ions is called normal or neutral salt. These salts are neutral to litmus.

$$HCl_{(aq)} + KOH_{(aq)} \longrightarrow KCl_{(aq)} + H_2O_{(l)}$$

Q.53 Name an acid used in the preservation of food.

Ans. Benzoic acid is used for food preservation.

Q.54 Name the acids present in.

Ans.

1) **Vinegar:**
   Acetic acid
2) **Ant sting**
   Formic acid
3) **Citrus fruit**
   Citric acid
4) **Sour milk**
   Lactic acid

Q.55 How can you justify that $Pb(OH)NO_3$ is a basic salt?

Ans. Pb(OH) $NO_3$is a basic salt because it is formed by the incomplete neutralization of a poly hydroxyl base by an acid.

$$Pb(OH)_2 + HNO_3 \longrightarrow Pb(OH)NO_3 + H_2O$$

It can react with acids to form normal salts. $Pb(OH)NO_3 + HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$

Q.56 You are in a need of an acidic salt. How can you prepare it?

Ans. An acidic salt is formed by the partial replacement of a replaceable H^+ ions of an acid by a positive metal ion.

$$H_2SO_4 + KOH \longrightarrow KHSO_4 + H_2O$$

$$H_3PO_4 + NaOH \longrightarrow NaH_2PO_4 + H_2O$$

Q.57 Which salt is used to prepare plaster of paris?

Ans. Calcium sulphate($CaSO_4.2H_2O$) is used to prepare plaster of Paris.

Q.58 What is the difference between Arrhenius base and Bronsted-lowry base?

Ans. Difference between Arrhenius base and Bronsted-Lowry base

Arrhenius base:	**Bronsted-Lowry base:**
A base is a substance which dissociates in aqueous solution to give hydroxide ion. (OH^-) e.g., NaOH	Bronsted-Lowry base is a substance which can accept a proton $(H)^+$ from another substance e.g., NH_3

Q.59 What do you mean by neutralization reaction according to Arrhenius acid base concept?

Ans. A neutralization reaction according to Arrhenius concept acid gives H^+ ions and bases gives OH^- ions.

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

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

Q.60 Prove that water is an amphoteric specie.

Ans. Water is an amphoteric specie because it acts as acid as well as base.

As a base:

$$HCl_{(aq)} + H_2O_{(aq)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$$

Acid **Base** **Conjugate Acid**

As a acid:

$$NH_{3(aq)} + H_2O_{(aq)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-_{(aq)}$$

Base **Acid** **Conjugate Acid**

Q.61 How can you justify that NH_3 is Bronsted-Lowry base but not Arrhenius base?

Ans. Ammonia(NH_3) is Bronsted-Lowry base because it has the ability to accept a proton(H^+)but not Arrhenius base because it does not produce hydroxide ion (OH^-)in aqueous solution.

Q.62 State and explain the neutralization reaction according to Lewis concept.

Ans. A neutralization reaction according to Lewis concept is donation and acceptance of an election pair to form a coordinate covalent bond in an adduct.

Q.63 Define and Give the characteristics of Lewis acid.

Ans. There are following characteristics of Lewis acids.

i. Lewis acids, are molecules, in which the central atom has incomplete octet e.g. BF_3, $AlCl_3$

ii. Simple cations can act as Lewis acids. since they are deficient in electrons e.g. Na^+, Ca^{2+}

Q.64 Why BF_3 behaves as a Lewis acid?

Ans. BF_3 acts as Lewis acid because it accepts a pair of electrons, the central atom has only six electrons around it, therefore, it accepts an electron pair.

Q.65 Water is an amphoteric species= according to Bronsted-Lowry concept. What is the nature of water according to Lewis concept?

Ans. According to Lewis concept water acts as Lewis base because it has the ability to donate electron pair.

Q.66 When acid reacts with carbonates and bicarbonates, which gas evolves out?

Ans. When acid reacts with carbonates and bicarbonates carbon dioxide(CO_2) gas evolves it.

$$CaCO_3+2HCl \longrightarrow CaCO_3+H_2O+CO_2\uparrow$$

$$2NaHCO_3 + H_2SO_4 \longrightarrow Na_2SO_4+2H_2O+2CO_2\uparrow$$

Q.67 Which type of salts produce SO_2gas on reacting with acids?

Ans. Acids react with sulphites and bisulphate to form salts with liberation of sulphur dioxide (SO_2) gas.

$$CaSO_3 + 2HCl \longrightarrow CaCl_2 + SO_2 + H_2O$$

$$NaHSO_3 + HCl \longrightarrow NaCl + SO_2\uparrow + H_2O$$

Q.68 Write down colours of the precipitates formed by reaction of aqueous caustic soda with solutions of copper, zinc and ferric salts.

Ans.

1) $CuSO_4 + 2NaOH \longrightarrow Cu(OH)_2 + Na_2SO_4$
(Blue ppt)

2) $ZnCl_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaCl$
(Whiteppt)

3) $FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$
(Brown ppt)

Q.69 Why pure water is not a strong electrolytes?

Ans. Because water has smaller value of degree of ionization due to presence of strong forces i-e Hydrogen bonding.

Q.70 HCl and H_2SO_4 are strong acids while their solutions are equimolar, they have different PH values. Why they have different PH values?

Ans. Because H_2SO_4 is a dibasic acid. It produces two hydrogen ions while HCl is monobasic acid it produces only one hydrogen ion. That is why both acids have different pH values with their equimolar solutions.

Q.71 Difference between 'P' and Ph value.

Ans.

P	**pH**
'P' scale is the conversion of very small figures into positive figure by taking the common logarithm of the small figure and multiplying it with-1	pH is the negative logarithm of molar concentration of the hydrogen ions, that is $PH = -\log[H^+]$

Q.72 How the salts are named?

Ans. A salt gets its name from the names of the metal and the acid e.g

Metal	Acid	Salt Name
Sodium(Na)	Hydrochloric Acid (HCl)	Sodium Chloride (NaCl)

Q.73 Name the salts which are formed when Zn metal reacts with following acids.

a. Nitric Acid b. Phosphoric Acid

c. Acetic Acid

Ans.

Zinc nitrate $Zn(NO_3)_2$
Zinc phosphate $Zn_3(PO_4)_2$
zinc acetate $Zn(CH_3COO)_2$

Q.74 Name the type of reaction that takes place between an acid and a metal. Which gas would evolve in the reaction? Explain with an example.

Ans. When acid reacts with metal, salt and hydrogen gas are produced. This type of reaction is called direct displacement method.

Acid Metal Salt Hydrogen gas

$$2HCl + Mg \longrightarrow MgCl_2 + H_2$$

Q.75 Names the types of salts.

Ans. There are following types of salts.

i. Normal Salts
ii. Acidic Salts
iii. Basic Salts
iv. Double Salts
v. Mixed Salts
vi. Complex Salts

Q.76 H_3PO_4 is weak acid but its salt(Na_3PO_4)with strong base NaOH is neutral. Explain it.

Ans. It is normal or neutral salt which is formed by the total replacement of ionization of H^+ ions of an acid by a positive metal ion or NH_4^+ ions is called normal or neutral salt.

$$H_3PO_4 + 3NaOH \longrightarrow Na_3PO_4 + 3H_2O$$

Q.77 How the basic salts turns into normal salts. Explain with an example.

Ans. When basic salts react with acids it produces normal salts.

$$Al(OH)_2Cl + HCl \longrightarrow Al(OH)Cl_2 + H_2O$$

$$Al(OH)Cl_2 + HCl \longrightarrow AlCl_3 + H_2O$$

Normal Salt

Q.78 Define acid rain

Ans. Acid rain is formed by dissolving acidic air pollutants like oxides of sulphur and nitrogen by rain water. As a result pH of the rain it damages animals, Plants, buildings, water bodies and even soil.

Multiple Choice Questions

1. A base is a substance which neutralizes an acid. Which of these substances is not a base?

(a) aqueous ammonia

(b) sodium chloride

(c) sodium carbonate

(d) calcium oxide

2. Lewis acid-base concept have the following characteristics except:

(a) formation of an adduct

(b) formation of a co-ordinate covalent bound

(c) donation and acceptance of an electron pair

(d) donation and acceptance of a proton

3. Acetic acid is a weak acid because it

(a) is used in cooking and flavouring food

(b) has very low pH

(c) is not fully ionized

(d) does not cotain any hydrogen ions

4. A salt is not composed of

(a) a metallic cation

(b) non-metallic anion

(c) an anion of a base

(d) an anion of an acid

5. If a liquid has a pH of 7 then it must

(a) be a colourless and odourless liquid

(b) freeze at 0°C and boil at 100°C

(c) be natural

(d) be a solution containing water

6. A salt always

(a) contain ions

(b) contains water of crystallization

(c) dissolves in water

(d) forms crystals which conduct electricity.

7. Dilute acids react with carbonates to produce the given products except

a) salt b) water

c) carbon dioxide d) hydrogen

8. In the preparation of insoluble salts, which one of the facts is incorrect?

(a) two soluble salts are mixed

(b) two in soluble salts are mixed

(c) one of the salt produced is insoluble

(d) both of the salts produced are insoluble

9. A reaction between an acid and a base produces.

(a) salts and water

(b) salt and gas

(c) salt and an acid

(d) salt and a base

10. The conjugate acid of HPO_4^{2-} is

(a) PO_4^{3-} (b) $H_2PO_4^{2-}$

(c) $H_2PO_4^-$ (d) H_3PO_4

11. What is the POH of a 0.02 M $Ca(OH)_2$?

(a) 1.698 (b) 1.397

(c) 12.31 (d) 12.61

12. Which one of the following species is not amphoteric?

(a) H_2O (c) NH_3

(c) HCO_3 (d) SO_4^{2-}

13. The product of Lewis acid-base reaction is called adduct. The bond between the adduct species is

(a) ionic
(b) covalent
(c) metallic
(d) co-ordinate covalent

14. The water of crystallization is responsible for the

(a) melting points of crystals
(b) boiling points of crystals
(c) shapes of crystals
(d) transition point of crystals

15. You want to dry a gas which one of the following salt you will use?

(a) $CaCl_2$ (b) NaCl
(c) CaO (d) Na_2SiO_3

16. Ferric hydroxide ($Fe(OH)_3$) is precipitated out of solution when aqueous sodium hydroxide solution is added to ferric chloride ($FeCl_3$)

$$FeCl_{3(aq)} + 3NaOH_{(aq)} \longrightarrow Fe(OH)_{3(ppt)} + 3NaCl_{(aq)}$$

Colour of the precipitate

(a) white (b) blue
(c) dirty green (d) brown

17. Which ion is the conjugate base of sulphuric acid?

(a) SO_3^{2-} (b) S^{2-}
(c) HSO_3^- (d) HSO_4^-

18. Which one of the following is a Lewis base?

(a) NH_3 (b) BF_3
(c) H^+ (d) $AlCl_3$

19. According to the Lewis concept, acid is a substance which can

(a) donate a proton
(b) donate a pair of electron
(c) accept a proton
(d) accept a pair of electron

20. Give $K_w = [H^+]\,[OH^-] = 1.0 \times 10^{-14}$ at 25°C what is the concentration of H^+ in pure water at 25°C?

(a) 1×10^{-7} mol dm^{-3}
(b) 1×10^{7} mol dm^{-3}
(c) 1×10^{-14} mol dm^{-3}
(d) 1×10^{14} mol dm^{-3}

21. Jabir Bin Haiyan prepared

(a) Nitric acid (b) hydrochloric acid
(c) Sulphuric acid (d) All of these

22. Lavoisier named binary compounds of oxygen acids in

(a) 1787 (b) 1790
(c) 1815 (d) 1828

23. Who proved that the presence of hydrogen as the main constituent of all acids.

(a) Lavoisier (b) Humphrey Dav
(c) Dalton (d) Arrhenius

24. The word acid is derived from th

(a) Greek word (b) Latin word
(c) English word (d) Arabic word

25. Acidus means

(a) Sour (b) Bitter
(c) Sweet (d) salty

26. Which acid is present in our stomach.

(a) Nitric acid (b) Hydrochloric acid
(c) Sulphuric acid (d) All of these

27. All acids turn blue litmus

(a) Red (b) Blue
(c) Pink (d) White

28. All bases turn red litmus

(a) Red (b) Blue
(c) Pink (d) White

29. Arrhenius presented his concept about acids and bases in

(a) 1785 (b) 1787
(c) 1923 (d) 1930

30. According to Arrhenius concept acid is a substance which dissociates in aqueous solution to give

(a) Hydrogen ions (b) Hydroxide ions
(c) Both a & b (d) None of these

31. According to Arrhenius concept base is a substance which dissociates in aqueous solution to give

(a) Hydrogen ions (b) Hydroxide ion
(c) Both a & b (d) None of these

32. Which one is not an Arrhenius acid?

(a) HCl (b) H_2SO_4
(c) CO_2 (d) HNO_3

33. Which one is not an Arrhenius base?

(a) NaOH (b) KOH
(c) $Ca(OH)_2$ (d) NH_3

34. Bronsted and Lowry presented their theories of acids and bases in

(a) 1785 (b) 1787
(c) 1923 (d) 1925

35. According to Bronsted and Lowry concept an acid is a substance that can donate

(a) proton (b) electron pair
(c) neutron (d) electron

36. A conjugate acid is a specie formed by accepting a

(a) proton (b) electron pair
(c) neutron (d) electron

37. According to Bronsted and Lowry concept a base is a substance that can accept

(a) proton (b) electron pair
(c) neutron (d) electron

38. A conjugate base is a specie formed by donating a

(a) proton (b) electron pair
(c) neutron (d) electron

39. A substance which can behave as an acid as well as a base is called

(a) Acid (b) base
(c) amphoteric (d) neutral

40. According to Lewis concept a base is a substance which can donate

(a) Proton (b) electron pair
(c) neutron (d) electron

41. According to Lewis concept an acid is a substance which can accept

(a) proton (b) electron
(c) neutron (d) electron pair

42. The product of any Lewis acid base reaction is a single specie called

(a) salt (b) water
(c) adduct (d) none

43. Which one is Lewis acid?

(a) BF_3 (b) $AlCl_3$
(c) $FeCl_3$ (d) All these

44. Which one is Lewis base?

(a) NH_3 (b) $R\text{-}NH_2$
(c) ROH (d) All of these

45. When acids react with metals which gas is evolved?

(a) H_2 (b) O_2
(c) Cl_2 (d) N_2

46. When acids react with carbonates and bicarbonates which gas is evolved?

(a) H_2 (b) CO_2
(c) Cl_2 (d) N_2

47. When acid reacts with sulphites and bisulphites which gas is evolved?

(a) H_2 (b) CO_2
(c) SO_2 (d) NH_3

48. Which one is mineral acid?

(a) HCl (b) H_2SO_4
(c) HNO_3 (d) All of these

49. Which acid is used an electrolyte in lead storage battery?

(a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3 COOH

50. Which acid is used for etching designs on copper plates?

(a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3 COOH

51. Which acid is used for food preservation?

(a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3 COOH

52. Citric acid is present in

(a) citrus fruits (b) sour milk
(c) Rancid butter (d) apple

53. Formic acid is present in

(a) stings of bees (b) sour milk
(c) apple (d) fats

54. Butyric acid is present in

(a) citrus acid (b) sour milk
(c) rancid butter (d) apple

55. Mallic acid is present in

(a) Apple (b) Feats
(c) String of bees (d) urine

56. Uric acid is present in

(a) apple (b) fats
(c) urine (d) grapes

57. stearic acid present in

(a) apples (b) fats
(c) urine (d) grapes

58. Alkalis react with ammonium salt to liberate

(a) SO_2 (b) CO_2
(c) NH_3 (d) H_2

59. Which is used to manufacture of soap?

(a) NaOH (b) $Ca(OH)_2$
(c) KOH (d) $Mg(OH)_2$

60. Which one is used for alkaline batteries?

(a) NaOH (b) Ca(OH)2
(c) KOH (d) $Mg(OH)_2$

61. Which is used as foaming agent in fire extinguishers?

(a) NaOH (b) KOH
(c) Al $(OH)_3$ (d) NH_4OH

62. Which is used to remove the grease stains from clothes?

(a) NaOH (b) KOH
(c) $Al(OH)_3$ (d) NH_4OH

63. The value of constant of ionic product of water K_w at 25 C

(a) 1.0×10^{-4} (b) 1.0×10^{14}
(c) 1.0×10^{7} (d) 1.0×10^{-7}

64. pH value normally varies from

(a) 0 - 14 (b) 1-14
(c) 7 - 14 (d) 10 - 14

65. pH of neutral solution is always

(a) 6 (b) 5
(c) 7 (d) 10

66. Acidic solutions have pH value

(a) less than 7 (b) greater than 7
(c) equal to 7 (d) None of these

67. Basic solutions have pH value

(a) Less than 7 (b) greater than 7
(c) equal to 7 (d) none of these

68. Indicators are the

(a) Inorganic compounds
(b) organic compounds
(c) Ionic compounds
(d) covalent compounds

69. Phenolphthalein produces red colour in

(a) Acid (b) base
(c) both a & b (d) None

70. Methyl orange produces which colour in basic solution

(a) Red (b) Yellow
(c) Pink (d) white

71. Which salt is used as a table salt?

(a) NaCl (b) Na_2CO_3
(c) Na_2SiO_3 (d) NaCl

72. Which salt is used for the manufacture of detergents, pulp and paper?

(a) NaCl (b) Na_2CO_3
(c) Na_2SiO_3 (d) NaCl

73. Which is used for cleaning agent for domestic and commercial purpose?

(a) NaCl (b) Na_2CO_3
(c) $NaHCO_3$ (d) Na_2SiO_3

Answer Key

1	b	2	d	3	c	4	c	5	c
6	a	7	d	8	d	9	a	10	c
11	b	12	d	13	d	14	c	15	c
16	d	17	d	18	a	19	d	20	a
21	b	22	a	23	b	24	b	25	a
26	b	27	a	28	b	29	b	30	a
31	b	32	c	33	b	34	c	35	a
36	a	37	a	38	a	39	c	40	b
41	d	42	c	43	d	44	d	45	a
46	b	47	c	48	d	49	a	50	b
51	d	52	a	53	a	54	c	55	a
56	c	57	b	58	c	59	a	60	c
61	c	62	d	63	b	64	a	65	c
66	a	67	b	68	b	69	b	70	b
71	a	72	b	73	d				

Unit
11

Organic Chemistry

Long Answer Questions

Q.1 Explain the types of formulae of organic compounds.

Ans. There are four types of formulae of organic compounds:

(i) Molecular formula

(ii) Structural formula

(iii) Condensed formula

(iv) Dot and cross formula

(i) Molecular Formula

The formula which represents the actual number of atoms in one molecule of the organic compound is called the molecular formula. For example molecular formula of butane is C_4H_{10}. It shows:

(a) Butane is made up of carbon and hydrogen atoms.

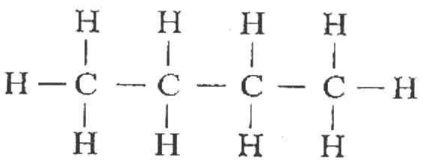
(b) Each molecule of butane consists of 4 carbon atoms and 10 hydrogen atoms.

(ii) Structural Formula

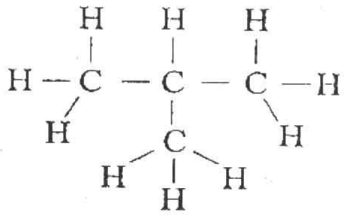
Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance.

In a structural formula, single bond is represented by a single line (—), a double bond by two lines (=) and a triple bond by three lines (≡) between the bonded atoms.

Organic compounds may have same molecular formulae but different structural formulae, e.g., structural formulae of butane C_4H_{10} are:



n-Butane



isobutane

(iii) Condensed Formula

The formula that indicate the group of atoms joined together to each carbon atom in a straight chain or a branched chain is called the condensed formula.

$H_3C-(CH_2)_2-CH_3$

n-butane

or

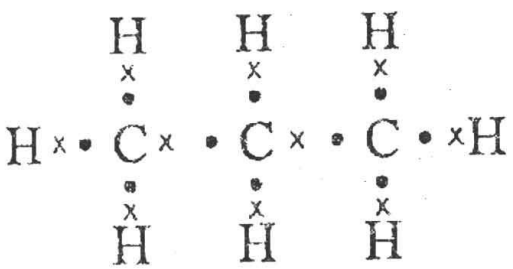
$H_3C-CH_2-CH_2-CH_3$

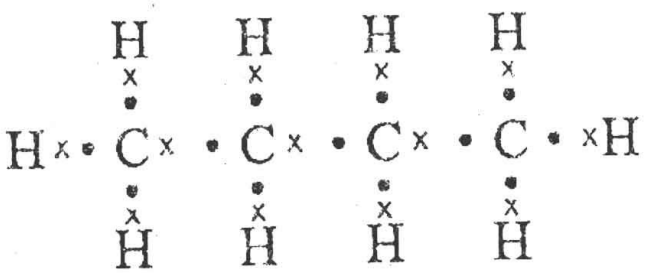
$H_3C-CH(CH_3)-CH_3$

isobutane

(iv) Electronic or Dot and Cross Formula

The formula which shows the sharing of electrons between various atoms in one molecule of the organic compound is called dot and cross formula or electronic formula.





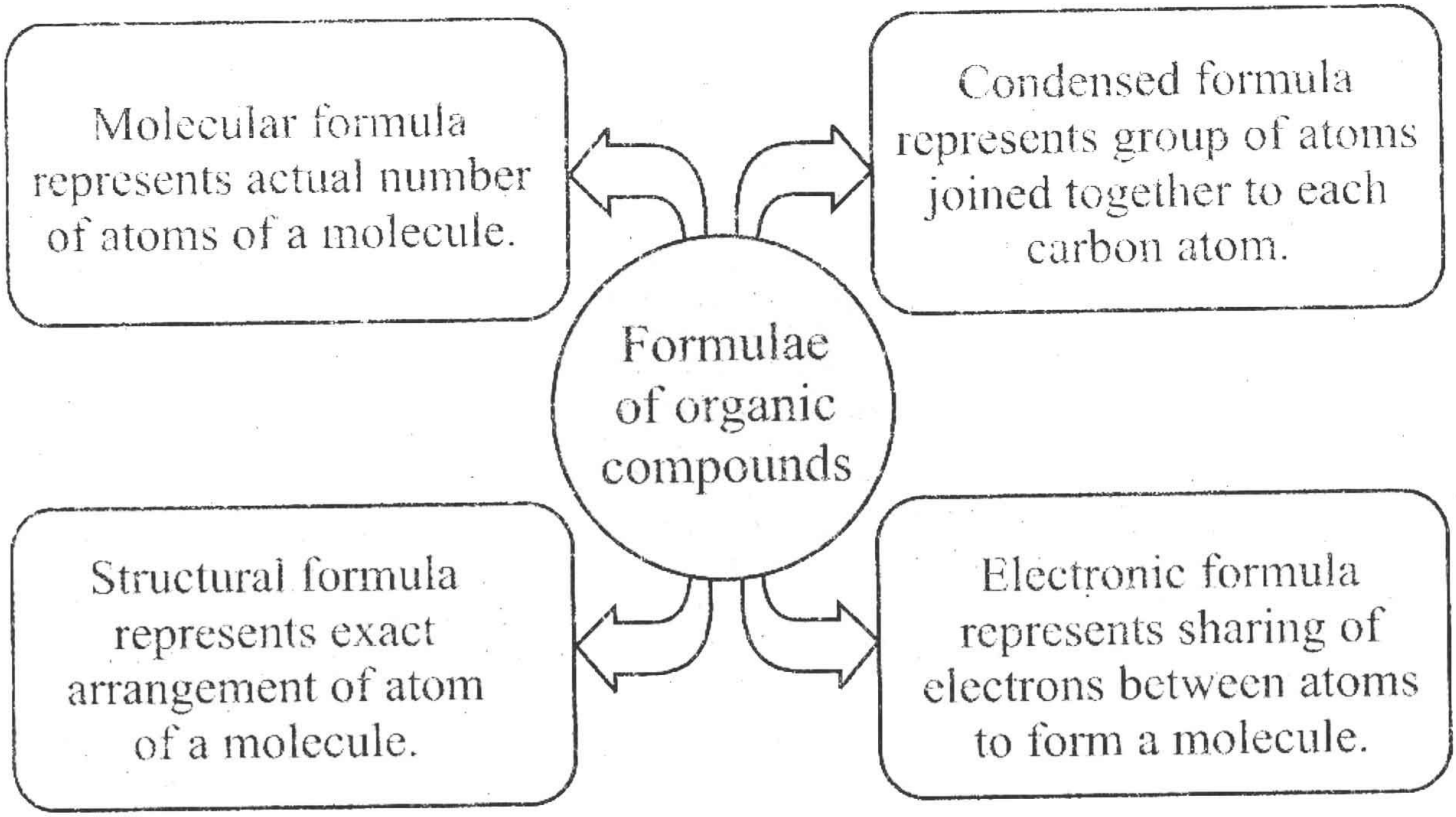


Table: presents the names, molecular formulae, condensed form and structural formulae of the first ten hydrocarbons.

Hydrocarbons

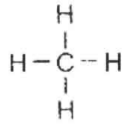
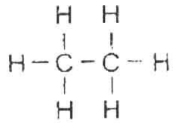
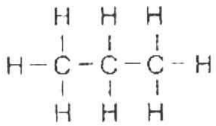
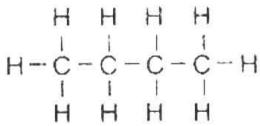
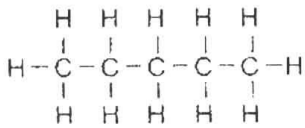
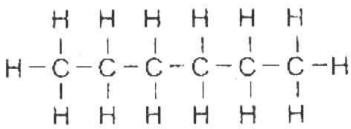
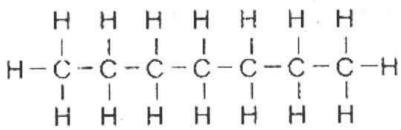
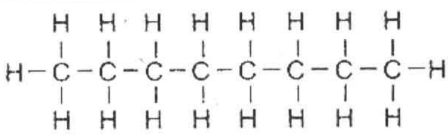
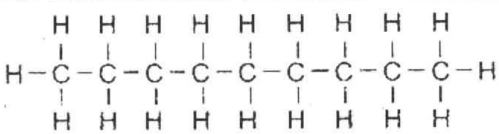
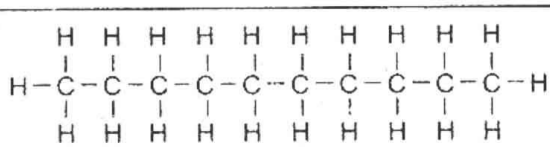
Name	Molecular Formula	Condensed Form	Structural Form
Methane	CH_4	CH_4	
Ethane	C_2H_6	H_3CCH_3	
Propane	C_3H_8	$H_3CCH_2CH_3$	
Butane	C_4H_{10}	$H_3C\,(CH_2)_2CH_3$	
Pentane	C_5H_{12}	$H_3C(CH_2)_3CH_3$	
Hexane	C_6H_{14}	$H_3C(CH_2)_4CH_3$	
Heptane	C_7H_{16}	$H_3C(CH_2)_5CH_3$	
Octane	C_8H_{18}	$H_3C(CH_2)_6CH_3$	
Nonane	C_9H_{20}	$H_3C(CH_2)_7CH_3$	
Decane	$C_{10}H_{22}$	$H_3C(CH_2)_8CH_3$	

Table: Names, Molecular, Condensed and Structural Formulae of Hydrocarbons

Q.2 Explain the Classification of organic compounds.

Ans. Classification of organic compounds

All known organic compounds have been broadly divided into two categories depending upon their carbon skeleton. These are:

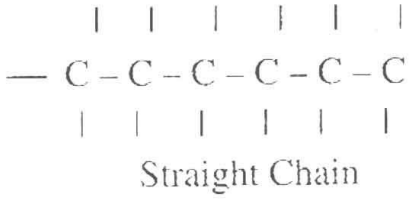
(i) Open chain or acyclic compounds.

(ii) Close chain or cyclic compounds.

(i) Open chain or Acyclic compounds

Open chain compounds are those in which the end carbon atoms are not joined with each other in this way they form a long chain of carbon atoms. These chains may be either straight or branched. For example

(a) Straight chain compounds are those in which carbon atom link with each other through a single, double or triple bonds forming a straight chain, such as

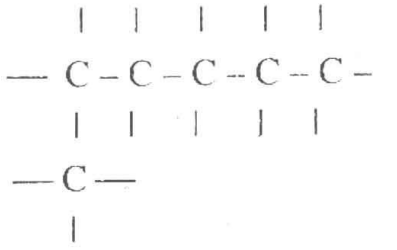


Straight Chain

$H_3C - CH_2 - CH_2 - CH_3$

Straight Chain (n-Butane)

(b) Branched chain compounds are those in which there is a branch along a straight chain, such as:



Branched chain

$H_3C - CH - CH_3$

CH_3

Branched chain (isobutane)

Open chain compounds are also called **aliphatic compounds**.

(ii) Closed chain or Cyclic compounds

Closed chain or cyclic compounds are those in which the carbon atoms at the end of the chain are not free. They are linked to form a ring. They are further divided into two classes:

(a) Homocyclic or carbocyclic compound

(b) Heterocyclic compounds.

(a) Homocyclic or carbocyclic compounds

Homocyclic or carbocyclic compounds contain rings which are made up of only one kind of atoms, i.e., carbon atoms. These are further divided into two classes:

- Aromatic compounds
- Alicyclic compounds

Aromatic compounds

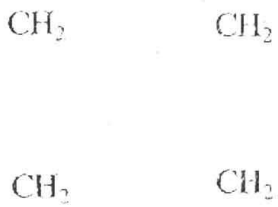
These organic compounds contain at least one benzene ring in their molecule. A benzene ring is made up of six carbon atoms with three alternating double bonds. They are called aromatic because of aroma or smell they have. For example,

Benzene Naphthalene

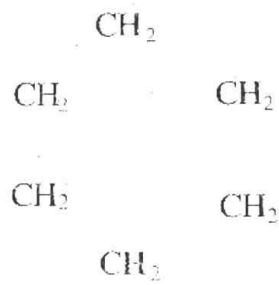
They are also called **benzenoid compounds**.

Alicyclic or non-benzenoid compounds:

Carbocyclic compounds which do not have benzene ring in their molecules are called alicyclic or non-benzenoid compounds. For examples,



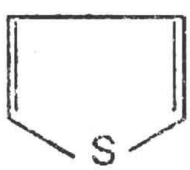
Cyclobutane



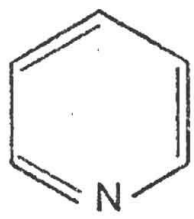
Cyclohexane

(b) Heterocyclic compounds

Cyclic compounds that contains one or more atoms other than that of carbon atoms in their rings are called heterocyclic compounds.

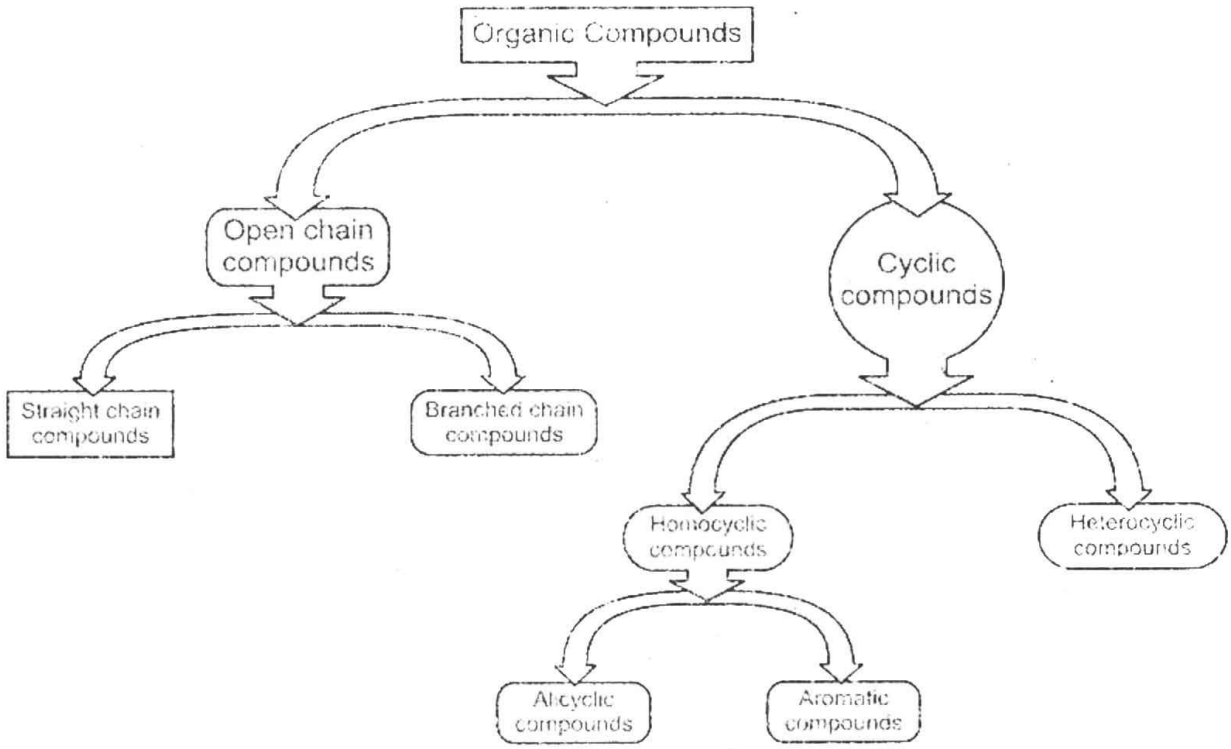


Thiophene



Pyridine

The above classification may be summarized as follows:



Q.3 Explain Diversity and Magnitude of Organic Compounds.

Ans: Diversity and Magnitude of Organic Compounds

There are a total of 118 elements known today. The number of organic compounds (carbon compounds) is more than ten million. This number is far more than the number of compounds of all the remaining elements taken together. The existence of such a large number of organic compounds is due to the following reasons:

(i) Catenation:

The main reason for the existence of a large number of organic compounds is that carbon atoms can link with one another by means of covalent bonds to form long chains or rings of carbon atoms. The chains can be straight or branched. **The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation.**

Condition for Catenation

Two basic conditions for an element to exhibit catenation are:

(a) Element should have valency two or greater than two.

(b) Bonds made by an element with its own atoms should be stronger than the bonds made by the element with other atoms especially oxygen.

Silicon does not show isomerism's

Both silicon and carbon have similar electronic configurations but carbon shows catenation whereas silicon does not. It is mainly due to the reason that C-C bonds are much stronger (355 kJ mol^{-1}) than Si-Si (200 kJ mol^{-1}) bonds. On the other hand, Si – O bonds are much stronger (452 kJ mol^{-1}) than C – O bonds (351 kJ mol^{-1}). Hence silicon occurs in the form of silica and silicates in nature.

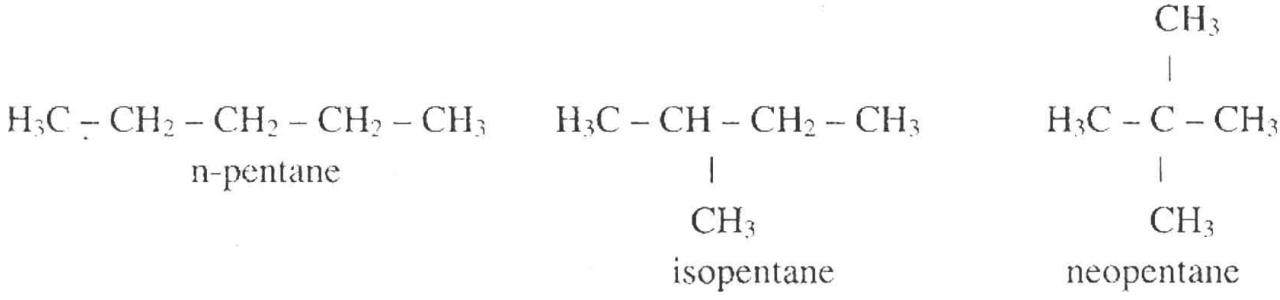
(ii) Isomerism

Another reason for the abundance of organic compounds is the phenomenon of isomerism.

Definition

The compounds are said to be isomers if they have the same molecular formula but different arrangement of atoms in molecules or different structural formulae.

Isomerism also adds to the possible number of structure. For example molecular formula of pentane C_5H_{12} can be represented by three different structures. Thus, C_5H_{12} has three isomers, as shown below:



Number of isomers increase with the increase in number of carbon atom in the given molecular formula.

iii. Strength of covalent bonds of carbon

Due to its very small size, carbon can form very strong covalent bonds with other carbon atoms, hydrogen, oxygen, nitrogen and halogens. This enables it to form a large number of compounds.

iv. Multiple bonding

In order to satisfy its tetravalency, carbon can make multiple bonds (i.e., double and triple bonds). This further adds to the possible number of structures. For example, two carbons in ethane are linked by a single covalent bond, by a double covalent bond in ethylene and a triple covalent bond in acetylene.

Q.4 Write down the general characteristic of Organic Compounds.

Ans. General characteristic of Organic Compounds

Organic compounds have the following general characteristics.

(i) Origin: Naturally occurring substances are obtained from plants and animals. On the other hand, inorganic compounds are obtained from minerals and rocks.

(ii) Composition: Carbon is an essential constituent of all organic compounds. They are made up of few elements such as carbon, hydrogen, nitrogen, oxygen, halogen, sulphur etc. On the other hand inorganic compounds are made up of almost all the elements of the Periodic Table known so far.

(iii) **Covalent linkage:** organic compound contain covalent bonds that may be polar or non-polar, while the inorganic compounds mostly contain ionic bonds.

(iv) **Solubility:** Organic compounds having non-polar linkages are generally soluble in organic solvents like alcohol, ether, benzene, carbon disulphide etc. on the other hand, the inorganic compounds with ionic bonds are soluble in polar solvents like water.

(v)**Electrical Conductivity:** Due to the presence of covalent bonds, organic compounds are poor conductor of electricity. Whereas inorganic compounds being ionic in nature, are good conductors of electricity.

(vi) **Melting and boiling points:** Generally organic compounds have low melting and boiling points and are volatile in nature. Inorganic compounds, on the other hand, have comparatively high melting and boiling points.

(vii) **Stability:** Since organic compounds have low melting and boiling points they are less stable than inorganic compounds.

(viii) **Combustibility:** Organic compounds with high percentage of carbon are generally combustible. On the other hand, inorganic compounds are mostly non-combustible.

(ix) **Isomerism:** A main characteristics of organic compounds which differentiate them from inorganic substances is their tendency to exhibit the phenomenon of isomerism. Isomerism is rare in inorganic substance.

(x)**Rate of reaction:** Due to the presence of covalent linkages, the reactions of organic compounds are molecular in nature. They are often slow and require specific conditions such as temperature, pressure or catalyst.

Q.5 How coal is formed? Explain the different types of coal.

Ans: Coal

Coal is blackish, complex mixture of compounds of carbon, hydrogen and oxygen. It also consists of small amounts of nitrogen and sulphur compounds.

Formation of coal

Coal was formed by the decomposition of dead plants buried under the Earth's crust millions of years ago. **Conversion of wood into coal is called carbonization.** It is a very slow bio-chemical process. It takes place in the absence of air under high pressure and high temperature over a long period of time (about 500 millions of years) as shown in figure. Wood contains about 40% carbon, so depending upon the extent of carbonization process, four types of coal are found. These types differ with respect to carbon content, volatile matter and moisture. Table shows the detail of contents of different types of coals and their uses in daily life and industry.

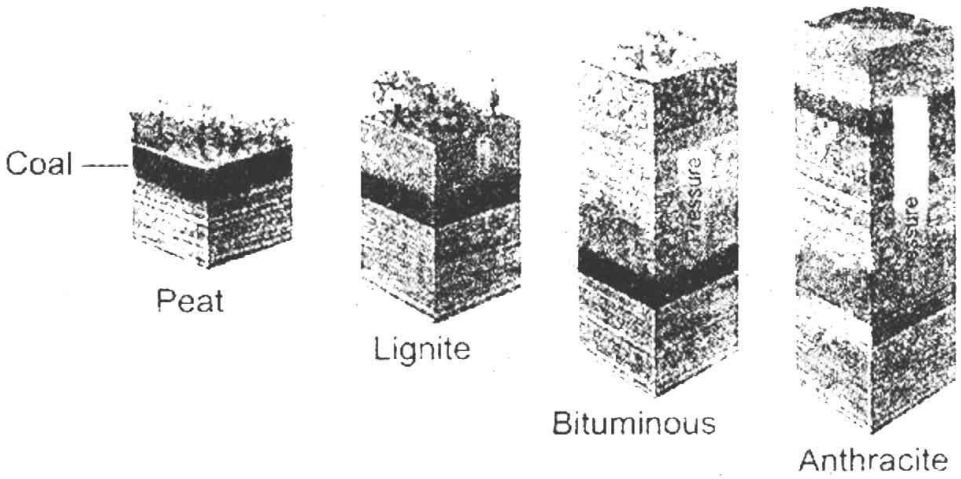


Fig. Formation of coal in different stages with the increase of pressure.

Type of Coal	Carbon contents	Uses
Peat	60%	It is inferior quality coal used in kiln.
Lignite	70%	It is soft coal used in thermal power stations.
Bituminous	80%	It is common variety of coal used as household coal.
Anthracite	90%	It is superior quality hard coal that is used in industry.

Q.6 What is destructive distillation of coal? Explain the different types of the products obtained by the destructive distillation.

Ans. Destructive distillation of Coal

Coal has become a major source of organic compounds because of destructive distillation. **The strong heating of coal in the absence of air is called destructive distillation**. As we know coal contains elements like carbon, hydrogen, oxygen, nitrogen, and sulphur. So destructive distillation of coal provides a large number of organic compounds along with a few inorganic compounds.

Products obtained by the destructive distillation of coal

(i) Coal Gas:

It is mixture of hydrogen, methane and carbon monoxide. It produces heat when burnt in air. Therefore, it is mainly used as a fuel in industry. It is also used to provide an inert or reducing atmosphere in various metallurgical processes.

(ii) Ammonical Liquor:

It is a solution of ammonia gas in water. It is used to prepare nitrogenous fertilizers. For example, when it is treated with sulphuric acid, it produces ammonium sulphate, fertilizer.

(iii) Coal-Tar:

It is a thick black liquid. It is a mixture of more than 200 different organic compounds, mostly aromatic. These compounds are separated by fractional distillation. Some of the important aromatic compounds are benzene, phenol, toluene, aniline, etc. These chemicals are used to synthesize drugs, dyes, explosives, paints, varnishes, plastics, synthetic fiber and pesticides. Besides these valuable chemicals, **the black residue of the coal tar is called pitch.** It is used for surfacing of roads and roofs.

(iv) Coke:

Coke is 98% carbon. It is left behind residue of coal. When coal is subjected to destructive distillation, it loses all its volatile components and leaves behind a solid residue called coke. It is mainly used as a reducing agent in the extraction of metals especially iron. It is also used as fuel.

Q.7 Write down the uses of organic compounds.

Ans: Uses of organic compounds

No doubt, thousands of organic compounds are synthesized naturally by animals and plants. But millions of organic compounds are being prepared in the laboratories by the chemists. Because these compounds are part of everything from food we eat to the various items we use in daily life to fulfill our needs.

(i) **Uses as Food:** The food we eat daily such as milk, eggs, meat, vegetables, etc., contain carbohydrates proteins, fats, vitamins, etc., are all organic stuff.

(ii) **Uses as Clothing:** All types of clothing (we wear, we use as bed sheets etc.) are made up of natural fibres.

(iii) **Uses as Houses:** Wood is cellulose (naturally synthesized organic compound). It is used for making house and furniture of all kinds.

(iv) **Uses as Fuel:** The fuels we use for automobiles and domestic purposes are coal, petroleum and natural gas. These are called fossil fuels. All of these are organic compounds.

(v) **Uses as medicines:** A large number of organic compounds (naturally synthesized by plants) are used as medicines by us. Most of the life saving medicines and drugs such as antibiotics (inhibit or kill microorganisms which cause infectious diseases) are synthesized in laboratories.

(vi) **Uses as Raw Material:** Organic compounds are used to prepare a variety of material, such as rubber, paper, ink, drugs, dyes, paints, varnishes, pesticides, etc.

Q.8 Define homologous series write down characteristics of homologous series.

Ans: Homologous series

Organic compounds are divided into groups of compounds having similar chemical properties. Each group is known as a homologous series. Organic compounds of the same homologous series have the following properties in common:

Characteristics of homologous series

(i) All members of a series can be represented by a general formula for example general formulae of alkane, alkenes and alkynes are CnH_{2n+2}, CnH_{2n}, and CnH_{2n-2}, respectively.

(ii) Successive members of the series differ by one unit of – CH_2 – and 14 units in their relative molecular mass.

(iii) They have similar chemical properties (because they contain the same functional group).

(iv) There is a regular change in their physical properties; the melting and boiling points increase gradually with the increase of molecular masses.

(v) They can be prepared by similar general methods.

Hydrocarbons are regarded as parent organic compounds. All other compounds are considered to be derived from them by substituting one or more hydrogen atoms of a hydrocarbon by one or more reactive atoms.

Q.9 Write detail note on functional groups.

Ans: Functional Group

An atom or group of atoms or presence of double or triple bound which determines the characteristic properties of an organic compound is known as the functional group. The remaining part of the molecule mainly determines the physical properties such as melting point, boiling point, density etc

Example

- OH group is the functional group of alcohols, which gives characteristics properties of alcohols. The characteristic properties of carboxylic acids are due to the presence of – COOH group in them. Therefore, functional group of carboxylic acids is – COOH group.

Functional groups containing Carbon, Hydrogen and Oxygen

The organic compounds containing carbon, hydrogen and oxygen as functional group are alcohols, ethers, aldehydes, ketones, carboxylic acids and ester. Their class name, functional group, class formula and examples are given below

(i) Alcoholic Group

The functional group of alcohols is – OH. Their general formula is ROH. Where R is any alkyl group.

$CH_3 - OH$	$CH_3 - CH_2 - OH$	$CH_3 - CH_2 - CH_2 - OH$
Methyl alcohol	Ethyl Alcohol	n-Propyl alcohol

(ii) Ether Linkage

The functional group of ether is C – O – C. their general formula is

R-O-R′. where R and R′ are alkyl groups

R and R may be same or different, such as

H_3C-O-CH_3 Dimethyl ether

C_2H_5-O-C_2H_5 Diethyl ether

H_3C-O-C_2H_5 Ethyl methyl ether

(iii) Aldehydic Group

Aldehyde family consists of functional group $-\overset{\overset{O}{\|}}{C}-H$

Their general formula is RCHO.

Where R stands for H or some alkyl group, such as:

$H-\overset{\overset{O}{\|}}{C}-H$ Formaldehyde

$H_3C-\overset{\overset{O}{\|}}{C}-H$ Acetaldehyde

(iv) Ketonic Group

Compounds containing the functional group $\diagdown\!\!\diagup C=O$ are called ketones.

They have the general formula $R-\overset{\overset{O}{\|}}{C}-R'$

Where R and R′ are alkyl groups. They may be same or different, such as:

$H_3C-\overset{\overset{O}{\|}}{C}-CH_3$
Acetone
(Dimethyl Ketone)

$H_3C-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$
EthylmethylKetone

(v) Carboxyl Group

Compounds containing functional group $-\overset{\overset{O}{\|}}{C}-OH$ are called carboxylic acids. their

general formula is $R-\overset{\overset{O}{\|}}{C}-OH$;

Where R stands for – H or some alkyl group. Such as:

$H-\overset{\overset{O}{\|}}{C}-OH$ Formic acid

$H_3C-\overset{\overset{O}{\|}}{C}-OH$ Acetic acid

vi) Ester Linkage

compound containing functional group $R-\overset{\overset{O}{\|}}{C}-OR'$ are called ester linkage and their

general formula is $R-\overset{\overset{O}{\|}}{C}-OR'$.

Example:

$H_3C-\overset{\overset{O}{\|}}{C}-OCH_3$
Methyl Acetate

Q.10 Write the note on the followings (i) Petroleum (ii) Natural gas

Ans. Petroleum

Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons mixed with water, salt and earth particles.

Petroleum is a main source of organic compounds. It consists of several compounds mainly hydrocarbons. These compounds are separated by

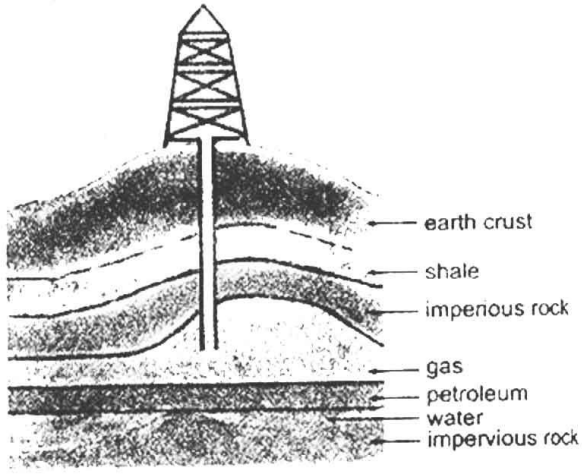


Fig: Occurrence and drilling of gas

fractional distillation (separation of fractions or components depending upon their boiling point ranges). Each fraction is not a single compound; rather each of it consists of different organic compounds.

Natural Gas

It is a mixture of low molecular mass hydrocarbons. The main component about 85% is methane, along with other gases ethane, propane and butane. Its origin is similar to that of coal and petroleum. Therefore, it is found with their deposits as shown in figure. Natural gas is used as fuel in homes as well as in industries. It is used as fuel in auto-mobiles as compressed natural gas (CNG). Natural gas is also used to make carbon black and fertilizer.

Q.11 Explain the formation of Alkyl radical.

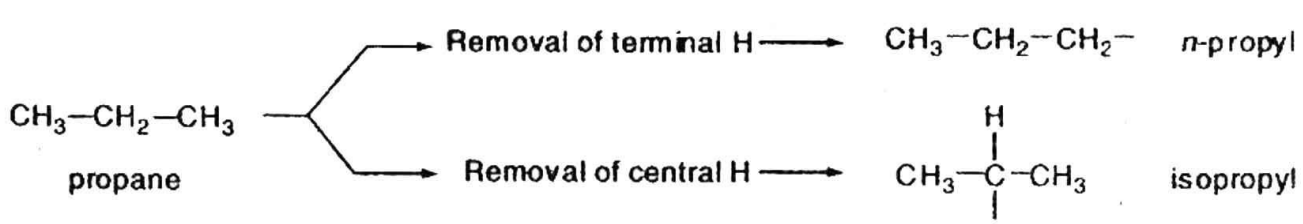
Ans: Formation of Alkyl Radicals

Alkyl radicals are derivatives of alkanes. They are formed by the removal of one of the hydrogen atom of an alkane and are represented by a letter 'R'. their name is written by replacing 'ane' of alkane with 'yl'. Table represents first ten alkanes and their alkyl radicals. Their general formula is C_nH_{2n+1}.

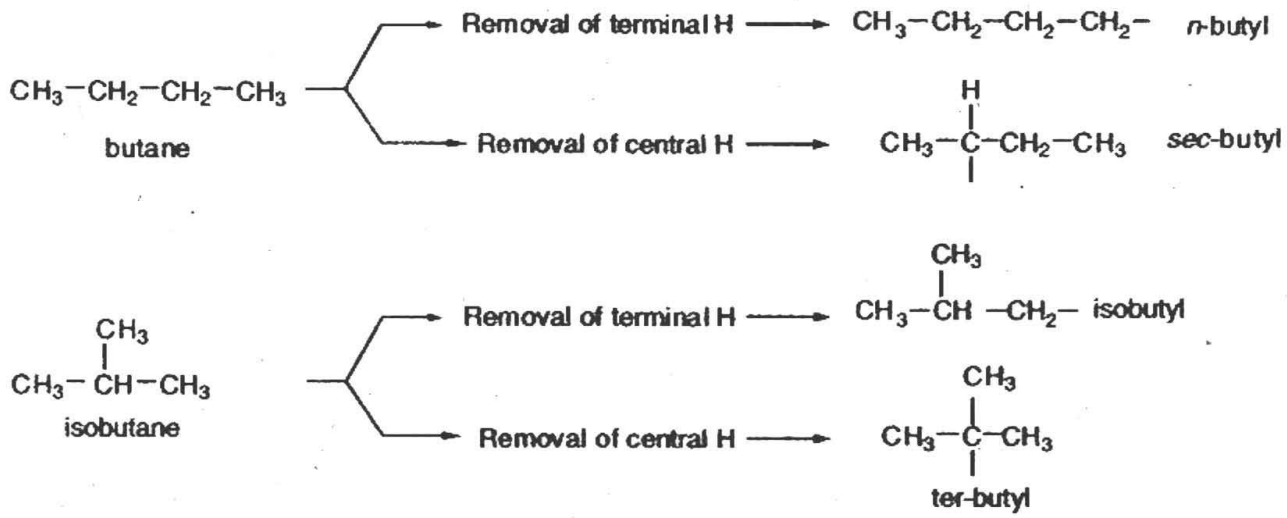
Table: Names and Molecular Formulae of Alkanes and their Alkyl Radicals

Alkane	Molecular Formula	Alky radical	Name
Methane	CH_4	CH_3 ---	Methyl
Ethane	C_2H_6	C_2H_5 ---	Ethyl
Propane	C_3H_8	C_3H_7 ---	Propyl
Butane	C_4H_{10}	C_4H_9 ---	Butyl
Pentane	C_5H_{12}	C_5H_{11} ---	Pentyl
Hexane	C_6H_{14}	C_6H_{13} ---	Hexyl
Heptane	C_7H_{16}	C_7H_{15} ---	Heptyl
Octane	C_8H_{18}	C_8H_{17} ---	Octyl
Nonane	C_9H_{20}	C_9H_{19} ---	Nonyl
Decane	$C_{10}H_{22}$	$C_{10}H_{21}$ ---	Decyl

It is better to explain the type of radicals of propane and butane. Propane has a straight chain structure. When terminal H is removed it is called ***n – propyl***. When hydrogen from central carbon is removed it is called ***isopropyl,*** as explained below:



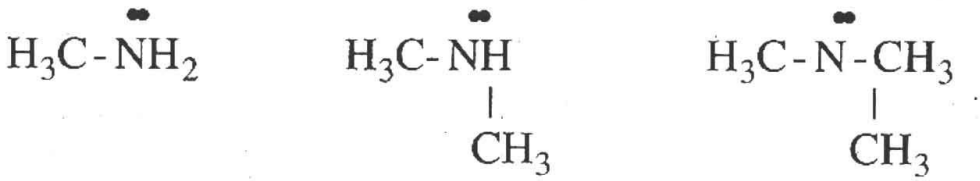
Similarly, different structures of butyl radicals are explained:



Q.12 Explain functional group containing carbon, hydrogen and Nitrogen.

Ans: Functional Group Containing Carbon, Hydrogen and Nitrogen:

The organic compounds containing carbon, hydrogen and nitrogen as functional group are called as amines. Their functional group is $-NH_2$, and their general formula is $R\text{-}NH_2$. Examples of amines are:



Functional Group Containing Carbon, Hydrogen and Halogens:

The organic compounds having functional group containing carbon, hydrogen and halogens are called alkyl halides. Their functional group is R-X. 'X' may be F, Cl, Br or I.

Table Functional group containing carbon, hydrogen and halogens

Class Name	Functional Group	Class Formula	Examples
Alkyl Halides			
a. Primary	$-CH_2-X$	$R-CH_2-X$	H_3C-CH_2-X Ethyl halide
b. Secondary	$>CH-X$	R_2CH-X	$(H_3C)_2CH-X$ *sec*-Propyl halide
c. Tertiary	$-\overset{\vert}{\underset{\vert}{C}}-X$	$R-\overset{R}{\underset{R}{C}}-X$	$H_3C-\overset{CH_3}{\underset{CH_3}{C}}-X$ *ter*-Butyl halide

Double and Triple Bond:

Organic compounds consisting of double bonds in their molecules are called as alkenes, such as:

$H_2C = CH_2$ Ethene $\qquad$ $H_3C - CH = CH_2$ Propene

Organic compounds consisting of triple bonds in their molecules are called as alkynes, such as:

$HC \equiv CH$ Ethyne $\qquad$ $H_3C - C \equiv CH$ Propyne

Q. 13 Explain the tests of functional groups?

Ans: Tests of functional groups

Test for Unsaturation $>C = C<$ **or** $-C \equiv C-$

i. **Bromine water test:**

Dissolve a pinch of the given organic compound in 2.0 cm^3 of carbon tetrachloride(CCl_4). Add 2 cm^3 of bromine water in it and shake.

Result: Bromine will be decolourised.

ii. **Baeyer's test:**

Dissolve about 0.2 g of the organic compound in water. Add to it 2-3 drops of alkaline $KMnO_4$ solution and shake.

Result: Pink colour will disappear.

Test for Alcoholic Group - OH

i. **Sodium metal test:**

Take about 2-3 cm^3 of the given organic liquid in a dry test tube and add a piece of sodium metal.

Result: Hydrogen gas will evolve.

ii. **Ester formation test**

Heat about 1.0 cm^3 of the organic compound with 1.0 cm^3 of acetic acid and 1 – 2 drops of concentrated sulphuric acid.

Result: Fruity smell will be given out

Test for Carboxylic Group $-\overset{\overset{O}{\|}}{C}-OH$

i. **Litmus test:**

Shake a pinch of the given compound with water and add a drop of blue litmus solution.

Result: Litmus paper will turn red.

ii. $NaHCO_3$ solution test:

Take about 2.0 cm^3 of 5% $NaHCO_3$ solution and add a pinch of given compound.

Result: CO_2 gas with effervescence evolves.

Detection of Aldehydic Group $-\overset{\overset{O}{\|}}{C}-H$

i. Sodium bisulphite test

Shake about 0.2 g or 0.5 cm^3 of the given compound with 1-2 cm^3 of saturated solution of sodium bisulphate.

Result: A crystalline white precipitate will be formed.

ii. Fehling's solution test:

Mix equal volumes of Fehling's solution A and B in a test tube. Add a pinch of organic compound and boil for five minutes.

Result: Red precipitate will be formed.

Test for ketonic Group

i. Phenyl hydrazine test:

Shake a pinch of the given organic compound with about 2.0 cm^3 of phenyl hydrazine solution.

Result: Orange red precipitate will be formed.

ii. Sodium nitroprusside test:

Take about 2.0 cm^3 of sodium nitroprusside solution in a test tube and add 2-3 drops of NaOH solution. Now add a pinch of the given compound and shake.

Result: Red colour will be formed.

iii. With Fehling's solution:

No reaction

Test for Primary Amino Group ($-NH_2$)

Carbyl amine test:

Heat about 0.2 g of the given compound and add 0.5 cm^3 of chloroform and add 2-3 cm^3 of alcoholic KOH.

Result: Extremely unpleasant odour will be given out.

Test of Ester:

They are recognized by their fruity smell.

Short Answer Questions

Q.1 What is vital force theory who proposed it?

Ans: According to vital force theory organic compounds could not be prepared in laboratories because they were supposed to be synthesized under the influence of a mysterious force called vital force inherent only in living things

In early 19th century Swedish chemist Jacob Berzellius proposed this theory.

Q.2 Who rejected the vital force theory and how?

Ans: Vital force theory was rejected by Wohler in 1828 when he synthesized the first organic compound urea from inorganic substance by heating ammonium cyanate (NH_4CNO)

$$NH_4CNO \xrightarrow{\Delta} H_2N - \underset{\underset{\text{Urea}}{\|}}{\overset{\overset{O}{\|}}{C}} - NH_2$$

Q.3 Define organic chemistry.

Ans: The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as organic chemistry".

Q.4 What are different types of formula by which we can represent organic compounds?

Ans: Organic compounds can be represented by following four types of formula.

a) Molecular formula. b) Structural formula

c) Condensed formula d) dot and cross formula.

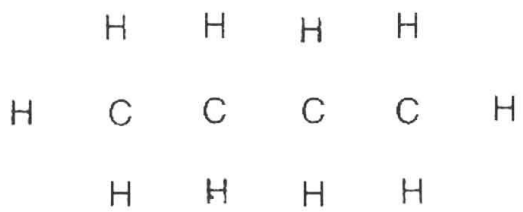
Q.5 Define molecular formula.

Ans: The formula which represents the actual number of atoms in one molecule of the organic compound is called molecular formula. For example molecular formula of butane is C_4H_{10}.

Q.6 Define structural formula.

Ans: Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in molecule of a substance.

Structural formula of butane is



(n - butane)

Q.7 Define condensed formula.

Ans: The short form of formula that indicates the group to each carbon atom in a straight chain or branched chain is called a condensed formula.

For example condensed formula for n – butane is

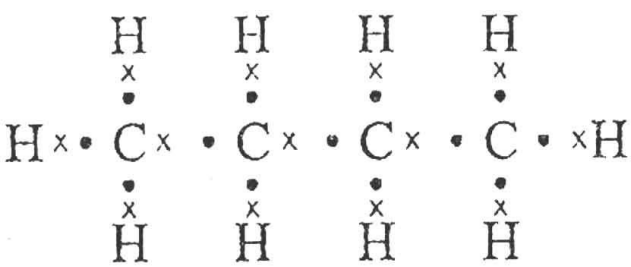
⇨ $CH_3 - CH_2 - CH_2 - CH_3$

OR ⇨ $CH_3 - (CH_2)_2 - CH_3$

Q.8 What is dot and cross formula.

Ans: "The formula which shows the sharing of electrons between various atoms of one molecule of the organic compound is called dot cross formula or electronic formula".

For example: cross and dot formula for butane is



Q.9 Write down the names of classes in which organic compounds are classified.

Ans: All organic compounds are broadly classified into two classes.

a) Open chain or Acyclic compound:

b) Closed chain or Cyclic compound:

Q.10 Define open chain compound. Explain their types.

Ans: Open chain compounds are those in which the end carbon atoms are not joined with each other in this way they form long chain of carbon atoms.

There are two types of open chain compound

a) Straight chain compounds.

b) Branched chain compounds:

a) Straight chain compounds.

Compounds in which carbon atoms link with each other through a single, double or triple bonds forming a straight chain.

For example $H_3C - CH_2 - CH_2 - CH_3$

(Straight chain butane)

b) Branched chain compounds.

"compounds in which there is a branch along a straight chain".

For example:

$$H_3C - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$$

(Branched chain) (Iso–butane)

Q.11 What are aliphatic compounds?

Ans: Open chain compounds in which only single bond is present are also called aliphatic compounds.

Q.12 Define cyclic compounds explain their types.

Ans: Those compounds in which the carbon atoms at the ends are not free and they join to form rings.

They are further divided into two classes.

a) Homocyclic compound b) Heterocyclic compound

Q.13 Define Homocyclic compounds. Explain their types.

Ans: Compounds contain rings which are made up of only one kind of atoms, i.e, carbon atoms are called Homocyclic compounds.

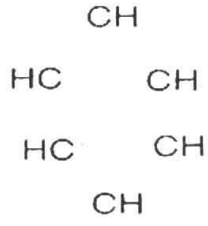
There are two types of Homocyclic compounds.

a) Aromatic compounds **b)** Alicyclic compounds

Q.14 Define aromatic compound. Give example.

Ans: "Those homocyclic compounds in which at least one benzene ring having six carbon atoms with three alternate double and single bonds are called aromatic compound".

Example benzene ring.



Q.15 What is the meaning of term aromatic?

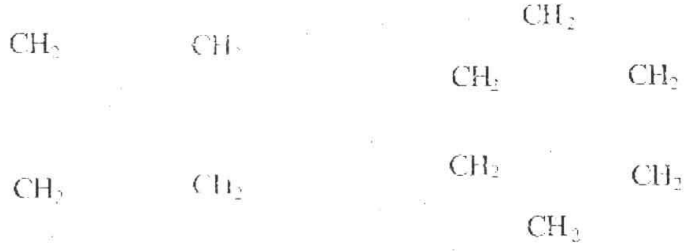
Ans: Term aromatic is derived from Greek word "Aroma" which means fragrant".

Q.16 What are benzenoid compounds?

Ans: Aromatic compounds are also called benzenoid compounds.

Q.17 Define alicyclic or non benzenoid Compounds.

Ans: Carbocyclic or homocyclic compound which do not have benzene ring in their molecules are called alicyclie or non benzenoid compounds.



Cyclobutane Cylohexane

Q.18 Define Heterocyclic compound. Give example.

Ans: Cyclic compounds that contain one or more atoms other than carbon atoms in their rings are called heterocyclic compounds.

For examples:

Pyridine **Thiophene**

Q.19 Define catenation.

Ans: The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation.

Q.20 What are two basic conditions for elements to exhibit catenation?

Ans: Two basic conditions for catenation are:

a) Element should have valency two or more greater than two.

b) Bond made by an element with its own atoms should be stronger than the bonds made by the element with other atoms especially oxygen.

Q.21 Define Isomerism. Give examples.

Ans: Isomerism

The compounds having same molecular formulae but different arrangement of atoms in their molecules or different structural formulae are called isomers and the phenomenon is

called Isomerism.

e.g. pentane (C_5H_{12}) has three isomers

$H_3C - CH_2 - CH_2 - CH_2 - CH_3$, $H_3C - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$

(n – Pentane) Iso – pentane

(Neo - pentane) $H_3C - \underset{\underset{H_3C}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_3$

Q.22 Why and how carbon complete its octet?

Ans: To get stability, carbon completes its octet by making four covalent bond with other atoms.

Q.23 Why melting and boiling points and of organic compounds are very low?

Ans: Melting points and boiling point of organic compounds are low because carbon forms weak covalent bond with other carbon atoms which break up easily.

Q.24 Why organic compounds are poor conductor of electricity?

Ans: Due to presence of covalent bonds, organic compounds are poor conductor of electricity.

Q.25 How we get organic compounds from Earth's crust?

Ans: We get organic compounds by Destructive distillation of coal and by Fractional distillation of Petroleum.

Q.26 What are the reasons for the formation of millions of organic compounds?

Ans: Organic compounds have large diversity due to

a) catenation b) isomerism c) weak covalent bond

d) Multiple bonds forming ability of carbon.

Q.27 What is coal?

Ans: Coal is blackish, complex mixture of compounds of carbon, hydrogen and oxygen. It also consists of small amount of nitrogen and sulphur compounds.

Q.28 Define Carbonization.

Ans: Conversion of wood into coal is called carbonization. It is very slow bio-chemical process. It takes place in the absence of air under high pressure and high temperature over a long period of time.

Q.29 Write down the names of different types of coal.

Ans: Coal is of following four types.

a) Peat b) lignite c) Bituminous d) anthracite

Q.30 Define Destructive Distillation?

Ans: Breakdown of coal into smaller compounds by strong heating of coal in the absence of air is called destructive distillation.

Q.31 Write down the names of product obtained by destructive distillation of coal.

Ans: Products obtained by destructive distillation of coal are;

a) Coal Gas b) Ammonical Liquor c) Coal tar d) coke

Q.32 What is Pitch? What is its use?

Ans: Black residue of coal tar is called Pitch. In common words it is also known as "look". It is used for surfacing of roads and roofs.

Q.33 What is petroleum? What is its composition?

Ans: Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons in water mixed with salts and earth particles.

Q.34 What is composition of natural gas?

Ans: Natural gas is a mixture of low molecular mass hydrocarbons. The main component about 85% is methane, along with other gases i.e. ethane, butane, propane.

Q.35 What types of compounds are synthesized by plants?

Ans: Living plants synthesized macro-molecule e.g. carbohydrates, proteins, oils and vitamins plants also produce gums, rubber, medicines etc.

Q.36 What are alkanes? Give their general formula?

Ans: Alkanes are saturated hydrocarbons or paraffin's (Para - little , affines -- affinity). Their general formula is C_nH_{2n+2}. Where n is the number of carbon atoms.

Q.37 Define alkyl radical. How they formed?

Ans: Alkyl Radicals are derivatives of alkanes they are formed by removal of one of the hydrogen atom of an alkane and are represented by "R.". Their general formula is C_nH_{2n+1}

Q.38 What is Functional group? Give example.

Ans: "An atom or group of atom or presence of double or triple bond which determines the characteristics properties of an organic compound is known as the functional group".

For example - OH – hydroxyl group is the functional group of alcohol which give characteristic properties of alcohols.

Q.39 What is functional group for aldehyde and ketone?

Ans: Functional groups for aldehyde and ketone are

$$(-\overset{\overset{O}{\|}}{C}-H) \text{ and for ketone is } (-\overset{\overset{O}{\|}}{C}-R)$$

Q.40 What is functional group for ether and carboxylic compounds?

Ans: Functional group for ether is (R – O – R) and for carboxylic compound is $(R-\overset{\overset{O}{\|}}{C}-OH)$

Q.41 What is ester linkage?

Ans: Organic compounds in which carbon has $R-\overset{\overset{O}{\|}}{C}-OR'$ linkage is called ester linkage.

These compounds are called esters.

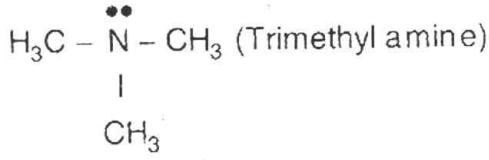
Q.42 What are amines give examples?

Ans: "The organic compounds containing carbon, hydrogen and nitrogen as a functional group ($-NH_2$) are called amines. ($-NH_2$) is functional group and their general formula is R – NH_2.

Examples:

$H_3C-\ddot{N}H_2$ (Methyl amine)

$H_3C-\underset{\underset{CH_3}{|}}{\ddot{N}H_2}$ (Dimethyl amine)



Q.43 What is functional group for an alkyl Halide?

Ans: Functional group for alkyl halide is R – X where R is alkyl radical and X is halogen i.e. F, Cl, Br or I., etc.

Q.44 Give functional group for alkene and alkyne.

Ans: For alkene double bond (=) is functional group and triple bond (≡) is functional group for alkyne.

e.g. $H_2C = CH_2$ (ethene)

$HC \equiv CH$ (ethyne)

Q.45 Write down the name of tests for detection of double bond (unsaturation)?

Ans: i) Bromine water test **and**

ii) Baeyer's test is used to detect unsaturation.

Q.46 What are identification test for alcoholic group?

Ans: i) sodium metal test and

ii) Ester formation test is used to test alcoholic group.

Q.47 How carboxylic group is identified?

Ans: Carboxylic group is identified by

i) Litmus test

ii) Sodium bicarbonate test.

Q.48 Give identification test for aldehyde group?

Ans: Aldehydes are identified by

i) Sodium bisulphate test

ii) Fehling's solution Test

Q.49 What are identification test for ketonic group?

Ans: ketone group is identified by

i. Phenyl hydrazine Test

ii. Sodium Nitroprusside Test

iii. Fehling Solution Test

Q.50 Write down the name of identification test for primary Amines?

Ans: Carbyl amine test is use to identify primary amine group.

Q51. Point out the properties of carbon which are responsible for formation of long chains of carbon atom compounds?

Ans: Catenation is the process which is responsible for formation of long chains of carbon atom compounds.

Q.52 Name the gases which are found in coal gas.

Ans: Carbon monoxide hydrogen and methane gases are present in coal gas.

Q.53 Is coal tar a compound? What is importance of coal tar?

Ans: No it is a mixure of more than 200 different organic compounds, mostly chromatic. The importance of coal tar is, the compounds obtained from coal tar are used to synthesize drugs, dyes. Paints, explosives, varnishes, plastics, synthetic fibre and pesticides.

Q.54 What is coke? For what purpose it is used?

Ans: When coal is subjected to destructive distillation it loses all its volatile components and leaves behind solid residue called coal. It is used as a reducing agent in the extraction of metal especially iron. It is also used as fuel.

Q.55 Which is the best quality of coal?

Ans: Anthracite is the best quality of coal. It contains 90% of carbon.

Q.56 What is destructive distillation?

Ans: The strong heating of coal in the absence of air is called destructive distillation

Q.57 Define petroleum.

Ans: Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons in water mixed with salts and earth particles.

Q.58 What types of compounds are synthesized by plants?

Ans: Living plants synthesized macro-molecules e.g. carbohydrates, proteins, oils and vitamins.

Q.59 What is the basic unit of carbohydrates and how it is synthesized?

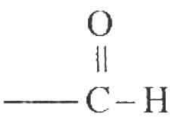
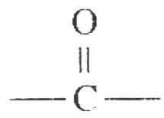
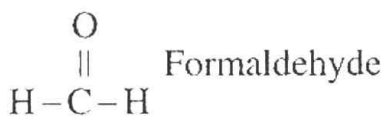
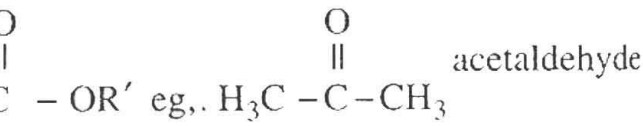
Ans: The basic unit of all carbohydrates is glucose which is synthesized by plant through photosynthesis.

Q.60 CNG stands for.

Ans: CNG stands for compressed natural gas.

Q.61 What is the difference between aldehyde and ketones?

Ans:

Aldehydes	**Ketenes**
i. Aldehyde family consists of functional group 	i. Ketone family consist of functional group 
ii. Their general formula is RCHO eg  Formaldehyde	ii. Their general formula is  acetaldehyde

Q62. What is the importance of natural gas?

Ans: The importance of natural gas are

i. Natural gas is used as fuel in homes as well as in industries.

ii. It is used as fuel in automobiles as compressed natural gas (CNG).

iii. Natural gas is also used to make carbon black and fertilizer.

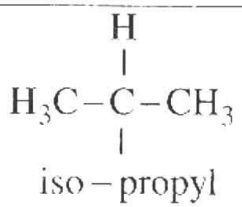
Q63. Justify that organic compounds are used as food.

Ans: The food we eat daily such as milk, eggs, meats, vegetables, etc, contain carbohydrates proteins, fats, vitamins etc are all organic stuff.

Q64. What is the difference between n-propyl and isopropyl? explain with structure.

Ans:

n-propyl	**Iso-propyl**
When terminal hydrogen is removed from propane it is called n-propyl e.g. $CH_3 - CH_2 - CH_2 -$ n–propyl	When hydrogen is removed from central carbon is called iso-propyl e.g.

Multiple Choice Questions

1. The ability of carbon atoms to form chains is called

(a) isomerism (b) catenation
(c) resonance (d) condensation

2. Coal having 90% carbon contents is called

(a) peat (b) lignite
(c) anthracite (d) bituminous

3. Main component of natural gas is

(a) methane (b) propane
(c) butane (d) propene

4. The strong heating of coal in retorts in the absence of air is called

(a) fractional distillation
(b) sublimation
(c) roasting
(d) destructive distillation

5. Pitch is black residue of

(a) coke (b) coal-tar
(c) coal (d) coal gas

6. Natural gas is 85% methane. It is used to make the following except

(a) carbon black (b) ethane
(c) propane (d) coal gas

7. Which one of the following does not contain starch

(a) sugar cane (b) maize
(c) barley (d) potatoes

8. Petroleum is refined by

(a) destructive distillation
(b) fractional distillation
(c) simple distillation
(d) dry distillation

9. In laboratory urea was prepared by

(a) Wohler (b) Rutherford
(c) Berzelius (d) Dalton

10. General formula of alkyl radical is

(a) $C_nH_{2\,n+2}$ (b) $C_nH_{2\,n-2}$
(c) $C_nH_{2\,n+1}$ (d) C_nH_{2n}

11. Identify which one of the following compounds is a ketone?

(a) $(CH3)_2$ CHOH
(b) $(CH_3)_2CHCl$
(c) $(CH_3)_2CO$
(d) $(CH_3)_2CHCl$

12. The functional group – COOH is found in

(a) carboxylic acid
(b) aldehydes
(c) alcohols
(d) esters

13. Which one of the following statements is not true about fossil fuels?

(a) they all contain carbon
(b) they are renewable
(c) they produce pollutants when burnt
(d) they cause acid rain

14. Which one of the following is the hardest coal?

(a) peat (b) lignite
(c) bituminous (d) anthracite

15. In which of the following groups, oxygen is attached on both sides with carbon atoms?

(a) ketone (b) ether
(c) aldehyde (d) ester

16. Carbonization process is the conversion of

(a) coal into coal gas
(b) coal into wood
(c) wood into coal
(d) wood into coal tar

17. Coal gas is a mixture of

(a) CO and CH_4
(b) CO, CH_4, CO_2
(c) CO, CH_4, H_2
(d) CO, H_2 and CO_2

18. Which one of the following is a synthetic fibre?

(a) cotton (b) wool
(c) nylon (d) silk

19. Which one of the following is not a fossil fuel?

(a) coal (b) natural gas
(c) biogas (d) petroleum

20. Which one of the following does not contain protein

(a) pulses (b) potatoes
(c) beans (d) eggs

21. Conversion of dead plants into coal by the action of bacteria and heat is called

(a) carbonization (b) catenation
(c) hydrogenation (d) cracking

22. Which one of the following compounds is an aldehyde?

(a) $CH_3 - CH_2 - OH$
(b) $CH_3 - COOH$
(c) CH_3CHO
(d) CH_3COCH_3

23. Formula of acetaldehyde is

(a) $CH - CH_2\,OH$

(b) $CH_3 - \overset{\overset{O}{\|}}{C} - OH$

(c) $CH_3 - \overset{\overset{O}{\|}}{C} - H$

(d) $H - \overset{\overset{O}{\|}}{C} - H$

24. Who put forward the vital force theory?

(a) Berzelius (b) Wohler
(c) Dalton (d) Lavoisier

25. Who was discarded vital force theory?

(a) Berzelius (b) Wohler
(c) Dalton (d) Lavoisier

26. The 1st organic compound prepared in laboratory

(a) Sodium Chloride
(b) Urea
(c) thiourea (d) Pyridine

27. Who was prepared acetic acid in laboratory?

(a) Berzelius (b) Wohler
(c) Kolbe (d) Dalton

28. The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as

(a) Organic chemistry
(b) Inorganic chemistry
(c) Biochemistry
(d) Nuclear Chemistry

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

(a) Molecular formula
(b) Structural formula
(c) Condensed formula
(d) Dot and cross formula

30. Molecular formula of butane is

(a) C_4H_{10} (b) C_5H_5
(c) C_4H_8 (d) C_4H_6

31. Which of the following formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance?

(a) Molecular formula
(b) Structural formula
(c) Condensed formula
(d) Dot and cross formula

32.Which one is homocyclic compound?

(a) Benzene (b) Cyclobutane
(c) Cyclohexane (d) All

33. Which one is hetrocyclic compound?

(a) Benzene (b) Cyclobutane
(c) Thiophene (d) Naphthalene

34. Silicon occurs in the form of

(a) Silica (b) Silicates
(c) both a & b (d) None

35. Which one contains double covalent bond?

(a) Pentane (b) ethylene
(c) acetylene (d) all

36. Which one contains triple covalent bond?

(a) Pentane (b) ethylene
(c) acetylene (d) all

37. Coal is blackish complex mixture of compounds of

(a) Carbon (b) hydrogen
(c) oxygen (d) all

38. Conversion of wood into coal is called

(a) Carbonization
(b) destructive distillation
(c) fractional distillation
(d) all

39. The % age of carbon in coal is

(a) 40-60 (b) 50-70
(c) 40-80 (d) 40-90

40. The % age of carbon in peat is

(a) 60% (b) 70%
(c) 80% (d) 90%

41. The % age of carbon is lignite is

(a) 60 (b) 70
(c) 80 (d) 90

42. The % age of carbon in bituminous is

(a) 60 (b) 70
(c) 80 (d) 90

43. The strong heating of coal in the absence of air is called

(a) Carbonization

(b) Destructive distillation

(c) Fractional distillation (d) All

44. Coal gas is the mixture of

(a) hydrogen (b) methane

(c) Carbon monoxide (d) all

45. Coal tar contains compounds

(a) benzene (b) phenol

(c) toluene (d) all

46. The % age of carbon in coke is

(a) 60 (b) 70

(c) 90 (d) 98

47. Natural gas contains

(a) methane (b) ethane

(c) propane (d) all

48. The general formula of alkane is

(a) CnH_{2n+2} (b) CnH_{2n-2}

(c) CnH_{2n} (d) CnH_{2n+1}

49. Alkyl radical is derivative of

(a) alkane (b) alkene

(c) alkyne (d) all

50. The functional group of alcohol is

(a) $-OH$ (b) $-X$

(c) $-\overset{\overset{O}{\|}}{C}-H$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

51. Aldehyde family consists of functional group

(a) $-OH$ (b) $-X$

(c) $-\overset{\overset{O}{\|}}{C}-H$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

52. Ketonic group contains the functional group

(a) $-OH$ (b) $-X$

(c) $-\overset{\overset{O}{\|}}{C}-$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

53. Carboxylic group contains functional

(a) $-OH$ (b) $-X$

(c) $-\overset{\overset{O}{\|}}{C}-H$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

Answer Key

1	b	2	c	3	a	4	d	5	b
6	b,c	7	a	8	b	9	a	10	c
11	c	12	a	13	d	14	d	15	b
16	c	17	c	18	c	19	c	20	b
21	a	22	c	23	c	24	a	25	b
26	b	27	c	28	a	29	a	30	a
31	b	32	d	33	c	34	c	35	b
36	c	37	d	38	a	39	d	40	a
41	b	42	c	43	b	44	d	45	d
46	d	47	d	48	a	49	a	50	a
51	c	52	c	53	d				

Unit 12

Hydrocarbons

Long Answer Questions

Q.1 What are hydrocarbons? Give their different classes depending upon their structure.

Ans. Hydrocarbons

Hydrocarbons are those compounds which are made up of only carbon and hydrogen elements.

Hydrocarbons are regarded as the parent organic compounds since other organic compounds are considered to be derived from them by replacement of one or more hydrogen atoms by other atoms or group of atoms.

Classification of Hydrocarbons

On the basis of structure, hydrocarbons are divided into two main classes:

(i) Open chain or Aliphatic hydrocarbons

These are compounds in which the first and the last carbon are not directly joined to each other. The open chains of carbon may be straight or branched.

Examples;

$H_3C - CH_2 - CH_2 - CH_3$

Straight chain (n-butane)

$$\begin{array}{c} H_3C - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3 \end{array}$$

Branched chain (isobutane)

Types of open chain hydrocarbons

Open chain hydrocarbons have been further subdivided into saturated and unsaturated hydrocarbons.

(a) Saturated hydrocarbons

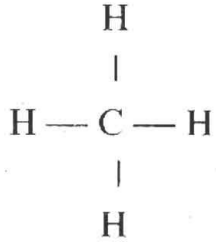
The compounds in which all the four valencies of carbon atoms are fully satisfied (saturated) by single bonds with other carbon atoms and hydrogen atoms are called saturated hydrocarbons. Saturated hydrocarbons are also called alkanes.

Thus, an alkane is a hydrocarbon in which the carbon atoms are connected by only single covalent bond (There are no double or triple covalent bonds in alkanes).

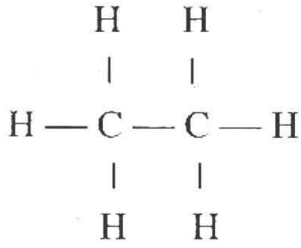
Examples:

Methane (CH_4), ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}) are all saturated

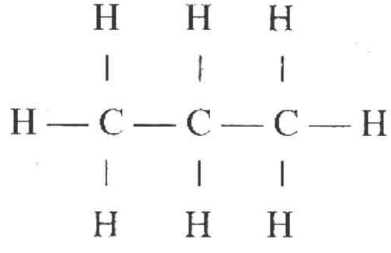
hydrocarbons because they contain only carbon-carbon single bonds, as shown below:



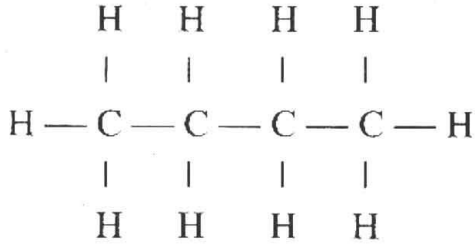
Methane



Ethane



Propane



Butane

General Formula of Alkanes;

The general formula of alkanes is C_nH_{2n+2}, where n is the number of carbon atoms in one molecule of the alkane.

(b) Unsaturated hydrocarbons:

The hydrocarbons in which two carbon atoms are linked by a double or a triple bond are called unsaturated hydrocarbons.

Alkenes;

The compounds in which two carbon atoms are linked by a double bond are called alkenes.

Examples;

Ethene and propene.

$H_2C = CH_2$ Ethene

$H_3C - CH = CH_2$ Propene

General Formula;

These compounds have general formula C_nH_{2n} and functional group $>C=C<$

Alkynes;

The hydrocarbons in which two carbon atoms are linked by a triple bond are called alkynes. For example, ethyne and propyne.

$HC \equiv CH$ Ethyne

$H_3C - C \equiv CH$ Propyne

General Formula;

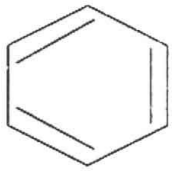
They have general formula C_nH_{2n-2} and functional group $-C \equiv C-$

(ii) Closed chain or Cyclic hydrocarbons: Compounds having closed chain or rings of carbon atoms in their molecules are called closed chain or cyclic hydrocarbons,

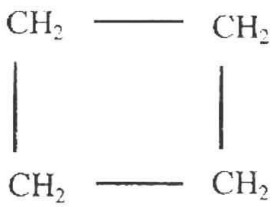
Examples;

Benzene (C_6H_6), cyclobutane and cyclohexane.

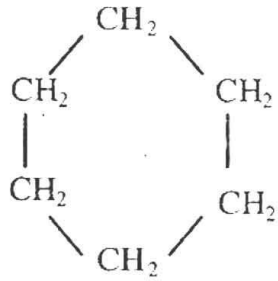
Structures;



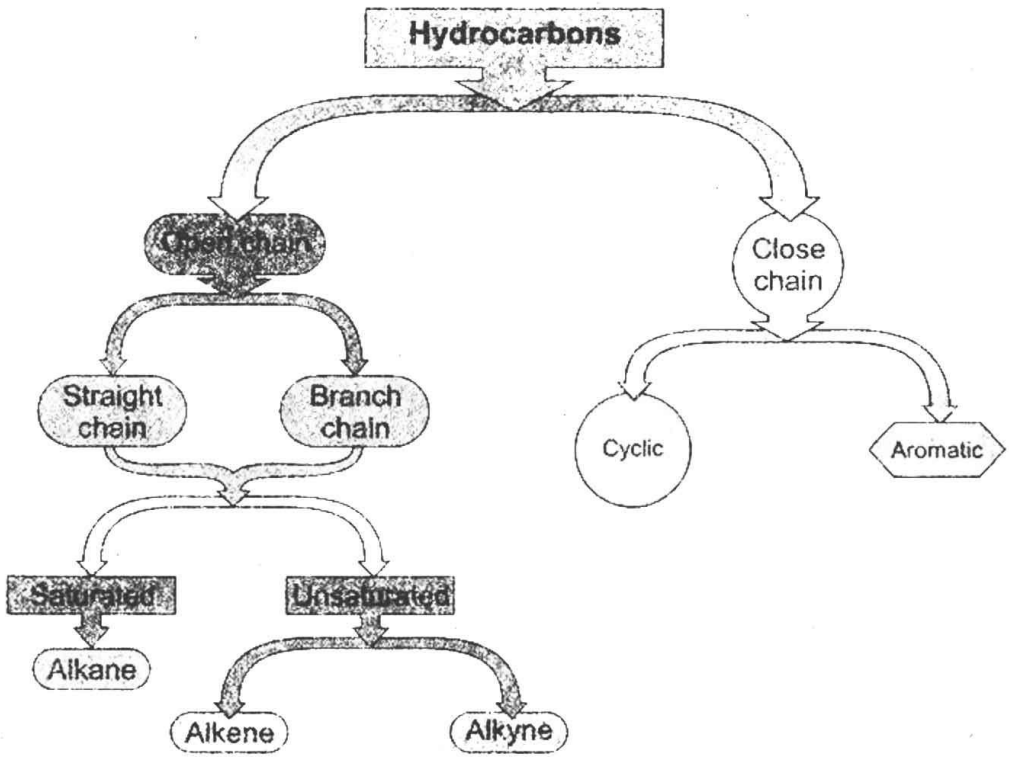
Benzene



Cyclobutane



Cyclohexane



Q.2 Write the preparation of Alkanes

Ans. Alkanes form a series of homologous compounds. So, their methods of preparation and chemical properties are similar. Although, there are many methods of preparation, but only two methods are discussed here.

(i) Hydrogenation of alkenes and alkynes

Hydrogenation means addition of hydrogen in alkenes and alkynes. As we know alkenes and alkynes are unsaturated compound, so they have the capacity to add up atoms in them. This reaction is carried out in the presence of nickel catalyst at 250°C to 300 °C. However, in the presence of catalyst platinum or palladium, the reaction takes place at room temperature, such as:

$$H_2C=CH_2 + H_2 \xrightarrow[250\text{-}300^\circ C]{Ni} H_3C-CH_3$$

Similarly,

$$HC\equiv CH + H_2 \xrightarrow[250\text{-}300^\circ C]{Ni} H_2C=CH_2$$

$$H_2C=CH_2 + H_2 \xrightarrow[250\text{-}300^\circ C]{Ni} H_3C-CH_3$$

(ii) Reduction of alkyl halides

Reduction means addition of nascent hydrogen. In fact, it is a replacement of a halogen atom with a hydrogen atom. This reaction takes place in the presence of Zn metal and HCl.

$$CH_3Br + 2[H] \xrightarrow{Zn/dil.HCl} CH_4 + HBr$$

$$CH_3CH_2Br + 2[H] \xrightarrow{Zn/dil.HCl} CH_3-CH_3 + HBr$$

Q.3 What type of reactions are given by alkanes? Explain with reference to halogenations of alkanes.

Ans. Alkanes give only substitution reaction. A reaction in which one or more hydrogen atoms of a saturated compound are replaced with some other atoms (like halogen) is called a substitution reaction. These reactions are a characteristic property of alkanes. Alkanes react fairly with halogens in diffused sunlight only. In dark there is no reaction. In direct sunlight reaction is explosive and carbon is deposited.

$$CH_4 + 2Cl_2 \xrightarrow{\text{bright sunlight}} C + 4HCl$$

In diffused sunlight a series of reactions take place and at each step one hydrogen atom is substituted by halogen atoms so that all the hydrogen atoms are substituted one by one by halogen atoms.

$$CH_4 + 2Cl_2 \xrightarrow[\text{sunlight}]{\text{diffused}} CH_3Cl + HCl$$

Chloromethane

$$CH_3Cl + Cl_2 \xrightarrow{h\nu} CH_2Cl_2 + HCl$$

Dichloromethane

$$CH_2Cl_2 + Cl_2 \xrightarrow{h\nu} CHCl_3 + HCl$$

Trichloromethane
(Chloroform)

$$CHCl_3 + Cl_2 \xrightarrow{h\nu} CCl_4 + HCl$$

Tetrachloromethane
(Carbon Tetrachloride)

Q.4 Alkanes are a source of heat. Explain it.

Ans. Alkanes burn in the presence of excess of air or oxygen to produce a lot of heat, carbon dioxide and water. This reaction takes place in automobile combustion engines, domestic heaters and cooking appliances. It is highly exothermic reaction and because of it alkanes are used as fuel.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{heat}$$

In the limited supply of oxygen, there is incomplete combustion. As a result carbon monoxide is produced that creates suffocation and causes death.

$$3CH_4 + 4O_2 \longrightarrow 2CO + C + 6H_2O$$

Q.5 Write the preparation of alkenes

Ans. Alkenes are prepared by the removal of small atoms (H,OH,X) from the adjacent carbon atoms of the saturated compounds, so as to create a double bond between carbon atoms.

Dehydration of alcohol

Dehydration is removal of water. Ethene is prepared by heating a mixture of ethanol and excess of concentrated sulphuric acid at 180°C. In first step, ethyl hydrogen sulphate is formed which decomposes on heating to produce ethene, which is collected over water.

$$CH_3-CH_2OH + H_2SO_4 \xrightarrow{180^\circ C} CH_3CH_2-OSO_3H + H_2O$$

$$CH_3-CH_2OSO_3H \xrightarrow{\text{heat}} H_2C=CH_2 + H_2SO_4$$

Dehydrohalogenation of alkyl halides

On heating ethyl bromide with alcoholic KOH, ethene is formed. Removal of hydrogen and halogen takes place from adjacent carbon atoms to create a double bond.

$$H_3C-CH_2-Br + KOH_{(\text{alcoholic})} \longrightarrow H_2C=CH_2 + KBr + H_2O$$

Q.6 Write the Chemical reaction of Alkenes.

Ans. Chemical properties of alkenes

Alkenes are reactive compounds because the electrons of the double bound are easily available for reaction. These compounds have the tendency to react readily by adding other atoms, to become saturated compounds. As a result, the double bond is converted into a single bound that is more stable.

Addition Reactions of Alkene

Thus, addition reactions are characteristic property of unsaturated compounds. These are the reactions in which the products are formed by the addition of some reagents like

H_2, Cl_2, etc., to an unsaturated organic compound. In the process, one of the bonds of a double bond gets broken and two new singie bonds are formed.

(i) Hydrogenation

Hydrogenation means addition of molecular hydrogen to an unsaturated hydrocarbon in the presence of a catalyst (Ni, Pt) to form saturated compound.

$$H_2C{=}CH_2 \quad + \quad H_2 \quad \xrightarrow[250\text{-}300^\circ C]{Ni} \quad H_3C-CH_3$$

On industrial scale, this reaction is used to convert vegetable oil into margarine (Banaspati ghee).

$$\text{Oil} \quad + \quad H_2 \xrightarrow{Ni} \text{margarine (Banaspati ghee)}$$

Halogenations of alkenes

Halogenation means addition of halogen like chlorine or bromine. This reaction is used to identify the unsaturation of an organic compound.

$$H_2C = \quad CH_2 \quad + \quad Br_2 \longrightarrow \quad Br-CH_2-CH_2-Br$$

Hydrohalogenation of alkenes

Dry gaseous hydrogen halides (HI, HBr and HCl) react with alkenes to produce alkyl halides.

$$H_2C=CH_2 \quad + \quad HX \longrightarrow H_3C-CH_2X$$

$$H_2C=CH_2 \quad + \quad HBr \longrightarrow H_3C-CH_2Br$$

The order of reactivity of hydrogen halides is HI > HBr > HCl.

Oxidation of alkenes with $KMnO_4$

Alkenes decolourise the pink colour of acidified dilute solution of potassium permanganate because the double bond electrons react with MnO_4^- ion, which further goes on to form MnO_2 and ethene glycol (1,2 ethanediol). Such as, there is addition of two 'hydroxyl group' at the double bond.

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

Q.7 Write the uses of ethene (Ethylene)

Ans. Ethene is used:

(i) for artificial ripening of fruits;

(ii) as a general anaesthetic;

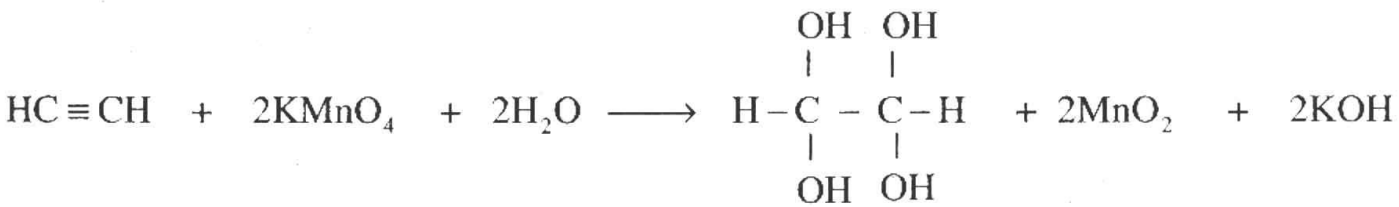
(iii) for manufacture of polythene. Polythene is a plastic material used in packaging, toys, bags, etc;

(iv) as a starting material for the manufacture of a large number of compounds such as ethylene oxide, ethyl alcohol, ethylene glycol, diethyl ether, etc.; ethylene oxide is used as a fumigant, ethylene glycol is used as an antifreeze, diethyl ether and ethyl alcohol are used as solvents and

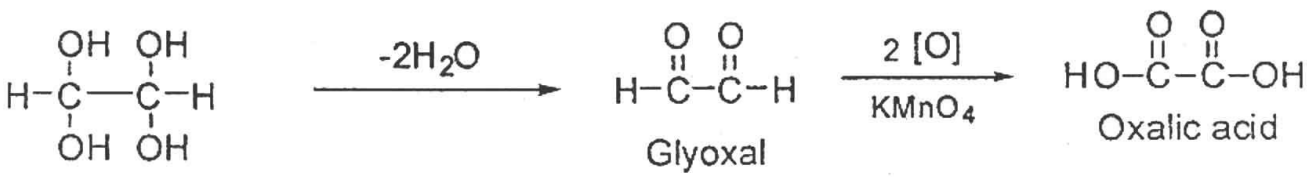
(v) for making poisonous mustard gas which is used in chemical warfare.

Q.8 Explain the oxidation of acetylene.

Ans. Acetylene is oxidized by alkaline $KMnO_4$ and four hydroxyl groups add to the triple bond, such as;



This intermediate product eliminates water molecules to form glyoxal, which is further oxidized to form oxalic acid.



Q.9 Write the uses of acetylene.

Ans.

(i) Acetylene produces oxy-acetylene flame with oxygen. It is a highly exothermic reaction. Heat released is used for welding purposes.

(ii) Acetylene is used to prepare other chemicals, such as; alcohols, acetaldehyde and acids.

(iii) It is used for the ripening of fruits.

(iv) It is used for the manufacturing of polymer products like polyvinyl chloride, polyvinyl acetate and synthetic rubber like neoprene.

(v) It is polymerized to form benzene, which is used as raw material to form a variety of organic compounds.

Q.10 Briefly describe the preparation of alkynes.

Ans. Preparation of alkynes

Alkynes are important hydrocarbons which have triple bond among their carbon atoms, alkynes are prepared by the following methods.

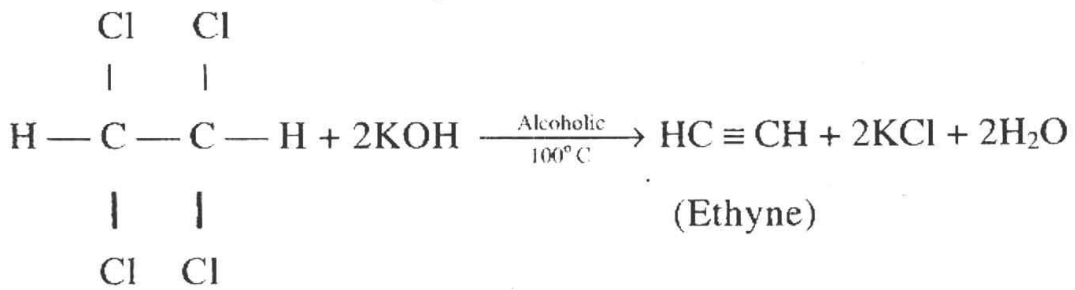
1. Dehydrohalogenation of Vicinal Dihalides:

Dehydrohalogenation:

The process of removal of hydrogen and halogen from a compound is known as dehydrohalogenation.

Procedure;

When a vicinal dihalide is heated with alcoholic KOH, two hydrogen atoms along with two halogen atoms are removed from two adjacent carbon atoms with the formation of a triple bond between the adjacent carbons.



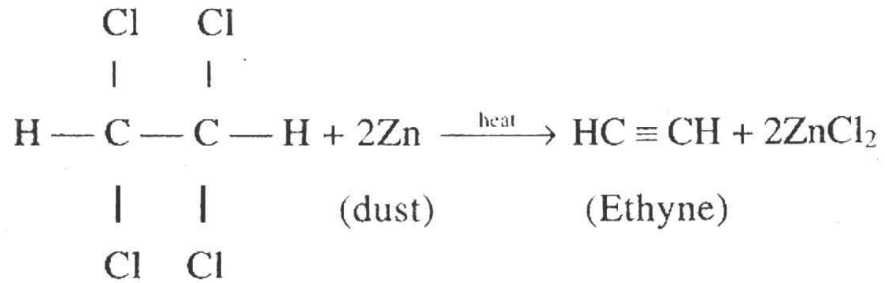
2. Dehalogenation of Tetrahalides;

Dehalogenation:

The removal of halogen from adjacent carbon atoms is called as dehalogenation.

Procedure:

When alkyl tetrahalides are heated with zinc dust, the elimination of halides takes place to form ethyne.



Q.11 Write the Chemical Properties of Alkynes:

Ans. Chemical Properties of Alkynes

Alkynes are reactive compounds because of presence of a triple bond. A triple bond consist of two weak bonds and a strong bond. When alkynes react with other substance, two weak bonds are readily broken one by one and addition takes place easily. The addition reactions of alkynes resemble to those of alkenes.

Following are the important chemical reactions of alkynes:

1. Addition of Halogen:

Chlorine and bromine adds to acetylene to form tetrachloroethane and tetrabromoethane, respectively.

Procedure

When bromine water is added to acetylene, red brown colour of bromine water is discharged rapidly due to formation of colourless tetrabromoethane.

$$HC \equiv CH + 2Br_2 \rightarrow H-\underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}}-\underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}}-H$$

(Tetrabromoethane)

This reaction is used to identify the unsaturation of alkynes.

2. Oxidation with $KMnO_4$:

Ethyne is oxidized by alkaline $KMnO_4$ and four hydroxyl groups add to the triple bond, such as;

Chemical Equation

$$HC \equiv CH + 2KMnO_4 + 2H_2O \rightarrow H-\underset{\underset{OH}{|}}{\overset{\overset{OH}{|}}{C}}-\underset{\underset{OH}{|}}{\overset{\overset{OH}{|}}{C}}-H + 2MnO_2 + 2KOH$$

This intermediate product eliminates water molecules to form glyoxal, which is further oxidized to form oxalic acid.

Chemical Equation:

$$H-\underset{\underset{OH}{|}}{\overset{\overset{OH}{|}}{C}}-\underset{\underset{OH}{|}}{\overset{\overset{OH}{|}}{C}}-H \xrightarrow{-2H_2O} H-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-H \xrightarrow[KMnO_4]{2[O]} HO-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-OH$$

(Glyoxal) (Oxalic acid)

Q.12 Write a detail note on hydrocarbons as feed stock in industry.

Ans. Hydrocarbons as Feed Stock in Industry:

Hydrocarbons are not only used as fuel in auto-mobiles or industries, they are also used as raw material in industry. It is explained as:

i. Petrochemical Industry:

The organic compounds prepared from hydrocarbons (petroleum and natural gas) are called petrochemicals. Some of the important petrochemicals are methyl alcohol, ethyl alcohol, chloroform, formic acid, carbon tetrachloride, ethylene butadiene, benzene, toluene etc.

ii. Plastic Industry:

Hydrocarbons are used as raw materials for the preparation of a large variety of items used in daily life. Such as synthetic polymers, called plastics like polythene, polyester. So plastics are synthetic materials which can be given any shape when soft and on hardening make a durable article to be used in common life, For example, crockery items (cups, glass, jug, plates, spoons) furniture items (Chair, table, stool) auto-mobile parts, electric and sewages items and a lot of other house hold items.

iii.Rubber Industry:

Hydrocarbons are used to prepare synthetic rubber. Such as, acetylene is used to prepare butadiene rubber used for making foot wear, tyres and toys. Similarly a good similarly a good quality rubber neoprene is prepared from chloroprene.

iv.Synthetic Fiber Industry:

Hydrocarbons are used to prepare synthetic fibers like nylon, rayon, polyesters. These fibers have better qualities like greater strength, good elasticity, resistance to wear and tear. So clothes made of synthetic fibers are long lasting than that of natural fibers.

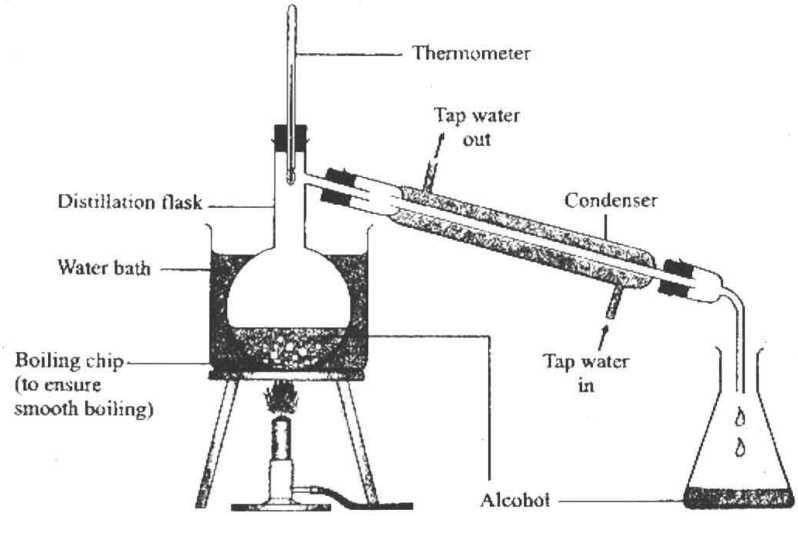
v. Synthetic Detergents:

Long chain hydrocarbons obtained from petroleum and used to make synthetic detergents and washing powders. These detergents have long chain of alkyl hydrogen sulphate. These detergents have better and stronger cleaning properties than that of soaps. They can be used even in hard water.

Q.13 Describe an experiment by which you can determine the boiling point of alcohol.

Ans. Point of Alcohol:

The boiling point of an alcohol (ethyl alcohol) at normal atmospheric pressure can be determined by using a set-up as shown in figure below:



When alcohol is heated, temperature rises up until it reaches upto 78°C. From there onward, even the heating process goes on but the temperature remains constant. This is the boiling point of alcohol. It is to be noted that temperatures does not change during the boiling process.

Short Answer Question

Q.1 Differentiate between saturated and unsaturated hydrocarbons.

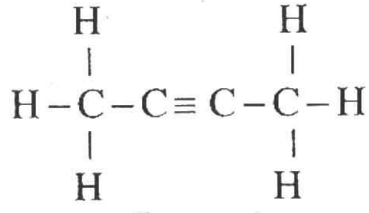
Ans.

Saturated Hydrocarbons	Unsaturated Hydrocarbons
The hydrocarbons in which all the four valencies of carbon atoms are fully satisfied (saturated) by single bond with other carbon atoms and hydrogen atoms are called saturated hydrocarbons	The hydrocarbons in which two carbon atoms are linked by a double or a triple bond are called unsaturated hydrocarbons
They are also called alkanes	They are also called alkenes and alkynes.
The general formula of saturated hydrocarbon is C_nH_{2n+2}	The general formula of alkenes is C_nH_2n and alkynes is C_nH_{2n-2}
Examples CH_4 , C_2H_6 , C_3H_8	Examples C_2H_4,C_2H_2

Q.2 A compound consisting of four carbon atoms has a triple bond in it. How many hydrogen atoms are present it?

Ans. There is six hydrogen atoms is presented in a compound containing the four carbon atoms has a triple bond in it.

Example



(butyne)

Q.3 Why the alkanes are called paraffin?

Ans. Alkanes are saturated hydrocarbons. In these compounds all the bonds of carbon atoms are single that mean valencies of carbon atoms are fully satisfied (saturated) therefore they are least reactive. That is the reason alkanes are called paraffin's.

Q.4 What do you know about hydrogenation of alkenes?

Ans. Hydrogenation means addition to an unsaturated hydrocarbon in presence of a catalyst (Ni, Pt) to form saturated compound.

$$H_2C=CH_2 + H_2 \xrightarrow[250-300^0C]{Ni} H_3C-CH_3$$

Q.5 Why the alkanes are used as fuel?

Ans. Alkanes burn in the presence of excess of air or oxygen to produce a lot of heat, carbon dioxide and water. This reaction is take place in automobile, combustion engines, domestic heaters and cooking appliances. It is highly exothermic reaction and because of its alkanes are used as fuel.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{heat}$$

Q.6 How can you prepare ethene from alcohol.

Ans. Ethene is prepared by heating a mixture of ethanol and excess of cone sulphuric acid at 180^0C in first step ethyl hydrogen sulphate is formed which decomposes on heating to produce ethane which is collected over water.

$$CH_3-CH_2OH + H_2SO_4 \xrightarrow{180^0C} CH_3CH_2-OSO_3H + H_2O$$
$$CH_3-CH_2OSO_3H \xrightarrow{Heat} H_2C=CH_2 + H_2SO_4$$

Q7. Indentify propene from propane with a chemical test.

Ans. Pass the two gases through bromine water separately. Propene will decolourise reddish brown colour of bromine but propane cannot. Reaction is

$$CH_3-CH=CH_2 + Br_2 \longrightarrow CH_3-\underset{\underset{Br}{|}}{CH}-\underset{\underset{Br}{|}}{CH_2}$$

reddish–brown in colour — Colourless

Q.8 Why alkenes are called olefins?

Ans. alkenes are called olefins. Because first members of alkenes form oily products when react with halogens.

Q.9 Why alkane can't be oxidized with $KMnO_4$ solution?

Ans. Alkanes are saturated hydrocarbons. They are least reactive at high temperatures that are why alkenes can't be oxidized with $KMnO_4$ solution.

Q.10 What are addition reactions? Explain with an example

Ans. Addition of substance to an unsaturated hydrocarbon is called addition reaction.

Example:

Addition of hydrogen to an unsaturated hydrocarbon in the presence of catalyst (Ni, Pt).

$$H_2C=CH_2 + H_2 \xrightarrow[250-300^0C]{Ni} H_3C-CH_3$$

Q.11 Justify that alkanes give substitution reactions.

Ans. A reaction in which one or hydrogen atoms of a saturated compound are replaced with some other atoms is called a substitution reaction these reactions are characteristic property of alkanes. For example in diffused sunlight alkanes react fairly with halogens. In these reactions at each step one hydrogen atom is substituted by halogen atom.

$$CH_4 + Cl_2 \xrightarrow[\text{sunlight}]{\text{diffused}} CH_3Cl + HCl$$
$$CH_3Cl + Cl_2 \xrightarrow[\text{sunlight}]{\text{diffused}} CH_2Cl_2 + HCl$$
$$CH_2Cl_2 + Cl_2 \xrightarrow[\text{sunlight}]{\text{diffused}} CHCl_3 + HCl$$
$$CHCl_3 + Cl_2 \xrightarrow{\text{sunlight}} CCl_4 + HCl$$

Q.12 Both alkenes and alkynes are unsaturated hydrocarbons. State the one most significant difference between them.

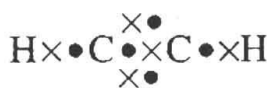
Ans. Alkynes have greater carbon to hydrogen ratio. So they give smokier flames but alkanes and alkenes do not.

Q.13 Write the molecular, dot and cross and structural formula of ethyne

Ans. (i) Moleculer formula of ethynes C_2H_2

(ii) Structural formula $H-C\equiv C-H$

(iii) Cross and dot formula



Q.14 Why hydrocarbons are soluble in organic solvents?

Ans. Hydrocarbons are soluble in organic solvents because they are non polar.

Q.15 Give the physical properties of alkanes.

Ans.

(i) Alkanes are non-polar, therefore they insoluble in water but soluble in organic solvents

(ii) The density of alkanes increases gradually with the increases of molecular size.

(iii) The alkanes become more viscous as their molecular size increase

(iv) Alkanes become less flammable i.e. difficult to burn with the increase of molecular sizes.

Q.16 How can you identify ethane from ethene?

Ans. When bromine water is added to ethane in an inert solvent like carbon tetrachloride, its colour is discharged at once.

$$\underset{\text{(red brown colour)}}{H_2C=CH_2} + Br_2 \longrightarrow \underset{\text{(colourless)}}{Br-CH_2-CH_2-Br}$$

Q.17 Why colour of bromine water discharges on addition of ether in it?

Ans. Because in the reaction double bond of ethane is converted into single bond by addition of a molecule of bromine

$$\underset{\text{(red brown colour)}}{H_2C=CH_2} + Br_2 \longrightarrow \underset{\text{(colourless)}}{Br-CH_2-CH_2-Br}$$

Q.18 State one important use of each:

(i) Ethene (ii) Acetylene (iii) Chloroform (iv) Carbon tetrachloride

Ans.

(i) Ethene

It is used for manufacturing of polythene.

(ii) Acetylene

It is used to prepare alcohols acetaldehyde and acids

(iii) Chloroform

It is used as a solvent for rubber, waxes and used for anaesthesia.

(iv) Carbon tetrachloride

It is used an industrial solvent and in dry cleaning

Q.19 Give the structural formula of isobutane and isopentane.

Ans. (a) Isobutene

$$H_3C - \underset{\displaystyle CH_3}{\underset{|}{CH_2}} - CH_3$$

(b) Isopentane

$$H_3C - CH - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$$

Q.20 Why hydrocarbons are considered as parent organic compounds?

Ans. Because mostly organic compounds are derived from hydrocarbons by the replacement of one or more hydrogen atoms by other atoms or group of atoms that why hydrocarbons are considered as a parent organic compounds.

Q.21 What is the difference between a straight and a branched chain hydrocarbons

Ans.

Straight Chain Hydrocarbons	Branched Chain Hydrocarbons
Straight chain hydrocarbons straight chain compound are these in which carbon atoms link with each other through a single, double or triple bond forming a straight chain.	Branched chain compounds are these in which there is a branch along a straight chain
Example: $H_3C - CH_2 - CH_2 - CH_3$ n-butane	Example: $H_3C - CH_2 - CH_3$ | CH_3 Isobutane

Q.22 Define unsaturated hydrocarbons? Give example.

Ans. The hydrocarbons in which two carbon atoms are linked by a double or a triple bond are called unsaturated hydrocarbons

Example:

$H_2C = CH_2$ Ethene

$HC \equiv CH$ Ethyne

Q.23 What do you mean by halogenations? Give the reaction of methane with chlorine in bright sunlight.

Ans. Halogenation means addition of halogen like chlorine or bromine to unsaturated hydrocarbons. In bright sunlight, the reaction of with chlorine is explosive and carbon is deposited.

$$CH_4 + Cl_2 \xrightarrow{\text{Bright Sunlight}} C + 4HCl$$

Q24. Why alkenes are reactive?

Ans. Alkenes are very reactive compounds because the electrons of the double bond are easily available for reaction. The compounds have tendency to react readily by adding other atoms to become saturated compounds.

(iv) Alkanes become less flamm... sizes.

Q.16 How can you identif... ...rganic compounds?
Ans. When bromine wa... ...ed from hydrocarbons by the tetrachloride, its colour i... ...ms or group of atoms that why ...member of series

...and a branched chain in Hydrocarbons

Q.17 Why colour ... ...pounds are these in
Ans. Because in ... ...ch along a straight ...wn colour of bromine water is addition of a mo... ...romoethane.

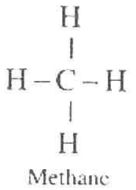
Q.18 State ...
(i) Ethe...
Ans.

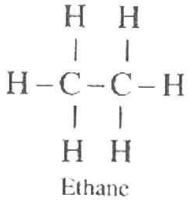
$$\longrightarrow H-\underset{\text{Br}}{\overset{\text{Br}}{\underset{|}{\overset{|}{C}}}}-\underset{\text{Br}}{\overset{\text{Br}}{\underset{|}{\overset{|}{C}}}}-H$$

(i) Ethe...
It is ... **...c acid?**
(ii) A...
It ... triple
(iii...

$$HO-\overset{O}{\overset{||}{C}}-\overset{O}{\overset{||}{C}}-OH$$

...anes. Give its general formula?
...s are hydrocarbons in which the carbon atoms are connected by only ...alent bond.
...les:


Methane


Ethane

The general formula of alkanes is C_nH_{2n+2}

Q.30 What are hydrocarbons?
Ans. Hydrocarbons are organic compounds of carbon and hydrogen elements. They are alkanes, alkenes and alkynes.

Q.31 What are aliphatic hydrocarbons?

Ans. These are the compounds in which the first and the last carbon are not directly joined to each other. These are may be straight or branched.

Examples: $H_3C - CH_2 - CH_2 - CH_3$ (n – butane)

$H_3C - \underset{\displaystyle CH_3}{\underset{|}{CH_2}} - CH_3$ (isobutane)

Q.32 Give a few uses of methane?

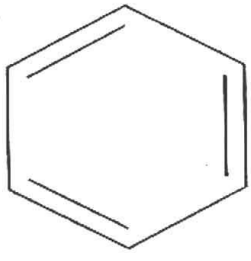
Ans. **i.** Natural gas is chiefly methane is used as domestic fuel.

ii. Compressed natural gas (CNG) is used as automobile fuel.

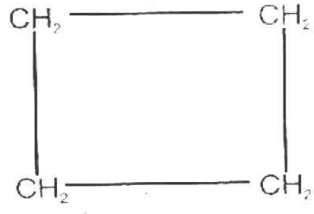
Q.33 What are Cyclic hydrocarbons?

Ans. Compounds having ring of carbon atoms in their molecule are called closed chain or cyclic hydrocarbons.

Examples:



(Benzene)



(Cyclo butane)

Q.34 What are alkenes? Give its general formula?

Ans. Alkenes are unsaturated hydrocarbons having double bond between two carbon atoms the

General formula:

C_nH_{2n}

Example: $H_2C = CH_2$ (Ethene)

Q.35 What are alkynes? Give its general formula?

Ans. The hydrocarbon in which two carbon atoms are linked by a triple bond are called alkynes.

Example:

$\underset{\text{(ethyne)}}{HC \equiv CH}$, $\underset{\text{(Propyne)}}{H_3C - C \equiv CH}$

Q.36 Write the sources of alkanes?

Ans.

i) The main sources of alkanes are petroleum and natural gas.

ii) Methane forms about 85% of Natural gas.

iii) Fuel gases obtained from coal gas contain alkanes in small amount.

Q.37 Why the burning of alkanes require sufficient supply of oxygen?

Ans. Because in the limited supply of oxygen there is incomplete combustion. As a result carbon monoxide is produced that creates suffocation and causes death. As shown in chemical reaction equation.

Chemical Equation:

$$3CH_4 + 4O_2 \longrightarrow 2CO + C + 6H_2O$$

Q.38 How can you prepare propene from propyl alcohol?

Ans. Dehydration of Alcohols: Alcohols when dehydrated in the presence of a catalys give alkene. The best procedure is to pass vapours of alcohol over heated alumina.

Chemical Equation:

$$\underset{\text{(Propyl alcohol)}}{CH_3-CH_2-\underset{OH}{\underset{|}{CH_2}}} \xrightarrow[340-450^{\circ}C]{Al_2O_3} \underset{\text{(Propene)}}{CH_3-CH=CH_2} + H_2O$$

Q.39 Give a test to identify unsaturation of an organic compound.

Ans. Oxidation with $KMnO_4$: When unsaturated compounds oxidized with KMnO the pink colour discharged.

For Example:

i. Reaction with Alkene:

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

ii. Reaction with Alkyne:

$$HC\equiv CH + 2KMnO_4 + 2H_2O \longrightarrow \underset{OH\quad OH}{\underset{OH\quad OH}{H-C-C-H}} + 2MnO_2 + 2KOH$$

Q. 40 How is tetrabromoethane prepared from acetylene.

Ans. Preparation of Tetrabromoethance from Acetylene: Tetrabromoethane can be prepared by the addition of halogens to the acetylenes what bromine water added to acetylene, red brown colour of bromine water is discharged rapidly due to formation of colourless tetrabromoethane.

Chemical Equation:

$$HC \equiv CH + 2Br_2 \rightarrow H-\underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}}-\underset{\underset{Br}{|}}{\overset{\overset{Br}{|}}{C}}-H$$

(Tetrabromoethane)

Q.41. What is difference between glycol and glyoxal?

Ans.

Glycol	Glyoxal
1. The functional group in glycol is "hydroxyl group"	1. The functional group in glyoxal is $-\overset{\overset{O}{\|\|}}{C}-$ group.
2. The formula of a glycol is H_2C-CH_2 (OH, OH)	2. The formula of a glyoxal is $H-\overset{\overset{O}{\|\|}}{C}-\overset{\overset{O}{\|\|}}{C}-H$

Q.42 Why methane is known as marsh gas?

Ans. Methane as a Marsh Gas: Poke around with a stick in the muddy bottom of a pond or marsh. You may see bubbles coming out of the mud. These bubbles are the hydrocarbon gas methane, which is sometimes called 'marsh gas. If you collect the gas in a jam jar you can set fire to it.

Q.43 Which chemicals were produced by orchids to attract the insects for their pollination?

Ans. Orchids: Orchids are beautiful ornamental and colourful flowers. Some orchids produce alkanes to attract bees to pollinate their flowers.

Q.44 Why butane is used in portable torches and gas lighters?

Ans. Propane and butane burn with very hot flames and are sold as liquefied petroleum gas (LPG). They are kept as liquids under pressure, but they vapourize easily when the

pressure is released. Cylinders of butane are used in the homes. Butane is also used in portable torches and gas lighters.

Q.45 Give few physical properties of alkenes.

Ans.

(i) The first member of alkenes is ethane. It is a colourless gas with pleasant odour.

(ii) Alkenes are non-polar therefore; they are insoluble in water but soluble in organic solvent.

(iii) The first member of the series ethane is slightly less dense than air.

Multiple Choice Questions

1. Which one of these hydrocarbon molecules would have no effect on an aqueous solution of bromine?

(a) CH_4 (b) $C_{10}H_{20}$

(c) C_2H_4 (d) C_2H_2

2. If an organic compound has 4 carbon atoms, all singly bonded, it will have the following characteristics except one

(a) it will be saturated hydrocarbon

(b) it will have 8 hydrogen atoms

(c) its name will be n-butane.

(d) it will be least reactive

3. The reduction of alkyl halides takes place in the presence of

(a) Zn/HCl (b) Na/HCl

(c) Mg/HCl (d) Cu/HCl

4. Halogenation of methane produces following valuable chemical compounds used as solvents except:

(a) carbontetrachloride

(b) chloroform

(c) carbon black

(d) chloromethane

5. Incomplete combustion of alkanes produces

(a) carbon dioxide only

(b) carbon monoxide only

(c) carbon monoxide carbon black and water

(d) carbon dioxide and carbon black

6. Alkenes are prepared from alcohols by a process called

(a) dehydrogenation

(b) dehalogenation

(c) dehydration

(d) dehydrohalogenation

7. Dehydrohalogenation takes place in the presence of

(a) NaOH aqueous

(b) alcoholic KOH

(c) aqeous KOH

(d) alcoholic NaOH

8. Oxidation of ethene with KMnO4 produces

(a) oxalic acid

(b) glyoxal

(c) ethene glycol

(d) propene glycol

9. Which one of these is a saturated hydrocarbon?

(a) C_2H_4 (b) C_3H_6

(c) C_4H_8 (d) C_5H_{12}

10. A hydrocarbon has molecular formula C_8H_{14}. What is the molecular formula of the next member of the same homologous series.

(a) C_9H_{18} (b) C_9H_{16}

(c) C_9H_{20} (d) C_9H_{12}

11. The molecular formulae of the first three members of the alkane hydrocarbons are CH_4, C_2H_6 and C_3H_8. What is the molecular formula for the eighth alkane member, octane, which is found in petrol?

(a) C_8H_8 (b) C_8H_{16}

(c) C_8H_{18} (d) C_8H_{20}

12. One of the hydrocarbons reacts with one mole of hydrogen to form a saturated hydrocarbon. What formula could be of the X.

(a) C_3H_8 (b) C_6H_{12}

(c) C_4H_{10} (d) C_7H_{16}

13. Dehydration of alcohols can be carried out with

(a) NaOH (b) KOH

(c) H_2SO_4 (d) HCl

14. The end product of oxidation of acetylene is

(a) oxalic acid (b) glycol

(c) glyoxal (d) none

15. Dehalogenation of tetrahalides produces acetylene. This reaction takes place in the presence of

(a) sodium metal

(b) zinc metal

(c) magnesium metal

(d) potassium metal

16. Substitution reaction is the characteristics of

(a) alkanes (b) alkenes

(c) alkynes (d) none of these

17. Halogenation of alkanes in the presence of diffused sunlight takes place

(a) suddenly, only in one step

(b) slowly in one step

(c) in a series of step

(d) fastly in two steps

18. Which one of the following is a substitution reaction?

(a) halogenations of alkynes

(b) halogenations of alkenes

(c) halogenations of alkanes

(d) bromination of alkene s

19. The order of reactivity of hydrogen halides with alkenes is

(a) HI > HBr

(b) HBr > HI

(c) HCl > HBr

(d) HBr < HCl

20. Oxidation of alkenes produce

(a) glyoxal (b) glycol

(c) oxalic acid (d) formic acid

21. Which is the simplest alkane?

(a) CH_4 (b) C_3H_8

(c) C_2H_2 (d) C_2H_4

22. Carbon black is used in the manufacture of

(a) dry cleaning (b) shoe polishes

(c) fertilizers (d) none of these

23. Alkanes give reaction only

(a) addition (b) decomposition
(c) substitution (d) displacement

24. Chemical formula of chloroform is

(a) CH_2Cl_2 (b) CH_3Cl
(c) $CHCl_3$ (d) CCl_4

25. Alkenes are produced in large amounts by cracking of

(a) natural gas (b) petroleum
(c) benzene (d) xylol

26. Traces of acetylene are present in coal gas about

(a) 0.06% (b) 0.08%
(c) 1.1% (d) 90%

27. Which of the following gas is used in warfare?

(a) methane (b) ethane gas
(c) mustard gas (d) none of these

28. Which one of the following is more reactive?

(a) methane (b) ethane
(c) ethene (d) acetylene

29. Condensed formula of ethane is

(a) C_3H_8 (b) C_2H_6
(c) H_3CCH_3 (d) none of these

30. The general formula of alkynes is

(a) C_nH_{2n} (b) C_nH_{2n+2}
(c) C_nH_{2n-2} (d) C_nH_{2n+1}

31. Alkanes do not react in

(a) diffused sunlight (b) bright sunlight
(c) dark (d) none of these

32. Carbon tetra chloride is used in

(a) fertilizers (b) dry cleaning
(c) metallurgy (d) anesthesia

33. The alkanes consisting of C_5 to C_{10} are

(a) gases (b) liquids
(c) solids (d) plasma

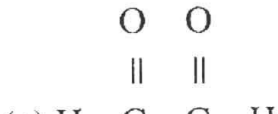
34. Chloroform is used for

(a) anesthesia (b) fever
(c) ink (d) toys

35. Molecular formula of butyne is

(a) C_4H_6 (b) C_3H_4
(c) C_4H_7 (d) C_4H_8

36. Formula of glycoxal is

(a)


(b)


(c) H – CO – H

(d) None of these

37. Alkanes are least reactive compounds because they are

(a) saturated hydrocarbons
(b) unsaturated hydrocarbons
(c) both (a) and (b)
(d) none of the above

38. Which is present 85% in natural gas?

(a) Ethane (b) Propane
(c) Methane (d) Butane

39. Hydrogenation of alkenes and alkynes takes place at room temperature in the presence of

(a) Ni (b) Pt
(c) Pd (d) Both a and b

40. Which one is the formula of chloromethane

(a) CH_2Cl_2 (b) CCl_4

(c) $CHCl_3$ (d) CH_3Cl

41. Which gas creates suffocation and causes death?

(a) CO (b) CO_2

(c) SO_3 (d) SO_2

42. In shoe polishes, which chemical is used

(a) ethanol (b) methanol

(c) carbon black

(d) formaldehyde

43. In dry cleaning, which chemical is used

(a) chloroform

(b) carbon tetrachloride

(c) acetaldehyde

(d) ethanol

44. some orchids attracts bees for pollination by producing

(a) alkanes (b) alkenes

(c) alkynes (d) above all

45. Dehydration means removal of

(a) water (b) halogen

(c) hydrogen (d) all above

46. Benzene is formed by the polymerization of

(a) alkene (b) alkane

(c) acetylene (d) CH_4

47. Ethylene is present in natural gas sometimes to the extent of

(a) 10% (b) 20%

(c) 30% (d) 40%

Answer Keys

1.	a	2.	b	3.	a	4.	c	5.	c
6.	c	7.	b	8.	c	9.	d	10.	b
11.	d	12.	d	13.	c	14.	c	15.	b
16.	a	17.	c	18.	c	19.	a	20.	b
21.	a	22.	b	23.	c	24.	c	25.	b
26.	a	27.	c	28.	d	29.	c	30.	c
31.	c	32.	b	33.	b	34.	a	35.	a
36.	a	37.	a	38.	c	39.	d	40.	d
41.	a	42.	c	43.	b	44.	a	45.	a
46.	c	47.	b						

Unit 13

Biochemistry

Long Answer Questions

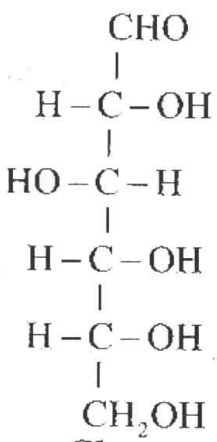
Q.1 What are monosaccharides? Describe with example

Ans. Introduction

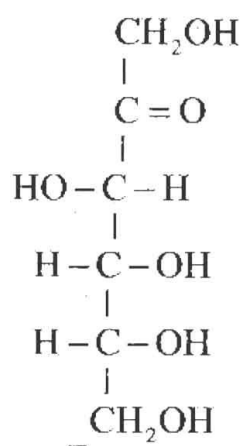
Monosaccharides are the simplest sugars which cannot be hydrolyzed. They consist of 3 to 9 carbon atoms. Therefore, they are classified according to the number of carbon atoms in their molecules as trioses, tetroses, pentoses, hexoses, and so on.

Example

The important monosaccharides are hexoses like glucose and fructose, etc. Glucose is a pentahydroxy aldehyde while fructose is pentahydroxy ketone having the open chain structures as follows and general formula $C_6H_{12}O_6$



Glucose



Fructose

Properties

Monosaccharides are white crystalline solids. They are soluble in water and have sweet taste. They cannot be hydrolyzed. They are reducing in nature, therefore, these are called reducing sugars.

Q.2 Explain the Sources and uses of proteins.

Ans. Sources and uses of proteins

Proteins make up more than 50% of the dry weight of animals. Each protein has its source and carries out a specific function. Sources and uses of protein are as follows:

(i) Sources of animal's proteins are meat, mutton, chicken, fish, and eggs. These are used as food by human beings as they are essential for the formation of protoplasm.

(ii) Enzymes are proteins that are produced by the living cells. They catalyze the chemical reactions taking place in the bodies. They are highly specific and have extra ordinary efficiency. Many enzymes are used as drugs. They control the bleeding and treatment of blood cancer.

(iii) Hides are proteins. These are used to make leather by tanning. Leather is used to make shoes, jackets, sports items, etc.

(iv) Proteins are found in bones. When bones are heated they give gelatin. Gelatin is used to make bakery items.

(v) Plants also synthesize proteins, such as pulses, beans, etc. These are used as food.

Q.3 What are the natural sources and uses of lipids?

Ans. Natural sources and uses of lipids

Fats and oils are synthesized naturally by animals, plants and marine organisms.

(i).Animal fats are found in adipose tissue cells. Animals secrete milk from which butter and ghee obtained. Butter and ghee are used for cooking and frying of food, for preparing bakery products and sweets.

(ii) Animals fats are used in soap industry.

(iii) Plants synthesize oils and store them in seeds, such as, sunflower oil, coconut oil, groundnut oil and corn oil. These oils are used as vegetable oils or ghee from cooking and other purposes.

(iv) Marine animals like salmon and whales are also source of oils. These oils are used as medicines, e.g., cod liver oil.

Q.4 What are the beneficial aspects of carbohydrates to our body?

Ans. Beneficial aspects of carbohydrates

i. Carbohydrate regulates the amount of sugar level in our body. Low sugar level in body results in hypoglycemia.

ii. They provide essential nutrients for bacteria in intestinal tract that helps in digestion.

iii. Dietary fibre helps to keep the bowel functioning properly.

iv. Fibre helps in lowering of cholesterol level and regulates blood pressure.

v. Carbohydrates protect our muscles from cramping.

Q.5 What is meant by dextrose? Write its composition and use.

Ans. Introduction to Dextrose

Dextrose is crystallized glucose (natural sugar found in starchy foods). It provides simple carbohydrates to the body that can be easily broken down and processed.

Composition

Dextrose solution is available in several concentrations. For example, five percent dextrose solution (D5W) consists of 5 grams of dextrose in each 100 ml. of solution.

Uses

It is used to provide fluid replacement and energy to the body. It contains approximately 170 calories of energy, but does not contain electrolytes. Therefore, electrolytes are added according to requirements in solution. Dextrose is given to patients directly into vein called intravenous (IV) therapy. It is commonly called drip system. It is the fastest way to deliver fluids, electrolytes and medications throughout the body. It prevents air entering into blood stream.

Q.6 Write a note on DNA.

Ans.

DNA consists of deoxyribose sugar.

Structure of DNA

Its structure was discovered by J. Watson and F. Crick in 1953. It is long double stranded molecule consisting of two chains. Each chain is made up of sugar, phosphate and a base. The sugar and phosphate groups make the backbone of the chains and two chains are linked through bases. The chains are wrapped around each other in a double helix form as shown in figure

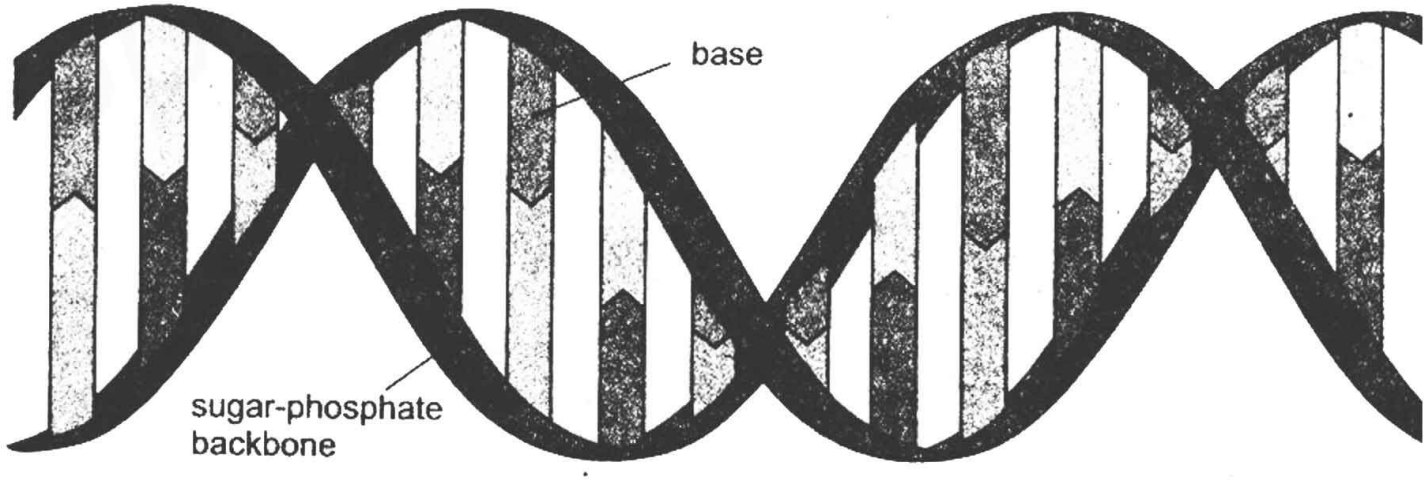


Fig. DNA Structure

Applications of DNA

DNA is the permanent storage place for genetic information in the nucleus of a cell. It carries and stores all genetic informations of the cell. It passes this informations as instruction from generation to generation how to synthesize particular proteins from amino acids. These instructions are a "genetic code of life". They determine whether an organism is a man or a tree or a donkey and whether a cell is a nerve cell or muscle cell.

The sequence of nitrogenous bases in DNA determines the protein development in new cells. The function of the double helix formation of DNA is to ensure that no disorder takes place. DNA carries genes that control the synthesis of RNA. Errors introduced into the genes synthesize faulty RNA. It synthesizes faulty proteins that do not function the way they are supposed to. This disorder causes genetic diseases.

Q.7 What is the importance of vitamins in our daily life?

Ans. Importance of vitamins in our daily life

(i) Each vitamin plays an important role in the healthy development of our body

(ii) Natural vitamins are organic food substances found only in plants and animals. Our body is unable to synthesize vitamins. Because of this, they must be supplied either directly in the diet or by way of dietary supplements. They are absolutely necessary for our normal growth.

(iii) Vitamins cannot be assimilated without ingesting food. This is why, it is suggested that vitamins must be taken with meal. They help to regulate our body's metabolism.

Q.8 Write uses of enzymes on commercial scale

Ans. Following are some of the uses of enzymes on commercial scale:

i) Enzymes present in the yeast are commercially used for the fermentation of molasses and starch to produce alcohol (Ethanol). These enzymes are diastase, invertase and zymase.

ii) Microbial enzymes are used in detergents (powder or liquid). Lipases decompose fats into more water soluble compounds. Amylase removes starch based stains. Cellulase degrades cellulose to glucose a water soluble compounds. Bacterial proteases break down protein stains on the clothes. Thus, enzymes containing detergents clean effectively and remove all stains on dirt.

iii) Enzymes are use for the purification of fruit juices. They are added to fruit that has been crushed like grapes. This increase the yield of the juice extracted by removing suspended particles. It also improves the colour derived from the fruit skins.

iv) Amylase enzymes are used in bread making because they can yield more starch of the flour. Even they are efficient enough to convert starch to sweet glucose syrup. This can be used as sweetener in the food as well as bread making.

v) Lactase enzyme is used to increase sweetener in ice cream. As lactose in milk is broken down to galactose and glucose, which are sweeter than lactose.

vi) In the dairy industry some enzymes are used for the production of cheeses, yogurt and other dairy products while others are used to improve texture or flavours of the products.

Short Answer Question

Q.1 Define carbohydrates. Give their general formula.

Ans. Carbohydrates are macromolecules defined as polyhydroxy aldehydes or ketones. They have general formula $C_n(H_2O)_n$.

Q.2 How carbohydrates are synthesized by plants?

Ans. Carbohydrates are synthesized by plants through photosynthesis process from carbon dioxide and water in the presence of sunlight and green pigment chlorophyll.

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$$

The glucose is further polymerized to form starch and cellulose.

Q.3 Give the classification of carbohydrates.

Ans. Carbohydrates are classified on the basis of units. They are classified as

i) Monosaccharides
ii) Oligosaccharides
iii) Polysaccharides

Q.4 What are monosaccharides? How they are classified?

Ans. Monosaccharides are the simplest sugars which cannot be hydrolyzed. They consist of 3 to 9 carbon atoms in their molecules; they are classified according to the number of carbon atoms in their molecules as trioses, tetroses, pentoses, hexoses, and so on

Q.5 What is meant by glucose and fructose?

Ans. Glucose is a pentahydroxy aldehyde while fructose is pentahydroxy ketone having the open chain structures and general formula is $C_6H_{12}O_6$.

Q.6 Write characteristics of monosaccharides. Why they are called reducing agents?

Ans. Monosaccharides are white crystalline solids. They are soluble in water and have sweet taste. They cannot be hydrolyzed. They are reducing in nature, therefore, these are called reducing sugars.

Q.7 What are oligosaccharides? How they are classified?

Ans. Oligosaccharides give 2 to 9 units of monosaccharides on hydrolysis. Therefore, they are classified as disaccharides, trisaccharides, tetrasaccharides, etc depending upon the

number of units they produce on hydrolysis. The most important oligosaccharides are disaccharides like sucrose.

Q.8 Describe hydrolysis of sucrose.

Ans. The most important oligosaccharides are disaccharides like sucrose. On hydrolysis sucrose produces one unit of glucose and one unit of fructose.

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow[\text{heat}]{\text{Dil.HCl}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{fructose}}{C_6H_{12}O_6}$$

Q.9 Name the products formed by the hydrolysis of sucrose.

Ans. On hydrolysis sucrose produces one unit of glucose and one unit of fructose.

Q.10 Write characteristics of oligosaccharides.

Ans. Oligosaccharides are white, crystalline solids easily soluble in water. They are also sweet in taste. They may be reducing or non-reducing.

Q.11 What are polysaccharides? Write its characteristics.

Ans. Polysaccharides are macromolecular carbohydrates consisting of hundreds to thousands of monosaccharides. Examples of polysaccharides are starch and cellulose. They are amorphous solids. They are tasteless and insoluble in water. They are non reducing in nature.

Q.12 Write sources of simple sugars.

Ans. Glucose, fructose and galactose are simple sugars which are found in fruits, vegetables, honey and cereals.

Q.13 Write sources of sucrose.

Ans. Sucrose is found in sugar beet, sugar cane, and fruits.

Q.14 Write sources of Lactose

Ans. Lactose consisting of glucose and galactose is the main sugar in milk and dairy products.

Q.15 Write sources of maltose.

Ans. Maltose is found in cereals.

Q.16 Write sources of starch and cellulose.

Ans. Starch is found in cereal crops: wheat, barley, maize, rice, etc while cellulose is found in cotton.

Q.17 Describe source of energy for brain and muscle?

Ans. Our body uses carbohydrates in the form of glucose. Glucose is the only form of carbohydrates that is used directly by muscles for energy. It is important to note that brain needs glucose as an energy source, because it cannot use fat for this purpose.

Q.18 How carbohydrates provide energy to our body system?

Ans. Carbohydrates provides 17 kilojoules of energy per gram. We take carbohydrates as food. Long chains of starch (carbohydrates) are broken down into simple sugars (glucose) by digestive enzymes. The glucose is absorbed directly by small intestine into the blood stream. Blood stream transports the glucose to its place of use, e.g., muscles.

Q.19 What are proteins? Write its composition.

Ans. Proteins are highly complicated nitrogenous compounds made up of amino acids. Proteins consist of carbon, hydrogen, oxygen, nitrogen and sulphur. They are polymers of amino acids. Amino acids are linked with each other through peptide linkage. Protein has more than 10,000 amino acids. All proteins yield amino acids upon hydrolysis.

$$\begin{array}{c} O \\ \| \\ -C-NH- \end{array}$$

Q.20 Write occurrence of protein in living organism.

Ans. Proteins are present in all living organisms. They make up bulk of the non-bony structure of the animal bodies. They are major component of all cells and tissues of animals. About 50% of the dry weight of cell is made up of proteins. They are found in muscles, skin, hair, nails, wool, feathers etc.

Q.21 What are amino acids? Write its general formula

Ans. Amino acids are organic compounds consisting of both amino and carboxyl groups. They have the general formula

(side chain) (carboxylic group)

$$\begin{array}{l} R - CH - COOH \\ \quad\quad | \\ \quad\quad NH_2 \end{array}$$

(amino group)

Side chain 'R' is different for different amino acids. There are 20 amino acids.

Q.22 How many amino acids are synthesized by human body?

Ans. Ten out of twenty amino acids can be synthesized by human body

Q.23 What is the difference between essential and non-essential amino acids?

Ans. That amino acid which cannot be synthesized in our body is termed as essential amino acids, while those which can be synthesized in our body are termed as non-essential amino acids. Essential amino acids are required by our bodies and must be supplied through diet.

Q.24 What is meant by peptide linkage? How it is formed?

Ans. Two amino acids link through peptide linkage. Peptide linkage (bond) is formed by the elimination of water molecule between the amino group of one amino acid and carboxyl acid group of another, such as

$$H_2N-CH(R)-COOH + HNH'-COOH \xrightarrow{-H_2O} H_2N\left[CH(R)-C(=O)-NH\right]-CH-COOH$$

Q.25 How peptide linkage is formed between amino group of amino acid and carboxyl group?

Ans.

$$H_2N-CH(R)-COOH + HNH-CH(R)-COOH \xrightarrow{-H_2O} H_2N\left[CH(R)-C(=O)-NH\right]-CH(R)-COOH$$

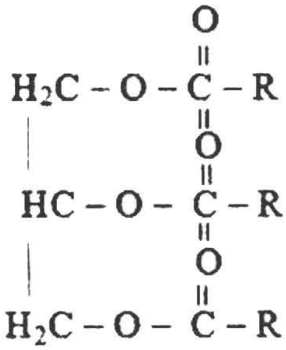
(Dehydration) Peptide linkage

Q.26 What are lipids? How they are classified?

Ans. Lipids are macromolecules made up of fatty acids. Lipids are classified into oils and fats. Oil and fats are esters of long chain carboxylic (fatty) acid with glycerol.

Q.27 What are triglycerides? Write its general formula

Ans. Oils and fats are esters of long chain carboxylic (fatty) acids with glycerol. These esters are made of three fatty acids, therefore, they are called triglyceride. General formula of triglycerides is as under



Q.28 What is the difference between oils and fats?

Ans. Oils exist in liquid form at room temperature. They are triglycerides of unsaturated fatty acids. While fats exist in solid form at room temperature. They are triglycerides of saturated fatty acids

Q.29 What are fatty acids? Give example

Ans. Fatty acids are building blocks of lipids. They are long chain saturated or unsaturated carboxylic acids. Examples are

Palmitic acid $C_{15}H_{31}COOH$

Stearic acid $C_{17}H_{35}COOH$

These acids form esters with glycerol in the presence of mineral acids.

Q.30 How esters are formed?

Ans. Fatty acids form esters (oils or fats) with glycerol in the presence of mineral acids.

Q.31 What are the sources of vitamins A, D and E? Write their uses

Ans. Fats and oils are high energy foods. They are the source of vitamins A, D and E. They are used to build brain cells, nerve cells and cell membranes. They are insoluble in water but soluble in organic solvents. The fats stored in the body insulate it as they are poor conductor of heat and electricity.

Q.32 How vegetable oil is converted into vegetable ghee?

Ans. Vegetable oils are triester of glycerol and fatty acids of unsaturated long chains. These oils are hydrogenated in the presence of nickel catalyst at 250 to 300 ^{0}C to from vegetable ghee.

$$\underset{\text{(Unsaturated triester)}}{\text{Vegetable Oil}} + H_2 \xrightarrow[250^\circ C]{Ni} \underset{\text{(Saturated triester)}}{\text{Vegetable ghee}}$$

Q.33 How margarine is produced?

Ans. Margarine is produced by adding hydrogen to vegetable oil at 200 ^{0}C in the presence of catalyst. Greater the amount of hydrogen is added the more solid the margarine becomes.

Q.34 As the presence of butanoic acid causes smell in food fruits? If yes, give suitable example.

Ans. The esters of butanoic acid have fruity smell. For example, methyl butanoate smells like apples and ethyl butanoate smells like pineapple.

Q.35 Why rancid butter has a foul smell?

Ans. Rancid butter has a foul smell because of butanoic acid.

Q.36 What is meant by nucleic acid? How it is classified?

Ans. Nucleic acids are essential components of every living cell. They are generally long chain molecules made up of nucleotides. Each nucleotide consists of three components; nitrogenous base, a pentose sugar and a phosphate group.

Q.37 Nucleic acid is classified into

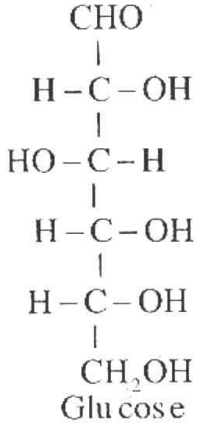
Ans. i) DNA (Deoxyribonucleic acid)
ii) RNA (Ribonucleic acids)

Q.38 Give the balanced chemical equation for the formation of glucose.

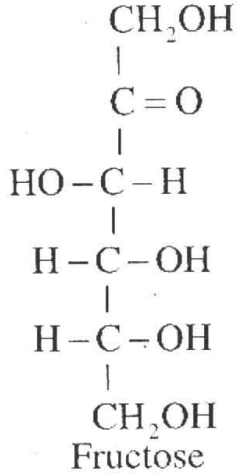
Ans. $6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6O_2$

Q.39 Draw the structure of glucose and fructose

Ans.



Glucose



Fructose

Q.40 Give the balanced equation for the hydrolysis of sucrose.

Ans. $C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{heat}]{\text{Dil.HCl}} C_6H_{12}O_6 + C_6H_{12}O_6$

sucrose glucose fructose

Q.41 Name the elements found in proteins.

Ans. (i) Carbon (ii) Hydrogen (iii) Oxygen (iv) Nitrogen (v) Sulphur

Q.42 How amino acids are bonded with each other?

Ans. Amino acids are bonded with each other through peptide linkage.

$$(-\overset{\overset{O}{\|}}{C}-NH-)$$

Q.43 Give the general formula of amino acid.

Ans.

(side chain) (carboxylic group)

$$R-\underset{\underset{NH_2}{|}}{CH}-COOH$$

(NH_2 (amino group))

Q.44 What are the disadvantages of fats soluble vitamins?

Ans. If fats soluble vitamins are taken in large quantity they accumulate in the body and cause disease for example accumulation of vitamin D in the body cause bone pain and bone-like deposits in kidney.

Q.45 What are the advantages of water soluble vitamins?

Ans. Water soluble vitamins are rapidly excreted from the body. Hence these vitamins are not toxic even if taken in lower quantity.

Q.46 Name components of nucleotides in DNA

Ans. (i) Nitrogenous base (ii) Pentose sugar (iii) Phosphate group

Q.47 What is the function of DNA?

Ans. DNA carries and stores all genetic information of the cell. It passes this information as instructions from generation to generation.

Q.48 Why RNA is called a messenger?

Ans. RNA receives, reads, decodes and uses the given information to synthesize new proteins. That is why RNA is also called a messenger.

Q.49 What is meant by RNA? What is its function?

Ans. RNA is synthesized by DNA to transmit the genetic information. RNA receives, reads, decodes and uses the given information to synthesize new proteins. Thus RNA is responsible for directing the synthesis of new proteins.

Q.50 Write brief history of vitamins

Ans. In 1912 Hopkins noticed that in addition to carbohydrates, proteins and fats there are other substances needed for normal growth. Although these substances were needed in small quantity, yet these substances were called Accessory Growth Factors. Later Funk proposed the name Vitamin for these substances. He discovered Vitamin B_1 (Thiamin).

Q.51 Write a short note on fats soluble vitamins?

Ans. the vitamins which dissolve in fats are called fat soluble vitamins. These are vitamin A, D, E and K. If these vitamins are taken in large quantity, they accumulate in the body and cause diseases. For example accumulation of vitamin D in the body causes bone-pain an bone-like deposits in the kidney. However, their deficiency also causes diseases.

Q.52 Write a short note on water soluble vitamins?

Ans. The vitamins that dissolve in water are called water soluble vitamins. These vitamins are B complex (this include 10 vitamins) and vitamin C (ascorbic acid). Water soluble vitamins are rapidly excreted from the body. Hence these vitamins are not toxic even if taken in large quantity. However, their deficiency causes diseases.

Q.53 What are the sources of vitamins A?

Ans. Dairy products eggs, oils, fats and fish. It can also be obtained from the beta-carotene found in green vegetables, carrots and liver.

Q.54 What is the importance of vitamin A?

Ans. Maintains the health of the epithelium and acts on the retina's dark adaptation mechanism.

Q.55 Write any two diseases caused by the deficiency of vitamin A

Ans. Night blindness and eye inflammation

Q.56 What is the source and importance of vitamin D?

Ans. Fish liver, dairy products oils and fats. Vitamin D is formed in the skin when it is expose to sunlight

Q.57 What is the role of vitamin D in body?

Ans. Vitamin D has a role in the absorption of calcium which is essential for the maintenance of healthy bones.

Q.58 Write uses of amylases enzyme.

Ans. Amylase enzymes are used in bread making because they can yield more starch of the flour. Even they are efficient enough to convert starch to sweet glucose syrup. This can be used as sweetener in the food as well as bread making.

Q.59 Write uses of lactase enzyme

Ans. Lactase enzyme is used to increase sweetness in ice cream. Lactase enzyme metabolizes the lactase sugar in the body. As lactose in milk is broken down to galactose and glucose. Which are sweeter than lactose.

Q.60 What is meant by denaturing of proteins?

Ans. Denaturing of protein means precipitation or coagulation of protein. It can be carried out by heating or changing pH. A simple common method for denaturing of protein is boiling of an egg. White viscous fluid (albumen) present in an egg is protein. When egg is boiled for a few minutes, albumen coagulates i.e., solidifies.

Q.61 What are macromolecules?

Ans. Macromolecules are the bigger molecules which are formed by smaller molecules. Macromolecules are synthesized by living organisms from simple molecules present in the environment. Macromolecules are essential for us as they are reservoirs of energy.

Multiple Choice Questions

1. Carbohydrates are synthesized by plants through photosynthesis process which requires the following except:

(a) CO_2 and water
(b) Sunlight
(c) O_2
(d) Chlorophyll

2. Which of the followings is a disaccharide?

(a) Glucose (b)Fructose
(c) Sucrose (d) Starch

3. Photosynthesis process produces

(a) starch (b) cellulose
(c) sucrose (d) glucose

4. Which of the following is tasteless?

(a) starch (b)glucose
(c) fructose (d) sucrose

5. When glucose and fructose combine they produce

(a) starch (b) cellulose
(c) sucrose (d) none of these

6. Glucose is:

(a) hexahydroxy aldehyde
(b) hexahydroxy ketone
(c) pentahydroxy aldehyde
(d) pentahydroxy ketone

7. Thousands of amino acids polymerize to form

(a) carbohydrates (b) proteins
(c) lipids (d) vitamins

8. Which of the followings is a triglyceride?

(a) carbohydrates (b) proteins
(c) lipids (d) vitamins

9. Enzymes are proteins which have the following properties except:

(a) they catalyze reaction
(b) they are highly non-specific
(c) they are highly efficient
(d) they are produced by living cells

10. Which one of the following vitamins is water soluble?

(a) vitamin A (b) vitamin C
(c) vitamin D (d) vitamin E

11. Which one of the following is a fat soluble vitamin?

(a) A (b) E
(c) K (d) All of these

12. Which one of the following is not the characteristics of monosaccharide?

(a) White crystalline solids
(b) Soluble in water
(c) Hydrolysable
(d) reducing in nature

13. Which one of the following statements about glucose and sucrose is incorrect?

(a)Soluble in water
(b)Naturally occurring
(c)Carbohydrates
(d)Disaccharides

14. Which one of the following is a reducing sugar?

(a) glucose (b) fructose
(c) sucrose (d) starch

15. The most important oligosaccharide is:

(a) sucrose (b) glucose
(c) fructose (d) maltose

16. Night blindness is because of deficiency of:

(a) vitamin A (b) protein
(c) vitamin C (d) vitamin D

17. The organic compound used as drugs to control bleeding are

(a) vitamins (b) proteins
(c) Lipids (d) glycerides

18. Deficiency of Vitamin E causes

(a) rickets. (b) scurvy.
(c) anemia in babies.
(d) night blindness

19. Lipids are macromolecules. They have characteristics except one of the following:

(a) they are high energy foods
(b) they are soluble in water
(c) they are poor conductor of heat.
(d) they are esters of fatty acids.

20. vitamins are accessory Growth factors they play important role in our body like;

(a) provide energy to the body.

(b) insulate our body from electric shock

(c) build brain cells

(d) regulate metabolism

21. General formula of carbohydrate is

(a) $C_n(H_2O)_n$ (b) CH

(c) C_nH_{2n} (d) $C_nH_{2n}O$

22. Carbohydrates are synthesized by plants through

(a) Respiration (b) Photosynthesis

(c) Dehydration (d) Evaporation

23. Which one of the following cannot be hydrolyzed?

(a) Polysaccharides

(b) Monosaccharides

(c) Oligosaccharides (d) All of these

24. Glucose and fructose are

(a) Pentose (b) Triose

(c) Hexoses (d) None of these

25. Fructose contain group

(a) ketone (b) Aldehyde

(c) Alcoholic (d) Alkyl

26. Monosaccharides are crystalline solids

(a) Grey (b) Crimson

(c) Silver (d) White

27. Which is not a reducing sugar?

(a) Glucose (b) Fructose

(c) Cellulose (d) All of them

28. Tetrasaccharides are classified under

(a) Monosaccharides

(b) Oligosaccharides

(c) Polysaccharides

(d) All of them

29. The most important disaccharide is

(a) Sucrose (b) Glucose

(c) Cellulose (d) None of them

30. Which one of the following are amorphous solids?

(a) Monosaccharides

(b) Oligosaccharides

(c) Polysaccharides

(d) All of them

31. On hydrolysis sucrose produces one unit of glucose and one unit of

(a) Fructose (b) starch

(c) Cellulose (d) None of them

32. The source of galactose

(a) Fruits (b) Vegetables

(c) Cereals (d) All of them

33. Which is the essential sugar found in milk?

(a) Maltose (b) Lactose

(c) Galactose (d) Starch

34. Maltose is commonly found in

(a) Cereals (b) Milk

(c) Cotton (d) Honey

35. Starch is commonly found in

(a) Wheat (b) Rice

(c) Maize (d) All of them

36. Human body uses carbohydrates in the form of

(a) Glucose (b) Maltose

(c) Fructose (d) Galactose

37. Which carbohydrate is used directly by muscles for energy?

(a) Galactose (b) Lactose

(c) Glucose (d) Fructose

38. Low sugar level in human body results in

(a) Hyperglycemia (b) Hypoglycemia
(c) Anemia (d)All of them

39. Which helps to keep the bowel functioning properly?

(a) Dietary fiber (b) Vitamins
(c) Lipids (d) Carbohydrates

40. Which helps in lowering of cholesterol level?

(a) vitamins (b) Fiber
(c) Carbohydrates (d) All of them

41. The energy provided by carbohydrates in per gram

(a) 17 KJ (b) 21 KJ
(c) 35 KJ (d) 10 KJ

42. Which is the natural sugar found in starchy foods?

(a) Pentose (b) Dextrose
(c) Hexose (d) All of them

43. 50% dextrose contains approximate amount of energy.

(a) 250 calories (b) 16 calories
(c) 170 calories (d) 120 calories

44. Amino acids are the building blocks of

(a) Proteins (b) Carbohydrates
(c) vitamins (d) fats

45. The percentage of protein in dry weight of cell

(a) 20% (b) 40%
(c) 50% (d) 70%

46. Protein is not found in

(a) Muscles (b) Skin
(c) Cotton (d) Hair

47. Chemical formula of amino group is

(a) NH_3 (b) NH_2
(c) NH_4^+ (d) COOH

48. Out of twenty how many amino acids can by synthesized by human body?

(a) Five (b) Ten
(c) Seven (d) Twelve

49. A bond formed between two amino acids is

(a) Peptide linkage (b) Covalent bond
(c) Hydrogen bond
(d) Glycosidic linkage

50. The nature of enzyme is

(a) Vitamin (b) Protein
(c) Carbohydrate (d) fats

51. When bones are heated they give

(a) Starch (b) Gelatin
(c) fats (d) Oils

52. Lipids are macromolecules made up of

(a) Fatty acids (b) amino acids
(c) nucleotides (d) none of them

53. Oils and fats are esters of large chain fatty acids with

(a) Glycogen (b) Glucose
(c) Starch (d) Glycerol

54. Triglycerides are fatty acids

(a) Unsaturated (b) Saturated
(c) Both of them (d) None of them

55. Chemical formula of Stearic acid

(a) $C_{15}H_{31}COOH$
(b) $C_{17}H_{35}COOH$
(c) $C_{17}H_{37}COOH$
(d) None of them

56. In hydrogenation of vegetable oil catalyst employed is

(a) Ni (b) Pt

(c) ZnO (d) Cr_2O_3

57. Margarine is produced by adding hydrogen to vegetable oil at

(a) 2000^0C (b) 100^0C

(c) 200^0C (d) 1000^0C

58. Rancid butter has

(a) Foul smell (b) Rotten egg smell

(c) Pungent smell (d) No smell

59. Smell of rancid butter is due to the presence of

(a) Propanoic acid (b) butanoic acid

(c) acetic acid (d) citric acid

60. Methyl butanoate smell like

(a) Apple (b) mango

(c) Lemon (d) Grapes

61. Ethyl butanoate smells like

(a) Apple (b) Lemon

(c) Pine apple (d) Melon

62. Nucleic acids are made up of long chain of

(a) Nucleotide (b) fatty acids

(c) Amino acid (d) none of them

63. DNA was discovered by

(a) J. Watson (b) Funk

(c) Robert Brown (d) Hopkins

64. RNA consists of

(a) Ribose (b) Pentose

(c) Hexose (d) Trioses

65. Synthesis of protein is directed by

(a) DNA (b) RNA

(c) Both of them (d) None of them

66. Vitamin B_1 was discovered by

(a) Funk (b) Hopkins

(c) Crick (d) Watson

67. The accumulation of which vitamin causes bone-like deposits in the kidney

(a) Vitamin D (b) Vitamin E

(c) Vitamin B (d) Vitamin A

68. Eggs oils and fats contain vitamin

(a) A (b) B

(c) E (d) D

69. Which is a hereditary material?

(a) DNA (b) RNA

(c) Protein (d) All of them

70. Denaturing of protein is caused by

(a) Heating (b) changing pH

(c) Both of them (d) None of them

71. White viscous fluid (albumen) present in an egg is

(a) Protein (b) Fats

(c) Vitamins (d) Carbohydrates

Answer Key

1	c	2	c	3	d	4	a	5	c
6	a	7	b	8	c	9	b	10	b
11	d	12	c	13	d	14	a	15	a
16	a	17	b	18	c	19	b	20	d
21	a	22	b	23	b	24	c	25	a
26	d	27	c	28	b	29	a	30	c
31	a	32	d	33	b	34	a	35	d
36	a	37	c	38	b	39	a	40	b
41	a	42	b	43	c	44	a	45	c
46	c	47	b	48	b	49	a	50	b
51	b	52	a	53	d	54	a	55	b
56	a	57	c	58	a	59	b	60	a
61	c	62	a	63	a	64	a	65	b
66	a	67	a	68	a	69	a	70	c
71	a								

Unit
14

THE ATMOSPHERE

Long Answer Questions

Q.1 What is the role of CO_2 in atmosphere?

Ans. Role of CO_2 in Atmosphere:

The CO_2 forms a layer around the Earth like an envelope. It allows the heat rays of the Sun to pass through it and reaches up to the Earth. These rays are reflected from the Earth surface and go back to upper atmosphere.

Normal concentration of CO_2 layer retains enough heat to keep the atmosphere warm. So, normal concentration of CO_2 is necessary and beneficial for keeping the temperature warm. Otherwise, the Earth would have been uninhabitable. The Earth's average temperature would be about -20°C, rather than presently average temperature 15°C.

Q.2 What are the effects of global warming?

Ans. Effects of Global Warming:

(i) Accumulation of carbon dioxide in air is resulting in increasing atmospheric temperature about 0.05 °C every year.

(ii) It is causing major changes in weather patterns. Extreme weather events are occurring more commonly and intensely than previously.

(iii) It melts glaciers and snow caps that are increasing food risks and intense tropical cyclones.

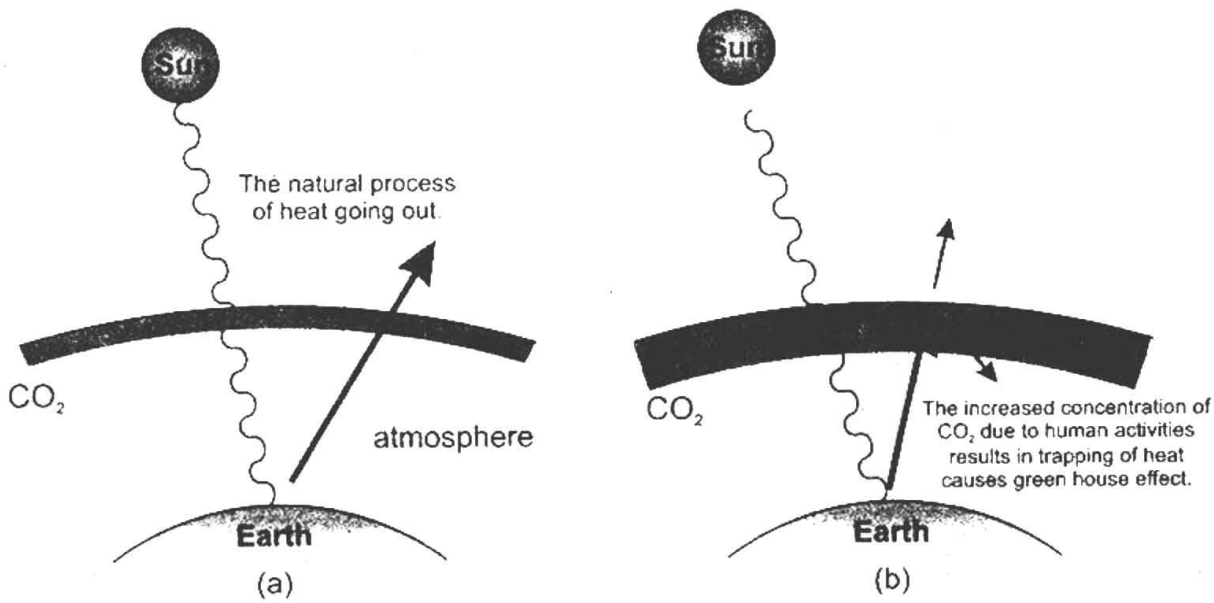
(iv) Sea-level is rising due to which low lying areas are liable to be submerged, turning p2reviously populated areas no longer habitable.

Q.3 Write a note on Green House Effect?

Ans. Green House Effect:

Although CO_2 is not a poisonous gas, yet its increasing concentration due to burning of fossil fuels in different human activities is alarming. Because CO_2 in the atmosphere acts like a glass wall of a green house. It allows UV radiations to pass through it but does not allow the IR radiations to pass through it. It traps some of the infrared radiations emitted by the Earth. Hence, increased concentration of CO_2 layer absorbs the infrared radiations emitted by

the Earth's surface and prevents heat energy escaping from the atmosphere. It helps to stop surface from cooling down during night. As the concentration of CO_2 in air increase, less heat energy is lost from the surface of the Earth. Therefore, the average temperature of the surface gradually increases. This is called greenhouse effect as shown in figure. This effect is proportional to amount of CO_2 in air. Greater is amount of CO_2, more is trapping of heat or warming. Due to increased warming this phenomenon is also called global warming.



Q.4 Is CO an air pollutant? If yes, What are its effect on human health?

Ans. CO is an air pollutant. It is a health hazard being highly poisonous gas. Being colorless and odorless, its presence cannot be noticed easily and readily. When inhaled, it binds with the hemoglobin most strongly than that of oxygen. Thus, hindering the supply of oxygen in body. Exposure to higher concentration of CO causes headache and fatigue. If inhaled for a longer time it results in breathing difficulties and ultimately death. It is the reason burning is not allowed in closed places. It is advised to switch off coal or gas heaters, cooking range, etc., before going to sleep.

Q.5 What should be the role of Government to control pollution?

Ans. Role of Government to Control Pollution:

(i) Quality of Fuel

First of all, quality of fuel must be improved by adding anti-knocking agents in fuels .at the same time, automobiles combustion engines must be efficient so that they should burn the fuel completely. No unburned hydrocarbon molecules (fuel) should come out of the exhaust. So government must guide the people to use converters in auto exhausts.

(ii) Alternative Fuel

Fossil fuel produces a number of air pollutants because of impurities and complex molecule nature of hydrocarbons. Government should promote the use of alternative fuels

such as methanol, ethanol and bio-diesel. These fuels are less polluting than hydrocarbons fuel, as their molecules are simple, and burn completely in the engine. Their burning produces less carbon monoxide, soot and other pollutants.

(iii) Battery-powered Electric Vehicles

The government must plan to avoid using carbon dioxide producing fuels as it is a greenhouse gas. It should go to battery-powered electric vehicles.

Government should provide efficient transport in the big cities, so that people should avoid using their own vehicles.

Q.6 How acid rain is formed? Explain

Ans. Formation of Acid Rain:

The burning of fossil fuels produces oxides of sulphur and nitrogen in air. Rain water converts SO_2 into H_2SO_4 and NO_x to HNO_2 and HNO_3. Normal rain water is weakly acidic because it consists of dissolved CO_2 of the air. Its pH is about 5.6 to 6. But rain water on dissolving air pollutants (acids) becomes more acidic and its pH reduces to 4. Thus, acid rain is formed on dissolving acidic air pollutants such as sulphur dioxide and nitrogen dioxide by rain water.

Q.7 Write harmful effects of acid rain?

Ans. Harmful Effects of Acid Rain:

(i) Effects on Aquatic Life

Acid rain on soil and rocks leaches heavy metals (Al, Hg, Pb, Cr, etc) with it and discharges these metals into rivers and lakes. This water is used by human beings for drinking purpose. These metals accumulate in human body to a toxic level. On the other hand, aquatic life present in lakes also suffers because of high concentration of these metals. Especially high concentration of aluminium metal clogs the fish gills. It causes suffocation and ultimately death of fish.

(ii) Effects on Buildings and Monuments

Acid rain attacks the calcium carbonate present in the marble and limestone of buildings and monuments. Thus, these buildings are getting dull and eroded day by day.

(iii) Effects on Soil

Acid rain increases the acidity of the soil. Many crops and plants cannot grow properly in such soil. It also increases the toxic metals in the soil that poisons the vegetation. Even old trees are being affected due to acidity of soil. Their growth is retarded. They get dry and die.

(iv) Effects on Trees and Plants

Acid rain directly damages the leaves of trees and plants, thus limiting their growth. Depending upon the severity of the damage, plants growth can be hampered.

Q.8 How ozone layer is depleted? Explain

Ans. Depletion of Ozone Layer:

Ozone layer is being depleted through various chemical reactions, such as

(i) The ozone molecule absorbs solar radiations and dissociate readily, i.e., self dissociation of ozone takes place.

(ii) However, chlorofluorocarbons (CFCs) (used as refrigerants in air conditioners and refrigerators) are major cause of depletion of ozone layer. These compounds leak in one way or other escape and diffuse to stratosphere. These ultraviolet radiations break the C-Cl bond in $CFCl_3$ and generates chlorine free radicals as

$$CFCl_3 \xrightarrow{UV} CFCl_2 + Cl$$

These free radicals are very reactive. They react with ozone to form oxygen as

$$O_{3\,(g)} + Cl \longrightarrow O_{2\,(g)} + OCl^{\bullet}$$

$$OCl^{\bullet} \longrightarrow O^{\bullet} + Cl^{\bullet}$$

$$O^{\bullet} + O^{\bullet} \longrightarrow O_2$$

A single chlorine free radical released by the decomposition of CFCs is capable of destroying up to many lacs of ozone molecules. The region in which ozone layer depletes is called ozone hole.

Q.9 What are the after effects of ozone layer depletion?

Ans: Effects of Depletion on Ozone Layer:

Even minor problems of ozone depletion can have major effects.

(i) Depletion of ozone enables ultraviolet radiations of Sun to reach to the Earth, that can cause skin cancer to human beings and other animals.

(ii) Decreased ozone layer will increase infections disease like malaria.

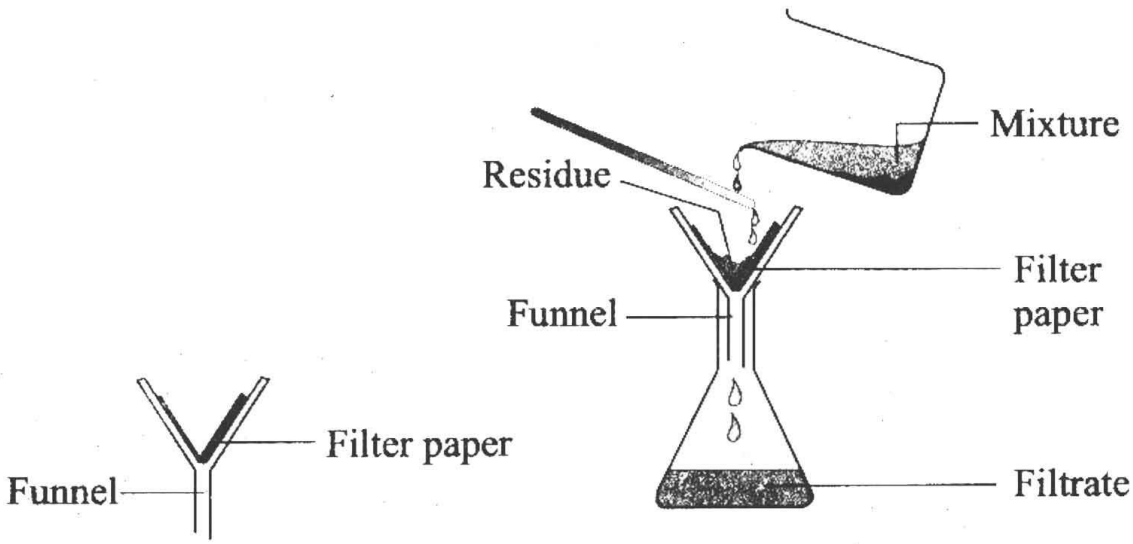
(iii) It can change the life cycle of plants disrupting the food chain.

(iv) It can change the wind patterns, resulting in climatic changes all over the world. Especially, Asia and Pacific will be the most affected regions, facing climate induced migration of people crisis.

Q.10 How the process of filtration is carried out? Explain

Ans: A filter paper is first folded half way, and then another fold is made, so that a filter paper gets four folds. This folded filter paper is placed in a filter funnel in such a way that on one side is three layers and on the other side is one layer as shown in figure.

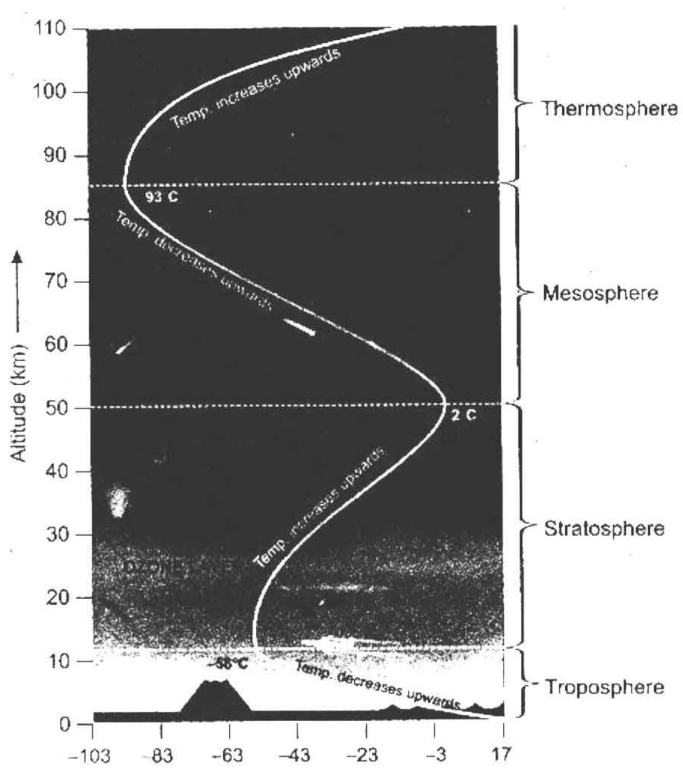
The mixture (sand in water or chalk in water) is poured into the filter paper as shown in figure.



Filtrate passes through the filter paper and is collected in a conical flask. The solid particles (residue) deposit on the filter paper. It is then dried.

Q.11 How atmosphere is divided on the basis of variation in temperature? Explain

Ans: Depending upon the temperature variation, atmosphere is divided into four regions. Temperature decreases form 17°C to -58°C regularly in the lowest layer extending upto 12 km. This layer of atmosphere is called troposphere. Above this layer lies the stratosphere th extends upto 50 km. In this layer temperature rises upto 2°C. Beyond the stratosphere lies t mesosphere, covering upto 85 km. In this region again temperature decreases down to -93° Beyond 85 km lies the thermosphere in which temperature goes on increasing upwards.



Characteristics of Atmospheric Regions

Name of Region	Height above the Earth Surface	Temperature range and Trend
Troposphere	0 — 12 km	17°C — -58°C (decreases)
Stratosphere	12 — 50 km	-58°C — 2°C (increases)
Mesosphere	50 — 85 km	2°C — -93°C (decreases)
Thermosphere	85 — 120 km	> - 93°C (increases)

Q.12 How ozone is formed in stratosphere? Explain

Ans. Formation of Ozone Layer

This atmospheric region is next to troposphere and extends upto 50 kilometers. In this region, temperature rises gradually upto 2°C. The presence of ozone (due to absorption of radiation) in this region is responsible for the rise of temperature in stratosphere. Within this region, temperature increases as a altitude increases, such as lower layer temperature is about – 58°C and upper layer is about 2°C. Thus, stratosphere is layered in temperature. Since ozone in the upper layer absorbs high energy ultraviolet radiations from the Sun, it breaks down into monoatomic (O) and diatomic oxygen (O_2).

$$O_{3(g)} \longrightarrow O_{2(g)} + O_{(g)}$$

The mid stratosphere has less UV light passing through it. Here O and O_2 recombine to form ozone which is an exothermic reaction. Ozone formation in this region results in formation of ozone layer. Thus, ozone layer exists in mid stratosphere.

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

The lower stratosphere receives very low UV radiations, thus monoatomic oxygen is not found here and ozone is not formed here.

Q.13 Write a note on troposphere?

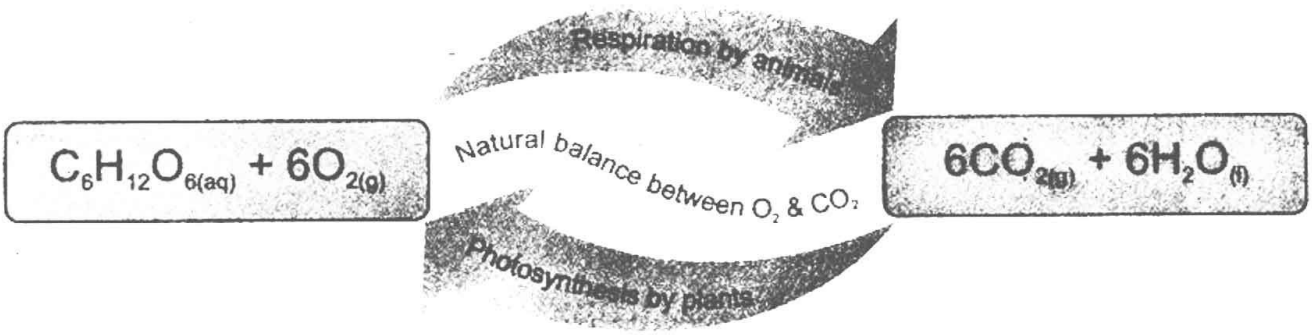
Ans. Troposphere

The major constituents of troposphere are nitrogen and oxygen gases. These two gases comprise 99% by volume of the Earth's atmosphere.

Although concentration of carbon dioxide and water vapours is negligible in atmosphere, yet they play a significant role in maintaining temperature of the atmosphere. Both of these gases allow visible light to pass through but absorb infrared radiations emitted by the Earth's surface. Therefore, these gases absorb much of the outgoing radiations and warm the atmosphere. As the concentration of gases decreases gradually with the increases of altitude, correspondingly temperature also decreases at a rate of 6K per kilometer. This is the region where all weathers occur. Almost all aircrafts fly in this region.

Q.14 Is CO_2 an air pollutant? How a natural balance exists between CO_2 and O_2 in atmosphere.

Ans. CO_2 is not an air pollutant. Rather, it is an essential gas for plants as O_2 is essential for animals. Plants consume CO_2 in photosynthesis process and produce O_2. While animals use O_2 in respiration and give out CO_2. In this way, a natural balance exists between these essential gases as represented here. But this balance is being disturbed by emitting more and more CO_2 in air through different human activities.



Short Answer Questions

Q.1 What is meant by atmosphere?

Ans. Atmosphere is the envelope of different gases around the Earth. It extends continuously from the Earth's surface outwards without any boundary. About 99% of atmospheric mass lies within 30 kilometers of the surface and 75% lies within the lowest 11 kilometers.

Q.2 Write composition of dry air.

Ans.

Gas	% by Volume
Nitrogen	78.09
Oxygen	20.94
Argon	0.93
Carbon dioxide	0.03

Q.3 What is the difference between primary and secondary pollution.

Ans. Primary pollutants are the waste or exhaust products driven out because of combustion of fossil fuels and organic matter. These are the oxides of sulphur (SO_2 and SO_3); oxides of

carbon (CO_2 and CO); oxides of nitrogen (specially nitric oxide NO); hydrocarbon (CH_4); ammonia and compounds of fluorine.

Secondary pollutants are produced by various reactions of primary pollutants. These are sulphuric acid, nitric acid, hydrofluoric acid, ozone and peroxy acetyl nitrate (PAN)

Q.4 What are the sources of CO_2 and CO?

Ans.

(a) Both of these gases are emitted due to volcanic eruption and decomposition of organic matter naturally.

(b) The major source for the emission of these gases is combustion of fossil fuels (coal, petroleum and natural gas). Fossil fuels burnt in combustion engine of any type of automobile, kiln of any industry, or open air fires emit CO_2 and CO.

(c) Forest fires and burning of wood also emit CO_2 and CO. Especially, when supply of oxygen is limited, emission of CO dominates.

Q.5 Why converters should be used in automobile exhausts?

Ans. Converters should be used in automobile exhaust so that they convert CO to CO_2 and oxides of nitrogen NO to N_2 before it enters in air.

Q6. Write importance of CO_2 to life on earth.

Ans. CO_2 is the 'life gas' for plants. CO_2 absorbs infrared radiations emitted by the Earth. Although CO_2 is negligible as compared to N_2 and O_2, yet its heat retaining capacity is tremendous. Without CO_2 life on earth would have been impossible.

Q7. Write occurrence of sulphur compounds in the atmosphere.

Ans. Naturally occurring sulphur containing compounds are emitted in the bacterial decay of organic matter, in volcanic gases and forest fires. But the concentration of sulphur containing compounds in the atmosphere because of natural sources is very small as compared to the concentration of those compounds emitted by fossil fuel combustion in automobiles and industrial units. About 80% of the total SO_2 is released by the combustion of coal and petroleum products.

Q.8 How SO_2 and SO_3 are formed? How these gases cause air pollution?

Ans. Fossil fuels contain Sulphur → Fossil fuels are burned to produce energy → The sulphur in the fuel forms oxides of sulphur. SO_2 and SO_3 → Oxides of sulphur escape into the air. They are air pollutants → Oxides of sulphur dissolve in water and form Acid Rain. That falls on the earth.

Q.9 What are the effects of SO_2 gas? Also writes its properties / characteristics.

Ans. It cause suffocation, irritation SO_2 forms sulphuric acid which damages buildings and vegetations. SO_2 is a colourless gas having irritating smell.

Q.10 How to control pollution because of sulphur?

Ans. To control pollution because of SO_2. It is necessary to remove sulphur from fossil fuels before they are burnt.

Q.11 How nitric oxide is produced in air?

Ans. naturally occurring oxides of nitrogen, mainly nitric oxide (NO), is produced by the electrical lightening in air.

Q12. How nitric oxide is produced by the combustion of fossil fuels?

Ans. Combustion of fossil fuels in internal combustion engine in thermal power stations and factories where huge amount of coal is burnt, NO is formed by the direct combination of nitrogen and oxygen.

$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$$

Q.13 How nitric oxide reacts with oxygen?

Ans. Nitric oxide quickly reacts with air to form nitrogen dioxide. NO is highly toxic gas.

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

Q.14 How NO and NO_2 are formed? How these gases causes air pollution.

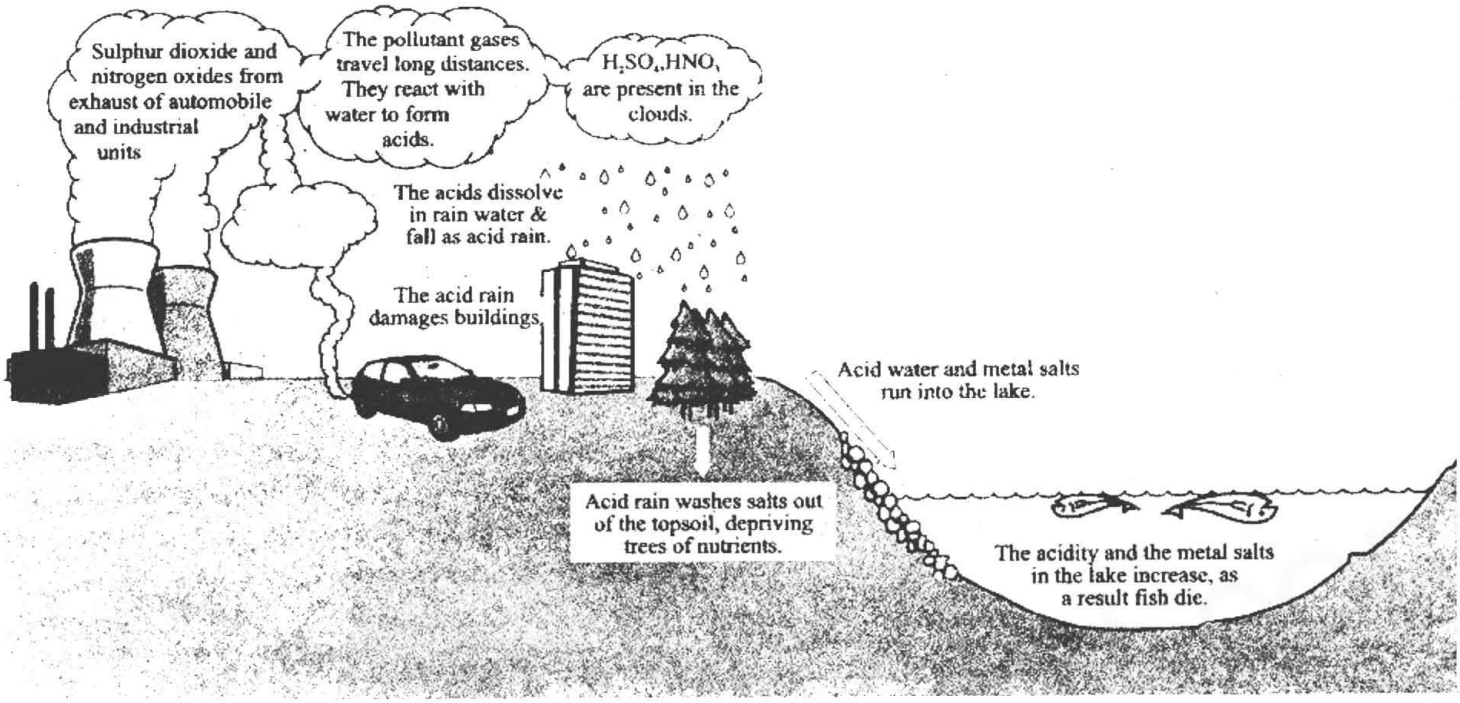
Ans. Nitrogen in the air is normally un-reactive → At high temperature it reacts with oxygen to form oxides of nitrogen. NO & NO_2 → These gases escape into the air. They are pollutants → Oxides of nitrogen dissolve in water and form Acid Rain. That falls on the earth.

Q.15 How the mixture of NO and NO_2 gases are represented? Write their effects.

Ans. Mixture of these gases represented as NO_x enter in the air through automobile exhaust and chimneys of thermal power station and factories. It irritates breathing passage. These oxide form nitric acid combining with water vapours in air. Nitric acid is a component of acid rain which damage soil, animals, plants and aquatic life.

Q.16 Sketch the labeled diagram showing the formation of acid rain and its effect

Ans:



Q.17 What is meant by ozone? How it is formed in atmosphere?

Ans. Ozone is an allotropic form of oxygen consisting of three oxygen atoms. It is formed in atmosphere by the association of an oxygen atom with an oxygen molecule in the mid of stratosphere.

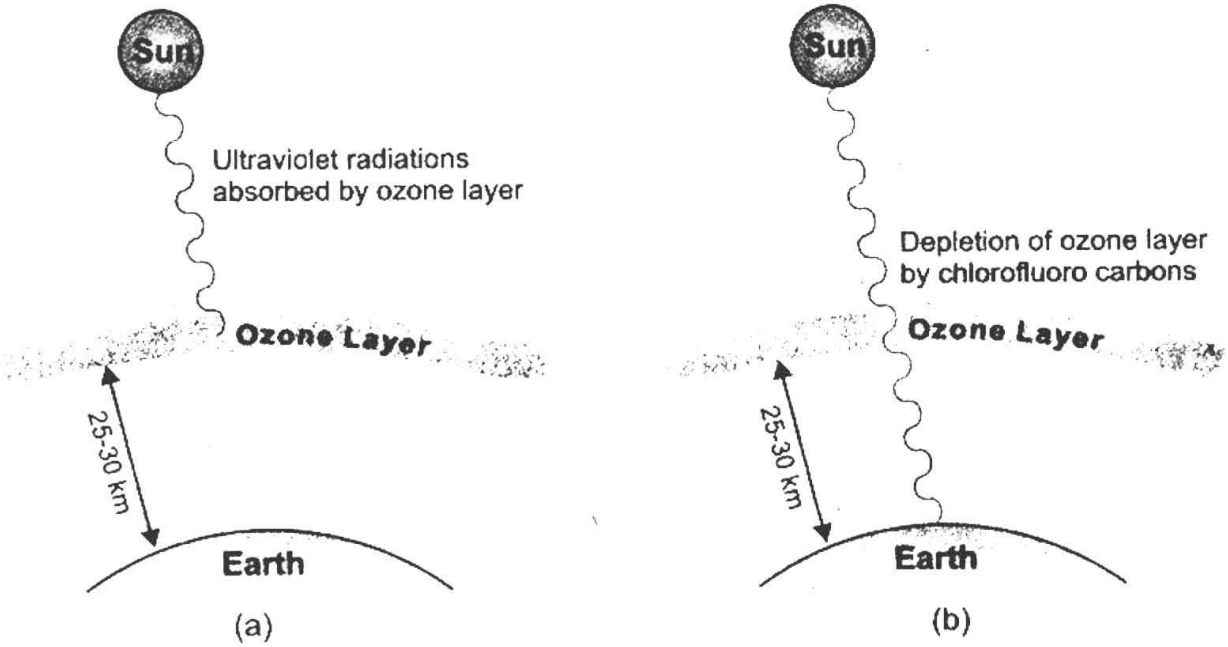
$$O_{(g)} + O_{2(g)} \longrightarrow O_{3(g)}$$

Q.18 What is meant by Ozone? Where ozone layers exist in atmosphere?

Ans. Ozone is an allotropic form of oxygen. It is represented by O_3. Ozone is present throughout the atmosphere. But its maximum concentration called ozone layer lies in stratosphere region about 25 to 30 km away from the Earth's surface.

Q.19 How ozone layer protects our earth?

Ans. Ozone layer surrounds the globe and protects Earth like a shield from harmful ultraviolet radiation of sunlight as shown in figure otherwise, ultraviolet radiations would cause skin cancer. Thus ozone layer is stratosphere is beneficial for life on Earth.



Q.20 How the concentration of ozone in stratosphere remains nearly constant?

Ans. Under normal condition ozone concentration in stratosphere remains nearly constant through a series of complex atmospheric reactions. Two reactions that maintain a balance in ozone concentration are as follows:

$$O_{2(g)} + O_{(g)} \longrightarrow O_{3(g)} \quad \text{(formation)}$$

$$O_{3(g)} + O_{(g)} \longrightarrow 2O_{2(g)} \quad \text{(decomposition)}$$

Q.21 What is meant by incineration?

Ans. Incineration is a waste treatment process that involves the burning of solid waste at high temperature between 650°C to 1100°C in incinerators.

Q.22 What is the function of incinerator?

Ans. Incinerators reduce the solid mass of the original waste by 80-85% and convert the waste materials into ash, flue gas and heat. Although, the volume of solid waste is reduced effectively by incineration, it produces highly poisonous gases and toxic ash.

Q23. Write composition of flue gas.

Ans. The flue gas includes dioxins, furans, sulphur dioxide, carbon dioxide, carbon monoxide, hydrochloric acid and a large amount of particulate matter.

Q.24 What is meant by filtration?

Ans. Filtration is separation of insoluble solid particles (sand, clay, dust or precipitates) from a liquid. It is carried out by filtering a mixture.

Q.25 What is the difference between pollutant and contaminants?

Ans. The pollutants are those substances which cause pollution. While contaminants are those substance that make something impure.

Q26. What is meant by air pollution? Write its effects.

Ans. The harmful substances present in air are called air pollutants. Even a beneficial substance beyond a specific concentration may be harmful. Air pollutants change the weather, badly affects the human health, damage the plants and destroy buildings.

Q.27 What do you mean by atmosphere?

Ans Our planet Earth has four natural systems; lithosphere, hydrosphere, atmosphere, and biosphere. So, atmosphere is the natural system of our planet Earth. It can be defined as Atmosphere is the envelope of different gases around the Earth. It extends continuously from the Earth's surface outwards without any boundary.

Q.28 What is difference between atmosphere and environment?

Ans.

Atmosphere	Environment
1. Atmosphere is the envelope of different gases around the Earth	1. Environment is the sum of all social, biological, physical and chemical factors which constitutes the surroundings of man.
2. It consists of four layers i.e., troposphere, stratosphere, mesosphere, thermosphere.	2. It consists of air, water, food and sunlight.

Q.29 Name the major constituents of atmosphere is maintained?

Ans. The major constituents of troposphere are as follows:

(a) Nitrogen (b) Oxygen

These two gases comprises 99% by volume of the Earth's atmosphere.

Q.30 How the temperature of atmosphere is maintained?

Ans. CO_2 and water vapours are present in atmosphere. Yet these are in low concentration but play an important role in maintaining temperature of atmosphere. Because both these gases allow visible light to pass through but absorb infrared radiations emitted by the Earth's surface. So, temperature of atmosphere is maintained.

Q.31 Where the ozone layer exists?

Ans. Ozone layer exist in mid stratosphere.

Q.32 Why the temperature of upper stratosphere is higher?

Ans. Because ozone in the upper layer absorbs high, energy ultraviolet radiations from the sun, it raises the temperature of stratosphere. That is the reason temperature of upper stratosphere is higher.

Q.33 What do you meant by an air pollutant?

Ans. The harmful substances present in air are called air pollutants.

For example: Carbon monoxide CO

Q.34 Name three primary air pollutants.

Ans. (i) Hydrocarbon (CH_4) (ii) Ammonia (NH_3) (iii) Oxides of nitrogen (NO_x)

Q.35 Identify as primary or secondary air pollutant SO_2, CH_4, HNO_3, NH_3, H_2SO_4, O_3

Ans.

Primary Pollutant	Secondary Pollutant
NH_3	HNO_3
CH_4	H_2SO_4
SO_2	Ozone

Q.36 Why CO_2 is called a greenhouse gas?

Ans. Carbon dioxide is called as a greenhouse gas because it forms a layer around the Earth like an envelope. It allows the heat rays of the sun to pass through it and reaches upto the Earth but does not allow the IR radiations to pass through. So, it acts like a glass and also called as a greenhouse gas.

Q.37 Why the flood risks are increasing.

Ans. CO is an air pollutant. It is a health hazard being highly poisonous gas. Being colorless and odourless, it presence cannot be noticed easily and readily. When inhaled, it binds with the hemoglobin most strongly than that of oxygen. Thus hindering the supply of oxygen in body. Exposure to higher concentration of CO causes headache and fatigue. If inhaled for a longer time it results in breathing difficulties and ultimately death. It is the reason burning is not allowed in closed places, it is advised to switch off coal or gas heaters, cooking range, etc., before going to sleep.

Q.38 How sulphur containing compounds are emitted naturally?

Ans. Naturally occurring sulphur containing compounds are emitted in the bacterial decay of organic matter, in volcanic gases any forest fires.

Q.39 How combustion of fossil fuels in internal combustion engine produces oxides of nitrogen.

Ans. Combustion of fossil fuels in internal combustion engines, in thermal power stations and factories where huge amount of coal is burnt, NO is formed by the direct combination of nitrogen and oxygen.

$$N_{2(g)} + O_2 \longrightarrow 2NO_{(g)}$$

Q.40 How acid rain is produced?

Ans. Acid rain means presence of excessive acids in rain water. This rain is produced when normal rain water dissolved oxides of sulphur and nitrogen in air. Rain water converts SO_2 into H_2SO_4 and NO to HNO_2 and HNO_3. These acids reduces the pH of rain water upto 4. Thus acid rain formed on dissolving acidic air pollutant such as SO_2 and NO_2 in rain water.

Q.41 Why acid rain damages buildings?

Ans. Acid rain attacks the calcium carbonate present in the marble and limestone of buildings and monuments. Thus, these buildings are getting dull and eroded day by day.

Q.42 How aquatic life is affected by acid rain?

Ans. Water Pollution: Acid rain on soil and rocks leaches heavy metals (Al, Hg, Pb, Cr, etc.) with, it and discharges these metals into rivers and lakes. This water is used by human beings for drinking purpose. These metals accumulate in human body to a toxic level. On the other hand, aquatic life present in lakes also suffers because of high concentration of these metals. Especially high concentration of aluminium metal clogs the fish gills. It causes suffocation and ultimately death of fish.

Q.43 Why plants are dying day by day? Comment.

Ans. Damages Leaves of Trees and Plants: Acid rain directly damages the leaves of trees and plants, thus limiting their growth. Depending upon the severity of the damage, plants growth can be hampered. Plants ability to bear cold or diseases reduce to get it die.

Q.44 Justify, ozone is beneficial for human beings.

Ans. Ozone is present throughout the atmosphere. But is maximum concentration called ozone layer lies in stratosphere region about 25 to 30 km away from the Earth's surface. This layer surrounds the globe and protects Earth like a shield from harmful ultraviolet radiations of sunlight. Otherwise ultraviolet radiations would cause skin cancer. Thus ozone layer in stratosphere is beneficial for life on the earth.

Q.45 Why ozone is depleting in atmosphere?

Ans. Cause of Depletion of Ozone Layer:

The ozone layer is being depleted through various chemical reactions, such as:

(a) The ozone molecule absorbs solar radiations and dissociates readily, i.e., self-dissociation of ozone takes place.

(b) However, chlorofluorocarbons (CFCs) (under as refrigerants in air conditioners and refrigerators) are major cause of depletion of ozone layer. These compounds leak in one way or other escape and diffuse to stratosphere. These ultraviolet radiations break the C-Cl bond in $CFCl_3$ and generates chlorine free radicals as;

$$CFCl_3 \xrightarrow{UV} CFCl_2 + Cl^{\cdot}$$

These free radicals are very reactive. They react with ozone to form oxygen as

$$O_{3(g)} + Cl \longrightarrow O_{2(g)} + OCl^{\bullet}$$

$$OCl^{\cdot} \longrightarrow O^{\cdot} + Cl^{\bullet}$$

$$O^{\cdot} + O^{\cdot} \longrightarrow O_2$$

A single chlorine free radical released by the decomposition of CFCs is capable of destroying upto many lacs of ozone molecules. The region in which ozone layer depletes is called ozone hole.

Q.46 What do you mean by ozone hole?

Ans. The region in which ozone layer depletes is called ozone hole. A single chlorine free radical released by the decomposition of CFCs is capable of destroying upto many lacs of ozone molecules.

Q.47 Where the ozone layer is found?

Ans. Ozone layer lies in stratosphere region and formed by the associates of an oxygen atom with an oxygen molecule in the mid of stratosphere.

$$O_{(g)} + O_{2(g)} \longrightarrow O_{3(g)}$$

Multiple Choice Questions

1. About 99% atmosphere's mass lies within:

(a) 30 kilometre
(b) 35 kilometre
(c) 15 kilometre
(d) 11 kilometre

2. Depending upon temperature variation, atmosphere is divided into how many regions?

(a) one (b) two
(c) three (d) four

3. Just above the Earth's surface is

(a) mesosphere (b) stratosphere
(c) thermosphere (d) troposphere

4. A group of gases that maintains temperature of atmosphere is

(a) carbon dioxide and water vapours
(b) nitrogen and carbon dioxide
(c) thermosphere
(d) troposphere

5. The Earth's atmosphere is getting hotter because of

(a) increasing concentration of CO
(b) increasing concentration of CO_2
(c) increasing concentration of O_3
(d) increasing concentration of SO_2

6. Which one of the followings is not a greenhouse Effect?

(a) increasing atmosphere temperature
(b) increasing food chains
(c) increasing flood risks
(d) increasing sea-level

7. Normally rain water is weakly acidic because of

(a) SO_3 gas (b) CO_2 gas
(c) SO_2 gas (d) NO_2 gas

8. Buildings are being damaged by acid rain because it attacks

(a) calcium sulphate
(b) calcium nitrate
(c) calcium carbonate
(d) calcium oxalate

9. Acid rain affects the aquatic life by clogging fish gills because of:

(a) lead metal
(b) chromium metal
(c) mercury metal
(d) aluminium metal

10. Ozone is beneficial for us as it

(a) absorbs infrared radiation
(b) absorbs ultraviolet radiations
(c) absorbs chlorofluorocarbons
(d) absorbs air pollutant

11. Which one of the following is not an air pollutants?

(a) nitrogen
(b) carbon monoxide
(c) nitrogen dioxide
(d) ozone

12. Iron and steel structure are damaged by

(a) carbon monoxide
(b) sulphur dioxide
(c) methane
(d) carbon dioxide

13. Infrared radiations emitted by the Earth are absorbed by

(a) CO_2 and H_2O
(b) N_2 and O_2
(c) CO_2 and N_2
(d) O_2 and CO_2

14. Global warming causes rising of the sea level. The cause of global warming is

(a) CO_2 gas (b) SO_2 gas
(c) NO_x gases (d) O_3 gases

15. Which gas protects the Earth's surface from ultraviolet radiations?

(a) CO_2 (b) CO
(c) N_2 (d) O_3

16. Effects of ozone depletion are following except the one

(a) increases infectious diseases
(b) increases crops production
(c) can cause skin cancer
(d) can cause climatic changes

17. Which one of these pollutants are not found in car exhaust fumes?

(a) CO (b) O_3

(c) NO_2 (d) SO_2

18. The process by which atmospheric nitrogen is turned into nitrates in the soil is called

(a) nitration (b) fixing

(c) oxidation (d) reduction

19. Global warming is because of

(a) absorption of infrared radiation emitted by earth surface

(b) absorption of infrared radiations coming from sun.

(c) absorption of ultraviolet coming from the sun.

(d) emission of ultraviolet radiation from the earth's surface.

20. Carbon monoxide is harmful to us because

(a) it paralyses the lungs

(b) it damages lungs tissues

(c) it reduces oxygen carrying ability of haemoglobin

(d) it makes the blood coagulate.

21. Earth has natural systems

(a) One (b) two

(c) Three (d) Four

22. Atmosphere has regions

(a) One (b) two

(c) Three (d) four

23. The envelope of different gases around the earth is called

(a) Atmosphere (b) brosphere

(c) Lithosphere (d) hydrosphere

24. The percentage by volume of nitrogen in dry gas is

(a) 78.09% (b) 20.94%

(c) 0.93% (d) 0.03%

25. the percentage of sunlight absorbed by atmospheric gases is

(a) 2% (b) 10%

(c) 18% (d) 25%

26. Atmospheric region found between 50-85 km from the earth is

(a) Thermosphere (b) Stratosphere

(c) Mesosphere (d) Thermosphere

27. Mesosphere has a temperature range

(a) 17^0C-58^0C (b) 58^0C-2^0C

(c) 2^0C-93^0C (d) -93^0C

28. Which gas is the major constituent of troposphere?

(a) Nitrogen (b) Oxygen

(c) Hydrogen (d) both a and b

29. Which gas is responsible in warming the atmosphere?

(a) Nitrogen (b) hydrogen

(c) Helium (d) Fluorine

30. At which region all weather occurs?

(a) Troposphere (b) Stratosphere

(c) Mesosphere (d) thermosphere

31. Almost all air crafts fly in which region?

(a) Troposphere (b) stratosphere

(c) Mesosphere (d) thermosphere

32. Major portion of ozone layer is found in

(a) troposphere (b) Stratosphere

(c) Mesosphere (d) thermosphere

33. The region of ozone decomposition in stratosphere is

(a) 20km (b) 30 km

(c) 40 km (d) 50 km

34. The recombination of O and O_2 in mid stratosphere is an

(a) Exotherimic reaction
(b) Endothemic reaction
(c) heat absorbing process
(d) None of these

35. The percentage of SO_2 released by the combustion of coal and petroleum product

(a) 40% (b) 60%
(c) 70% (d) 80%

36. Which is not a character of SO_2

(a) It is a colourless gas
(b) It has irritating smell
(c) It causes suffocation
(d) It do not form sulphuric acid

37. Which gas is produce by the electrical lightening of air

(a) NO (b) SO_2
(c) SO_3 (d) CO_2

38. Which of the following can be used as a fuel?

(a) Methanol (b) Ethanol
(c) bio-diesel (d) all of them

39. The pH of water containing CO_2 is

(a) 4-6 (b) 5.6-6
(c) 6-7 (d) 7-8

40. The PH of acid rain is

(a) 2 (b) 3
(c) 4 (d) 5

41. High concentration of which metal clogs the fish gills.

(a) Zinc (b) Aluminium
(c) Sodium (d) copper

42. Ozone is an allotropic form of

(a) Carbon (b) oxygen
(c) Sulphur (d) Phosphorous

43. Ultraviolet radiations can causes

(a) Hepatitis (b) Asthma
(c) Skin cancer
(d) Night Blindness

44. Which gas is in involved in ozone depletion?

(a) nitrogen (b) CFC's
(c) chlorine (d) all of them

45. The region in which ozone layer depletes is called

(a) Ozone hole (b) black hole
(c) both of them (d) None of them

46. Ozone depletion was first noticed is

(a) 1970 s (b) 1980 s
(c) 1990 s (d) 1960 s

47. Which is not an air pollutant?

(a) CO_2 (b) SO_2
(c) CO (d) NH_3

48. The gas used by plants to perform photosynthesis.

(a) O_2 (b) CO_2
(c) N_2 (d) CO

49. The gas used by animals to perform respiration

(a) O_2 (b) N_2
(c) SO_2 (d) Cl_2

50. Which is not a poisonous gas?

(a) Ozone (b) Chlorine
(c) Carbon dioxide (d) all of them

51. Which gas acts as a glass wall of a green house?

(a) Oxygen (b) Carbon dioxides
(c) Sulphur dioxide (d) hydrogen

52. By the increase in the concentration of CO_2 in air,

(a) decrease in heat energy
(b) increase in heat energy

(c) heat energy remains same
(d) None of them

53. The green house effect is proportional to the amount of which gas in air?

(a) CO_2 (b) O_2
(c) N_2 (d) All of them

54. Which is the major effect of global warming?

(a) Increase in temperature
(b) Rise in sea level
(c) Melting of glaciers
(d) All of them

55. Higher concentration of CO causes

(a) fatigue (b) headache
(c) Both of them (d) None of them

56. Catalytic converters convert

(a) CO to CO_2 (b) N_2 to NO
(c) CO_2 to CO (d) N_2 to NO_2

57. Which gas is also known as life gas for plants

(a) CO (b) O_2
(c) CO_2 (d) NO_2

58. In the bacterial decay, the compounds of which element are emitted

(a) Sulphur (b) Carbon
(c) Nitrogen (d) All of them

59. Ozone layer is not found in

(a) Upper Stratosphere
(b) Mid Stratosphere
(c) Lower Stratosphere
(d) All of them

60. A pollutant is a waste material that pollutes

(a) Air (b) Water
(c) Soil (d) All of them

61. Which factor determines the severity of a pollutant?

(a) Chemical nature (b) concentration
(c) Persistence (d) All of them

62. Which pollutant is responsible for changing weather?

(a) Air pollutant (b) Water pollutant
(c) Soil pollutant (d) all of them

63. Ozone has a smell

(a) bitter (b) Rotten egg
(c) Sweat (d) None of them

64. Which of the following is a poisonous gas

(a) oxygen (b) Ozone
(c) Nitrogen (d) Carbon dioxide

65. The waste products driven out because of the combustion of fossil fuels

(a) Primary pollutant
(b) Secondary pollutant
(c) Tertiary Pollutant
(d) None of them

66. The smell of photocopies machine is due to the presence of

(a) Chlorine gas (b) neon gas
(c) helium gas (d) ozone gas

67. PAN strands for

(a) Poly aniline nitrate
(b) peroxy acetyl nitrate
(c) poly acetyl nitrite
(d) Peroxy acetyl nitrite

68. Which of the following is a secondary pollutant

(a) CO_2 (b) CO
(c) SO_3 (d) HF

69. 99% of atmosphere consists of

(a) N_2 and H_2
(b) N_2 and O_2

(c) N_2 and CO_2

(d) O_2 and CO_2

70. Which gas is emitted due to volcanic eruption?

(a) CO_2 (b) SO_2

(c) NO_2 (d) H_2

71. Fossil fuel means

(a) Coal (b) Petroleum

(c) Natural gas (d) All of them

72. Forest fires and burning of wood emit

(a) CO_2 (b) NO_2

(c) SO_2 (d) Cl_2

73. The range of temperature in burning solid waste burning in incinerators is

(a) 650^0-1000^0C (b) 650^0C to 1100^0C

(c) 1000^0-2000^0C (d) 5000C to 1000^0C

74. Incinerator reduces solid waste into

(a) Ash (b) flue gas

(c) heat (d) all of them

75. Which is not a part of flue gas?

(a) Furans (b) Dioxins

(c) HCl (d) H_2SO_4

76. Thermosphere lies beyond

(a) Stratosphere (b) Troposphere

(c) Mesosphere (d) Biosphere

77. The solid particle deposit on the filter paper during filtration is called

(a) Precipitates (b) Residue

(c) Crystals (d) All of them

Answer Key

1	a	2	d	3	d	4	a	5	b
6	b	7	b	8	c	9	d	10	b
11	d	12	b	13	d	14	a	15	d
16	b	17	b	18	a	19	c	20	c
21	d	22	d	23	a	24	a	25	c
26	c	27	c	28	d	29	a	30	a
31	a	32	b	33	c	34	a	35	d
36	d	37	a	38	d	39	b	40	c
41	b	42	b	43	c	44	b	45	a
46	b	47	a	48	b	49	a	50	c
51	b	52	b	53	a	54	d	55	c
56	a	57	c	58	a	59	c	60	d
61	d	62	a	63	a	64	b	65	a
66	d	67	b	68	d	69	b	70	a
71	d	72	a	73	b	74	d	75	d
76	c	77	b						

Unit 15

Environmental Chemistry II Water

Long Answer Questions

Q.1 Write the physical properties of water.

Ans. Physical properties of water:

Water is composed of two elements: oxygen and hydrogen. One atom of oxygen combines with two atoms of hydrogen to form one molecule of water. Pure water is a clear, colourless, odourless and tasteless liquid with following properties:

(i) It is neutral to litmus.

(ii) Its freezing point is 0^0C and boiling point is 100 ^{0}C at sea level.

(iii) Its maximum density is 1 gcm^{-3} at 40 ^{O}C.

(iv) It is excellent solvent for ionic as well as molecular compounds.

(v) It has unusually high that of heat capacity about 4.2 $Jg^{-1}K^{-1}$, which is about six times greater than that of rocks. This specific property of water is responsible for keeping the Earth's temperature within limits. Otherwise, day time temperature would have been too high to bear and night time temperature would have been too low to freeze everything.

(vi) It has high surface tension. This unique property of water is responsible for its high capillary action. Capillary action is the process by which water rises up from the roots of plants to leaves. This process is vital for the survival of the land plants.

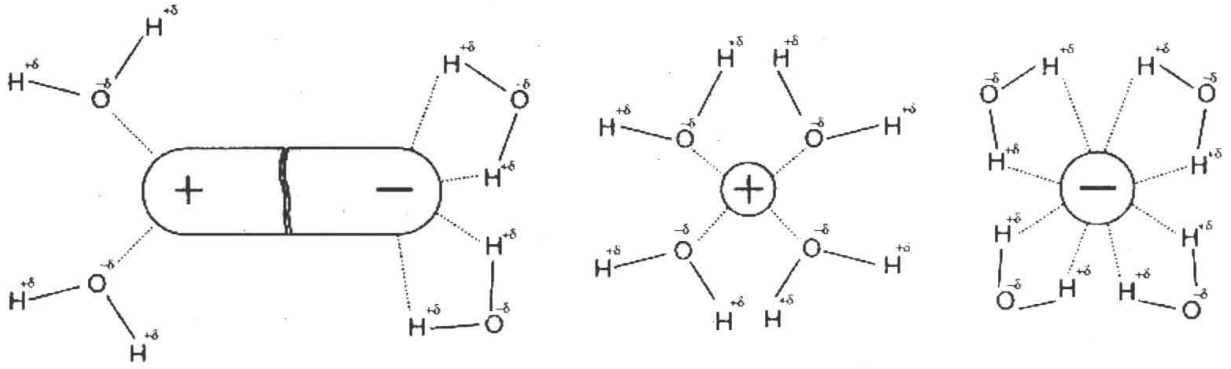
Q.2 How polarity of water molecule plays its role to dissolve the substance?

Ans. Polar nature of water

Water molecule has a polar structure, i.e., one end of the molecule is partially positive while the other end is partially negative because of electronegativity difference between oxygen and hydrogen atoms.

All other polar substances are soluble in water, because the positive $H^{\delta-}$ end of the substance is attracted by the negative end ($O^{\delta-}$) of the water and negative end of the substance is attracted by the positive end ($H^{\delta+}$) of the water. The electrostatic attraction among the ions are overcome by the ion-dipole forces of attraction between ion and water

molecules. In this way positive and negative ions of the compounds are pulled apart as shown in figure 15.1. Ultimately, these oppositely charged ions are most of the salts like NaCl, KCl, Na_2SO_4, etc., are soluble in water.



On the other hand, many covalent substances like benzene, ether, octane, etc., which do not have polar ends or bonds are not attracted by water molecules. Therefore, non-polar compounds do not dissolve in water.

Q.3 Explain the water pollution because of industrial waste.

Ans. Industrial units are installed to produce the desired substances (chemicals, cloth, leather goods, paper, plastic items, petrochemicals and rubber items) on commercial scale to meet the needs of the society. But unfortunately all the industrial units discharge their wastes (chemicals and solid materials) either to open ground or to water channels. This is called industrial effluent. The industrial effluent may be highly toxic organic chemicals, inorganic salts, heavy metals, mineral acids, oil and grease, etc. On the other hand, water used as cleaning agent in industries is directly discharged out. This water contains all kinds of toxic chemicals and detergents.

When these effluents or used water enter lakes, streams, rivers or oceans, they either get dissolved or float suspended in water. Even they get deposited on the bed. This results in the pollution of water, i.e.,

(i) They deteriorate the quality of water.

(ii) They reduce the quantity of dissolved oxygen, ultimately affects aquatic life and ecosystem.

(iii) They can also seep down and affect the ground water deposits. They contaminate the water deposits. When this water is used by human beings it causes serious diseases like cancer and gastro. This polluted water damage soil, plants and animals.

(iv) Heavy metals like cadmium, lead and mercury are toxic and health hazards for human beings. Acute cadmium poisoning causes high blood pressure, kidney damage and destruction of red blood cells. Acute lead poisoning causes

dysfunction of kidney, liver, brain, central nervous system and reproduction system. Mercury poisoning causes neurological damage.

Q.4 Justify the statement house hold water is the reason of water pollution.

Ans. Use of detergents is increasing day by day for cleaning purposes in houses and industries. It is because, It is because, detergents have strong cleaning action than that of soap even in hard water. They can cork even in acidic solutions. But they have a major disadvantage over the soaps, as some of the detergents are non-biodegradable (cannot be decomposed by micro-organisms like bacteria). When household water containing these detergents is discharged in streams, ponds, lakes and rivers, it causes water pollution.

The detergent remains in the water for a long time and makes the water unfit for aquatic life. The phosphate salts present in detergents cause rapid growth of algae in water bodies, which floats over the surface of water. These plants ultimately die and decay. Decaying plants being bio-degradable consume O_2 present in water. Thus, depletion of O_2 results in death of aquatic life.

Domestic sewage contains a wide variety of dissolved and suspended impurities. They include food and vegetable waste, garbage, cans, bottles, chemical soaps, washing powder, etc. It also contains disease causing microbes. All these substances add to water pollution.

Q.5 Explain agricultural effluents are fatal for aquatic life.

Ans. Water pollution due to agricultural waste is because of use of fertilizers and pesticides. Fertilizers are used to make up the deficiency of nitrogen, phosphorus, etc., of the soil because of intensive cultivation of crops in the recent years.

On the other hand, pesticides are used either directly to kill or control the growth of pests. Pests may be weeds, herbs, insects, fungi, viruses, etc. They all damage crops and transmit diseases both to human beings and animals.

Run-off from the agricultural land (where fertilizer and pesticides have been used) enters into ponds, streams or rivers. This water contains nitrate NO_3^- and phosphate PO_4^{3-} salts. These substances results in a rapid growth of algae, floating over the surface of water. They prevent the sunlight and air (oxygen) to reach up to aquatic life. When algae dies, and decompose bacteria consume oxygen of the water for decomposition. As a result oxygen depletes in the water. Aquatic animals feel suffocation and ultimately die due to insufficient supply of oxygen.

Q.6 What are waterborne infectious diseases? Explain any four waterborne diseases

Ans. Diseases that spread because of drinking polluted water or eating food prepared with polluted water are called water borne diseases. Water pollution may be due to toxins or

microorganisms. Toxins are arsenic, mercury, arsenic, lead and many organic chemicals. Microorganisms are viruses, bacteria, protozoa and worms.

Lack of proper sanitation facilities is the main cause of rapidly spreading waterborne diseases. A few common diseases are mentioned here:

Diarrheal disease

Intestinal diseases, such as cholera, that may cause dangerous dehydration. Diarrhea may be caused by viruses, bacteria, or parasites.

Dysentery

Dysentery is an intestinal disease which is typically caused by certain bacteria or parasites. It is characterized by severe diarrhea that may be accompanied by blood or mucous.

Cholera

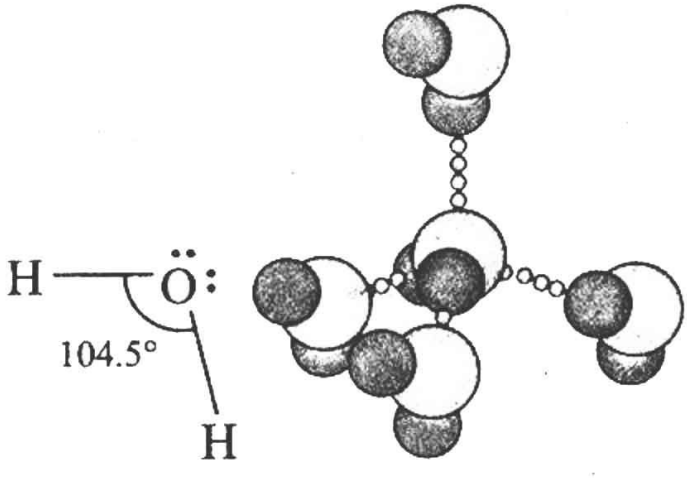
Cholera is an acute infection caused by the bacteria Vibrios cholera, which may be found in water contaminated by human feaces. Cholera causes severe diarrhea and can be fatal.

Cryptosporidium

Waterborne micro-organism (protozoa) that causes gastrointestinal illness (cryptosporidiosis) including diarrhea and vomiting. These tiny pathogens are found in surface water sources like reservoirs, lakes, and rivers.

Q.7 Explain hydrogen bonding in water molecule?

Ans. Water molecule is composed of oxygen and hydrogen atoms. Because of two O-H bonds and two lone pairs, one H2O molecule can form hydrogen bonding with four other H_2O molecules, which are arranged like tetrahedral around the H_2O molecule as shown in Figure. This unique behaviour of water enables it to dissolve many polar non-ionic compounds having hydroxyl group (-OH), like alcohols, organic acids, glucose, sugar, etc. by forming hydrogen bonds with them.



Hydrogen bonding of water molecule

Q.8 Write disadvantages of hard water?

Ans. Following are some of the disadvantages of hard water:

i. Hard water consumes large amount of soap in washing purposes.

ii. Drinking hard water causes stomach disorders.

iii. Hard water is unfit for use in steam engines, boilers and turbines because insoluble calcium and magnesium salts are deposited inside. Which is called scales. They are bad conductors of heat and hence more fuel is used. Insoluble calcium and magnesium sulphates not only reduce the efficiency of the engine but also cause the boiler to burst.

Q.9 How hardness in water is caused? Explain

Ans. The rain water while coming down absorbs carbon dioxide from the atmosphere. The water mixed with carbon dioxide, when passes through the beds of the soil, converts insoluble carbonates of calcium and magnesium into soluble bicarbonates. It may also dissolve chlorides and sulphates of calcium and magnesium.

These salts make the water hard.

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

$$MgCO_{3(s)} + CO_{2(g)} + H_2O_{(l)} \longrightarrow Mg(HCO_3)_{2(aq)}$$

Thus, rain water dissolves many salts of divalent cations like Mg^{2+} , Ca^{2+}, and anions like Cl^- , SO_4^{2-} , HCO_3^- and CO_3^{2-} for example, gypsum ($CaSO_4.2H_2O$) and limestone ($CaCO_3$). These salts make the water hard.

Gypsum is sparingly soluble in water, while limestone is insoluble in water. However, in the presence of carbon dioxide small quantity of limestone is soluble in water according to the above chemical reaction.

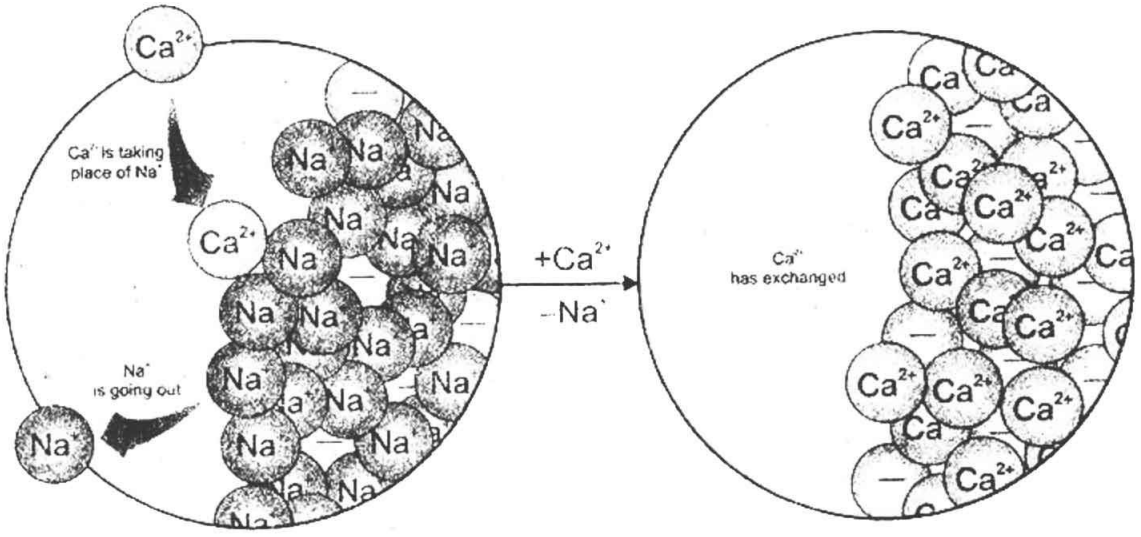
Q.10 How permanent hardness is removed by using sodium zeolite?

Ans. Using sodium Zeolite (an ion Exchanger) Sodium zeolite is a naturally occurring resin of sodium aluminium silicate $NaAl(SiO_3)_2$, which can also be prepared artificially . It is used for softening of water at domestic as well as on industrial scale. When water is passed through resin sodium ions of the resin are exchanged with the unwanted calcium and magnesium ions of the hard water as shown in figure

$$Na_2 \text{ zeolite} + CaSO_{4(aq)} \longrightarrow Ca \text{ zeolite} + Na_2SO_{4(aq)}$$

When resin is fully used up it can be regenerated by flushing it with concentrated solution of NaCl. The reverse process take place because of high concentration of sodium ions.

$$Ca \text{ zeolite} + 2NaCl \longrightarrow Na_2 \text{ zeolite} + CaCl_2$$

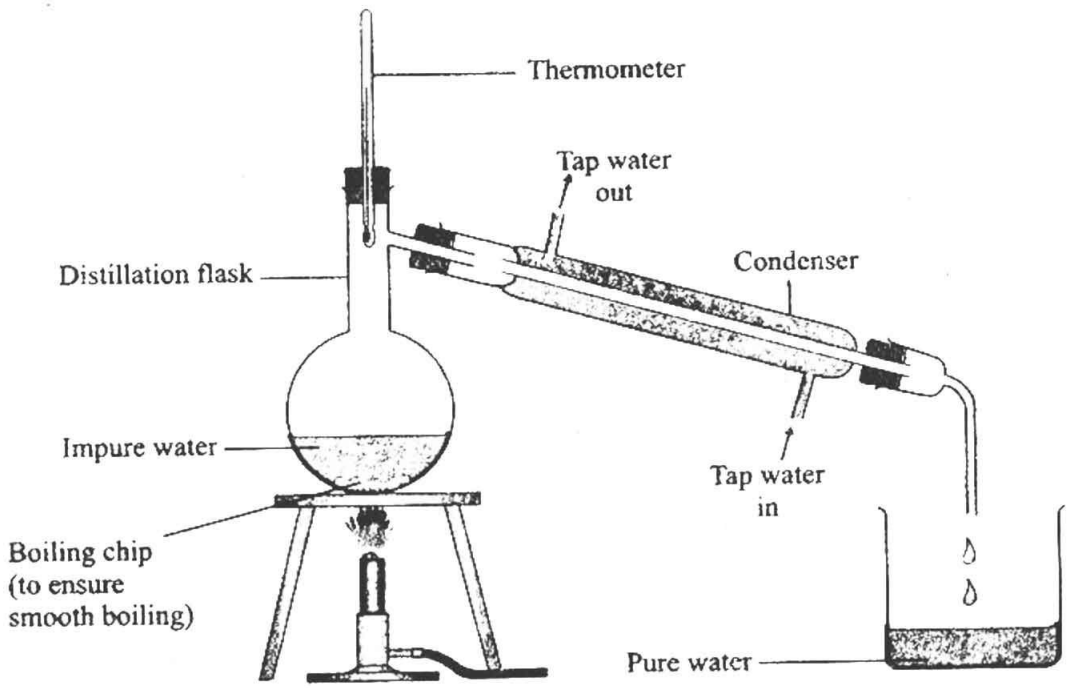


Ion exchange for removal of hard water ions

Q.12 How impure water is purified by distillation process?

Ans. Impure waster can be purified by simple distillation apparatus as shown in figure. Distillation process involves boiling of a liquid and then condensing the vapours.

Impure water in taken in a distillation flask. It is boiled. Water vapours rise and enter the condenser. The vapours condense while passing through condenser. Thus, they are changed back into pure water, which is called distillate (distilled water). The distillate is collected in a beaker.



Q.13 What are the effects of water pollution explain?

Ans. Following are some of the effects of water pollution:

i. It is hazardous to human health. Drinking polluted water can cause cholera, typhoid and diarrhea.

ii. The use of polluted water is not only devastating for people but also for animals and birds.

iii. It causes It cause rapid growth of algae. Death and decomposition of algae cause deficiency of oxygen in water that affects other organism living in water.

iv. It is damaging aquatic life, thus breaking a link in food chain.

v. It reduces the aesthetic quality of lakes and rivers.

vi. It is unfit for cleaning or washing purposes.

Q.14 How waterborne diseases can be prevented?

Ans. Waterborne diseases can be prevented by taking the following measures:

i. Provision of safe water: Drinking water must be properly treated and purified.

ii. Disposal of sewage: There must be adequate sanitary disposal of sewage. Any type of waste must not be thrown or discharged directly in water supplies or reservoirs.

iii. Control of toxic chemicals: Chemical contamination can cause acute illness, but often toxic contaminants are slow poisons and carcinogens. There must be a strict control over the use of pesticides and other chemicals.

Q.15 Explain the chemistry of swimming pool cleanliness?

Ans. Swimming pools are cleaned by chlorination process. It is the addition of chlorine solution in swimming pools. Chlorine kills bacteria and other micro-organisms. Cl_2 itself does not kill rather it dissociate in water to form hypoclorous acid (HOCl) and hydrochloric acid.

$$Cl_2 + H_2O_{(l)} \longrightarrow HOCl_{(aq)} + H^+_{(aq)} + Cl^-_{(aq)}$$

HOCl further ionizes to produce hypochlorite and proton

$$HOCl_{(aq)} \longrightarrow H^+_{(aq)} + OCl_{(aq)}$$

Both the products HOCl and OCl kill bacteria and micro-organisms.

Short Answer Questions

Q.1 Why water is considered to be universal solvent?

Ans. Water is the universal solvent because it can dissolve almost all the minerals. Its ability to dissolve substances is because of two unique properties of water.

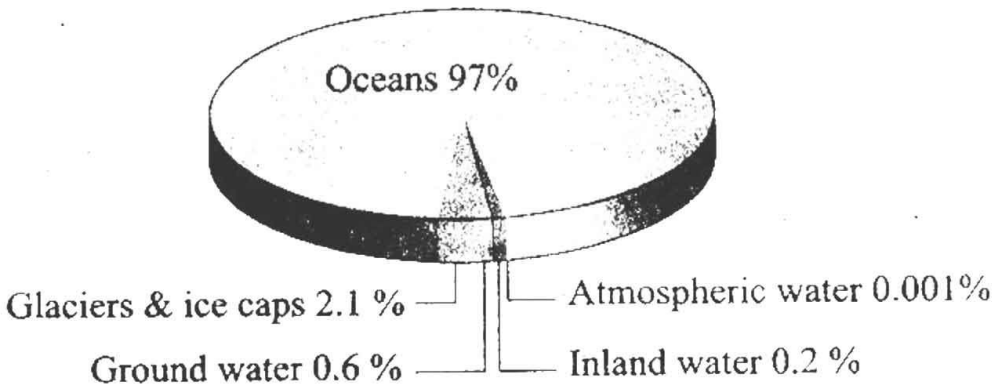
(i) Polarity of water molecule.

(ii) Exceptional hydrogen bonding ability.

Q.2 Write occurrence of water?

Ans. The oceans contain about97% of world water. The rest of the water is in the form of glaciers, ice caps, ground water and inland water (river, lakes, and steams), It is also present

in atmosphere in the form of water vapours.



Distribution of water

Q.3 Why sea water is unfit for drinking purpose?

Ans. Sea water is unfit for drinking and agricultural purposes due to high percentage of dissolved salts. Only 20.2% of the total water on the Earth is potable, i.e. fit for drinking purposes.

Q.4 What happen if you add lump of cesium to water?

Ans. If you add a lump of cesium to water in a glass trough, the reaction is so vigorous that the trough will shatter into small pieces.

Q.5 How fluorine is beneficial for life?

Ans. In some parts of the world, the water supply contains small amounts of fluorine compounds. It was found that, in these areas, people did not suffer much from tooth decay. This is because compounds of fluorine protect teeth from decay. This is way many tooth pastes contain fluorine compounds.

Q.6 How hard water hampers the cleanings action of soap?

Ans. Soap is the sodium salt of a long chain carboxylic acid (fatty acid).

Hard water contains salts of magnesium and calcium. These ions react with the soap molecule to form an insoluble precipitate of calcium and magnesium salts of fatty acids called scum. As a result, a large amount of soap is wasted in scum formation. Thus, it reduces the efficiency of soap.

Q.7 What is meant by water pollution?

Ans. Water pollution is a contamination of water bodies (e.g. lakes, rivers, oceans and ground water). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.

Q.8 What is the difference between soft and hard water?

Ans. Soft water: Soft water is that produces good lather with soap.

Hard water: Hard water is that which does not produce lather with soap.

Q.9 What are the types of hardness in water?

Ans.

i. Temporary hardness is because of presence of bicarbonates of calcium and magnesium.

ii. Permanent hardness is because of presence of sulphates and chlorides of calcium and magnesium.

Q.10 How temporary hardness is removed by boiling method?

Ans. Temporary hardness of water is easily removed by boiling water. On boiling calcium bicarbonate $Ca(HCO_3)_2$ decomposes to produce insoluble calcium carbonate, which precipitates out of the solution.

$$Ca(HCO_3)_{2(aq)} \xrightarrow{\Delta} CaCO_{3(s)} + H_2O + CO_{2(g)}$$

Q.11 How temporary hardness is removed by Clark's method?

A chemical method to remove temporary hardness is by the addition of slaked lime $Ca(OH)_2$. A calculated amount of lime water is added to temporary hard water.

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

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

Thus once the magnesium and calcium ions precipitate out water becomes soft.

Q.12 What is hepatitis?

Ans. It is liver inflammation commonly caused by one of five viruses called hepatitis A,B,C,D and E. Hepatitis A and E can be transmitted by contaminated water.

Q.13 What is the importance of water in our daily life?

Ans. Its importance is because of two reasons. Firstly, it is an essential and major component of each and every living cell. For example, human body consists of about 70% water. Secondly, it provides an environment for animals, and plants that live in water. So, all living organisms owe their life because of water.

Q.14 Write characteristics of pure water?

Ans. Good quality water is colourless, odourless and tasteless. Hardness of water can be checked by washing. Soft water produces lather with water. Pure water has least conductivity.

Q.15 What are the industrial effluents of water pollution?

Ans. Industrial effluents are one of the main causes of water pollution. It includes high toxic organic chemicals, inorganic salts, heavy metals, mineral acids, oil and greases, etc.

Q.16 What is meant by water borne diseases? How they are controlled?

Ans. Waterborne diseases are those diseases that spread because of drinking polluted water. These diseases spread because of lack of proper sanitation arrangements. These diseases can be prevented by using safe water, properly disposing sewage and controlled use of toxic chemicals.

Q.17 What is the effect of detergents on scarcity of oxygen?

Ans. Household water in the sewage from toilets, baths, kitchens, etc. consists of detergents used for cleaning purposes. Detergent being non-biodegradable causes rapid growth of aquatic plants. When these plants die and decay, they consume O_2 present in the water. Thus, aquatic life is badly affected because of scarcity of O_2.

Q.18 Write a short note on agricultural effluents?

Ans. Agricultural effluents consist of fertilizers and pesticides. These substances provide nitrate and phosphate ions for rapid growth of aquatic plants. When these plants die and decay, their decomposition process consumes O_2 of water. Thus, depletion of O_2 causes damage to the aquatic life.

Q.19 What is meant by fluorosis?

Ans. Fluorosis is a disease caused by the consumption of excess fluoride. Fluorosis can cause bones and teeth damage.

Q.20 Give composition of water molecule.

Ans. Water is composed of two elements: oxygen and hydrogen. One atom of oxygen combines with two atoms of hydrogen to form one molecule of water.

Q.21 What is hepatitis?

Ans. It is liver inflammation commonly caused by one of five viruses called hepatitis A, B,

C, D, and E, Hepatitis A and E can be transmitted by contaminated water.

Q.22 Write the role of hookworm in causing waterborne disease.

Ans. Hookworm is a parasitic worm that infects the small intestine. Severe cases can result in anemia and stunted growth in children. Hookworm larvae enter the body through the skin, often via the feet. Spread by poor sanitary conditions, hookworms infect about one billion people worldwide per annum.

Q.23 How Jaundice is caused?

Ans. Jaundice is caused by an excess of bile pigments in the blood. Liver ceases to function and eyes turn yellow. Patient feels weakness and fatigue.

Q.24 How typhoid is caused?

Ans. A dangerous bacterial disease often spread by contaminated water or by food prepared with contaminated water.

Q.25 What is meant by water softening?

Ans. The removal of Mg^{2+} and Ca^{2+} ions which are responsible for the hardness is called water softening.

Q.26 What is Capillary action?

Ans. Capillary action is the process by which water rises up from the roots of plants to leaves.

This process is vital for survival of land plants.

Q.27 Point out two properties of water that makes it an excellent solvent.

Ans. The ability of water to dissolve substances is because of two unique properties which are given below.

(1) Polarity of water molecule.

(2) Exceptional hydrogen bonding ability.

Q.28 Why the water molecule is polar?

Ans. Polar nature of Water: Water molecule has a polar structure i.e., one end of the molecule is partially positive while the other end is partially negative because of electronegativity difference between oxygen and hydrogen atoms.

Q.29 Explain why non-polar gases are soluble in water?

Ans. Water can even dissolve non-polar (un-ionizable) gases like oxygen, hydrogen and nitrogen etc. through dipole-induced dipole forces.

Q.30 Which salts are responsible for hardness of water?

Ans. Rain water dissolves many salts of divalent cations like Mg^{+2}, Ca^{+2}, and anions like Cl^{-1}, SO_4^{-2}, HCO_3^- and CO_3^{-2}. For example, gypsum ($CaSO_4.2H_2O$) and lime stone ($CaCO_3$). These salts make the water hard.

Q.31 What is the principle of removing permanent harness of water?

Ans. The permanent hardness can only be removed by using chemicals calcium (Ca^{+2}) and magnesium (Mg^{+2}) are removed as "Insoluble salts" by adding washing soda (Na_2CO_3) or sodium zeolite.

Q.32 How addition of Na_2CO_3 removes permanent hardness of water?

Ans. The addition of washing soda removes the calcium and magnesium ions as the insoluble calcium and magnesium carbonate respectively.

$$CaSO_4 + Na_2CO_3 \longrightarrow CaCO_3 + Na_2SO_4$$

$$Na_2CO_3 + MgSO_4 \longrightarrow MgCO_3 + Na_2SO_4$$

Q.33 How sodium zeolite softens water?

Ans. Sodium zeolite is a naturally occurring resin of sodium aluminium silicate $NaAl(SiO_3)_2$, which can also be prepared artificially. When water is passed through resin sodium ions of the resin are exchanged with the unwanted calcium and magnesium ions of the hard water.

$$Na_2 - \text{zeolite} + CaSO_{4(aq)} \longrightarrow \text{Ca-zeolite} + Na_2SO_{4(aq)}$$

Q.34 What do you mean by boiler scales? How are they removed?

Ans. Hard water is unfit for use in steam engines, boilers and turbines because insoluble calcium and magnesium salts are deposited inside. This hard deposited layer of calcium and magnesium salts is called as boiler scale, they can be removed by washing the boilers with washing soda, slaked lime and sodium zeolite.

Q.35 What is an industrial waste?

Ans. All the industrial units discharge their wastes (chemical and solid materials) either to open ground or to water channels this is called industrial effluent.

Q.36 How water used as a cleaning agent in industries cause pollution?

Ans. Water used as cleaning agent in industries is directly discharged out. This water contains all kinds of toxic chemicals and detergents.

When these effluents or used water enter lakes, streams, rivers or oceans, they either get dissolved or float suspended in water. Even they get deposited on the bed. This results in pollution of water.

Q.37 Why use of detergents is increasing day by day?

Ans. The use of detergents is increasing in houses and industries because detergents have strong cleaning action that of soap even in hard water. They can even work in acidic solution.

Q.38 How decaying plants consume oxygen?

Ans. Decaying plants consume oxygen for the biodegradable.

Q.39 What is function of fertilizers?

Ans. Fertilizers are used to make up the deficiency of nitrogen, phosphorous etc. of the soil because of intensive cultivation of crops in the recent years.

Q.40 How pesticides cause water pollution?

Ans. Run-off from the agricultural land (where fertilizer and pesticides have been used) enters into ponds, streams or rivers. This water contains nitrate $\left(NO_3^{-1}\right)$ and phosphate $\left(PO_4^{-3}\right)$ salts. These substances results in a rapid sunlight and air to reach the aquatic life. When algae dies and decompose, bacteria consume oxygen of the water for decomposition. As a result, oxygen depletes in water. Aquatic animals feel suffocation and ultimately die due to insufficient supply of oxygen.

In this way, pesticides play their role in water pollution.

Q.41 Define water borne diseases.

Ans. Diseases that spread because of drinking polluted water or eating food prepared with polluted water are called water borne diseases.

Q.42 What is dysentery?

Ans. Dysentery is an intestinal disease which is typically caused by certain bacteria or parasites. It is characterized by severe diarrhea that may be accompanied by blood or mucous.

Q.43 Which of the bacteria causes the cholera?

Ans. Bacteria vibrio cholera causes cholera.

Multiple Choice Questions

1. Which one of the properties of water is responsible for rising of water plants?

(a) specific heat capacity
(b) surface tension
(c) excellent solvent action
(d) capillary action

2. Specific heat capacity of water is

(a) 4.2 $kJg^{-1}K^{-1}$
(b) 4.2 $Jg^{-1}K^{-1}$
(c) 2.4 $KJg^{-1}K^{-1}$
(d) 2.4 $Jg^{-1}K^{-1}$

3. Water dissolves non-ionic compound by

(a) ion-ion forces
(b) ion-dipole forces
(c) dipole –dipole forces
(d) hydrogen bonding

4. Temporary hardness is because of

(a) $Ca(HCO_3)_2$
(b) $CaCO_3$
(c) $MgCO_3$
(d) $MgSO_4$

5. Temporary hardness is removed by adding

(a) quick lime (b) slaked lime
(c) lime stone (d) lime water

6. Permanent hardness is removed by adding

(a) Na_2zeolite (b) soda lime
(c) lime water (d) quick lime

7. Which one of the following salts makes the water permanently hard?

(a) $NaCO_3$ (b) $NaHCO_3$
(c) $Ca(HCO_3)_2$ (d) $CaSO_4$

8. Rapid growth of algae in water bodies is because of detergent having

(a) carbonate salts
(b) sulphonic acid salts
(c) sulphate salts
(d) phosphate salts

9. Which one of the followings is not a reason of depletion of O_2 from water

(a) decaying of aquatic plants
(b) biodegradation of aquatic plants
(c) sulphate salts
(d) phosphate slats

10. Which one of the following diseases causes liver inflammation?

(a) typhoid
(b) jaundice
(c) cholera
(d) hepatitis

11. Which one of the following diseases causes severe diarrhea and can be fatal?

(a) jaundice
(b) dysentery
(c) cholera
(d) typhoid

12. Which one of the following gases is used to destroy harmful bacteria in water?

(a) iodine
(b) chlorine
(c) fluorine
(d) bromine

13. The percentage of water in human body is

(a) 40% (b) 50%
(c) 60% (d) 70%

14. The percentage of oceans in world water is

(a) 50% (b) 67%
(c) 97% (d) 25%

15. Inland water includes

(a) River (b) Lakes
(c) Streams (d) All of them

16. Sea water is unfit for drinking purpose due to the presence of

(a) Salts (b) Algae
(c) Fishes (d) All of them

17. The percentage of potable water on earth is

(a) 2% (b) 0.2%
(c) 0.02% (d) 0.002%

18. The freezing point of water is

(a) 10^0C (b) 100^0C
(c) 0^0C (d) 46^0C

19. The boiling point of water is

(a) 100^0C (b) 4^0C
(c) 0^0C (d) 25^0C

20. Water has a maximum density at

(a) 10^0C (b) 0^0C
(c) 4^0C (d) 100^0C

21. The heat capacity of water is

(a) 4.2 $Jg^{-1}k^{-1}$ (b) 2.1 $Jg^{-1}k^{-1}$
(c) 3.2 $Jg^{-1}k^{-1}$ (d) 5.9 $Jg^{-1}k^{-1}$

22. Water has a maximum density at 4°C

(a) 12 cm^{-3} (b) 2 g cm^{-3}
(c) 1 g cm^{-3} (d) 4gcm^{-3}

23. How many times the heat capacity of water is greater than that of rocks.

(a) two (b) three
(c) four (d) Six

24. The process by which water rises up from the roots of plants to leaves is called

(a) Photosynthesis (b) Respiration
(c) Surface tension (d) Capillary action

25. Which of the following salt is soluble in water?

(a) NaCl (b) KCl
(c) Na_2SO_4 (d) All of them

26. Which of the following is insoluble in water?

(a) Benzene (b) NaCl
(c) KCl (d) All of them

27. One H_2O molecule can form hydrogen bonding with how many other H_2O molecules?

(a) One (b) Two
(c) Three (d) Four

28. Water molecules show structure

(a) Tetrahedral (b) Trigonal
(c) Pentagonal (d)

29. Some organic compounds are soluble in water due to the presence of

(a) -OH (b) H^+
(c) both a and b (d) covalent bond

30. Which of the following is soluble in water?

(a) Organic acids (b) glucose
(c) alcohols (d) all of them

31. Water which produces good lather with soap is called

(a) Soft water (b) Hard water
(c) Heavy water (d) All of them

32. Chemical form of gypsum

(a) $MgSO_4.5H_2O$ (b) $CaSO_4.2H_2O$
(c) $FeSO_4.5H_2O$ (d) $CuSO_4.5H_2O$

33. Chemical formula of lime stone is

(a) CaO (b) $Ca(OH)_2$
(c) $CaCO_3$ (d) All of them

34. Gypsum in water is

(a) Sparingly soluble (b) insoluble
(c) Highly soluble (d) None of them

35. Temporary hardness is due to the presence of bicarbonates of

(a) Calcium (b) Magnesium
(c) Both of them (d) None of them

36. The removal of which ion causes water softening

(a) Na^+ (b) Mg^2
(c) Li^+ (d) K^+

37. Calcium carbonate is in water

(a) Insoluble (b) Sparingly
(c) None of them (d) soluble

38. Temporary hardness in water can be removed by

(a) Boiling Method
(b) Using washing soda
(c) Using Sodium zeolite
(d) All of them

39. Sodium zeolite is naturally occurring reason of

(a) $NaAl(SiO_3)_2$ (b) Na_2CO_3
(c) $CaCO_3$ (d) Na_2SiO_3

40. Hard water can cause

(a) Stomach disorder
(b) Boiler blasts
(c) Inefficiency of engine
(d) All of them

41. Soap is the sodium salt of long chain

(a) Amino acids (b) Fatty acids
(c) Nucleotides (d) None of them

42. Mg^{2+} and Ca^{2+} ions react with soap to form calcium and magnesium salts of fatty acids called

(a) gelatin (b) Scum
(c) Paste (d) None of them

43. Industrial effluents are highly

(a) Toxic organic compounds
(b) Inorganic Salts
(c) Heavy Metals
(d) All of them

44. Which is not a heavy metal?

(a) Cadmium (b) Lead
(c) Zinc (d) Mercury

45. Acute cadmium poisoning causes

(a) High Blood pressure
(b) Kidney damage
(c) Destruction of RBC's
(d) All of them

46. Acute lead poisoning causes dysfunction of

(a) Kidney (b) liver
(c) CNS (d) All of them

47. Neurological damage is caused by the poisoning of

(a) Lead (b) Cadmium
(c) Mercury (d) All of them

48. The salts of which element are present in detergent that causes the rapid growth of algae in water bodies is

(a) Phosphate (b) Calcium
(c) Sodium (d) All of them

49. The depletion of which gas results in the death of aquatic life.

(a) Oxygen (b) Carbon dioxide

(c) Both of them (d) None of them

50. Example of pest is

(a) Weeds (b) Herbs

(c) Insects (d) all of them

51. Which element protects teeth from decay?

(a) Potassium (b) Fluorine

(c) Sodium (d) Calcium

52. Which disease is caused by polluted water?

(a) Cholera (b) Typhoid

(c) Diarrhea (d) All of them

53. Which element do not causes toxicity in water?

(a) Lead (b) Arsenic

(c) Sodium (d) Mercury

54. Vibrious cholera causes

(a) Cholera (b) Dysentery

(c) Fluorsis (d) Hepatitis

55. Which hepatitis is caused by contaminated water?

(a) Hepatitis A (b) Hepatitis B

(c) Hepatitis D (d) Hepatitis C

56. Hookworm infects.

(a) Liver (b) small intestine

(c) Large intestine (d) Stomach

57. Hook worm larvae enter the body through

(a) Food (b) water

(c) Skin (d) All of them

58. A disease is caused by excess of bile pigments in the blood is

(a) typhoid (b) Jaundice

(c) Cholera (d) Dysentery

59. Which organ ceases to function during Jaundice?

(a) Liver (b) Kidney

(c) Stomach (d) large intestine

60. Swimming pools are cleaned by the process

(a) Chlorination

(b) Hydrogenations

(c) None of these

(d) Saponification

61. Chemical formula of hypochlorous acid is

(a) HCl (b) HOCl

(c) H_2CO_3 (d) HF

Answer Key

1	d	2	B	3	d	4	A	5	b
6	a	7	d	8	d	9	C	10	d
11	b	12	d	13	d	14	C	15	d
16	a	17	b	18	c	19	A	20	c
21	a	22	c	23	d	24	D	25	d
26	a	27	d	28	a	29	A	30	d
31	a	32	b	33	c	34	A	35	c
36	b	37	a	38	a	39	a	40	d
41	b	42	b	43	a	44	c	45	d
46	d	47	c	48	a	49	a	50	d
51	b	52	d	53	c	54	a	55	a
56	b	57	c	58	b	59	a	60	a
61	b								

Unit
16

Chemical Industries

Long Answer Questions

Q.1 Describe in detail the various process involved in the concentration of ore explain your answer with the help of diagram.

Ans. Concentration of the Ore

The process of removal of gangue from the ore is technically known as concentration and the purified ore is called the concentrate. Concentration of the crushed ore is carried out by the following methods:

a) Gravity separation

Gravity separation is based on the differences in densities of the metallic ore and the gangue particles.

In the process, the powdered heavy metal bearing ore settles down on agitation in a stream of water, while the lighter gangue particles are carried away by the water as shown in figure

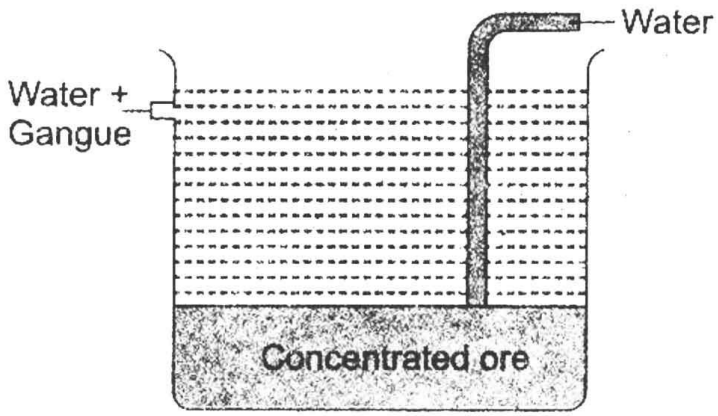


Fig. Gravity separation

b) Froth flotation process

Froth flotation process is based on the wetting characteristic of the ore and the gangue particles with oil and water, respectively.

The ore particles are preferentially wetted by oil and the gangue particles by the water. The whole mixture is agitated with compressed air. Hence, oil coated ore particles being lighter come to the surface in the form of a froth that can be skimmed as shown in figure:

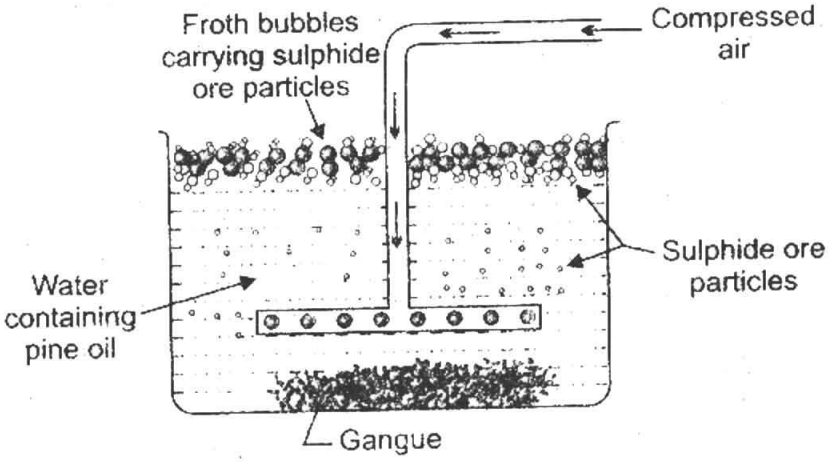


Fig: Froth flotation process

c) Electromagnetic separation

Electromagnetic separation is based on the separation of magnetic ores from the non-magnetic impurities by means of electro-magnets or magnetic separators.

The powdered are is dropped over a leather belt moving over two rollers, one of which is magnetic. The one gets attracted and is collected nearer to the magnet while the non-magnetic impurities fall further away as shown in figure

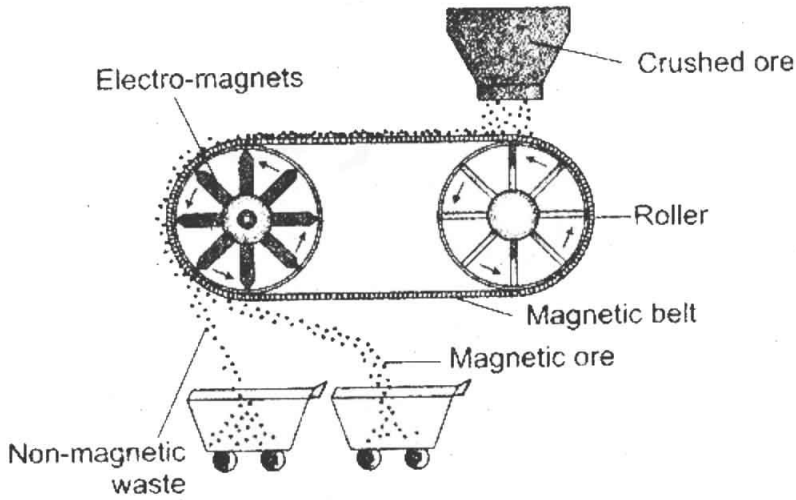


Fig: Magnetic separation

Q.2 Explain the process of roasting.

Ans. Roasting

It is a process of heating the concentrated ore to a high temperature in excess of air.

Example

copper pyrite ($CuFeS_2$) is strongly heated in excess of air to convert it into a mixture of cuprous sulphide and ferrous sulphide ($Cu_2S + FeS$). While impurities react with oxygen to form volatile oxides. Such as

$$2CuFeS_{2(s)} + O_{2(g)} \longrightarrow Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2(g)}$$

Q.3 Write a note on smelting and bessemerization, giving a specific examples.

Ans. Smelting

It is the further heating of the roasted ore, sand flux and coke in a blast furnace in the presence of excess of air.

It is highly exothermic process, therefore, a small amount of coke is required in the process. In the process, first ferrous sulphide oxidize to form ferrous oxide which reacts with sand to form iron silicate slag ($FeSiO_3$). It being lighter rise to the top and is removed from the upper hole.

$$2FeS_{(s)} + 3O_{2(g)} \longrightarrow 2\,FeO_{(s)} + 2SO_{2(g)} \uparrow$$

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

On the other hand, cuprous sulphide also oxidize to form cuprous oxide which reacts with ureacted ferrous sulphide to form ferrous oxide and cuprous sulphide. In this way, cuprous sulphide and ferrous sulphide form a mixture ($Cu_2S.FeS$). This molten mixture is called matte.

It is withdrawn from the lower hole. It contains about 45% of copper.

$$2Cu_2S_{(l)} + 3O_{2(g)} \longrightarrow 2\,Cu_2O_{(s)} + 2SO_{2(g)} \uparrow$$

$$Cu_2O_{(l)} + FeS_{(l)} \longrightarrow Cu_2S_{(l)} + FeO_{(l)}$$

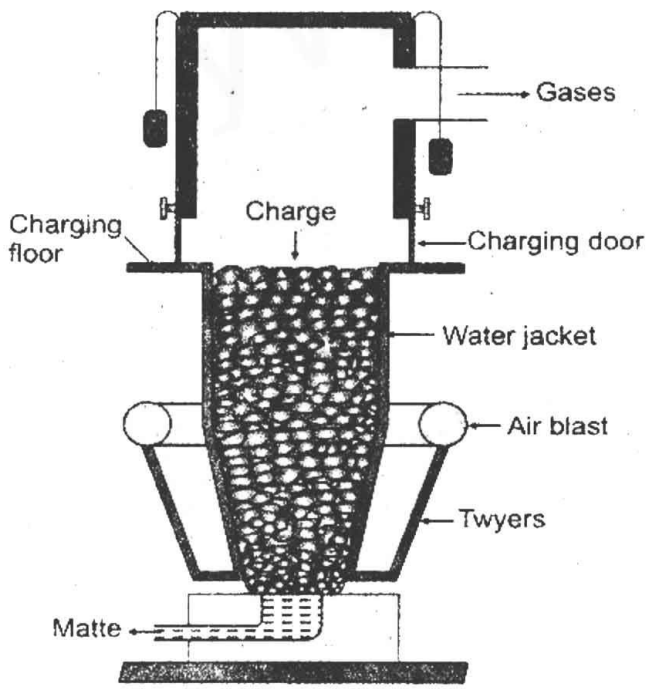


Fig: Blast furnace for smelting of copper

Bassemerization

It is the further heating of the molten matte in a pear shaped Bessemer converter as shown in figure. It is fixed on a pivot, so that it can be tilted in any direction. Molten matte is mixed

with sand and heated with a hot blast of air through tuyers. Ferrous sulphide is oxidized to form ferrous oxide. Which reacts with sand to form slag ($FeSiO_3$) that float on the top.

$$2FeS_{(l)} + 3O_{2(g)} \longrightarrow 2FeO_{(l)} + 2SO_{2(g)}$$

$$FeO_{(l)} + SiO_{2(s)} \longrightarrow Fe\,SiO_{3(slag)}$$

On the other hand, cuprous sulphide is oxidized to form cuprous oxide, which again reacts with remaining cuprous sulphide to form metallic copper.

$$2Cu_2S_{(l)} + 3O_{2(g)} \longrightarrow 2\,Cu_2O_{(l)} + 2SO_{2(g)} \uparrow$$

$$2Cu_2O_{(l)} + Cu_2S_{(l)} \longrightarrow 6Cu_{(s)} + SO_{2(g)} \uparrow$$

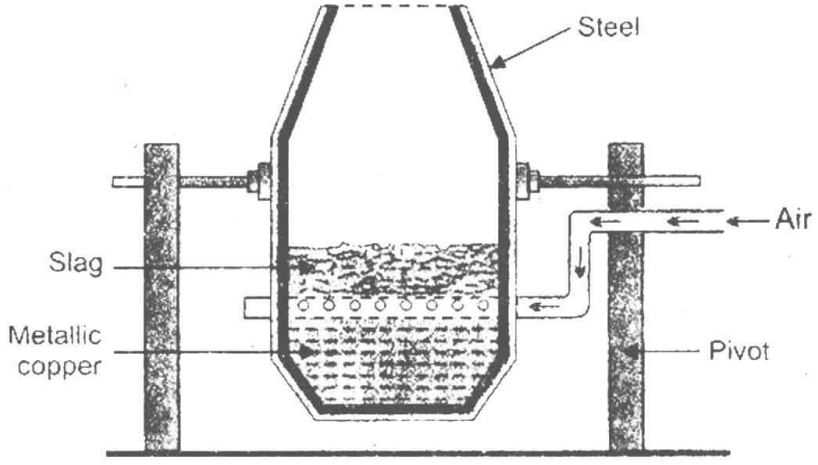


Fig: Bessemer Converter used for Bessemerization of copper

The molten metal is shifted from the converter to sand moulds and is allowed to cool. The dissolved gases escape out forming blisters on the surface of the solid copper therefore it is called blister copper. It is about 98% pure copper. It is further refined by electrolysis.

Q.4 Explain the process of refining with reference to copper.

Ans. Refining or purification of the copper metal.

Refining the impure metal by electrolysis is the most widely used process of refining metals.

Example

Electrolytic refining of copper is carried out in an electrolytic tank having copper sulphate solution in it as shown in figure. Two electrodes; one of impure copper metal that acts as anode and the other of pure copper metal that acts as cathode are suspended in the electrolytic solution.

On passing the electric current through the solution, anode (impure copper) dissolves to provide Cu^{2+} ions to the solution. These Cu^{2+} ions are discharged by gaining of electrons from the cathode. Thereby copper atoms deposit on the cathode, making it thick block of pure copper metal as is shown in figure. The impurities like gold and silver settle down as anode mud.

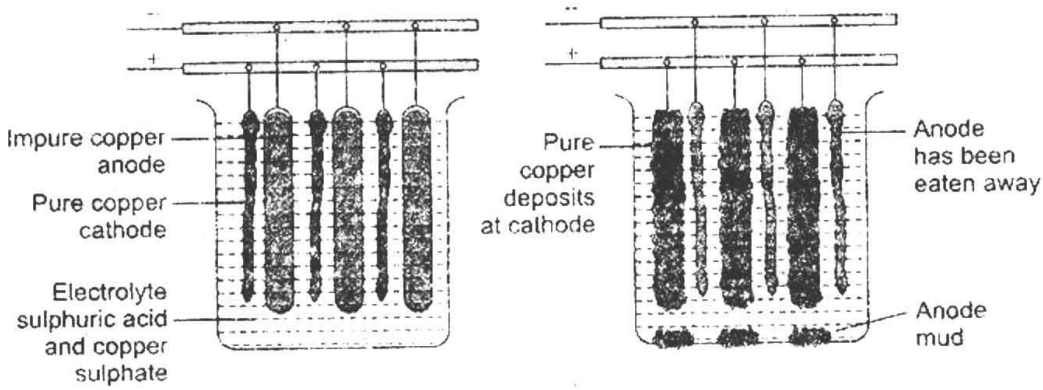


Fig: Electro refining of copper

In the process, impure copper from the anode dissolves and goes into the copper sulphate solution. Side by side, pure copper ions from the solution deposit on the cathode. Thus, cathode becomes a pure copper metal. The impurities like gold and silver settle down as anode mud.

Q.5 Write detail note on ammonia Solvay process.

Ans. Principle of ammonia solvay's process

Principle of Solvay's process lies in the low solubility of sodium bicarbonate at low temperature i.e. at 15°C. When CO_2 is passed through an ammonical solution of NaCl called ammonical brine only $NaHCO_3$ precipitates.

$$Na^+_{(aq)} + HCO_3^-{}_{(aq)} \longrightarrow NaHCO_{3(s)}$$

Raw Materials

The raw materials needed for this process are cheap and easily available. They are in abundance, such as,

i. Sodium chloride (NaCl) or brine. ii. Limestone ($CaCO_3$)

iii. Ammonia gas (NH_3)

Basic Reactions

The process consists of the following steps:

i. Preparation of ammonical brine

First of all ammonical brine is prepared by dissolving ammonia gas in sodium chloride solution (brine).

ii. Carbonation of ammonical brine

Ammonical brine is fed into carbonating tower and carbon dioxide is passed through it. Following reactions take place in the carbonating tower.

$$CO_{2(g)} + NH_{3(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3(aq)}$$

$$NH_4HCO_{3(aq)} + NaCl\ (brine) \longrightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$$

The temperature of the mixture is lowered to 15^0C and precipitates of $NaHCO_3$ are obtained.

iii. Filtration of precipitates

The milky solution from the carbonating tower is filtered to get sodium bicarbonate. It is used as a baking soda.

iv. Calcinations

Sodium bicarbonate is heated to get sodium carbonate.

$$2NaHCO_{3(1)} \xrightarrow{\Delta} Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(1)}$$

CO_2 is again used in tower. It is about half of CO_2 needed in the process.

v. Preparation of carbon dioxide and slaked lime

CO_2 is prepared by heating limestone in a lime kiln. Then it is carried to carbonating tower

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$$

Quick lime (CaO) formed in lime kiln is slaked with water. Then, it is pumped to the ammonia recovery tower.

$$CaO(g) + H_2O_{(1)} \xrightarrow{\Delta} \underset{\text{(Slaked lime)}}{Ca(OH)_2}$$

vi. Ammonia recovery tower

Ammonia is recovered in this tower from ammonium chloride solution produced in the carbonated tower and calcium hydroxide formed in lime kiln.

$$2NH_4Cl_{(s)} + Ca(OH)_{2(1)} \longrightarrow 2NH_{3(s)} + CaCl_{2(s)} + 2H_2O_{(1)}$$

In fact, all ammonia is recovered in this tower and is reused in the process. There are minor losses of ammonia in the process which are compensated by using fresh ammonia.

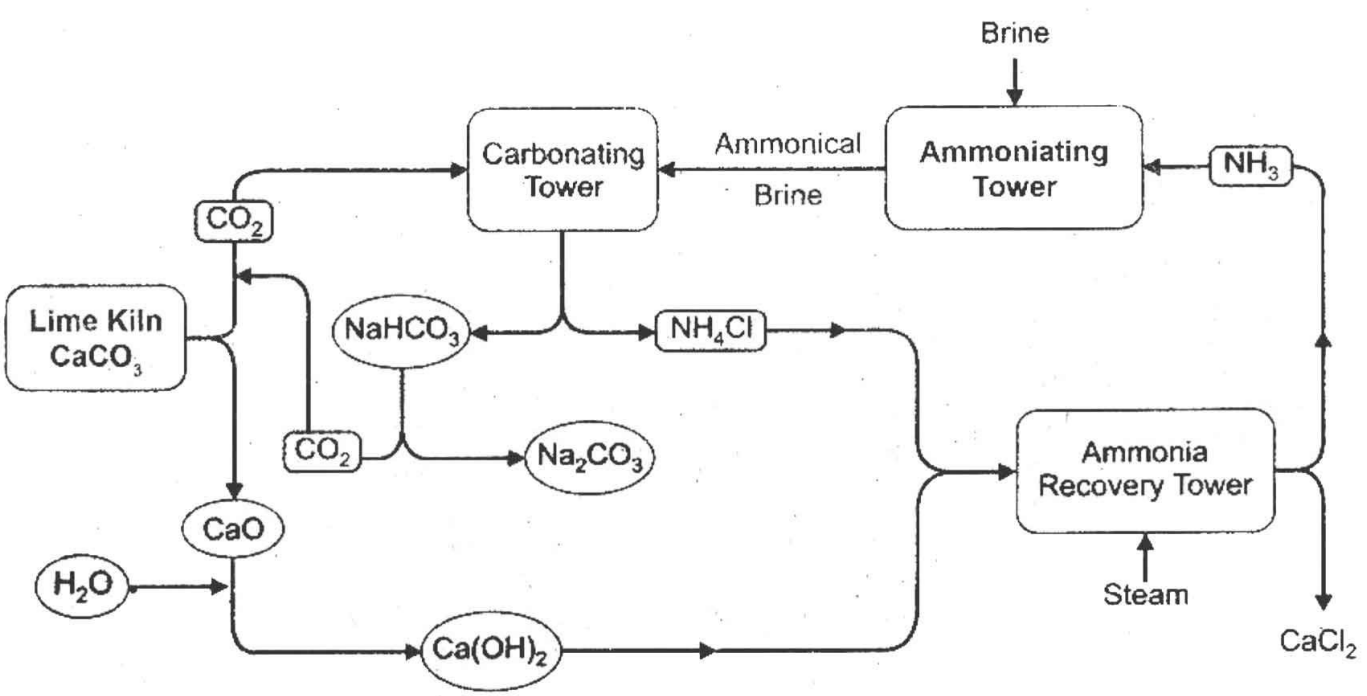


Fig: Flow sheet diagram of Solvay's process for the manufacturing of sodium carbonate

Q.6 Write down advantages of Solvay's process.

Ans. Advantages of Solvay's process

Following are the advantages of Solvay's process

i. It is a cheap process as raw materials are available at very low prices.
ii. Carbon dioxide and ammonia are recovered and reused.
iii. Process is pollution free, because the only waste is calcium chloride solution.
iv. Sodium carbonate of very high purity is obtained.
v. Consumption of fuel is very less since no solution is to be evaporated.

Q.7 How urea is manufactured. Explain showing the flow sheet diagram?

Ans. Manufactured of Urea

Urea is nitrogenous fertilizer. It consists of 46.6% nitrogen. It is white crystalline compound, highly soluble in water. It is used for the manufacturing of important chemicals, but its major (about 90%) use is as a fertilizer.

Raw Material

The raw materials for the manufacturing of urea are:

(i) Ammonia (NH_3) **(ii)** Carbon dioxide (CO_2)

Preparation of Ammonia by Haber's process

Ammonia is prepared by the "Haber's process". One volume of nitrogen (from air and three volumes of hydrogen (obtained by passing methane and steam over nickel catalyst) is passed over iron catalyst at 450°C and 200 atm pressure.

$$N_{2(g)} + 3H_{2(g)} \xrightarrow[200\,atm]{450^\circ C} 2NH_{3(g)}$$

Process

Manufacturing of urea involves three stages

i. Reaction of ammonia and carbon dioxide

Carbon dioxide is passed through liquid ammonia under high pressure to form **ammonium carbamate**

$$2NH_3 + CO_2 \xrightarrow{\Delta} \underset{\text{Ammonium carbonate}}{NH_2COONH_4}$$

ii. Urea formation:

When ammonium carbamate is evaporated with the help of steam, it dehydrates to form urea.

$$NH_2COONH_4 \longrightarrow \underset{\text{(Urea)}}{NH_2CONH_2} + H_2O \uparrow$$

iii. Granulation of urea

At this stage, liquid urea is evaporated to form granules. When liquid urea is sprayed from top of a tower under pressure and a hot current of air is introduced from the base, it evaporates to form granules. This is stored to be marketed.

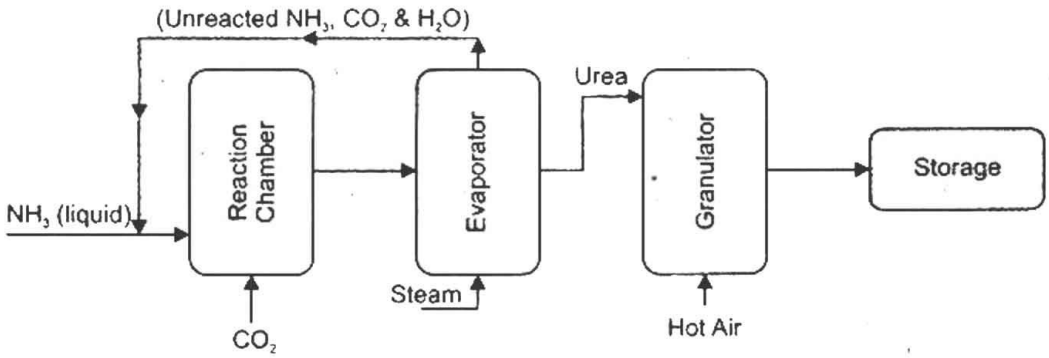


Fig: Flow sheet diagram of urea

Q.8 Explain importance and status of urea.

Ans. Importance and Status of Urea

It is white crystalline organic compound. Its importance is because of following usage:

i. Urea is widely used world over in the agriculture sector both as a fertilizer and animal feed additive. About 90% of urea is used as fertilizer. It has the highest nitrogen percentage, i.e. much higher than other nitrogenous fertilizers. It is harmless and is useful for all types of crops and soils.

It is non-toxic, non-explosive, therefore, can be stored safely. But it is very soluble in water and hygroscopic, therefore, storage requires better packing.

ii. It is used as a raw material for the manufacture of many important compounds.

iii. It is used to make explosives.

iv. It is used in automobile systems to reduce the NO_x pollutants in exhaust gases.

There are about six urea manufacturing units in Pakistan. The major four are Fauji Fertilizer company; Engro Chemicals; Faugji Fertilizer, Bin Qasim and Dawood Hercules company. Fauji Fertilizer is the biggest fertilizer manufacturer with 59% market shares.

Government provides an indirect subsidy to manufacturers but this industry is still facing supply shortfall problems. The price of urea has grown since the last years.

Q.9 Define Petroleum explain the origin of petroleum in detail.

Ans.

1. Petroleum

Petroleum is a natural product found under the Earth's crust trapped in rocks. Petroleum means rock oil. It is a complex mixture of several gaseous, liquid and solid hydro carbon

having water, salts and earth particles with it. It is lighter than water is insoluble in it.

2. Origin of Petroleum

Petroleum was formed by the decomposition of dead plants and animals buried under earth's crust millions of years ago. It is believed that millions of years ago living plants and animals in the sea died. Their bodies sank and buried under mud and sand. Then decomposition process took place in the absence of air because of high pressure, temperature and bacterial effects. This process took millions of years for completion. Thus, remains of dead plants and animals were converted into a dark brownish viscous **crude oil**. It was trapped between two layes of impervious rocks. As shown in figure

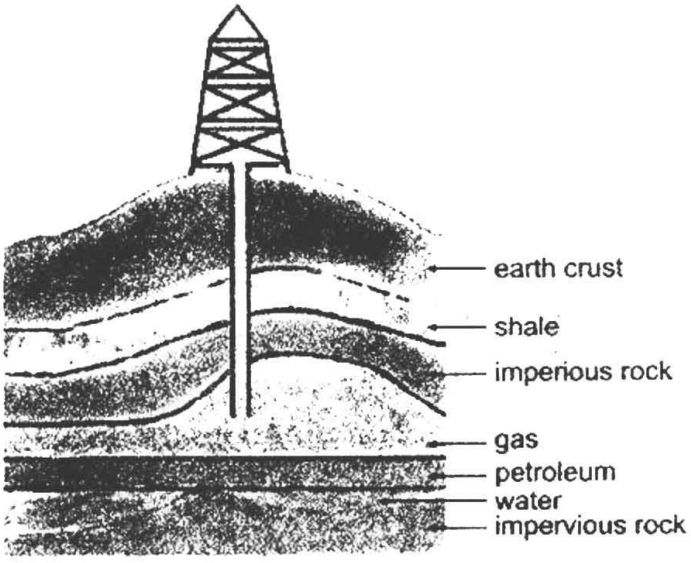


Fig: Occurrence of petroleum

Being lighter and insoluble in water it floats over the water and forms an oil trap. The gaseous products accumulated over the petroleum are found as natural gas.

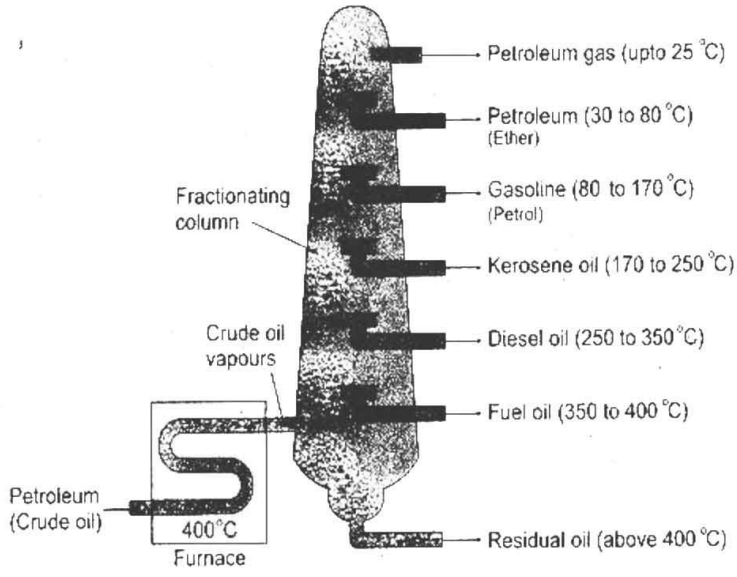
Petroleum is extracted by drilling holes (oil wells) into Earth's crust where the oil is found. When a well is drilled through the rocks, natural gas comes first with a great pressure. For some time crude oil also comes out by itself due to gas pressure. When gas pressure subsides, then crude oil is pumped out.

Q.10 Write a note on fractional distillation of petroleum.

Ans. Refining

The crude oil is refined in the refineries. **Refining** process is the separation of crude oil mixture into various useful products (fractions). It is carried out by a process called **fractional distillation**. The principle of fractional distillation is based upon separation of substances depending upon their boiling points. The substances having low boiling point out first, living behind others. The next fraction of having slightly higher boiling point boils out. This process remain continue until a residue is left behind. The vapours of each fraction are collected and condensed separately.

The crude oil is heated in a furnace upto a temperature of 400°C under high pressure. Then vapours are passed through a fractionating column from near its bottom as shown in figure. Hot vapours rise up in the column and gradually is cools down and condense. Such that vapours of higher boiling point fraction (350°C to 400°C) condense first in the lower part of the tower, while vapours of medium lower boiling point fractions rise upwards in the tower and condense gradually respect to their boiling points at different levels. In this way, crude oil is separated in to six hydrocarbon fractions. Each fraction has its specific boiling range, composition and uses.



Q.11 Describe some important fractions of petroleum and their uses.

Ans. Important fractions of petroleum and their uses

Each fraction is not a single compound. Each one is a mixture of hydrocarbons having different number of carbon atoms in it. The name of each fraction, its molecular composition, boiling range and uses are given in the following table.

Name	Composition	Boiling range	Uses
Petroleum Gas	C_1 to C_4	Up to 25°C	As a fuel, as such in the form of LPG, used for the production of carbon black (needed in tyre industry) and hydrogen gas (needed to form NH_3 used to manufacture fertilizer)
Petroleum Ether	C_5 to C_7	30 to 80°C	Used as laboratory solvent and for dry cleaning purposes.
Gasoline or Petrol	C_7 to C_{10}	80 to 170°C	Used as fuel in motor cycles, motor cars and other light vehicles. It is more volatile than kerosene oil. It is also used for dry cleaning.
Kerosene oil	C_{10} to C_{12}	170 to 250°C	Used as domestic fuel, a special grade of it is sued as jet fuel.

Diesel oil	C_{13} to C_{15}	250 to 350°C	Fuel for buses, trucks railway engines, tubewell engines and other heavy vehicles.
Fuel oil	C_{15} to C_{18}	350 to 400°C	Used in ships and industries to heat boilers and furnaces.

Residual Oil

The residual oil, which does not vapourize under these conditions is collected and heated above 400°C for further fractional distillation. The four fractions of residual oil are:

lubricants; paraffin wax; asphalt and petroleum coke.

Q.12 Explain that natural fertilizers are better than synthetic fertilizers.

Ans. Fertilizer is a substance added to soil to improve plants' growth and yield.

Natural Fertilizers

Contain all nautral biodegradable materials are decomposed by bacteria. Decomposed materials contain useful nutrient for plants. Organic matter is essential part of fertile soil. Use of natural fertilizers return the nutrients and organic matter of soil

They improve the soil condition to support plant growth.

i. They improve the porosity of the soil to make it capable of absorbing water. Thus improves crops production.

ii. They improve the structure of soil which in turn allows more air to get to plant roots.

iii. The chance of water shortage because of the moisture holding capacity of soil increases.

iv. Natural fertilizers practically do not contain toxic chemicals. Thus, they do not damage the soil and crops yield increase.

Chemical Fertilizers

Include one or more of the three elements most important for plant nutrition; nitrogen, phosphorus and potassium.

i. They release the nutrients very fastly.

ii. Their effects are short lived, so they are required again and again, after short intervals may be 4 to 6 times in a year.

iii. Use of synthetic fertilizers may cause over fertilization resulting in burning of plants instead of greening them.

Short Answer Question

Q.1 Define concentration process, is it used in metallurgy of copper?

Ans. The process of removal of gangue from the ore is technically known as concentration and the purified ore is called the concentrate. Yes, concentration process used in metallurgy of copper.

Q.2 Why a small amount of coke is required in the smelting process?

Ans. Because smelting is carried out in blast furnace. The process in blast furnace is highly exothermic process. Therefore a small amount of coke is required in this process.

Q.3 Why lime is added in the smelting process?

Ans. Lime is added to remove excess of SiO_2 .Lime reacts with sand to form slag.

$$CaO + SiO_2 \longrightarrow CaSiO3_{(slag)}$$

Q.4 How slag and matte are removed from the blast furnace?

Ans. Slag being lighter rise to the top and is removed from the upper hole of the blast furnace and matte is withdrawn from the lower hole of the blast furnace. It contains about 45% of copper.

Q.5 What is the difference between slag and matte?

Ans.

Slag	Matte
When flux combine with gangue it will form slag which being lighted in weight and floats on the molten metal	In blast furnace cuprous sulphide and ferrous sulphide form a mixture (Cu_2S. Fes). This molten mixture is called matte.

Q.6 Mention the chemical reaction for the formation of metallic copper in the bessemerization process.

Ans. Following, chemical reactions for the formation of metallic copper in the bessemerization process

$$2\,FeS_{(l)} + 3O_{2(g)} \longrightarrow 2FeO_{(l)} + 2SO_{2(g)}$$

$$FeO_{(l)} + SiO_{2(s)} \longrightarrow FeSiO_{3(slag)}$$

$$2\,Cu_2S_{(l)} + 3O_2 \longrightarrow 2Cu_2O_{(l)} + 2SO_{2(g)} \uparrow$$

$$2\,CU_2O_{(l)} + Cu_2S_{(l)} \longrightarrow 6\,Cu_{(s)} + SO_{2(g)} \uparrow$$

Q.7 Why anode is eaten up in electro – refining process?

Ans. Because on passing the electric current through the Copper sulphate solution, anode (Impure copper) dissolves to provide Cu^{2+} ions to the solution, these Cu^{2+} ions are discharged by gaining of electrons from the cathode thereby copper atoms deposit on the cathode, making it thick block of pure copper metal. The impurities like gold and silver settle down as anode mud.

Q.8 What do you mean by anode mud?

Ans. During the electro refining process of copper which carried out in an electrolytic tank. The impurities like gold and silver settle down as anode mud.

Q.9 Why only $NaHCO_3$ precipitates when CO_2 is passed through the ammonical brine ?

Ans. When CO_2 is passed through the ammonical brine, a mixture of NH_4Cl and $NaHCO_3$ is obtained. The temperature of the mixture is lowered to 15^0C and precipitates of $NaHCO_3$ are formed. Because $NaHCO_3$ is insoluble in NH_4Cl at low temperature.

Q.10 Which raw materials are required for the formation of sodium carbonate?

Ans. The raw materials needed for the formation of sodium carbonates are

i. Sodium chloride (NaCl) or brine
ii. Lime stone ($CaCO_3$)
iii. Ammonia gas (NH_3)

Q.11 How CO_2 is prepared in the Solvay's process?

Ans. CO_2 is prepared by heating lime stone in a lime kiln.

$$CaCO_3(s) \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}$$

Q.12 Give the advantages of Solvay's process.

Ans. i. It is a cheap process as raw materials are available at very low prices.
ii. Carbondioxide and ammonia are recovered and reused.
iii. Process is pollution free, because the only waste is calcium chloride solution.
iv. Sodium carbonate of very high purity is obtained.
v. Consumption of fuel is very less since no solution is to be evaporated.

Q.13 What happens when ammonium carbonate is heated with steam?

Ans. When ammonium carbamate is evaporated with the help of steam, it dehydrate, to form urea.

$$H_2NCOONH_4 \longrightarrow H_2NCONH_2 + H_2O \uparrow$$

Q.14 How many stages are involved in the formation of urea?

Ans. There are three stages are involved in the formation of urea.

i. Reaction of ammonia and carbondioxide.

ii. Urea formation

iii. Granulation of urea.

Q.15 What role is played by pine oil in the froth flotation process?

Ans. Pine oil is played an important role in froth flotation process because Pine oil coated ore particles being lighter come to the surface in the form of froth that can be skimmed easily.

Q.16 Name the various metallurgical operation.

Ans. The process involved in metallurgy for extraction of a metal in the pure state from its ore are.

i. Concentration of the ores

ii. Extraction the metal

iii. Refining of metal

Q.17 How roasting is carried out?

Ans. Roasting process is carried out in a special furnace which is called Reverberatory furnace.

Q.18 What happens when ammonical brine is carbonated??

Ans. Ammonical brine is fed into carbonating tower and carbondioxide is passed through following reaction take place in carbonating tower.

$$CO_{2(g)} + NH_{3(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3(aq)}$$

$$NH_4HCO_{3(aq)} + NaCl_{(brine)} \longrightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$$

The temperature of the mixture is lowered to 15°C and precipitates of $NaHCO_3$ are obtained.

Q.19 How $NaHCO_3$ is converted in to Na_2CO_3?

Ans. Sodium hydrogen carbonate is heated to get sodium carbonate.

$$2NaHCO_{3(l)} \xrightarrow{\Delta} Na_2CO_{2(s)} + CO_{2(g)} + H_2O(l)$$

CO_2 is again used in tower. It is about half of CO_2 needed in the process.

Q.20 How ammonia is recovered in solvay's process?

Ans. Ammonia is recovered in this tower from ammonium chloride solution produced in the carbonated tower and calcium hydroxide formed in lime kiln.

$$2NH_4Cl_{(s)} + Ca(OH)_{2(l)} \longrightarrow 2NH_{3(g)} + CaCl_{2(s)} + 2H_2O_{(l)}$$

In fact all ammonia is recovered in this tower and is reused in the process.

Q.21 How ammonia is prepared for synthesis is Urea?

Ans. Ammonia is prepared by the Haber's process". One volume of nitrogen (from air) and three volumes of hydrogen (obtained by passing methane and steam over heated nickel catalyst) is passed over iron catalyst at. 450^0C and 200 atm pressure.

$$N_{2(g)} + 3H_{2(g)} \xrightarrow[200atm]{450^\circ C} 2NH_{3(g)}$$

Q.22 Describe the formation of petroleum?

Ans. Petroleum was formed by the decomposition of dead plants and animal buried under earth's crust millions of years ago.

Q.23 What is refining of petroleum and how it is carried out?

Ans. Refining process is the separation of crude oil mixture into various useful products (fractions). It is carried out by a process called fractional distillation.

Q.24 Give uses of kerosene oil.

Ans: It is used as domestic fuel, a special grade of it is used as jet fuel.

Q.25 Describe the difference between diesel oil and fuel oil.

Ans:

Diesel oil	Fuel oil
i. It contains number of carbon atoms, 13 to 15.	**i.** It contains number of carbon atoms, 5 to 18.
ii. It is used as fuel for buses, trucks, railway engines, tubewell engines and other heavy vehicles.	**ii.** It is used in ships and industries to heat boilers and furnace.

Q.26 Write down the names of four fractions obtained by the fractional distillation, of residual oil.

Ans: The four fractions of residual oil are.

i. lubricants **ii.** wax **iii.** Paraffin **iv.** Asphalt

Q.27 What is the difference between crude oil and residual oil?

Ans:

Crude oil	Residual oil
1. It is dark brownish viscous liquid which is formed of dead plants and animals	1. After the fractional distillation of petroleum, the oil is left behind called residual oil.

Q.28 Which petroleum fraction is used in dry cleaning?

Ans: Gasoline or petrol is used in dry cleaning

Q.29 Define Metallurgy.

Ans. Metallurgy is the science of extracting metals from ores.

Q.30 Define Minerals.

Ans. The solid natural materials found beneath the earth surface, which contains compound of metals in the combined state along with earthly impurities are called minerals.

Q.31 Define ores.

Ans. The minerals from which the metals are extracted commercially at a comparatively low cost with minimum effort are called ores of the metals. For example ores of copper are copper glance (Cu_2S) and challopyrite ($CuFeS_2$)

Q.32 Why the colour of hairs different from different people?

Ans. The colour of hairs caused by the presence of transition metal compound in the hair. Brown hair contains iron or copper compounds blonde hair contains compounds of titanium and redhead hair is because of the presence of molybdenum compounds

Q.33 Define Gangue.

Ans. Impurities associated with the ore known as gangue.

Q.34 Write down the names of steps used in metallurgy.

Ans. The process involved in metallurgy for extraction of a metal in the pure state from its ore are

(i) Concentration of the ore

(ii) Extraction of the metals

(iii) Refining of the metal

Q.35 What is concentration of the ore?

Ans. The process of removed of gangue from the ore is technically known as concentration and the purified ore is called concentrate

Q.36 What is gravity separation?

Ans. Gravity separation is based on the difference in densities of the metallic ore and gangue particles.

Q.37 Define Forth flotation process.

Ans. Froth flotation process is based on the welting characteristics of the ore and the gangue particles with oil and water respectively.

Q.38 Define electromagnetic separation.

Ans. Electromagnetic separation is base on the separation of magnetic ores from the non-magnetic impurities by means of electromagnetic or magnetic separators.

Q.39 Define Roasting.

Ans. It is the process of heating the concentrated ore to a high temperature in excess of air.

Q.40 What is blister copper?

Ans. The dissolved gases escape out forming blisters on the surface of the solid copper. Therefore of the solid copper it is called blister cupper. It is about 98% pure copper.

Q.41 Describe the principle of Solvay's process.

Ans. Principle of Solvay's process lies in the low solubility of sodium bicarbonate at low temperature i.e at 15^0C. When CO_2 is passed through an ammonical solution of NaCl called ammonical brine only $NaHCO_3$ precipitates.

$$\underset{(aq)}{Na^+} + \underset{(aq)}{HCO_3^-} \longrightarrow \underset{(s)}{NaHCO_3}$$

Q.42 Write down advantages of Solvay's process.

Ans. It is a cheap process as raw materials are available at very low prices

(ii) Carbondioxide and ammonia are recovered and reused

(iii) Process is pollution free because the only waste is calcium chloride solution

(iv) Consumption of fuel is very less since no solution is to be evaporated

Q.43 What do you know about Urea?

Ans. Urea is nitroghenous fertilizers. It consists of 46.6% nitrogen. It is white crystalline compound, highly soluble in water. It is used for the manufacturing of important chemical, but its major (about 90%) use is as a fertilizer.

Q.44 Define petroleum.

Ans. Petroleum means rock oil. It is a complex mixture of several gaseous, liquid and solid hydrocarbons having water, salts and earth particles with it. It is lighter than water and is insoluble in it.

Q.45 Define refining.

Ans. Refining process is the separation of crude oil mixture into various useful products (fractions). It is carried out by a process called fractional distillation

Q.46 Describe the difference between diesel oil and fuel oil.

Ans.

Diesel oil	Fuel oil
i. It contains number of carbon, 13 to 15.	**i.** It contains number of carbon, 15 to 18.
ii. It is used fuel for buses, trucks, railway engines, tubewell. Engines and other heavy vehicles.	**ii.** It is used in ships and industries to heat boilers and furnace.

Q.47 Write down the name, of our fractions obtained by the fractional distillation of residual oil.

Ans. The four fractions of residual oil are

i. lubricants iii. wax

ii. paraffin iv. asphalt

Q.48 What is the difference between crude oil and residual oil?

Ans.

Crude oil	Oil
It is dark brownish viscous liquid which is formed of dead plant, and animals, where converted into a dark brownish viscous liquid.	After the fractional distillation of petroleum, the oil is left behind called residual oil

Q.49 Which petroleum fraction is used in dry cleaning?

Ans. Gasoline or petrol is used in dry cleaning.

Multiple Choice Questions

1. Extraction of metals from its ores is called

(a) Metallurgy (b) Mining

(c) Grinding (d) All

2. At the time of partition, How many industries were present in Pakistan

(a) 30 (b) 32

(c) 34 (d) 40

3. Which one of the ore of copper?

(a) Copper glance (b) Chalcopyrite
(c) Both a & b (d) None

4. Brown hair contains

(a) Iron compound
(b) Copper compound
(c) titanium compound (d) both a & b

5. Blonde hair contains compounds of

(a) Iron (b) copper
(c) titanium (d) Molybdenum

6. Red hair contains compounds of

(a) Iron (b) copper
(c) titanium (d) molybdenum

7. Process of heating the concentrated ore to high temperature in excess of air is called

(a) Roasting (b) Smelting
(c) Bessemerization (d) All

8. Which one is not metal?

(a) Copper (b) Carbon
(c) Chromium (d) Iron

9. The elements that do not conduct heat and electricity are called

(a) Metallurgy (b) Non metal
(c) Metalloid (d) alloy

10. Metallurgy involves which of the following steps?

(a) Mining and enrichment
(b) Reduction
(c) Refining and casting
(d) All of these

11. Blast furnace usually used for the metallurgy of

(a) Iron (b) copper
(c) Aluminum (d) both a & b

12. The process of roasting during metallurgy of copper is carried out in a special furnace called

(a) Blast furnace (b) Fire furnace
(c) Bessemer converter
(d) Reverberatory Furnace

13. Froth flotation process is used to concentrate

(a) Copper ore (b) Iron ore
(c) Chromium ore (d) aluminum ore

14. Compounds of metals exist under earth crust are called

(a) Ore (b) Gangue
(c) Mineral (d) None

15. An ore consists of two portions pure metal and impurities called

(a) ore (b) Silicates
(c) Slag (d) gangue

16. Which contains sufficient amount of metal?

(a) Mineral (b) ores
(c) Rocks (d) Soil

17. A saturated solution of sodium chloride is called

(a) Brine (b) Suspension
(c) colloidal (d) None

18. Raw materials used in Solvay's process.

(a) Brine (b) Lime stone
(c) Ammonia gas (d) All

19. Formula of baking soda is

(a) Na_2CO_3 (b) $NaHCO_3$
(c) Na_2SO_4 (d) Na_3PO_4

20. Formula of soda ash is

(a) Na_2CO_3 (b) $NaHCO_3$
(c) Na_2SO_4 (d) Na_3PO_4

21. Imperial chemical industries (ICI) was established in

(a) 1942 (b) 1944
(c) 1950 (d) 1996

22. Sindh alkalies limited was established near Karachi in

(a) 1965 (b) 1966
(c) 1970 (d) 2000

23. How many % age of nitrogen in urea fertilizers?

(a) 40.6 (b) 45.6
(c) 46.6 (d) 50

24. The raw materials for the manufacturing of urea are

(a) Ammonia (b) Carbondioxide
(c) Limestone (d) a & b

25. Ammonia is prepared by the process

(a) Ostwald (b) Haber
(c) Clark (d) all

26. How many % age of urea is used as fertilizers?

(a) 80% (b) 90%
(c) 95% (d) 98%

27. How many % age of nitrogen present in air by volume?

(a) 70% (b) 75%
(c) 78% (d) 80%

28. Formula of urea is

(a) KCNO (b) $H_2N–CO–NH_2$
(c) $HN-CO_2-NH$ (d) $H_3N-CO-NH_3$

29. The number of carbon atoms present in petroleum gas

(a) 1-2 (b) 1-3
(c) 1-4 (d) 1-5

30. The number of carbon atoms present in petroleum ether

(a) 1-5 (b) 2-5
(c) 3-7 (d) 5-7

31. The number of carbon atoms present in gasoline or petrol

(a) 5-10 (b) 6-10
(c) 7-10 (d) 8-10

32. The number of carbon atoms present in kerosene oil

(a) 8-12 (b) 9-12
(c) 10-12 (d) 11-12

33. The number of carbon atoms present in diesel oil

(a) 10-15 (b) 11-15
(c) 12-15 (d) 13-15

34. The number of carbon atoms present in fuel oil

(a) 14-18 (b) 15-18
(c) 16-18 (d) 17-18

35. Concentration is a separating technique in which mineral is separated from

(a) Gangue (b) Silicates
(c) Aluminates (d) all

36. Sodium carbonate is manufactured by

(a) Haber's process
(b) Ostwald's process
(c) Solvay's process (d) All

37. Ammonical brine is prepared by dissolving ammonia gas in

(a) NaCl (b) $CaCO_3$
(c) $CaCl_2$ (d) Na_2SO_4

38. The residual oil is heated above 400c to produce

(a) lubricants (b) Paraffin wax
(c) Asphalt (d) All

39. Concentration is a

(a) mixing technique

(b) separating technique
(c) boiling technique
(d) cooling technique

40. Froth flotation process is used to concentrate the ore on:
(a) density basis
(b) concentration basis
(c) wetting basis
(d) magnetic basis

41. Matte is a mixture of:
(a) FeS and CuS (b) Cu_2O and FeO
(c) Cu_2S and FeS (d) CuS and FeO

42. In the bessemerization process:
(a) roasted ore is heated
(b) molten matte is removed
(c) molten matte is heated
(d) molten matte is added

43. Concentration of the copper ore is carried out by:
(a) calcinations (b) roasting
(c) forth flotation (d) distillation

44. When CO_2 is passed through the ammonical brine the only salt that precipitates is:
(a) $NaHCO_3$ (b) NH_4HCO_3
(c) Na_2CO_3 (d) $(NH_4)_2CO_3$

45. In Solvay's process slaked lime is used to:
(a) prepare CO_2
(b) prepare quick lime.
(c) recover ammonia
(d) Form Na_2CO_3

46. When $NaHCO_3$ is heated it forms:
(a) CO_2 (b) $Ca(OH)_2$
(c) $CaCO_3$ (d) CaO

47. Formula of urea is:
(a) NH_2COONH_4
(b) NH_2COONH_2
(c) NH_2CONH_4
(d) NH_2CONH_2

48. Crude oil is heated in the fractionating furnace upto:
(a) 300^0C (b) 350^0C
(c) 400^0C (d) 450^0C

49. When crude oil is heated in the fractionating tower:
(a) vapours of higher boiling point fraction condense first in the lower part of the tower
(b) vapours of lower boiling point fraction condense first in the lower part of tower
(c) vapours of higher boiling point condense lather in the upper part of tower
(d) vapours of higher boiling point never condense

50. Which one of the following is used as jet fuel:
(a) kerosene oil (b) lubricating oil
(c) fuel oil (d) diesel oil

51. Which one of the following is not fraction of crude oil
(a) paraffin wax (b) asphalt
(c) fuel oil (d) petroleum coke

52. Which one of the following is not a fraction of petroleum?
(a) kerosene oil (b) diesel oil
(c) alcohol (d) petrol

53. The nitrogen present in urea is used by plants to synthesize
(a) sugar (b) proteins
(c) fats (d) DNA

54. Which one of the following organic compound is found in gasoline?

(a) C_2H_4 (b) C_3H_8 (c) C_7H_{10} (d) $C_{12}H_{26}$

Answer key

1	a	2	c	3	c	4	b	5	c
6	d	7	a	8	b	9	b	10	d
11	d	12	d	13	a	14	c	15	d
16	b	17	a	18	d	19	b	20	a
21	b	22	b	23	c	24	d	25	b
26	b	27	c	28	b	29	c	30	d
31	c	32	c	33	d	34	b	35	a
36	d	37	a	38	d	39	b	40	c
41	c	42	c	43	c	44	a	45	c
46	a	47	d	48	c	49	a	50	d
51	c	52	c	53	b	54	c		