CHEMISTRY

REFERENCE STUDY MATERIAL

for

CLASS – X

CHAPTER WISE CONCEPTS, FORMULAS AND QUESTIONS INLCUDING HOTS QUESTIONS

Prepared by

M. S. KUMARSWAMY, TGT(MATHS)
M. Sc. Gold Medallist (Elect.), B. Ed.

Kendriya Vidyalaya gachibowli

ISAMPAL
DEPUTY COMMISSIONER

केन्द्रीय विधालय संगठन, क्षेत्रीय कार्यालय,
के. कामराज मार्ग, बेंगलूर–560 042
KENDRIYA VIDYALAYA SANGATHAN
REGIONAL OFFICE
K. KAMARAJA ROAD, BANGALORE- 560042

F. DO-DC./2013-KVS(BGR) Dated:05.09.2013

Dear Shri M.S.Kumarswamy,

It has been brought to my notice the good work done by you with regard to making question bank and worksheets for classes VI to X in Mathematics. I am pleased to look at your good work. Mathematics is one discipline which unfortunately and wrongly perceived as a phobia. May be lack of motivation from teachers and inadequate study habits of students is responsible for this state of affairs. Your work in this regard assumes a great significance. I hope your own students as well as students of other Vidyalayas will benefit by your venture. You may mail the material to all the Kendriya Vidyalayas of the region for their benefit. Keep up the good work.

May God bless!,

Yours sincerely,

(Isampal)

Shri M.S.Kumarswamy
TGT (Maths)
Kendriya Vidyalaya
Donimalai

Copy to: the principals, Kendriya Vidyalayas, Bangalore Region with instructions to make use of the materials prepared by Mr. M.S.Kumarswamy being forwarded separately.

DEDICATED

TO

MY FATHER

LATE SHRI. M. S. MALLAYYA

CHAPTER – 1

CHEMICAL REACTIONS AND EQUATIONS

CHEMICAL REACTIONS

Any change can be classified as physical change and chemical change. Physical changes can be easily reversed but, it is not easy to reverse a chemical change.
In chemical changes, new substances are formed and it is difficult to regenerate the original substances. Chemical changes are more permanent than physical changes.
Chemical reaction involves chemical changes.
Chemical reactions are the processes in which new substances with new properties are formed.
During a chemical reaction, atoms of one element do not change into those of another element. Only a rearrangement of atoms takes place in a chemical reaction.

Magnesium ribbon burns with a dazzling white flame and changes into a white powder. This powder is magnesium oxide. It is formed due to the reaction between magnesium and oxygen present in the air.

Magnesium (As ribbon)	+	Oxygen (From air)	$\xrightarrow{\text{Heat}}$	Magnesium Oxide (White powder)

The burning of magnesium in air to form magnesium oxide is an example of chemical reaction.

REACTANTS AND PRODUCTS

The substances which take part in a chemical reaction are called reactants.
The new substances produced as a result of chemical reaction are called products.
In the above chemical reaction, there are two reactants : Magnesium and Oxygen but only one product : Magnesium oxide.

CHARACTERISTICS OF CHEMICAL REACTIONS

In a chemical reaction, reactants are transformed into products.
The important characteristics of chemical reaction are:

- ❖ Evolution of a gas
- ❖ Formation of a precipitate
- ❖ Change in colour
- ❖ Change in temperature and
- ❖ Change in state.

Any one of these characteristics can tell us whether a chemical reaction has taken place or not.

CHEMICAL EQUATIONS

The method of representing a chemical reaction with the help of symbols and formulas of the substances involved in it is known as chemical equation.

A word-equation shows change of reactants to products through an arrow placed between them. The reactants are written on the left-hand side (LHS) with a plus sign (+) between them. Similarly, products are written on the right-hand side (RHS) with a plus sign (+) between them. The arrowhead points towards the products, and shows the direction of the reaction.

Example: $A + B \rightarrow C + D$

In this equation, A and B are called reactants and C and D are called the products. Arrow shows the direction of chemical reaction. Condition, if any, is written generally above the arrow.

When hydrogen reacts with oxygen, it gives water. This reaction can be represented by following chemical equation:

$$\text{Hydrogen} + \text{Oxygen} \Rightarrow \text{Water}$$

$$H_2 + O_2 \rightarrow H_2O$$

In first equation words are used and in second symbols of substances are used to write the chemical equation. For convenience, symbol of substance is used to represent chemical equations. Chemical Equation is a way to represent the chemical reaction in concise and informative way.

Chemical equation can be divided into two types – Balanced Chemical Equation and Unbalanced Chemical Equation.

Balanced Chemical Equation: A balanced chemical equation has number of atoms of each element equal on both sides.

Example: $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

In this equation, numbers of zinc, hydrogen and sulphate are equal on both sides, so it is a balanced chemical equation.

Unbalanced Chemical Equation: If the number of atoms of each element in reactants is not equal to the number of atoms of each element present in product, then the chemical equation is called unbalanced chemical equation.

Example: $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

In this example number atoms of elements are not equal on two sides of the reaction. For example, on the left hand side only one iron atom is present, while three iron atoms are present on the right hand side. Therefore, it is an unbalanced chemical equation.

BALANCING A CHEMICAL EQUATION:

To balance the given or any chemical equation, follow these steps:

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

Write the number of atoms of elements present in reactants and in products in a table; as shown here.

Name of atom	No. of atoms in reactant	No. of atoms in product
Iron	1	3
Hydrogen	2	2
Oxygen	1	4

Balance the atom which is the maximum in number; on either side of chemical equation.
In this equation, the number of oxygen atom is the maximum on the RHS.
To balance the oxygen one needs to multiply the oxygen on the LHS by 4; so that the number of oxygen atoms becomes equal on both sides.

$$Fe + 4 \times H_2O \rightarrow Fe_3O_4 + H_2$$

Now, the number of hydrogen atoms becomes 8 on the LHS; which is more than that on the RHS. To balance it, one needs to multiply the hydrogen on the RHS by 4.

$$Fe + 4 \times H_2O \rightarrow Fe_3O_4 + 4 \times H_2$$

After that number of oxygen and hydrogen atoms becomes equal on both sides. The number of iron is one on the LHS, while it is three on the RHS. To balance it, multiply the iron on the LHS by 3.

$$3 \times Fe + 4 \times H_2O \rightarrow Fe_3O_4 + 4 \times H_2$$

Now the number of atoms of each element becomes equal on both sides. Thus, this equation becomes a balanced equation.

Name of atom	No. of atoms in reactant	No. of atoms in product
Iron	3	3
Hydrogen	8	8
Oxygen	4	4

After balancing, the above equation can be written as follows.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

Writing the symbols of Physical States of substances in Chemical equation:

By writing the physical states of substances a chemical equation becomes more informative.

- Gaseous state is represented by symbol 'g'
- Liquid state is represented by symbol 'l'
- Solid state is written by symbol 's'
- Aqueous solution is written by symbol 'aq'

Writing the condition in which reaction takes place: The condition is generally written above and/or below the arrow of a chemical equation.

Thus, by writing the symbols of physical state of substances and condition under which reaction takes place, a chemical equation can be made more informative.

INTEXT QUESTIONS PAGE NO. 6

Q1: Why should a magnesium ribbon be cleaned before it is burnt in air?

Answer : Magnesium is an extremely reactive metal. When stored, it reacts with oxygen to form a layer of magnesium oxide on its surface. This layer of magnesium oxide is quite stable and prevents further reaction of magnesium with oxygen. The magnesium ribbon is cleaned by sand paper for removing this layer so that the underlying metal can be exposed to air.

Question 2: Write the balanced equation for the following chemical reactions.

(i) Hydrogen + Chlorine → Hydrogen chloride

(ii) Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride

(iii) Sodium + Water → Sodium hydroxide + Hydrogen

Answer :

$$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$$

$$3BaCl_{2(s)} + Al_2(SO_4)_{3(s)} \longrightarrow 3BaSO_{4(s)} + 2AlCl_{3(s)}$$

$$2Na_{(s)} + 2H_2O_{(l)} \longrightarrow 2NaOH_{(aq)} + H_{2(g)}$$

Question 3: Write a balanced chemical equation with state symbols for the following reactions.

(i) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(ii) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Answer :

$$BaCl_{2(aq)} + Na_2SO_{4(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

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

TYPES OF CHEMICAL REACTION

Chemical reactions can be classified in following types:

- Combination Reaction
- Decomposition Reaction
- Displacement Reaction
- Double Displacement Reaction
- Oxidation and Reduction Reaction

COMBINATION REACTION

Reactions in which two or more reactants combine to form one product are called COMBINATION REACTION.
A general combination reaction can be represented by the chemical equation given here.

Example: When magnesium is burnt in air (oxygen), magnesium oxide is formed. In this reaction, magnesium is combined with oxygen.

$$Mg + O_2 \rightarrow 2MgO$$

Magnesium + Oxygen ⇨ Magnesium oxide

When carbon is burnt in oxygen (air), carbon dioxide is formed. In this reaction, carbon is combined with oxygen.

$$C + O_2 \rightarrow CO_2$$

Carbon + Oxygen ⇨ Carbon dioxide

When hydrogen reacts with chlorine, hydrogen chloride is formed.

$$H_2 + Cl_2 \rightarrow 2HCl$$

Hydrogen + Chlorine ⇨ Hydrogen chloride

When calcium oxide reacts with water, calcium hydroxide is formed

$$CaO + H_2O \rightarrow Ca(OH)_2$$

Calcium oxide + Water → Calcium hydroxide

When carbon monoxide reacts with oxygen, carbon dioxide is formed.

$$2CO + O_2 \rightarrow 2CO_2$$

Carbon monoxide + Oxygen → Carbon dioxide

DECOMPOSITION REACTION

Reactions in which one compound decomposes in two or more compounds or element are known as DECOMPOSITION REACTION. Decomposition reaction is just opposite of combination reaction.
A general decomposition reaction can be represented as follows:

Example: When calcium carbonate is heated, it decomposes into calcium oxide and carbon dioxide

$$CaCO_3 \rightarrow CaO + CO_2$$

Calcium carbonate → Calcium oxide + Carbon dioxide

When ferric hydroxide is heated, it decomposes into ferric oxide and water

$$2Fe(OH)_3 \rightarrow Fe_2O_3 + 3H_2O$$

Ferric hydroxide → Ferric oxide + Water

When lead nitrate is heated, it decomposes into lead oxide, nitrogen dioxide and oxygen.

$$2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$$

Lead nitrate ⇨ Lead oxide + Nitrogen oxide + Oxygen

In above examples, compound is decomposed because of heating, so, these reactions are called THERMAL DECOMPOSITION REACTION.

ELECTROLYTIC DECOMPOSITION

Reactions in which compounds decompose into simpler compounds because of passing of electricity, are known as ELECTROLYTIC DECOMPOSITION. This is also known as ELECTROLYSIS.

Example: When electricity is passed in water, it decomposes into hydrogen and oxygen.

$$2H_2O \rightarrow 2H_2 + O_2$$

PHOTOLYSIS OR PHOTO DECOMPOSITION REACTION

Reactions in which a compound decomposes because of sunlight are known as PHOTOLYSIS or PHOTO DECOMPOSITION REACTION.

Example: When silver chloride is put in sunlight, it decomposes into silver metal and chlorine gas.

$$2AgCl \rightarrow 2Ag + Cl_2$$

Similarly, when silver bromide is put under sunlight, it decomposes into silver metal and bromine gas.

$$2AgBr \rightarrow 2Ag + Br_2$$

Photographic paper has coat of silver chloride, which turns into grey when exposed to sunlight. It happens because silver chloride is colourless while silver is a grey metal.

INTEXT QUESTIONS PAGE NO. 10

Question 1: A solution of a substance 'X' is used for white washing.
(i) Name the substance 'X' and write its formula.
(ii) Write the reaction of the substance 'X' named in (i) above with water.

Answer : (i) The substance 'X' is calcium oxide. Its chemical formula is CaO.

(ii) Calcium oxide reacts vigorously with water to form calcium hydroxide (slaked lime).

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

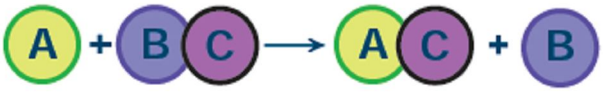
Calcium oxide	Water	Calcium hydroxide
(Quick lime)		(Slaked lime)

Question 2: Why is the amount of gas collected in one of the test tubes in Activity 1.7 double of the amount collected in the other? Name this gas.

Answer : Water (H_2O) contains two parts hydrogen and one part oxygen. Therefore, the amount of hydrogen and oxygen produced during electrolysis of water is in a 2:1 ratio. During electrolysis, since hydrogen goes to one test tube and oxygen goes to another, the amount of gas collected in one of the test tubes is double of the amount collected in the other.

DISPLACEMENT REACTION

Reactions in which atoms or ions move from one compound to other to form new compound are known as DISPLACEMENT REACTION. Displacement reaction is also known as Substitution Reaction or Single displacement /Replacement Reaction.
A general displacement reaction can be represented using chemical equation as follows:



Displacement reaction takes place only when 'A' is more reactive than B. If 'B' is more reactive than 'A', then 'A' will not displace 'C' from 'BC' and reaction will not be taken place.
Example: When zinc reacts with hydrochloric acid, it gives hydrogen gas and zinc chloride.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

When zinc reacts with copper sulphate, it forms zinc sulphate and copper metal.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

When silver metal is dipped in copper nitrate, no reaction takes place because silver metal is less reactive than copper.

$$Ag + Cu(NO_3)_2 \rightarrow \text{No reaction takes place}$$

DOUBLE DISPLACEMENT REACTION

Reactions in which ions are exchanged between two reactants forming new compounds are called double displacement reactions.

Example: When solution of barium chloride reacts with the solution of sodium sulphate, white precipitate of barium sulphate is formed along with sodium chloride.

$$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$$

When sodium hydroxide (a base) reacts with hydrochloric acid, sodium chloride and water are formed.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Double displacement reaction, in which precipitate is formed, is also known as precipitation reaction. Neutralisation reactions are also examples of double displacement reaction.

EXOTHERMIC AND ENDOTHERMIC REACTION

The chemical reactions which proceed with the evolution of heat energy are called exothermic reactions.

$$\mathbf{N_2 + 3H_2 \rightarrow 2NH_3 + Heat}$$

All combustion reactions are exothermic. Heat energy is liberated as the reaction proceeds.

The chemical reactions which proceed with the absorption of heat energy are called endothermic reactions.

$$\mathbf{2NH_3 + Heat \rightarrow N_2 + 3H_2}$$

Most of the combination reactions are endothermic. Most of the decomposition reactions are exothermic. Respiration is a decomposition reaction in which energy is released. When quick lime (calcium carbonate) is added to water, it decomposes and releases energy. Cooking involves chemical reactions which are endothermic as cooking is possible because of heating.

OXIDATION AND REDUCTION REACTION:

Oxidation: Addition of oxygen or non-metallic element or removal of hydrogen or metallic element from a compound is known as oxidation.
Elements or compounds in which oxygen or non-metallic element is added or hydrogen or metallic element is removed are called to be oxidized.
Oxidizing agent: Compounds which can add oxygen or a non-metallic compound or remove hydrogen or metallic element are known as oxidizing agents.

Reduction: Addition of hydrogen or metallic element or removal of oxygen or non-metallic element from a compound is called reduction. The compound or element which goes under reduction is called to be reduced.
Reducing agent: Compounds or elements which can cause reduction are called reducing agents.
In a chemical reaction oxidation and reduction both take place simultaneously and such reactions are also known as REDOX REACTIONS. In the word REDOX, 'Red' stands for reduction and 'Ox' stands for oxidation.

Example: When iron reacts with air, it forms iron oxide (rust)

$$4Fe + 3O_2 \rightarrow 2Fe_2O_3$$

In this reaction, oxygen is added to iron, thus, iron is oxidized. Here oxygen is oxidizing agent.
When cupric oxide reacts with hydrogen, it gives copper and water.

$$CuO + H_2 \rightarrow Cu + H_2O$$

In this reaction, oxygen is removed from copper and oxygen is added to hydrogen. So, cupric oxide is reduced to copper and hydrogen is oxidized to water. Cupric oxide is oxidizing agent and hydrogen is reducing agent.
When sodium hydroxide reacts with hydrochloric acid, it gives sodium chloride and water.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

In this reaction, sodium hydroxide is reduced to sodium chloride since hydrogen is removed from sodium hydroxide. Hydrochloric acid is oxidized to water, since oxygen is added to hydrogen chloride and non-metallic element chloride is removed. Sodium hydroxide is oxidising agent and hydrochloric acid is reducing agent.

In this reaction oxidation and reduction both takes place simultaneously, thus it is an example of redox reaction.

SIGNIFICANCE OF OXIDATION REDUCTION IN EVERYDAY LIFE:

- Respiration is oxidation reaction in which food is oxidized to produce energy.
- Iron gets oxidized to form rust; which leads to corrosion of iron in the long run.
- Most of the metals react with atmospheric oxygen and it leads to formation of a layer on the metal article. The metal gets corroded in the long run.
- Rusting of iron can be prevented by painting the iron article. This can also be prevented by applying a layer of zinc over iron article. This process is known as galvanization.
- Fried food gets oxidized when exposed to air. This spoils the taste of the food and the food becomes unfit for consumption. The spoiling of fried food because of oxidation is called rancidity. Fried food is often packed in airtight packets to prevent rancidity.

- We are able to utilize various types of fuel because of oxidation. Oxidation of fuel helps in producing energy.

CORROSION

Corrosion is defined as the slow and steady destruction of a metal by the environment. It results in the deterioration of the metal to form metal compounds by means of chemical reactions with the environment.

Corrosion is a simple electro chemical reaction. When the surface of iron is in contact with moisture and other gases in the atmosphere an electrochemical reaction occurs. In this, impure iron surface acts as the cathode and pure iron acts as anode. H_2CO_3 formed from moisture and CO_2 from air acts as electrolyte.

The electrochemical reactions are as follows:

$$Fe \rightarrow Fe^{2+} + 2e^-$$

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

The Fe^{2+} ions are oxidised to Fe^{3+} ions.

The Fe^{3+} ions combine with OH^- ions to form $Fe(OH)_3$.This becomes rust ($Fe_2O_3.xH_2O$) which is hydrated ferric oxide.

METHODS OF PREVENTING CORROSION

Corrosion of metals is prevented by not allowing them to come in contact with moisture,CO2 and O2.This is achieved by the following methods:

- **By coating with paints:** Paint coated metal surfaces keep out air and moisture.
- **By coating with oil and grease:** Application of oil and grease on the surface of iron tools prevents them from moisture and air.
- **By alloying with other metals:** Alloyed metal is more resistant to corrosion.
- **Example:** stainless steel.
- **By the process of galvanization:** This is a process of coating zinc on iron sheets by using electric current. In this zinc forms a protective layer of zinc carbonate on the surface of iron. This prevents corrosion.
- **Electroplating:** It is a method of coating one metal with another by passing electric current. Example: silver plating, nickel plating. This method not only lends protection but also enhances the metallic appearance.
- **Sacrificial protection:** Magnesium is more reactive than iron. When it is coated on the articles made of steel it sacrifices itself to protect the steel.

RANCIDITY

When fats and oils are oxidised, they become rancid and their smell and taste change. Rancidity is the chemical decomposition of fats, oils and other lipids.

There are three basic types of rancidity.

- ❖ Hydrolytic rancidity occurs when water splits fatty acid chains away from the glycerol backbone in glycerides.
- ❖ Oxidative rancidity occurs when the double bonds of an unsaturated fatty acid react chemically with oxygen.
- ❖ Microbial rancidity refers to a process in which microorganisms such as bacteria use their enzymes, including lipases, to break down chemical structures in the fat.

In each case, these chemical reactions result in undesirable odors and flavors. it is a condition produced by aerial oxidation of unsaturated fat present in foods and other products, marked by unpleasant odour or flavour.

When a fatty substance is exposed to air, its unsaturated components are converted into hydroperoxides, which break down into volatile aldehydes, esters, alcohols, ketones, and hydrocarbons, some of which have disagreeable odours.

Butter becomes rancid by the foregoing process and by hydrolysis, which liberates volatile and malodorous acids, particularly butyric acid. Saturated fats such as beef tallow are resistant to oxidation and seldom become rancid at ordinary temperatures.

Usually substances which prevent oxidation (antioxidants) are added to foods containing fats and oil. Keeping food in air tight containers helps to slow down oxidation.

Rancidity can be avoided by:
1. Storing food in air tight containers
2. Storing food in refrigerators
3. Adding antioxidants
4. Storing food in an environment of nitrogen

INTEXT QUESTIONS PAGE NO. 13

Question 1: Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Answer : When an iron nail is placed in a copper sulphate solution, iron displaces copper from copper sulphate solution forming iron sulphate, which is green in colour.

$$Fe_{(s)} + CuSO_{4(aq)} \longrightarrow FeSO_{4(aq)} + Cu_{(s)}$$

Iron	Copper sulphate (Blue colour)	Iron sulphate (Green colour)	Copper

Therefore, the blue colour of copper sulphate solution fades and green colour appears.

Question 2: Give an example of a double displacement reaction other than the one given in Activity 1.10.

Answer : Sodium carbonate reacts with calcium chloride to form calcium carbonate and sodium chloride.

$$Na_2CO_{3(aq)} + CaCl_{2(aq)} \longrightarrow CaCO_{3(s)} + 2NaCl_{(aq)}$$

Sodium carbonate	Calcium chloride	Calcium carbonate	Sodium chloride

In this reaction, sodium carbonate and calcium chloride exchange ions to form two new compounds. Hence, it is a double displacement reaction.

Question 3: Identify the substances that are oxidised and the substances that are reduced in the following reactions.

$$4Na_{(s)} + O_{2(g)} \longrightarrow 2Na_2O_{(s)}$$

$$CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)}$$

Answer : (i) Sodium (Na) is oxidised as it gains oxygen and oxygen gets reduced.

(ii) Copper oxide (CuO) is reduced to copper (Cu) while hydrogen (H_2) gets oxidised to water (H_2O).

EXERCISE QUESTIONS PAGE NO. 14, 15 and 16

Question 1: Which of the statements about the reaction below are incorrect?

$$2PbO_{(s)} + C_{(s)} \longrightarrow 2Pb_{(s)} + CO_{2(g)}$$

(a) Lead is getting reduced.
(b) Carbon dioxide is getting oxidised.
(c) Carbon is getting oxidised.
(d) Lead oxide is getting reduced.
(i) (a) and (b)
(ii) (a) and (c)
(iii) (a), (b) and (c)
(iv) all
Answer : (i)(a) and (b)

Question 2:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

The above reaction is an example of a
(a) combination reaction.
(b) double displacement reaction.
(c) decomposition reaction.
(d) displacement reaction.
Answer : (d) The given reaction is an example of a displacement reaction.

Question 3: What happens when dilute hydrochloric acid is added to iron filings? Tick the correct answer.
(a) Hydrogen gas and iron chloride are produced.
(b) Chlorine gas and iron hydroxide are produced.
(c) No reaction takes place.
(d) Iron salt and water are produced.
Answer : (a) Hydrogen gas and iron chloride are produced. The reaction is as follows:

$$Fe_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_2 \uparrow$$

Question 4: What is a balanced chemical equation? Why should chemical equations be balanced?
Answer : A reaction which has an equal number of atoms of all the elements on both sides of the chemical equation is called a balanced chemical equation.
The law of conservation of mass states that mass can neither be created nor destroyed. Hence, in a chemical reaction, the total mass of reactants should be equal to the total mass of the products. It means that the total number of atoms of each element should be equal on both sides of a chemical equation. Hence, it is for this reason that chemical equations should be balanced.

Question 5: Translate the following statements into chemical equations and then balance them.
(a) Hydrogen gas combines with nitrogen to form ammonia.
(b) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.
(c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.
(d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Answer :

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

(b) $2H_2S_{(g)} + 3O_{2(g)} \longrightarrow 2H_2O_{(l)} + 2SO_{2(g)}$

(c) $3BaCl_{2(aq)} + Al_2(SO_4)_{3(aq)} \longrightarrow 2AlCl_{3(aq)} + 3BaSO_{4(s)}$

(d) $2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)}$

Question 6: Balance the following chemical equations.

(a) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

(b) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(c) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Answer :

(a) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$

(b) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(c) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(d) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Question 7: Write the balanced chemical equations for the following reactions.
(a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water
(b) Zinc + Silver nitrate → Zinc nitrate + Silver
(c) Aluminium + Copper chloride → Aluminium chloride + Copper
(d) Barium chloride + Potassium sulphate → Barium sulphate + Potassium chloride
Answer :

(a) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(b) $Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag$

(c) $2Al + 3CuCl_2 \longrightarrow 2AlCl_3 + 3Cu$

(d) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2KCl$

Question 8: Write the balanced chemical equation for the following and identify the type of reaction in each case.
(a)Potassium bromide (aq) + Barium iodide (aq) → Potassium iodide (aq) + Barium bromide(s)
(b) Zinc carbonate (s) → Zinc oxide (s) + Carbon dioxide (g)
(c) Hydrogen (g) + Chlorine (g) → Hydrogen chloride (g)
(d) Magnesium (s) + Hydrochloric acid (aq) → Magnesium chloride (aq) + Hydrogen (g)
Answer :

(a) $2KBr_{(aq)} + BaI_{2(aq)} \longrightarrow 2KI_{(aq)} + BaBr_{2(s)}$; Double displacement reaction

(b) $ZnCO_{3(s)} \longrightarrow ZnO_{(s)} + CO_{2(g)}$; Decomposition reaction

(c) $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$; Combination reaction

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

Question 9: What does one mean by exothermic and endothermic reactions? Give examples.

Answer : Chemical reactions that release energy in the form of heat, light, or sound are called exothermic reactions.

Example: Mixture of sodium and chlorine to yield table salt

$$Na_{(s)} + \frac{1}{2} Cl_{2(s)} \longrightarrow NaCl_{(s)} + 411 \text{ kJ of energy}$$

In other words, combination reactions are exothermic.

Reactions that absorb energy or require energy in order to proceed are called endothermic reactions.

For example: In the process of photosynthesis, plants use the energy from the sun to convert carbon dioxide and water to glucose and oxygen.

$$6CO_{2(g)} + 6H_2O_{(l)} \xrightarrow{\text{Sunlight}} \underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + 6O_{2(g)}$$

Question 10: Why is respiration considered an exothermic reaction? Explain.

Answer : Energy is required to support life. Energy in our body is obtained from the food we eat. During digestion, large molecules of food are broken down into simpler substances such as glucose. Glucose combines with oxygen in the cells and provides energy. The special name of this combustion reaction is respiration. Since energy is released in the whole process, it is an exothermic process.

$$\underset{\text{Glucose}}{C_6H_{12}O_{6(aq)}} + \underset{\text{Oxygen}}{6O_{2(g)}} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_{2(g)}} + \underset{\text{Water}}{6H_2O_{(l)}} + \text{Energy}$$

Question 11: Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Answer : Decomposition reactions are those in which a compound breaks down to form two or more substances. These reactions require a source of energy to proceed. Thus, they are the exact opposite of combination reactions in which two or more substances combine to give a new substance with the release of energy.

Decomposition reaction: $AB + \text{Energy} \longrightarrow A + B$

$$2H_2O_{(l)} \xrightarrow{\text{Electrolysis}} 2H_{2(g)} + O_{2(g)}$$

Combination reaction: $A + B \longrightarrow AB + \text{Energy}$

$$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)} + \text{Energy}$$

Question 12: Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

Answer : (a) Thermal decomposition:

$$\underset{\text{Ferrous sulphate}}{2FeSO_{4(s)}} \xrightarrow{\Delta} \underset{\text{Ferric oxide}}{Fe_2O_{3(s)}} + \underset{\text{Sulphur dioxide}}{SO_{2(g)}} + \underset{\text{Sulphur trioxide}}{SO_{3(g)}}$$

(b) Decomposition by light:

$$\underset{\text{Silver chloride}}{2AgCl_{(s)}} \xrightarrow{\text{Light}} \underset{\text{Silver}}{2Ag_{(s)}} + \underset{\text{Chlorine}}{Cl_{2(g)}}$$

(c) Decomposition by electricity:

$$2Al_2O_{3(aq)} \xrightarrow{\text{Electricity}} 4Al_{(s)} + 3O_{2(g)}$$

Aluminium oxide Aluminium Oxygen

Question 13: What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Answer : In a displacement reaction, a more reactive element replaces a less reactive element from a compound.

$$A + BX \longrightarrow AX + B;$$

where A is more reactive than B

In a double displacement reaction, two atoms or a group of atoms switch places to form new compounds.

$$AB + CD \longrightarrow AD + CB$$

For example:

Displacement reaction:

$$CuSO_{4(aq)} + Zn_{(s)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$$

Double displacement reaction:

$$Na_2SO_{4(aq)} + BaCl_{2(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

Question 14: In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Answer :

$$2AgNO_{3(aq)} + Cu_{(s)} \longrightarrow Cu(NO_3)_{2(aq)} + 2Ag_{(s)}$$

Silver nitrate Copper Copper nitrate Silver

Question 15: What do you mean by a precipitation reaction? Explain by giving examples.

Answer : A reaction in which an insoluble solid (called precipitate) is formed is called a precipitation reaction.

For example:

$$Na_2CO_{3(aq)} + CaCl_{2(aq)} \longrightarrow CaCO_{3(s)} + 2NaCl_{(aq)}$$

Sodium carbonate Calcium chloride Calcium carbonate Sodium chloride

In this reaction, calcium carbonate is obtained as a precipitate. Hence, it is a precipitation reaction.

Another example of precipitation reaction is:

$$Na_2SO_{4(aq)} + BaCl_{2(aq)} \longrightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

Sodium sulphate Barium chloride Barium sulphate Sodium chloride

In this reaction, barium sulphate is obtained as a precipitate.

Question 16: Explain the following in terms of gain or loss of oxygen with two examples each. (a) Oxidation (b) Reduction

Answer : (a) Oxidation is the gain of oxygen.

For example:

(i) $CO_2 + \underbrace{H_2}_{\text{Addition of oxgyen - oxidation}} \longrightarrow CO + H_2O$

(ii) $\underbrace{2Cu + O_2}_{\text{Gain of oxgyen - oxidation}} \longrightarrow 2CuO$

In equation (i), H_2 is oxidized to H_2O and in equation (ii), Cu is oxidised to CuO.
(b) Reduction is the loss of oxygen.
For example:

(i) $\underbrace{CO_2 + H_2 \longrightarrow CO + H_2O}_{\text{Removal of oxgyen – reduction}}$

(ii) $\underbrace{CuO + H_2 \xrightarrow{\Delta} Cu + H_2O}_{\text{Loss of oxgyen – reduction}}$

In equation (i), CO_2 is reduced to CO and in equation (ii), CuO is reduced to Cu.

Question 17: A shiny brown-coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.
Answer : 'X' is copper (Cu) and the black-coloured compound formed is copper oxide (CuO). The equation of the reaction involved on heating copper is given below.

$$\underset{\text{(Shiny brown in colour)}}{2Cu} + O_2 \xrightarrow{\text{Heat}} \underset{\text{(Black in colour)}}{2CuO}$$

Question 18: Why do we apply paint on iron articles?
Answer : Iron articles are painted because it prevents them from rusting. When painted, the contact of iron articles from moisture and air is cut off. Hence, rusting is prevented. So presence of air and moisture is essential for rusting to take place.

Question 19: Oil and fat containing food items are flushed with nitrogen. Why?
Answer : Nitrogen is an inert gas and does not easily react with these substances. On the other hand, oxygen reacts with food substances and makes them rancid. Thus, bags used in packing food items are flushed with nitrogen gas to remove oxygen inside the pack. When oxygen is not present inside the pack, rancidity of oil and fat containing food items is avoided.

Question 20: Explain the following terms with one example each.
(a) Corrosion (b) Rancidity
Answer :
(a) Corrosion:
Corrosion is defined as a process where materials, usually metals, deteriorate as a result of a chemical reaction with air, moisture, chemicals, etc.
For example, iron, in the presence of moisture, reacts with oxygen to form hydrated iron oxide.

$$4Fe + 3O_2 + nH_2O \longrightarrow \underset{\text{Hydrated iron oxide}}{2Fe_2O_3.nH_2O}$$

This hydrated iron oxide is rust.

(b) Rancidity:
The process of oxidation of fats and oils that can be easily noticed by the change in taste and smell is known as rancidity.
For example, the taste and smell of butter changes when kept for long.
Rancidity can be avoided by:
1. Storing food in air tight containers
2. Storing food in refrigerators
3. Adding antioxidants
4. Storing food in an environment of nitrogen

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 1
CHEMICAL REACTIONS AND EQUATIONS

VERY SHORT ANSWER TYPE QUESTIONS

1. How are chemical reactions expressed in the shortest way?

2. What is the type of reaction in which the reactant gives simpler products?

3. What is the type of reaction in which two or more reactants combine to a give a single product?

4. In which type of reaction does an exchange of partners take place?

5. Why are chemical equations balanced?

6. What symbol is used to indicate a solution made in water?

7. What type of reaction does occur during the digestion of food inside our body?

8. What type of reaction is represented by the following equation?

$$CaCO_3 \rightarrow CaO + CO_2$$

9. What type of reaction does occur when silver bromide is exposed to sunlight?

10. A solution of a substance is used for white-washing. Name the substance with its formula.

11. Name the type of reaction which is represented by the following equations:

$$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$$

12. Balance the following equation using state symbols: $Fe + HCl \rightarrow FeCl_2 + H_2$.

13. Express the following statement in the form of a balanced chemical equation: “Sodium reacts with water to form sodium hydroxide and hydrogen”.

14. Write the balanced chemical equation for the reaction that occurs between aluminium hydroxide and sulphuric acid forming aluminium sulphate and water.

15. What type of reaction does occur when ammonia is allowed to react with hydrogen chloride?

16. Name the type of reaction involved when a zinc plate is dipped in a solution of copper sulphate?

17. In the reaction, $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(l)$. Pick out the following:

(i) the substance which is oxidised

(ii) the substance which is reduced

(iii) the oxidizing agent

(iv) the reducing agent

18. What chemical reaction is involved in the corrosion of iron?

19. Aluminum metal when burnt in air forms aluminium oxide. Write the balanced chemical equation for the reaction.

20. Is the reaction represented by the following reaction a displacement reaction?

$$2KI + Cl_2 \rightarrow 2KCl + I_2$$

21. Express the following reaction in the form of a balanced chemical equation: "When a strip of copper is dipped in a solution of silver nitrate, silver metal is precipitated and a solution of copper nitrate is produced."

22. Write the following equation in a balanced form?

$$NH_3 + O_2 \rightarrow N_2 + 2H_2O$$

23. What is the process called in which a substance is converted into a new substance?

24. Name the gas evolved when a magnesium ribbon is dropped into dilute sulphuric acid?

25. Give an example of a double displacement reaction.

26. Is copper more reactive than iron? Give the equation of the reaction in support of your answer?

27. Can a combustion reaction be a redox reaction?

28. Can a double displacement reaction be a redox reaction?

29. State one characteristics of the chemical reaction when lemon juice is added gradually to potassium permanganate solution?

30. Which gas does evolve when dilute HCl is added to sodium carbonate?

31. Why is photochemical reaction considered an endothermic reaction?

32. Which term is applied for the process in which unpleasant smell and taste develop in foods containing fats and oils?

33. What are the substances called which are added to foods containing fats and oils to protect them from becoming rancid?

34. Why are potato chips packaged in nitrogen?

35. In the refining of silver, silver is obtained from silver nitrate by using copper metal. Write down the reaction involved?

36. A shiny brown coloured element when heated in air becomes black. Name the element and the black coloured substance so formed.

37. Name the substance which is oxidised in the following reaction:

$$H_2S + Cl_2 \rightarrow 2HCl + S$$

38. Why are all decomposition reactions endothermic?

39. Is the decomposition of vegetable matter into compost an exothermic reaction?

40. Why is photosynthesis an endothermic reaction?

41. Balance the following equation:

(i) $MNO_2 + HCl \rightarrow MNCl_2 + Cl_2 + H_2O$

(ii) $Na + O_2 \rightarrow Na_2O$

(iii) $H_2O_2 \rightarrow H_2O + O_2$

(iv) $Mg(OH)_2 + HCl \rightarrow MgCl_2 + H_2O$

(v) $Fe + O_2 \rightarrow Fe_2O_3$

(vi) $Al(OH)_3 \rightarrow Al_2O_3 + H_2O$

(vii) $NH_3 + CuO \rightarrow Cu + N_2 + H_2O$

(viii) $Al_2(SO_4)_3 + NaOH \rightarrow Al(OH)_3 + Na_2SO_4$

(ix) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$

(x) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

(xi) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + HCl$

(xii) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water

(xiii) Aluminium + Copper chloride → Aluminium chloride + Copper

(xiv) Calcium + Water → Calcium hydroxide + Hydrogen

(xv) Sulphur dioxide + Oxygen → Sulphur trioxide

(xvi) $MnO_2 + HCl \rightarrow MnCl_2 + Cl_2 + H_2O$

(xvii) $Zn + HCl \rightarrow ZnCl_2$

SHORT ANSWER TYPE QUESTIONS

1. What do you mean by a Chemical reaction? Give an example of a chemical reaction.

2. What do you mean by a combination reaction? Give an example.

3. What do you mean by a displacement reaction? Give an example.

4. What do you mean by a decomposition reaction? Give an example.

5. What do you mean by a double displacement reaction? Give an example.

6. Explain the term “Electrolytic decomposition”, giving a suitable example.

7. Mention any two uses of decomposition reaction.

8. Give an example of a reaction in which a less reactive non-metal is displaced by a more reactive non-metal.

9. Why does the blue colour of copper sulphate change when a piece of iron is dropped into it?

10. In the reactions given below, identify the substances that act as oxidizing and reducing agents:

(i) $4Na\ (s) + O_2\ (g) \rightarrow 2Na_2O\ (s)$

(ii) $ZnO\ (s) + C(s) \rightarrow Zn(s) + CO\ (g)$

11. Write the balanced chemical equation for the following reactions and identify the type of reaction in each case:

(i) Potassium chloride (aq) + Barium iodide (aq) → Potassium iodide (aq) + barium chloride (s)

(ii) Zinc carbonate (s) → Zinc oxide (s) + Carbon dioxide (g)

(iii) Hydrogen (g) + Chlorine (g) → Hydrogen chloride (g)

(iv) Magnesium (s) + Hydrochloride acid (aq) → Magnesium chloride (aq) + Hydrogen(g)

12. Name the type of reaction involved in the reactions represented by the following equations:

(i) $CaO + H_2O \rightarrow Ca(OH)_2$

(ii) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

(iii) $Al_2(SO_4)_3 + 6NH_4OH \rightarrow 2Al(OH)_3 + 3(NH_4)_2SO_4$

(iv) $CaCO_3 \rightarrow CaO + CO_2$

(v) $H_2 + Cl_2 \rightarrow 2HCl$

13. Why is magnesium ribbon cleaned before burning it in air?

14. State the characteristics of a chemical reaction.

15. What is a chemical equation?

16. Write the balanced chemical equations for the following chemical reactions:

(i) Hydrogen + Chlorine → Hydrogen Chloride

(ii) Barium Chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride

(iii) Sodium + water → Sodium Chloride + hydrogen

17. Write a balanced chemical equation with state symbols for the following reactions:

(i) Solutions of barium chloride and sodium sulphate in water react to give a precipitate of barium sulphate and the solution of sodium chloride.

(ii) Sodium hydroxide solution (in water) reacts with hydrochloride acid solution (in water) to produce sodium chloride solution and water.

18. How can you explain that respiration is an exothermic reaction?

19. What do you mean by a precipitation reaction? Explain by giving example.

20. What are anti-oxidants? Name two substances which are usually used as anti-oxidants.

21. State any two ways to prevent the rancidity of food containing oils and fats.

22. What observations do you expect to get when granulated zinc taken in a test tube is treated with dilute sulphuric acid?

23. Give an example of a chemical reaction which take place with fall in temperature.

24. State on characteristic of chemical reaction taking place when

(i) dilute sulphuric acid is made to react with marble chips.

(ii) lemon juice is added to a solution of potassium permanganate.

(iii) dilute hydrochloride acid is added to a solution of lead nitrate in the cold.

(iv) water is added to quick lime.

25. Which of the following reactions are exothermic and which are endothermic?

(i) Burning of natural gas

(ii) Photosynthesis

(iii) Electrolysis of water

(iv) Respiration

26. What would you observe when lead nitrate is heated in a test tube?

27. Why is respiration considered an exothermic reaction?

28. Give an example of a decomposition reaction. Describe an activity to illustrate such a reaction by heating.

29. When hydrogen is passed over copper oxide, copper and steam are formed. Write a balanced equation for this reaction and state which of the chemicals are (i) elements (ii)compounds (iii) reactants (iv) products (v) metals (vi) non-metals

30. (a) What is a balanced chemical equation? Why should chemical equations be balanced?

(b) Aluminium burns in chlorine to form aluminium chloride. Write a balanced chemical equation for this reaction.

LONG ANSWER TYPE QUESTIONS

1. Balance the chemical equations for the following reactions:

(i) $Cu + H_2SO_4 \rightarrow CuSO_4 + SO_2 + H_2O$

(ii) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

2. Differentiate between balanced and an unbalanced chemical equation.

3. Write the following chemical equation with state symbols:

(i) $CaCO_3 \rightarrow CaO + CO_2$

(ii) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

(iii) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

(iv) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

4. What do you mean by exothermic and endothermic reactions? Give examples.

5. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

6. Explain, how do oxidation and reduction processes occur simultaneously.

7. What is corrosion? Write the chemical reaction that takes place during the corrosion of iron?

8. What are the various ways to make a chemical equation more informative?

9. Explain the following terms: (i) corrosion (ii) Rancidity

10. When metal X is treated with a dilute acid Y, then a gas Z is evolved which burns readily by making a little explosion.

(a) Name any two metals which can behave like metal X.

(b) Name any two acids which can behave like acid Y.

(c) Name the gas Z.

(d) Is the gas Z lighter than or heavier than air?

(e) Is the reaction between metal X and acid Y exothermic or endothermic?

(f) By taking a specific example of metal X and dilute acid Y, write a balanced chemical equation for the reaction which takes place. Also indicate physical state of all the reactants and products.

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 1
CHEMICAL REACTIONS AND EQUATIONS

1. What is a balanced chemical equation? Why should chemical equations be balanced?

2. Balance the following chemical equations.
a) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
b) $Hg(NO_3)_2 + KI \rightarrow HgI_2 + KNO_3$
c) $H_2 + O_2 \rightarrow H_2O$
d) $KClO_3 \rightarrow KCl + O_2$
e) $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

3. Write the balanced chemical equations for the following reactions.
a) Zinc + Silver nitrate → Zinc nitrate + Silver.
b) Aluminum + copper chloride → Aluminum chloride + Copper.
c) Hydrogen + Chlorine. → Hydrogen chloride.
d) Ammonium nitrate → Nitrogen + Carbon dioxide + water.

4. Write the balanced chemical equation for the following and indentify the type of reaction in each case.
a) Calcium hydroxide $_{(aq)}$ + Nitric acid $_{(aq)}$ → Water $_{(l)}$ + Calcium nitrate $_{(aq)}$
b) Magnesium $_{(s)}$ + Iodine $_{(g)}$ → Magnesium Iodide. $_{(s)}$
c) Magnesium$_{(s)}$ + Hydrochloric acid$_{(aq)}$ → Magnesium chloride$_{(aq)}$ + Hydrogen$_{(g)}$
d) Zinc$_{(s)}$ + Calcium chloride $_{(aq)}$ → Zinc Chloride $_{(aq)}$ + Ca$_{(s)}$

5. $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$.
The above reaction is an example of:
a) Combination reaction b) Decomposition reaction
c) Displacement reaction d) Double decomposition reaction

6. What happens when dil.hydrochloric acid is added to iron filings? Chose the correct answer.
a) Hydrogen gas and iron chloride are produced.
b) Chlorine gas and iron hydroxide are produced.
c) No reaction takes place.
d) Iron salt and water are produced.

7. Write an equation for decomposition reaction where energy is supplied in the form of heat/ light/ electricity.

8. What do you mean by precipitation reaction?

9. Why is respiration considered as an exothermic reaction? Explain.

10. What is the difference between displacement and double displacement reactions? Write equations for these reactions?

11. What is the use of keeping food in air tight containers?

12. What do you mean by corrosion? How can you prevent it?

13. $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$
In the above equation, name the compound which is oxidized and which is reduced?

14. Match the following:

1) $2AgNO_3 + Na_2CrO_4 \rightarrow Ag_2CrO_4 + 2NaNO_3$	( ) a) combination reactions
2) $2\ NH_3 \rightarrow N_2 + 3H_2$	( ) b) decomposition reactions
3) $C_2H_4 + H_2O \rightarrow C_2H_6O$	( ) c) displacement reactions
4) $Fe_2O_3 + 3CO \rightarrow 2\ F_2 + 3CO_2$	( ) d) double displacement Reactions

15. Give two examples for oxidation-reduction reaction.

16. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write the reaction involved.

17. Explain rancidity.

18. Name the reactions taking place in the presence of sunlight?

19. $2\ PbO_{(s)} + C_{(s)} \rightarrow 2Pb_{(s)} + CO_{2\,(g)}$
Which of the following statements are correct for the above?
a) Lead is reduced. b) Carbon dioxide is oxidized.
c) Carbon is oxidized. d) Lead oxide is reduced.
i) (a)and (b) ii) (a) and (c) iii) (a), (b), and (c) d) all.

20. Balance the following chemical equations including the physical states.
a) $C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$
b) $Fe + O_2 \rightarrow Fe_2O_3$
c) $NH_3 + Cl_2 \rightarrow N_2H_4 + NH_4cl$
d) $Na + H_2O \rightarrow NaOH + H_2$

21. Balance the chemical equation by including the physical states of the substances for the following reactions.
a) Barium chloride and sodium sulphate aqueous solutions react to give insoluble Barium sulphate and aqueous solution of sodium chloride.
b) Sodium hydroxide reacts with hydrochloric acid to produce sodium chloride and water.
c) Zinc pieces react with dilute hydrochloric acid to liberate hydrogen gas and forms zinc chloride

22. Which of the following is not a physical change?
(a) Boiling of water to give water vapour
(b) Melting of ice to give water
(c) Dissolution of salt in water
(d) Combustion of Liquefied Petroleum Gas (LPG)

23. The following reaction is an example of a
$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$
(i) displacement reaction
(ii) combination reaction
(iii) redox reaction

(iv) neutralisation reaction

(a) (i) and (iv)
(b) (ii) and (iii)
(c) (i) and (iii)
(d) (iii) and (iv)

24. Which of the following statements about the given reaction are correct?

$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

(i) Iron metal is getting oxidised
(ii) Water is getting reduced
(iii) Water is acting as reducing agent
(iv) Water is acting as oxidising agent

(a) (i), (ii) and (iii)
(b) (iii) and (iv)
(c) (i), (ii) and (iv)
(d) (ii) and (iv)

25. Which of the following are exothermic processes?
(i) Reaction of water with quick lime
(ii) Dilution of an acid
(iii) Evaporation of water
(iv) Sublimation of camphor (crystals)

(a) (i) and (ii)
(b) (ii) and (iii)
(c) (i) and (iv)
(d) (iii) and (iv)

26. Three beakers labelled as A, B and C each containing 25 mL of water were taken. A small amount of NaOH, anhydrous $CuSO_4$ and NaCl were added to the beakers A, B and C respectively. It was observed that there was an increase in the temperature of the solutions contained in beakers A and B, whereas in case of beaker C, the temperature of the solution falls. Which one of the following statement(s) is(are) correct?
(i) In beakers A and B, exothermic process has occurred.
(ii) In beakers A and B, endothermic process has occurred.
(iii) In beaker C exothermic process has occurred.
(iv) In beaker C endothermic process has occurred.

(a) (i) only
(b) (ii) only
(c) (i) and (iv)
(d) (ii) and (iii)

27. A dilute ferrous sulphate solution was gradually added to the beaker containing acidified permanganate solution. The light purple colour of the solution fades and finally disappears. Which of the following is the correct explanation for the observation?
(a) $KMnO_4$ is an oxidising agent, it oxidises $FeSO_4$
(b) $FeSO_4$ acts as an oxidising agent and oxidises $KMnO_4$
(c) The colour disappears due to dilution; no reaction is involved
(d) $KMnO_4$ is an unstable compound and decomposes in presence of $FeSO_4$ to a colourless compound.

28. Which among the following is(are) double displacement reaction(s)?
(i) $Pb + CuCl_2 \rightarrow PbCl_2 + Cu$
(ii) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$
(iii) $C + O_2 \rightarrow CO_2$
(iv) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

(a) (i) and (iv)
(b) (ii) only
(c) (i) and (ii)
(d) (iii) and (iv)

29. Which among the following statement(s) is(are) true? Exposure of silver chloride to sunlight for a long duration turns grey due to
(i) the formation of silver by decomposition of silver chloride
(ii) sublimation of silver chloride
(iii) decomposition of chlorine gas from silver chloride
(iv) oxidation of silver chloride

(a) (i) only
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (iv) only

30. Solid calcium oxide reacts vigorously with water to form calcium hydroxide accompanied by liberation of heat. This process is called slaking of lime. Calcium hydroxide dissolves in water to form its solution called lime water. Which among the following is (are) true about slaking of lime and the solution formed?
(i) It is an endothermic reaction
(ii) It is an exothermic reaction
(iii) The pH of the resulting solution will be more than seven
(iv) The pH of the resulting solution will be less than seven

(a) (i) and (ii)
(b) (ii) and (iii)
(c) (i) and (iv)
(d) (iii) and (iv)

31. Barium chloride on reacting with ammonium sulphate forms barium sulphate and ammonium chloride. Which of the following correctly represents the type of the reaction involved?
(i) Displacement reaction
(ii) Precipitation reaction
(iii) Combination reaction
(iv) Double displacement reaction

(a) (i) only
(b) (ii) only
(c) (iv) only
(d) (ii) and (iv)

32. Electrolysis of water is a decomposition reaction. The mole ratio of hydrogen and oxygen gases liberated during electrolysis of water is
(a) 1:1

(b) 2:1
(c) 4:1
(d) 1:2

33. Which of the following is(are) an endothermic process(es)?
(i) Dilution of sulphuric acid
(ii) Sublimation of dry ice
(iii) Condensation of water vapours
(iv) Evaporation of water

(a) (i) and (iii)
(b) (ii) only
(c) (iii) only
(d) (ii) and (iv)

34. In the double displacement reaction between aqueous potassium iodide and aqueous lead nitrate, a yellow precipitate of lead iodide is formed. While performing the activity if lead nitrate is not available, which of the following can be used in place of lead nitrate?
(a) Lead sulphate (insoluble)
(b) Lead acetate
(c) Ammonium nitrate
(d) Potassium sulphate

35. Which of the following gases can be used for storage of fresh sample of an oil for a long time?
(a) Carbon dioxide or oxygen
(b) Nitrogen or oxygen
(c) Carbon dioxide or helium
(d) Helium or nitrogen

36. The following reaction is used for the preparation of oxygen gas in the laboratory

$$2KClO_3\,(s) \xrightarrow[\text{Catalyst}]{\text{Heat}} 2KCl\,(s) + 3O_2\,(g)$$

Which of the following statement(s) is(are) correct about the reaction?
(a) It is a decomposition reaction and endothermic in nature
(b) It is a combination reaction
(c) It is a decomposition reaction and accompanied by release of heat
(d) It is a photochemical decomposition reaction and exothermic in nature

37. Which one of the following processes involve chemical reactions?
(a) Storing of oxygen gas under pressure in a gas cylinder
(b) Liquefaction of air
(c) Keeping petrol in a china dish in the open
(d) Heating copper wire in presence of air at high temperature

38. In which of the following chemical equations, the abbreviations represent the correct states of the reactants and products involved at reaction temperature?
(a) $2H_2(l) + O_2(l) \rightarrow 2H_2O(g)$
(b) $2H_2(g) + O_2(l) \rightarrow 2H_2O(l)$
(c) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
(d) $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

39. Which of the following are combination reactions?

(i) $2KClO_3 \xrightarrow{Heat} 2KCl + 3O_2$

(ii) $MgO + H_2O \longrightarrow Mg(OH)_2$

(iii) $4Al + 3O_2 \longrightarrow 2Al_2O_3$

(iv) $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$

(a) (i) and (iii)
(b) (iii) and (iv)
(c) (ii) and (iv)
(d) (ii) and (iii)

40. Write the balanced chemical equations for the following reactions and identify the type of reaction in each case.

(a) Nitrogen gas is treated with hydrogen gas in the presence of a catalyst at 773K to form ammonia gas.
(b) Sodium hydroxide solution is treated with acetic acid to form sodium acetate and water.
(c) Ethanol is warmed with ethanoic acid to form ethyl acetate in the presence of concentrated H_2SO_4 .
(d) Ethene is burnt in the presence of oxygen to form carbon dioxide, water and releases heat and light.

41. Write the balanced chemical equations for the following reactions and identify the type of reaction in each case.

(a) Thermit reaction, iron (III) oxide reacts with aluminium and gives molten iron and aluminium oxide.
(b) Magnesium ribbon is burnt in an atmosphere of nitrogen gas to form solid magnesium nitride.
(c) Chlorine gas is passed in an aqueous potassium iodide solution to form potassium chloride solution and solid iodine.
(d) Ethanol is burnt in air to form carbon dioxide, water and releases heat.

42. Complete the missing components/variables given as *x* and *y* in the following reactions

(a) $Pb(NO_3)_2\ (aq) + 2KI(aq) \longrightarrow PbI_2\ (x) + 2KNO_3(y)$

(b) $Cu(s) + 2Ag\ NO_3(aq) \longrightarrow Cu(NO_3)_2(aq) + x(s)$

(c) $Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(x) + H_2(y)$

(d) $CaCO_3(s) \xrightarrow{x} CaO(s) + CO_2(g)$

43. Which among the following changes are exothermic or endothermic in nature?

(a) Decomposition of ferrous sulphate
(b) Dilution of sulphuric acid
(c) Dissolution of sodium hydroxide in water
(d) Dissolution of ammonium chloride in water

44. Write the balanced chemical equations for the following reactions

(a) Sodium carbonate on reaction with hydrochloric acid in equal molar concentrations gives sodium chloride and sodium hydrogencarbonate.
(b) Sodium hydrogencarbonate on reaction with hydrochloric acid gives sodium chloride, water and liberates carbon dioxide.

(c) Copper sulphate on treatment with potassium iodide precipitates cuprous iodide ($Cu_2 I_2$), liberates iodine gas and also forms potassium sulphate.

45. Identify the reducing agent in the following reactions

(a) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

(b) $H_2O + F_2 \longrightarrow HF + HOF$

(c) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

(d) $2H_2 + O_2 \longrightarrow 2H_2O$

46. Identify the oxidising agent (oxidant) in the following reactions

(a) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + Cl_2 + 4H_2O$

(b) $2Mg + O_2 \longrightarrow 2MgO$

(c) $CuSO_4 + Zn \longrightarrow Cu + ZnSO_4$

(d) $V_2O_5 + 5Ca \longrightarrow 2V + 5CaO$

(e) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(f) $CuO + H_2 \longrightarrow Cu + H_2O$

47. A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction?

48. Ferrous sulphate decomposes with the evolution of a gas having a characteristic odour of burning sulphur. Write the chemical reaction involved and identify the type of reaction.

49. Why do fire flies glow at night?

50. Grapes hanging on the plant do not ferment but after being plucked from the plant can be fermented. Under what conditions do these grapes ferment? Is it a chemical or a physical change?

51. Which among the following are physical or chemical changes?

(a) Evaporation of petrol
(b) Burning of Liquefied Petroleum Gas (LPG)
(c) Heating of an iron rod to red hot.
(d) Curdling of milk
(e) Sublimation of solid ammonium chloride

52. During the reaction of some metals with dilute hydrochloric acid, following observations were made.

(a) Silver metal does not show any change
(b) The temperature of the reaction mixture rises when aluminium (Al) is added.
(c) The reaction of sodium metal is found to be highly explosive
(d) Some bubbles of a gas are seen when lead (Pb) is reacted with the acid.

Explain these observations giving suitable reasons.

53. A substance X, which is an oxide of a group 2 element, is used intensively in the cement industry. This element is present in bones also. On treatment with water it forms a solution which turns red litmus blue. Identify X and also write the chemical reactions involved.

54. Write a balanced chemical equation for each of the following reactions and also classify them.
(a) Lead acetate solution is treated with dilute hydrochloric acid to form lead chloride and acetic acid solution.
(b) A piece of sodium metal is added to absolute ethanol to form sodium ethoxide and hydrogen gas.
(c) Iron (III) oxide on heating with carbon monoxide gas reacts to form solid iron and liberates carbon dioxide gas.
(d) Hydrogen sulphide gas reacts with oxygen gas to form solid sulphur and liquid water.

55. Why do we store silver chloride in dark coloured bottles?

56. Balance the following chemical equations and identify the type of chemical reaction.

57. A magnesium ribbon is burnt in oxygen to give a white compound X accompanied by emission of light. If the burning ribbon is now placed in an atmosphere of nitrogen, it continues to burn and forms a compound Y.
(a) Write the chemical formulae of X and Y.
(b) Write a balanced chemical equation, when X is dissolved in water.

58. Zinc liberates hydrogen gas when reacted with dilute hydrochloric acid, whereas copper does not. Explain why?

59. A silver article generally turns black when kept in the open for a few days. The article when rubbed with toothpaste again starts shining.
(a) Why do silver articles turn black when kept in the open for a few days? Name the phenomenon involved.
(b) Name the black substance formed and give its chemical formula.

60. On heating blue coloured powder of copper (II) nitrate in a boiling tube, copper oxide (black), oxygen gas and a brown gas X is formed
(a) Write a balanced chemical equation of the reaction.
(b) Identity the brown gas X evolved.
(c) Identity the type of reaction.
(d) What could be the pH range of aqueous solution of the gas X?

61. Give the characteristic tests for the following gases
(a) CO_2
(b) SO_2
(c) O_2
(d) H_2

62. What happens when a piece of
(a) zinc metal is added to copper sulphate solution?
(b) aluminium metal is added to dilute hydrochloric acid?
(c) silver metal is added to copper sulphate solution?
Also, write the balanced chemical equation if the reaction occurs

63. What happens when zinc granules are treated with dilute solution of H_2SO_4, HCl, HNO_3, NaCl and NaOH, also write the chemical equations if reaction occurs.

64. On adding a drop of barium chloride solution to an aqueous solution of sodium sulphite, white precipitate is obtained.
(a) Write a balanced chemical equation of the reaction involved
(b) What other name can be given to this precipitation reaction?
(c) On adding dilute hydrochloric acid to the reaction mixture, white precipitate disappears. Why?

65. You are provided with two containers made up of copper and aluminium. You are also provided with solutions of dilute HCl, dilute HNO_3, $ZnCl_2$ and H_2O. In which of the above containers these solutions can be kept?

CHAPTER – 2

ACIDS, BASES AND SALTS

ACIDS

Acid is a substance which furnishes H^+ ions or H_3O^+ ions when dissolved in water. Acids have one or more replaceable hydrogen atoms. The word acid is derived from the Latin name ' acidus ' which means sour taste. Substances with ' sour taste ' are acids. Lemon juice, vinegar and grape juice have sour taste, so they are acidic. They change blue litmus to red. They are colourless with phenolphthalein and pink with methyl orange. There are many substances which contain acid and hence taste sour, such as curd, tamarind, lemon, etc.

CLASSIFICATION OF ACIDS

1. **Based on their sources :** Acids are classified into two types namely organic acids and inorganic acids.

   Organic acids:- Acids present in plants and animals (living beings) are **organic acids** eg. HCOOH, CH_3COOH (Weak acids).

   Inorganic acids:- Acids from rocks and minerals are **inorganic acids** or mineral acids eg. HCl, HNO_3, H_2SO_4 (Strong acids).

2. **Based on their basicity**
   Monobasic acid: - It is an acid which gives one hydrogen ion per molecule of the acid in solution eg. HCl, HNO_3.
   Dibasic acid:- It is an acid which gives two hydrogen ions per molecule of the acid in solution e.g., H_2SO_4, H_2CO_3.
   Tribasic acid:- It is an acid which gives three hydrogen ions per molecule of the acid in solution. e.g.,H_3PO_4,

3. **Based on ionisation**
   Acids are classified into two types based on ionisation.
   Strong acids:- These are acids which ionise completely in water eg.HCl
   Weak acids:-These are acids which ionise partially in water eg. CH_3COOH

4. **Based on concentration:-** Depending on the percentage or amount of acid dissolved in water acids are classified into concentrated acid and dilute acid.
   Concentrated acid:- It is an acid having a relatively high percentage of acid in its aqueous solution.
   Dilute acid:- It is an acid having a relatively low percentage of acid in aqueous solution.

INTEXT QUESTIONS PAGE NO. 18

Question 1: You have been provided with three test tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus paper, how will you identify the contents of each test tube?
Answer : If the colour of red litmus paper gets changed to blue, then it is a base and if there is no colour change, then it is either acidic or neutral. Thus, basic solution can be easily identified.

Let us mark the three test tubes as A, B, and C. A drop of the solution in A is put on the red litmus paper. Same is repeated with solution B and C. If either of them changes colour to blue, then it is basic. Therefore, out of three, one is eliminated. Out of the remaining two, any one can be acidic or neutral. Now a drop of basic solution is mixed with a drop of each of the remaining two solutions separately and then the nature of the drops of the mixtures is checked. If the colour of red litmus turns blue, then the second solution is neutral and if there is no change in colour, then the second solution is acidic. This is because acidic and basic solutions neutralize each other. Hence, we can distinguish between the three types of solutions.

CHEMICAL PROPERTIES OF ACIDS

REACTION OF ACIDS WITH METAL:

Acids give hydrogen gas along with respective salt when they react with a metal.

Metal + Acid → Salt + Hydrogen

Example:

- Hydrogen gas and zinc chloride are formed when hydrochloric acid reacts with zinc metal.

  $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
- Hydrogen gas and sodium chloride are formed when hydrochloric acid reacts with sodium metal.

  $2Na + 2HCl \rightarrow 2NaCl + H_2$
- Hydrogen gas and iron chloride are formed when hydrochloric acid reacts with iron.

  $Fe + 2HCl \rightarrow FeCl_2 + H_2$
- Hydrogen gas and zinc sulphate are formed when zinc metal reacts with sulphuric acid

  $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

REACTION OF ACIDS WITH METAL CARBONATE:

Acids give carbon dioxide gas and respective salts along with water when they react with metal carbonates.

Metal carbonate + Acid → Salt + Carbon dioxide + Water

Examples:

- Sulphuric acid gives calcium sulphate, carbon dioxide gas, calcium sulphate and water when it reacts with calcium carbonate.

  $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$
- Sulphuric acid gives sodium sulphate, carbon dioxide gas and water when it reacts with sodium carbonate.

  $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$
- Hydrochloric acid gives carbon dioxide gas, calcium chloride and water when it reacts with calcium carbonate.

  $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
- Hydrochloric acid gives carbon dioxide gas, sodium chloride along with water when reacts with sodium carbonate.

  $Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$
- Hydrochloric acid gives carbon dioxide, magnesium chloride and water when it reacts with magnesium carbonate.

  $MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$
- Nitric acid gives sodium nitrate, water and carbon dioxide gas when it reacts with sodium carbonate.

  $2HNO_3 + Na_2CO_3 \rightarrow NaNO_3 + 2H_2O + CO_2$

REACTION OF ACID WITH HYDROGEN CARBONATES (BICARBONATES):

Acids give carbon dioxide gas, respective salt and water when they react with metal hydrogen carbonate.

Acid + Metal hydrogen carbonate $\rightarrow$ Salt + Carbon dioxide + Water

Examples:

- Hydrochloric acid gives carbon dioxide, sodium chloride and water when it reacts with sodium bicarbonate.

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

- Sulphuric acid gives sodium sulphate, carbon dioxide gas and water when it reacts with sodium bicarbonate.

  $2NaHCO_3 + H_2SO_4 \rightarrow Na_2SO_4 + 2CO_2 + 2H_2O$

- Sodium bicarbonate is also known as sodium hydrogen carbonate, baking soda, baking powder, bread soda and bicarbonate of soda.

  The gas evolved because of reaction of acid with metal carbonate or metal hydrogen carbonate turns lime water milky. This shows that the gas is carbon dioxide gas. This happens because of formation of white precipitate of calcium carbonate.

  $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

  $CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

  But when excess of carbon dioxide is passed through lime water, it makes milky colour of lime water disappear. This happens because of formation of calcium hydrogen carbonate. As calcium hydrogen carbonate is soluble in water, thus the milky colour of solution mixture disappears.

REACTION OF ACID WITH MARBLE AND EGG SHELL:

Since, marble and egg shell are made of calcium carbonate, hence when acid is poured over marble or egg shell, bubbles of carbon dioxide are formed.

USES OF ACIDS

- Sulphuric acid (King of chemicals) is used in car battery and in the preparation of many other compounds.
- Nitric acid is used in the production of ammonium nitrate which is used as fertilizer in agriculture.
- Hydrochloric acid is used as cleansing agent in toilet.
- Tartaric acid is a constituent of baking powder.
- Salt of benzoic acid (sodium benzoate) is used in food preservation.
- Carbonic acid is used in aerated drinks.

BASES

Base is a substance which releases hydroxide ions when dissolved in water. It is a substance which is bitter in taste and soapy to touch (e.g. Washing soda, caustic soda and caustic potash). They change red litmus to blue. They are pink with phenolphthalein and yellow with methyl orange.

CLASSIFICATION OF BASES

1. **Based on ionisation**

   Strong bases:- These are bases which ionise completely in aqueous solution eg.NaOH, KOH.

Weak bases:- These are bases which ionise partially in aqueous solution eg. NH_4OH, $Ca(OH)_2$.

2. Based on their acidity

Monoacidic base:- It is a base which ionises in water to give one hydroxide ion per molecule eg.NaOH, KOH.

Diacidic base:- It is a base which ionises in water to give two hydroxide ions per molecule eg. $Ca(OH)_2$, $Mg(OH)_2$.

Triacidic base:- It is a base which ionises in water to give three hydroxide ions per molecule eg. $Al(OH)_3$, $Fe(OH)_3$.

3. Based on the concentration:

Depending on the percentage or amount of base dissolved in water, bases are classified as concentrated alkali and dilute alkali.

Concentrated alkali:- It is an alkali having a relatively high percentage of alkali in its aqueous solution.

Dilute alkali:- It is an alkali having a relatively low percentage of alkali in its aqueous solution.

REACTION OF BASE WITH METALS:

When alkali (base) reacts with metal, it produces salt and hydrogen gas.

Alkali + Metal $\rightarrow$ Salt + Hydrogen

Example:

- Sodium aluminate and hydrogen gas are formed when sodium hydroxide reacts with aluminium metal.

  $2NaOH + 2Al + 2H_2O \rightarrow 2NaAlO_2 + 2H_2$

- Sodium hydroxide gives hydrogen gas and sodium zincate when reacts with zinc metal.

  $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

REACTION OF BASE WITH OXIDES OF NON-METALS:

Non-metal oxides are acidic in nature. For example; carbon dioxide is a non-metal oxide. When carbon dioxide is dissolved in water it produces carbonic acid.

Therefore, when a base reacts with non-metal oxide both neutralize each other resulting respective salt and water are produced.

Base + Non-metal oxide $\rightarrow$ Salt + Water

Example:

- Calcium hydroxide gives calcium carbonate and water when it reacts with carbon dioxide.

  $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

- Sodium hydroxide gives sodium carbonate and water when it reacts with carbon dioxide.

  $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

USES OF BASES

- Sodium hydroxide is used in the manufacture of soap.
- Calcium hydroxide is used in white washing the buildings.

- Magnesium hydroxide is used as a medicine for stomach troubles.
- Ammonium hydroxide is used to remove grease stains from clothes.

NEUTRALISATION REACTION:

An acid neutralizes a base when they react with each other and respective salt and water are formed.

Acid + Base → Salt + Water

Since in the reaction between acid and base both neutralize each other, hence it is also known as neutralization reaction.

Example:

- Sodium sulphate and water are formed when sulphuric acid reacts with sodium hydroxide (a base).

  $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

- In similar way, when nitric acid reacts with sodium hydroxide, sodium nitrate and water are formed.

  $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

- Sodium chloride and water are formed when hydrochloric acid reacts with sodium hydroxide (a strong base).

  $HCl + NaOH \rightarrow NaCl + H_2O$

- In similar way, calcium chloride is formed along with water when hydrochloric acid reacts with calcium hydroxide (a base).

  $2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$

REACTION OF ACID WITH METAL OXIDES:

Metal oxides are basic in nature. Thus, when an acid reacts with a metal oxide both neutralize each other. In this reaction, respective salt and water are formed.

Acid + Metal Oxide □ Salt + Water

Example:

- Calcium is a metal, thus calcium oxide is a metallic oxide which is basic in nature. When an acid; such as hydrochloric acid; reacts with calcium oxide, neutralization reaction takes place and calcium chloride; along with water; is formed.

  $2HCl + CaO \rightarrow CaCl_2 + H_2O$

- Similarly, when sulphuric acid reacts with zinc oxide, zinc sulphate and water are formed.

  $H_2SO_4 + ZnO \rightarrow ZnCl_2 + H_2O$

- When hydrochloric acid reacts with aluminium oxide, aluminium chloride and water are formed.

  $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

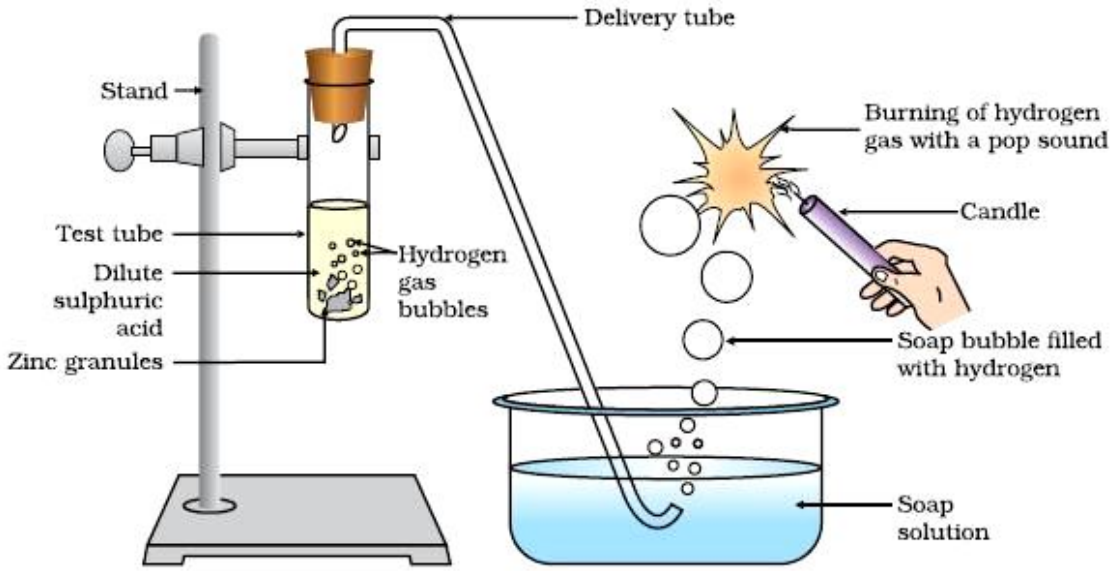
INTEXT QUESTIONS PAGE NO. 22

Question 1: Why should curd and sour substances not be kept in brass and copper vessels?

Answer : Curd and other sour substances contain acids. Therefore, when they are kept in brass and copper vessels, the metal reacts with the acid to liberate hydrogen gas and harmful products, thereby spoiling the food.

Question 2: Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test for the presence of this gas?

Answer : Hydrogen gas is usually liberated when an acid reacts with a metal.



Take few pieces of zinc granules and add 5 ml of dilute H2SO4. Shake it and pass the gas produced into a soap solution. The bubbles of the soap solution are formed. These soap bubbles contain hydrogen gas.

$$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2 \uparrow$$

We can test the evolved hydrogen gas by its burning with a pop sound when a candle is brought near the soap bubbles.

Question 3: Metal compound A reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction if one of the compounds formed is calcium chloride.

Answer :

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

Calcium carbonate	Hydrochloric acid	Calcium chloride	Carbon dioxide	Water

COMMON IN ACID AND BASE

Acids give hydrogen gas when they react with metal. This shows that all acids contain hydrogen. For example: Hydrochloric acid (HCl), sulphuric acid (H_2SO_4), nitric acid (HNO_3), etc.

When an acid is dissolved in water, it dissociates hydrogen. The dissociation of hydrogen ion in aqueous solution is the common property in all acids. Because of dissociation of hydrogen ion in aqueous solution, an acid shows acidic behavior.

Example:

- Hydrochloric acid (HCl) gives hydrogen ion (H^+) and chloride ion (Cl^-) when it is dissolved in water.

  $HCl\ (aq) \rightarrow H^+ + Cl^-$
- Sulphuric acid (H_2SO_4) gives hydrogen ion (H^+) and sulphate ion (SO_4^{--}) in water.

  $H_2SO_4\ (aq) \rightarrow H^+ + SO_4^{--}$
- Nitric acid (HNO_3) gives hydrogen ion (H^+) and nitrate ion (NO_3^-) in water.

  $HNO_3\ (aq) \rightarrow H^+ + NO_3^-$
- Acetic acid (CH_3COOH) gives acetate ion (CH_3COO^-) and hydrogen ion (H^+).

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

- Hydrogen ion which is produced by acid (when acid is combined with water molecule), exists in the form of hydronium ion (H_3O^-) in aqueous solution. That's why hydrogen ion is always written with suffix (aq), such as H^+ (aq).

$$HCl + H_2O \rightarrow\ H_3O^- + Cl^-$$

$$H_2SO_4 + H_2O \rightarrow\ H_3O^- + SO_4^{--}$$

Thus, because of dissociation of hydrogen ions; acid shows its acidic behavior.

Acids conduct electricity in their aqueous solution because of dissociation of hydrogen ion. Hydrogen ion in aqueous solution conducts electricity.

A dry acid, such as dry hydrochloric acid does not change the colour of blue litmus paper to red because a dry acid does not dissociate hydrogen ion. This is the cause that a moist litmus paper is used to check the acidic or basic character of a gas.

Acidic behavior of carbon dioxide gas:
Carbon dioxide gas produces carbonic acid when dissolved in water. This carbonic acid dissociates hydrogen ion and carbonate ion in the aqueous solution.

$$CO_2 + H_2O \rightarrow\ H_2CO_3 \rightarrow\ H^+ + CO_3^{--}$$

Are all compounds which contain hydrogen, necessarily acids?
No, all compounds which contain hydrogen are not acid. For example; glucose ($C_6H_{12}O_6$), methyl alcohol (CH_3OH), etc. are not acid in spite of the fact that they contain hydrogen. This is because these compounds do not dissociate hydrogen ion in their aqueous solution.

Common in all Base:
A base dissociates hydroxide ion in water, which is responsible for the basic behavior of a compound. Example:
When sodium hydroxide is dissolved in water, it dissociates hydroxide ion and sodium ion.

$$NaOH\ (aq) \rightarrow\ Na^+ + OH^-$$

Similarly, when potassium hydroxide is dissolved in water, it dissociates hydroxide ion and potassium ion.

$$KOH\ (aq) \rightarrow\ K^+ + OH^-$$

Thus, base shows its basic character because of dissociation of hydroxide ion.

NEUTRALISATION REACTION:
When an acid reacts with a base, the hydrogen ion of acid combines with the hydroxide ion of base and forms water. As these ions combine together and form water; instead of remaining free, thus both neutralize each other.

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

Example:

- When sodium hydroxide (a base) reacts with hydrochloric acid, sodium hydroxide breaks into sodium ion and hydroxide ion and hydrochloric acid breaks into hydrogen ion and chloride ion. Hydrogen ion and hydroxide ion combine together and form water, while sodium ion and chloride ion combine together and form sodium chloride.

$$NaOH + HCl \rightarrow\ OH^- + Na^+ + H^+ + Cl^- \rightarrow\ NaCl + H_2O$$

DILUTION OF ACID AND BASE:
The concentration of hydrogen ion in an acid and hydroxide ion in a base; per unit volume; shows the concentration of acid or base.

By mixing of acid to water, the concentration of hydrogen ion per unit volume decreases. Similarly, by addition of base to water the concentration of hydroxide ion per unit volume decreases. This process of addition of acid or base to water is called dilution and the acid or base is called diluted.

The dilution of acid or base is exothermic. Thus, acid or base is always added to water and water is never added to acid or base. If water is added to a concentrated acid or base a lot of heat is generated, which may cause splashing out of acid or base and may cause severe damage as concentrated acid and base are highly corrosive.

INTEXT QUESTIONS PAGE NO. 25

Question 1: Why do HCl, HNO_3, etc., show acidic characters in aqueous solutions while solutions of compounds like alcohol and glucose do not show acidic character?
Answer : The dissociation of HCl or HNO_3 to form hydrogen ions always occurs in the presence of water. Hydrogen ions (H^+) combine with H_2O to form hydronium ions (H_3O^+).
The reaction is as follows:

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

$$H^+ + H_2O \longrightarrow H_3O^+$$

Although aqueous solutions of glucose and alcohol contain hydrogen, these cannot dissociate in water to form hydrogen ions. Hence, they do not show acidic character.

Question 2: Why does an aqueous solution of an acid conduct electricity?
Answer : Acids dissociate in aqueous solutions to form ions. These ions are responsible for conduction of electricity.

Question 3: Why does dry HCl gas not change the colour of the dry litmus paper?
Answer : Colour of the litmus paper is changed by the hydrogen ions. Dry HCl gas does not contain H^+ ions. It is only in the aqueous solution that an acid dissociates to give ions. Since in this case, neither HCl is in the aqueous form nor the litmus paper is wet, therefore, the colour of the litmus paper does not change.

Question 4: While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?
Answer : Since the process of dissolving an acid in water is exothermic, it is always recommended that acid should be added to water. If it is done the other way, then it is possible that because of the large amount of heat generated, the mixture splashes out and causes burns.

Question 5: How is the concentration of hydronium ions (H_3O^+) affected when a solution of an acid is diluted?
Answer : When an acid is diluted, the concentration of hydronium ions (H_3O^+) per unit volume decreases. This means that the strength of the acid decreases.

Question 6: How is the concentration of hydroxide ions (OH^-) affected when excess base is dissolved in a solution of sodium hydroxide?
Answer : The concentration of hydroxide ions (OH^-) would increase when excess base is dissolved in a solution of sodium hydroxide.

STRENGTH OF ACID AND BASE

Acids in which complete dissociation of hydrogen ion takes place are called strong acid. Similarly, bases in which complete dissociation of hydroxide ion takes place are called strong base.

In mineral acids, such as hydrochloric acid, sulphuric acid, nitric acid, etc. hydrogen ion dissociates completely and hence they are considered as strong acid. Since, in organic acids hydrogen ions do not dissociate completely, so they are weak acid.

Alkalis are water soluble base, thus in alkali; complete dissociation of hydroxide ions takes place and they are considered as strong base.

The complete dissociation of hydrogen ions or hydroxide ions is shown by a single arrow. The incomplete dissociation of hydrogen ions or hydroxide ions is denoted by double arrow.

Example of complete dissociation:

$NaOH\ (aq) \rightarrow Na^+ + OH^-$

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

Example of incomplete dissociation:

$Mg(OH)2 \rightarrow Mg^{++} + OH^{--}$

$CH_3COOH \rightarrow CH_3COO^- + H^+$

Although acetic acid being an organic acid is a weak acid, but concentrated acetic acid is corrosive and can damage the skin if poured over it.

pH – MEASUREMENT OF STRENGTH OF ACID AND BASE

pH stands for the power of hydrogen ion concentration in a solution. pH values decide whether a solution is acidic or basic or neutral. pH scale was introduced by S.P.L. Sorenson. It is mathematically expressed as

$$\mathbf{pH = -\log_{10}[H^+]}$$

For neutral solution $[H^+] = 10^{-7}M$; pH = 7

For acidic solution $[H^+] > 10^{-7}M$; pH < 7

For basic solution $[H^+] < 10^{-7}M$; pH > 7

When OH^- ions are taken into account the pH expression is replaced by pOH

$$\mathbf{pOH = -\log_{10}[OH^-]}$$

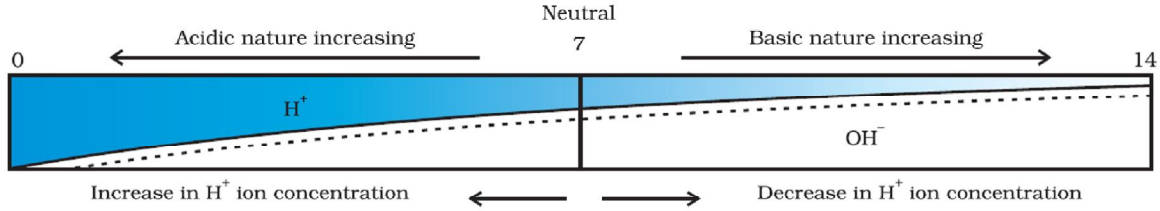
The strength of acid or base depends upon the hydrogen ion concentration. If the concentration of hydrogen ion is greater than hydroxide ion, the solution is called acidic. If the concentration of hydrogen ion is smaller than the hydroxide ion, the solution is called basic. If the concentration of hydrogen ion is equal to the concentration of hydroxide ion, the solution is called neutral solution.

pH is a scale which quantifies the concentration of hydrogen ion in a solution. The range of pH scale is between 0 to 14.

The pH value decreases with increase in hydrogen ion concentration. If the value of pH is 0, this shows maximum hydrogen ion concentration. pH value equal to 14 shows lowest hydrogen ion concentration. pH value equal to 7 shows the hydrogen ion concentration is equal to hydroxide ion concentration.

A neutral solution, such as distilled water has value of hydrogen ion concentration equal to 7 on pH scale. The acidic solution has value of hydrogen ion concentration less than 7 on pH scale. The basic solution has value of hydrogen ion concentration greater than 7 on pH scale.

In pH scale 'p' stands for 'potenz'. Potenz is a German word which means 'power' or 'potential'. Here; 'H' stands for hydrogen ion. Thus, pH means the potential of hydrogen or power of hydrogen.



IMPORTANCE OF pH IN EVERYDAY LIFE

1. **pH in human body**
   - Using pH factor the healthiness of our body is predicted. At pH level 6.9, the body becomes prone to viral infections like colds, cough and flu. Cancer cells thrive inside the body at a pH of 5.5.
   - The pH of a normal, healthy human skin is 4.5 to 6. Proper skin pH is essential for a healthy complexion.
   - pH of stomach fluid is approximately 2.0. This fluid is essential for the digestion of food.
   - Human blood pH range is 7.35 to 7.45. Any increase or decrease in this value, leads to diseases. The ideal pH for blood is 7.4.
   - pH of normal saliva ranges between 6.5 to 7.5.
   - White enamel coating in our teeth is calcium phosphate, hardest substance in our body. It does not dissolve in water. If pH of mouth falls below 5.5, the enamel gets corroded. Toothpastes are generally basic, and is used for cleaning the teeth, can neutralize the excess acid and prevent tooth decay.

2. **pH in soil**
   - In agriculture, the pH of soil is very important. Citrus fruits require slightly alkaline soil, while rice requires acidic soil and sugar cane requires neutral soil.

3. **pH in rain water**
   - pH of rain water is approximately 7 showing high level of its purity and neutrality. If rain water is polluted by SO_2 and NO_2, acid rain occurs, bringing the pH value less than 7.

INDICATOR:

Substances which show the acidic or basic behavior of other substance by change in colour are known as indicator.

Type of Indicator: There are many types of indicators. Some common types of indicators are

- Natural
- Olfactory Indicator
- Synthetic Indicator
- Universal Indicator

NATURAL INDICATOR

Indicators obtained from natural sources are called natural indicators. Litmus, turmeric, red cabbage, China rose, etc. are some common natural indicators used widely to show the acidic or basic character of substances.

LITMUS

Litmus is obtained from lichens. The solution of litmus is purple in colour. Litmus paper comes in two colour – blue and red.

- An acid turns blue litmus paper red.
- A base turns red litmus paper blue.

TURMERIC

Turmeric is another natural indicator. Turmeric is yellow in colour. Turmeric solution or paper turns reddish brown with base. Turmeric does not change colour with acid.

RED CABBAGE

The juice of red cabbage is originally purple in colour. Juice of red cabbage turns reddish with acid and turns greenish with base.

OLFACTORY INDICATORS

Substances which change their smell when mixed with acid or base are known as olfactory indicators. For example onion, vanilla, clove, etc.

ONION

Paste or juice of onion loses its smell when added with base. It does not change its smell with acid.

VANILLA

The smell of vanilla vanishes with base, but it's smell does not vanishes with an acid. Olfactory indicators are used to ensure the participation of visually impaired students in laboratory.

SYNTHETIC INDICATOR

Indicators that are synthesized in laboratory are known as synthetic indicators. For example; phenolphthalein, methyl orange, etc.

Phenolphthalein is a colourless liquid. It remains colourless with acid but turns into pink with a base.

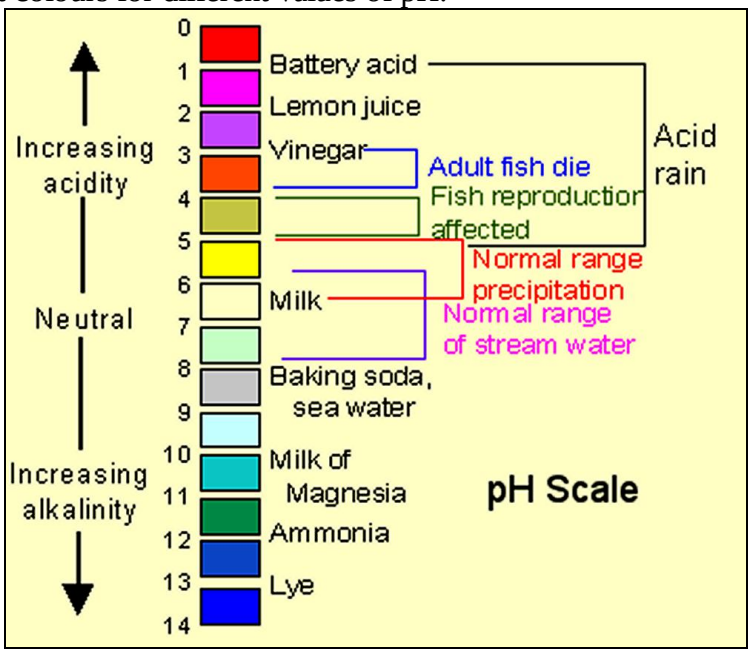
Methyl orange is originally orange in colour. It turns into red with acid and turns into yellow with base.

Indicator	Original colour	Acid	Base
Red litmus	Red	No change	Blue
Blue litmus	Blue	Red	No change
Turmeric	Yellow	No change	Reddish brown
Red cabbage juice	Purple	Reddish	Greenish yellow
Phenolphthalein	Colourless	Colourless	Pink
Methyl orange	Orange	Red	Yellow
Onion	n/a	No change	Smell vanishes
Vanilla	n/a	No change	Smell vanishes

UNIVERSAL INDICATOR:

Using a litmus paper, phelophthalein, methyl orange, etc. only the acidic or basic character of a solution can be determined, but use of these indicators does not give the idea about the strength of acid or base. So, to get the strength as well as acidic and basic nature of a given solution universal indicator is used.

Universal indicator shows different colour over the range of pH value from 1 to 14 for a given solution. Universal indicator is available both in the form of strips and solution. Universal indicator is the combination of many indicators, such as water, propanol, phelophthalein, sodium salt, sodium hydroxide, methyl red, bromothymol blue monosodium salt, and thymol blue monosodium salt. The colour matching chart is supplied with universal indicator which shows the different colours for different values of pH.



INTEXT QUESTIONS PAGE NO. 28

Question 1: You have two solutions, A and B. The pH of solution A is 6 and pH of solution B is 8. Which solution has more hydrogen ion concentration? Which of this is acidic and which one is basic?

Answer : A pH value of less than 7 indicates an acidic solution, while greater than 7 indicates a basic solution. Therefore, the solution with pH = 6 is acidic and has more hydrogen ion concentration than the solution of pH = 8 which is basic.

Question 2: What effect does the concentration of $H^+_{(aq)}$ ions have on the nature of the solution?

Answer : Concentration of $H^+_{(aq)}$ can have a varied effect on the nature of the solution. With an increase in H^+ ion concentration, the solution becomes more acidic, while a decrease of H^+ ion causes an increase in the basicity of the solution.

Question 3: Do basic solutions also have $H^+_{(aq)}$ ions? If yes, then why are these basic?

Answer : Yes, basic solution also has $H^+_{(aq)}$ ions. However, their concentration is less as compared to the concentration of OH^- ions that makes the solution basic.

Question 4: Under what soil condition do you think a farmer would treat the soil of his fields with quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate)?

Answer : If the soil is acidic and improper for cultivation, then to increase the basicity of soil, the farmer would treat the soil with quick lime or slaked lime or chalk.

SALT

Salts are the ionic compounds which are produced after the neutralization reaction between acid and base. Salts are electrically neutral. There are number of salts but sodium chloride is the most common among them. Sodium chloride is also known as table salt or common salt. Sodium chloride is used to enhance the taste of food.

CHARACTERISTICS OF SALT:

- Most of the salts are crystalline solid
- Salts may be transparent or opaque
- Most of the salts are soluble in water
- Solution of salts conducts electricity. Salts conduct electricity in their molten state also
- The salt may be salty, sour, sweet, bitter and umami (savoury)
- Neutral salts are odourless
- Salts can be colourless or coloured

Classification of salts

1. **Normal salts**
   A normal salt is obtained by complete neutralization of an acid by a base
   $NaOH + HCl \rightarrow NaCl + H_2O$

2. **Acid salts**
   Acid salts are derived by the partial replacement of hydrogen ions of an acid by a metal. When a calculated amount of a base is added to a polybasic acid, acid salt is obtained, as follows.
   $NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$

3. **Basic salts**
   Basic salts are formed by the partial replacement of hydroxide ions of a diacidic or triacidic base by an acid radical. A basic salt may further reacts with an acid to give a normal salt.
   $Pb(OH)_2 + HCl \rightarrow Pb(OH)Cl + H_2O$
   Diacidic base Basic salt

4. **Double salts**
   Double salts are formed by the combination of saturated solution of two simple salts in equimolar ratio followed by crystallization. e.g. potash alum

FAMILY OF SALT:

Salts having common acidic or basic radicals are said to belong to same family.

Example

- Sodium chloride (NaCl) and Calcium chloride ($CaCl_2$) belong to chloride family.
- Calcium chloride ($CaCl_2$) and calcium sulphate ($CaSO_4$) belong to calcium family.
- Zinc chloride ($ZnCl_2$) and Zinc sulphate ($ZnSO_4$) belong to zinc family.

ACIDIC, BASIC AND NEUTRAL SALTS

NEUTRAL SALT

Salts produced because of reaction between strong acid and strong base are neutral in nature. The pH of value of such salts is equal to 7, i.e. neutral. Example; Sodium chloride, sodium sulphate, potassium chloride, etc.

Sodium chloride (NaCl) is formed after the reaction between hydrochloric acid (a strong acid) and sodium hydroxide (a strong base).

$NaOH + HCl \rightarrow NaCl + H_2O$

SODIUM SULPHATE (Na_2SO_4)
It is formed after the reaction between sodium hydroxide (a strong base) and sulphuric acid (a strong acid).
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

Potassium chloride (KCl): It is formed after the reaction between potassium hydroxide (a strong base) and hydrochloric acid (a strong acid).
$KOH + HCl \rightarrow KCl + H_2O$

ACIDIC SALT
Salts which are formed after the reaction between a strong acid and weak base are called acidic salt. The pH value of acidic salt is lower than 7. Example: ammonium sulphate, ammonium chloride, etc.

Ammonium chloride is formed after reaction between hydrochloric acid (a strong acid) and ammonium hydroxide (a weak base).
$NH_4OH + HCl \rightarrow NH_4Cl + H_2O$

Ammonium sulphate is formed after reaction between ammonium hydroxide (weak base) and sulphuric acid (a strong acid).
$2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$

BASIC SALT
Salts which are formed after the reaction between weak acid and strong base are called basic salt. For example; sodium carbonate, sodium acetate, etc.

Sodium carbonate is formed after the reaction between sodium hydroxide (a strong base) and carbonic acid (a weak base).
$H_2CO_3 + 2NaOH \rightarrow Na_2CO_3 + 2H_2O$

Sodium acetate is formed after the reaction between a strong base, sodium hydroxide and a weak acid, acetic acid.
$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

CAUSE OF FORMATION OF ACIDIC, BASIC AND NEUTRAL SALT:
When a strong acid reacts with a weak base, the base is unable to fully neutralize the acid. Due to this an acidic salt is formed in this case.
When a strong base reacts with a weak acid, the acid is unable to fully neutralize the base. Due to this a basic salt is formed in this case.
When equally strong acid and base react they fully neutralize each other. Due to this a neutral salt is formed in this case.

pH Value Of Salt:
- Neutral salt: The pH value of a neutral salt is almost equal to 7.
- Acidic salt: The pH value of an acidic salt is less than 7.
- Basic salt: The pH value of a basic salt is more than 7.

COMMON SALT (SODIUM CHLORIDE)
Sodium chloride (NaCl) is also known as common or table salt. It is formed after the reaction between sodium hydroxide and hydrochloric acid. It is a neutral salt. The pH value of sodium

chloride is about 7. Sodium chloride is used to enhance the taste of food. Sodium chloride is used in manufacturing of many chemicals.

IMPORTANT CHEMICALS FROM SODIUM CHLORIDE:
SODIUM HYDROXIDE (NaOH)

Sodium hydroxide is a strong base. It is also known as caustic soda or Iye. It is obtained by the electrolytic decomposition of solution of sodium chloride (brine). In the process of electrolytic decomposition of brine (aqueous solution of sodium chloride), brine decomposes to form sodium hydroxide. In this process, chlorine is obtained at anode and hydrogen gas is obtained at cathode as byproducts. This whole process is known as Chlor-Alkali process.

$2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$

USE OF PRODUCTS AFTER THE ELECTROLYSIS OF BRINE:

- Hydrogen gas is used as fuel, margarine, in making of ammonia for fertilizer, etc.
- Chlorine gas is used in water treatment, manufacturing of PVC, disinfectants, CFC, pesticides. It is also used in manufacturing of bleaching powder and hydrochloric acid.
- Sodium hydroxide is used for de-greasing of metals, manufacturing of paper, soap, detergents, artificial fibres, bleach, etc.

BLEACHING POWDER ($CaOCl_2$):

Bleaching powder is also known as chloride of lime. It is a solid and yellowish white in colour. Bleaching powder can be easily identified by the strong smell of chlorine.
When calcium hydroxide (slaked lime) reacts with chlorine, it gives calcium oxychloride (bleaching powder) and water is formed.

$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

Aqueous solution of bleaching powder is basic in nature. The term bleach means removal of colour. Bleaching powder is often used as bleaching agent. It works because of oxidation. Chlorine in the bleaching powder is responsible for bleaching effect.

USE OF BLEACHING POWDER:

- Bleaching powder is used as disinfectant to clean water, moss remover, weed killers, etc.
- Bleaching powder is used for bleaching of cotton in textile industry, bleaching of wood pulp in paper industry.
- Bleaching powder is used as oxidizing agent in many industries, such as textiles industry, paper industry, etc.

BAKING SODA ($NaHCO_3$)

Baking soda is another important product which can be obtained using byproducts of chlor-alkali process. The chemical name of baking soda is sodium hydrogen carbonate ($NaHCO_3$) or sodium bicarbonate. Bread soda, cooking soda, bicarbonate of soda, sodium bicarb, bicarb of soda or simply bicarb, etc. are some other names of baking soda.

Baking soda is obtained by the reaction of brine with carbon dioxide and ammonia. This is known as Solvay process.

$$NaCl + CO_2 + NH_3 + H_2O \rightarrow NH_4Cl + NaHCO_3$$

In this process, calcium carbonate is used as the source of CO_2 and the resultant calcium oxide is used to recover ammonia from ammonium chloride.

PROPERTIES OF SODIUM BICARBONATE:

- Sodium bicarbonate is white crystalline solid, but it appears as fine powder.

- Sodium hydrogen carbonate is amphoteric in nature.
- Sodium hydrogen carbonate is sparingly soluble in water.
- Thermal decomposition of sodium hydrogen carbonate (baking soda).
- When baking soda is heated, it decomposes into sodium carbonate, carbon dioxide and water.

$$2NaHCO_3 + \text{heat} \rightarrow Na_2CO_3 + CO_2 + H_2O$$

Sodium carbonate formed after thermal decomposition of sodium hydrogen carbonate; decomposes into sodium oxide and carbon dioxide on further heating.

$$Na_2CO_3 \rightarrow Na_2O + CO_2$$

This reaction is known as dehydration reaction.

USE OF BAKING SODA:

- Baking soda is used in making of baking powder, which is used in cooking as it produces carbon dioxide which makes the batter soft and spongy.
- Baking soda is used as antacid.
- Baking soda is used in toothpaste which makes the teeth white and plaque free.
- Baking soda is used in cleansing of ornaments made of sliver.
- Since, sodium hydrogen carbonate gives carbon dioxide and sodium oxide on strong heating, thus it is used as fire extinguisher.

BAKING POWDER:

Baking powder produces carbon dioxide on heating, so it is used in cooking to make the batter spongy. Although baking soda also produces carbon dioxide on heating, but it is not used in cooking because on heating; baking soda produces sodium carbonate along with carbon dioxide. The sodium carbonate; thus produced; makes the taste bitter.

$$2NaHCO_3 + \text{heat} \rightarrow Na_2CO_3 + CO_2 + H_2O$$

Baking powder is the mixture of baking soda and a mild edible acid. Generally, tartaric acid is mixed with baking soda to make baking powder.

$$NaHCO_3 + C_4H_6O_6 \rightarrow CO_2 + H_2O + Na_2C_4H_4O_6$$

When baking powder (mixture of baking soda and an edible acid) is heated, the sodium carbonate formed because of heating of baking soda neutralizes after reacting with tartaric acid and sodium tartarate salt is formed. The smell of sodium tartarate is pleasant and taste is good. This makes the cake or any other food tasty.

WASHING SODA (SODIUM CARBONATE)

Sodium carbonate is manufactured by the thermal decomposition of sodium hydrogen carbonate obtained by Solvay process.

$$NaCl + CO_2 + NH_3 + H_2O \rightarrow NH_4Cl + NaHCO_3$$

$$NaHCO_3 + C_4H_6O_6 \rightarrow CO_2 + H_2O + Na_2C_4H_4O_6$$

The sodium carbonate obtained in this process is dry. It is called soda ash or anhydrous sodium carbonate. Washing soda is obtained by rehydration of anhydrous sodium carbonate.

$$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$$

Since there are 10 water molecules in washing soda, hence it is known as Sodium bicarbonate decahydrate.

Sodium carbonate is a crystalline solid and it is soluble in water when most of the carbonates are insoluble in water.

USE OF SODIUM CARBONATE:

- It is used in cleaning of cloths; especially in rural areas.
- In making of detergent cake and powder.

- In removing permanent hardness of water.
- It is used in glass and paper industries.

Water of crystallization: Many salts contain water molecule and are known as hydrated salts. The water molecule present in salt is known as water of crystallization.

Examples:

COPPER SULPHATE PENTAHYDRATE ($CuSO_4.5H_2O$)

Blue colour of copper sulphate is due to presence of 5 molecules of water. When copper sulphate is heated, it loses water molecules and turns into grey-white colour, which is known as anhydrous copper sulphate. After adding water; anhydrous copper sulphate becomes blue again.

$CuSO_4.5H_2O + \text{heat} \rightarrow CuSO_4$

FERROUS SULPHATE HEPTAHYDRATE (FeSO4.7H2O)

The green colour of Ferrous sulphate heptahydrate; commonly known as ferrous sulphate; is due to the presence of 7 molecules of water in it.

PLASTER OF PARIS

Plaster of Paris is obtained by heating of gypsum, a hydrated salt of calcium.

$$CaSO_4.2H_2O + \text{Heat} \rightarrow CaSO_4.\frac{1}{2}H_2O + \frac{3}{2}H_2O$$

After addition of water Plaster of Paris is again converted into gypsum.

$$CaSO_4.\frac{1}{2}H_2O + \frac{3}{2}H_2O \rightarrow CaSO_4.2H_2O$$

Plaster of Paris is used in making of toys, designer false ceiling, etc. Doctors use Plaster of Paris to set the fractured bone.

<u>INTEXT QUESTIONS PAGE NO. 33</u>

Question 1: What is the common name of the compound $CaOCl_2$?

Answer : The common name of the compound $CaOCl_2$ is bleaching powder.

Question 2: Name the substance which on treatment with chlorine yields bleaching powder?

Answer : Calcium hydroxide [Ca (OH)2], on treatment with chlorine, yields bleaching powder.

Question 3: Name the sodium compound which is used for softening hard water.

Answer : Washing soda (Na2CO3.10H2O) is used for softening hard water.

Question 4: What will happen if a solution of sodium hydrocarbonate is heated? Give the equation of the reaction involved.

Answer : When a solution of sodium hydrocarbonate (sodium hydrogencarbonate) is heated, sodium carbonate and water are formed with the evolution of carbon dioxide gas.

$$\underset{\text{Sodium hydrogencarbonate}}{2NaHCO_3} \xrightarrow{\Delta} \underset{\text{Sodium carbonate}}{Na_2CO_3} + \underset{\text{Water}}{H_2O} + \underset{\text{Carbon dioxide}}{CO_2\uparrow}$$

Question 5: Write an equation to show the reaction between Plaster of Paris and water.

Answer : The chemical equation for the reaction of Plaster of Paris and water can be represented as

$$CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O \longrightarrow CaSO_4.2H_2O$$

Plaster of Paris Water Gypsum

EXERCISE QUESTIONS PAGE NO. 34 and 35

Question 1: A solution turns red litmus blue, its pH is likely to be
(a) 1 (b) 4 (c) 5 (d) 10
Answer : (d) Bases turn red litmus blue and acids turn blue litmus red. Basic solution has a pH value more than 7. Since the solution turns red litmus blue, its pH is likely to be 10.

Question 2: A solution reacts with crushed egg-shells to give a gas that turns lime-water milky. The solution contains
(a) NaCl (b) HCl (c) LiCl (d) KCl
Answer : (b) The solution contains HCl.

Question 3: 10 mL of a solution of NaOH is found to be completely neutralised by 8 mL of a given solution of HCl. If we take 20 mL of the same solution of NaOH, the amount of HCl solution (the same solution as before) required to neutralise it will be
(a) 4 mL (b) 8mL (c) 12 mL (d) 16 mL
Answer : (d) 16 mL of HCl solution will be required.

Question 4: Which one of the following types of medicines is used for treating indigestion?
(a) Antibiotic (b) Analgesic (c) Antacid (d) Antiseptic
Answer : (c) Antacid is used for treating indigestion.

Question 5: Write word equations and then balanced equations for the reaction taking place when −
(a) dilute sulphuric acid reacts with zinc granules.
(b) dilute hydrochloric acid reacts with magnesium ribbon.
(c) dilute sulphuric acid reacts with aluminium powder.
(d) dilute hydrochloric acid reacts with iron filings.
Answer : (a) Sulphuric acid + Zinc → Zinc sulphate + Hydrogen

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

(b) Hydrochloric acid + Magnesium → Magnesium chloride + Hydrogen

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

(c) Sulphuric acid + Aluminium → Aluminium sulphate + Hydrogen

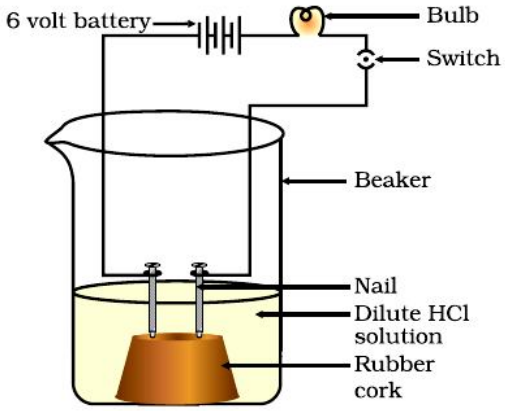
$$3H_2SO_{4(aq)} + 2Al_{(s)} \longrightarrow Al_2(SO_4)_{3(aq)} + 3H_{2(g)}$$

(d) Hydrochloric acid + Iron → Ferric chloride + Hydrogen

$$6HCl_{(aq)} + 2Fe_{(s)} \longrightarrow 2FeCl_{3(aq)} + 3H_{2(g)}$$

Question 6: Compounds such as alcohols and glucose also contain hydrogen but are not categorized as acids. Describe an activity to prove it.
Answer : Two nails are fitted on a cork and are kept it in a 100 mL beaker. The nails are then connected to the two terminals of a 6-volt battery through a bulb and a switch. Some dilute HCl is poured in the beaker and the current is switched on. The same experiment is then performed with glucose solution and alcohol solution.

Observations:



Result:
HCl dissociates into H+ and Cl− ions. These ions conduct electricity in the solution resulting in the glowing of the bulb. On the other hand, the glucose solution does not dissociate into ions. Therefore, it does not conduct electricity.

Conclusion:
From this activity, it can be concluded that all acids contain hydrogen but not all compounds containing hydrogen are acids.

That is why, though alcohols and glucose contain hydrogen, they are not categorised as acids.

Question 7: Why does distilled water not conduct electricity, whereas rain water does?
Answer : Distilled water is a pure form of water and is devoid of any ionic species. Therefore, it does not conduct electricity. Rain water, being an impure form of water, contains many ionic species such as acids and therefore it conducts electricity.

Question 8: Why do acids not show acidic behaviour in the absence of water?
Answer : Acids do not show acidic behaviour in the absence of water because the dissociation of hydrogen ions from an acid occurs in the presence of water only. It is the hydrogen ions that are responsible for the acidic behaviour.

Question 9: Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9, respectively. Which solution is
(a) neutral?
(b) strongly alkaline?
(c) strongly acidic?
(d) weakly acidic?
(e) weakly alkaline?
Arrange the pH in increasing order of hydrogen-ion concentration.
Answer :
(a) Neutral → Solution D with pH 7
(b) Strongly alkaline → Solution C with pH 11
(c) Strongly acidic → Solution B with pH 1
(d) Weakly acidic → Solution A with pH 4
(e) Weakly alkaline → Solution E with pH 9
The pH can be arranged in the increasing order of the concentration of hydrogen ions as: 11 < 9 < 7 < 4 < 1

Question 10: Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid (HCl) is added to test tube A, while acetic acid (CH3COOH) is added to test tube B. In which test tube will the fizzing occur more vigorously and why?
Answer : The fizzing will occur strongly in test tube A, in which hydrochloric acid (HCl) is added. This is because HCl is a stronger acid than CH3COOH and therefore produces hydrogen gas at a faster speed due to which fizzing occurs.

Question 11: Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.
Answer : The pH of milk is 6. As it changes to curd, the pH will reduce because curd is acidic in nature. The acids present in it decrease the pH.

Question 12: A milkman adds a very small amount of baking soda to fresh milk.
(a) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?
(b) Why does this milk take a long time to set as curd?
Answer : (a) The milkman shifts the pH of the fresh milk from 6 to slightly alkaline because in alkaline condition, milk does not set as curd easily.
(b) Since this milk is slightly basic than usual milk, acids produced to set the curd are neutralized by the base. Therefore, it takes a longer time for the curd to set.

Question 13: Plaster of Paris should be stored in a moisture-proof container. Explain why?
Answer : Plaster of Paris (POP) should be stored in a moisture-proof container because Plaster of Paris, a powdery mass, absorbs water (moisture) to form a hard solid known as gypsum.

$$CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O \longrightarrow CaSO_4.2H_2O$$

Plaster of Paris Water Gypsum

Question 14: What is a neutralization reaction? Give two examples.
Answer : A reaction in which an acid and base react with each other to give a salt and water is termed as neutralization reaction. In this reaction, energy is evolved in the form of heat.
For example:(i)

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

(Base) (Acid) (Salt) (Water)

(ii) During indigestion (caused due to the production of excess of hydrochloric acid in the stomach), we administer an antacid (generally milk of magnesia, $Mg(OH)_2$ which is basic in nature). The antacid neutralizes the excess of acids and thus gives relief from indigestion.

$$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

Question 15: Give two important uses of washing soda and baking soda.
Answer : Two important uses of washing soda and baking soda are as follows:
(1) Washing soda:
(a) It is used in glass, soap, and paper industries.
(b) It is used to remove permanent hardness of water.

(2) Baking soda:
(a) It is used as baking powder. Baking powder is a mixture of baking soda and a mild acid known as tartaric acid. When it is heated or mixed in water, it releases CO2 that makes bread or cake fluffy.
(b) It is used in soda-acid fire extinguishers.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 2
ACIDS, BASES AND SALTS

VERY SHORT ANSWER TYPE QUESTIONS

1. Name two natural indicators.

2. Name two indicators that are usually used in chemical laboratories to indicate acidic/basic nature of a solution.

3. What is the general name of bases that are soluble in water?

4. What is an acid?

5. Define base

6. What is the action of an acid on blue litmus paper?

7. Name two natural substances that contain acid.

8. What is the oxide of a metal called?

9. Are all bases alkalis?

10. Which type of substance is used to indicate an acid or a base?

11. What is the common element present in all acids?

12. Give the name and formula of two mineral acids.

13. Common salt contains a substance which is hygroscopic. Name the substance and write its formula.

14. Name any two organic acids.

15. What is the common to all bases?

16. Name two sources of common salt.

17. How do metals react with acid?

18. Name two metals that react with a base to produce hydrogen gas.

19. Which gas is evolved when sodium carbonate reacts with hydrochloric acid?

20. What happens when carbon dioxide gas is passed into lime water?

21. Name a sodium compound which loses its water of crystallization on exposure to air.

22. A compound of metal is obtained mainly from sea water. Write the name and formula of the compound.

23. What is the common name and formula of sodium hydroxide?

24. What is the reaction called in which an acid and a base nullify the effect of each other?

25. Name the salt which was an important symbol in India's struggle for freedom?

26. Name a sodium compound used as a cleansing agent for domestic purposes.

27. Why does and aqueous solution of an acid conduct electricity?

28. The pH of a solution is 4. What is the nature of the solution?

29. A solution reacts with crushed egg-shells to give a gas that turns lime water milky. Say, whether the solution contains an acid or a base.

30. Which type of medicine is used to treat indigestion?

31. Which compound of a metal is a constituent of many dry soap powders?

32. Name the acid which is used as a bathroom cleaner.

33. What is the action of litmus on an aqueous solution of ammonium chloride?

34. Why is a basic substance used to treat a honey-bee sting?

35. A solution turns blue litmus re. What is it pH value?

36. Which one is more acidic, pH = 2 or pH = 5?

37. Which one of the two solutions is more basic, pH = 8 or pH = 11?

38. What is the nature of the salt which dissolves in water to produce a solution which turns blue litmus to red?

39. A milkman adds some baking soda to fresh milk. How will the pH of the fresh milk change?

40. What is the pH of a solution which is neither acidic nor basic?

41. What is the chemical formula of common salt?

42. Name the process by which sodium hydroxide is made by electrolysis of brine?

43. Give the chemical name and formula of washing soda?

44. Mention the property of sodium carbonate that makes it useful as an ingredient for dry soap powders.

45. Name the carbonate of a metal which is soluble in water.

46. What is soda ash?

47. State whether the aqueous solution of washing soda is acidic or alkaline?

48. Name the substance which on being treated with chlorine yields bleaching powder.

49. Write the chemical formula of plaster of paris.

50. Write an equation to show the reaction between plaster of paris and water.

51. Write the chemical formula of quicklime.

52. Name a compound of calcium which is used for whitewashing.

53. Which compound of calcium is used for making cement and glass?

54. Write an equation to show the reaction between quicklime and water.

55. Which compound of calcium is used to produce limelight?

56. Write the chemical name and formula of baking soda?

57. Name a compound of sodium which is used in fire extinguisher.

58. Write the chemical name and formula of bleaching powder?

59. Two solutions have pH number 4 and 9 respectively which solution has more H^+ ion concentration?

60. Which compound of calcium is used for disinfecting water?

61. Why should cured and sour substances not be kept in brass and copper vessel?

62. Name a compound of calcium which hardens on being mixed with water.

63. Write down the molecular formula for one strong and one weak acid.

64. Explain why plaster of Paris should be stored in a moisture proof container?

65. Name the gas evolved when dil. sulphuric acid acts on sodium carbonate.

66. What is the use of common salt in soap industry?

67. Which compound of calcium is used in paper and textile industries?

68. What do you observe when a burning candle is brought near the test-tube containing hydrogen gas?

69. Name the indicator used to measure pH values over the whole range.

70. A white, solid substance is used to disinfect water, and it makes wool shrink-proof. Name the substance.

71. How many water of crystallization an present in copper sulphate crystals?

72. Write the name and formula of a compound which contains ten molecules of water of crystallization?

73. Name a sodium compound which is used in softening hard water.

74. A white powdery substance smells of chlorine and is used for disinfecting drinking water. What is the name of substance?

75. What happen when anhydrous copper sulphate is moistened with water?

76. Name the substance produced by the action of chlorine on dry slaked lime.

77. Name the compound of calcium used for bleaching cloth.

78. A compound is used to make casts for statues and for holding broken limbs and joints in place. What is this compound?

79. Write chemical equation to represent the action of dilute hydrochloric acid on bleaching powder?

80. Represent the reaction between plaster of paris and water in the form of an equation.

SHORT ANSWER TYPE QUESTIONS

1. What is an acid? Give some examples of organic and inorganic acids.

2. What is a base? Give examples?

3. What is an indicator? Give some examples of indicators?

4. What is litmus?

5. Describe some natural acid-base indicators, other than litmus.

6. What are olfactory indicators?

7. What do you mean by concentrated and dilute acid solutions?

8. Explain why brass and copper vessels are not used to keep curd and sour substances?

9. Name the gas which is liberated when metals react with an acid. Give an example. How is the presence of the gas tested?

10. HCL, HNO_3 etc. show acidic behavior in aqueous solutions but aqueous solutions of alcohol and glucose do not behave like acids. Explain why?

11. What would be the nature of solutions when the following salts are dissolved separately in water?

(i) NaCl

(ii) Na_2CO_3

(iii) CH_3COONa

(iv) $CuSO_4$

(v) $(NH_4)_2SO_4$

(vi) Na_2SO_4

12. What are the functions of sodium chloride in human body?

13. Given below are the pH values of four different liquids : 7.0, 14.0, 4.0, 2.0

Which of these could be that of

(i) lemon juice.

(ii) distilled water

(iii) 1 M sodium hydroxide solution

(iv) tomato juice

14. Why does an aqueous solutions of an acid conduct electricity?

15. During the dilution of an acid, it is advised that acid should be added to water, not water to acid. Why?

16. Ac acid solution is diluted with water. How does the concentration of hydrogen ions change?

17. What is the pH of a solution?

18. A metal compound when treated with dilute hydrochloride acid forms calcium chloride and a gas. The gas evolved extinguishers a burning splinter. Write the equation for the reaction that occurs.

19. Why does the colour of dry litmus paper not change in contact with dry HCL gas?

20. How is the concentration of OH^- ions change when excess of base is dissolved in a a solution of sodium hydroxide?

21. What will happen if solid sodium hydrogencarbonate or a solution of it is heated? Give the equation of the reaction involved?

22. Give two important uses of washing soda.

23. Give two important uses of baking soda.

24. A baker found that the cake prepared by him was hard and small in size. Which ingredient had he forgotten to add that would have made the cake fluffy? Give reasons.

25. How is soda ash obtained from washing soda crystals? Support your answer by a chemical equation.

26. How does a fire extinguisher work?

27. Why is an aqueous solution sodium carbonate alkaline in nature?

28. A given compound of sodium is used to remove hardness of water and also as a reagent in the laboratory. Identify the compound and mention two of its uses.

29. How is bleaching powder prepared? Give the reaction.

30. What happens when bleaching powder is left exposed to air?

31. State three important uses of bleaching powder?

32. (i) Name the chemical used in hospitals for setting fractured bones.

(ii) State the name of the above chemical and its formula.

(iii) How is the above compound prepared?

33. What is gypsum? What happens when gypsum is heated to 393k?

34. Explain giving reasons: "Potassium hydrogentartrate is a component of baking powder used in making cakes".

35. A white amorphous powder emits a greenish yellow gas having a smell of chlorine. It is used to remove yellowness of white clothes in laundries. Identify the powder. Write the chemical equation involved in its preparation.

36. You are provided with two solutions A and B having pH 6 and 8 respectively. Which of the solutions does contain more H^+ ion concentration? Which of them is acidic and which one basic?

37. Do basic solution also have H^+ ions. If yes, then why are they basic?

38. What do the farmers do to treat the soil when it becomes too acidic?

39. What effect does a bee-sting produce on human body? What is its remedy?

40. What is the chemical substance injected into a man's skin when (a) an ant stings him (b) a nettle-leaf stings him?

Suggest remedy to get relief from the effects of the stings.

41. How are the lives of aquatic animals affected with change in pH of the river water?

42. Explain the following: "Distilled water does not conduct electricity, but rain water does".

43. Why is an aqueous solution of sodium chloride neutral, whereas that of ammonium chloride acidic?

44. An efflorescent white, crystalline substance dissolves in water to produce an alkaline solution. The substance is used as a cleansing agent. Identify the substance and mention two uses it.

45. A white, powdery compound of calcium is used for making toys and casts of statues. It hardens when mixed with water. Identify the compound. Write the chemical equation of its preparation.

46. What is the chemical formula of plaster of paris? How is it prepared? State the common and the chemical names of the compound formed when plaster of paris mixed with water?

47. State two uses of the following:

(i) Sodium hydroxide

(ii) Chlorine

(iii) Hydrogen

(iv) Hydrochloric acid

48. (a) What is the common name of the compound $CaOCl_2$.

(b) Name the raw material used for the preparation of plaster of paris.

(c) Which property of plaster of paris is utilized in making casts for broken limbs in hospitals?

49. What happens when a cold and concentrate solution of sodium chloride reacts with ammonia and carbon dioxide? Write the chemical equation of the reaction which takes place.

50. Write the chemical formula of ammonium chloride. Explain why an aqueous solution of ammonium chloride is acidic in nature? Illustrate your answer with the help of a chemical equation.

LONG ANSWER TYPE QUESTIONS

1. What is baking soda? How is it obtained from sodium chjloride? Mention any two uses of baking soda.

2. What is the commercial name of bleaching powder? How is bleaching powder prepared? What are its different uses?

3. What do you mean by the strength of an acid? What are strong and weal acids?

4. What do you mean by the strength of a base? What are strong and weak base?

5. Three test tubes A, B and C contain distilled water, a basic solution and an acid solution separately. How would you identify the contents of the test tubes with the help of a red litmus paper only?

6. What are the different uses of sodium carbonate (Washing soda)?

7. State the important properties of washing soda.

8. What happens when carbon dioxide gas is passed through limewater? Give equations for the reactions that take place.

9. With the help of universal indicator the pH values of solutions A, B, C, D and E were found to be 5, 2, 12, 7 and 10 respectively. Say which solution is

(i) neutral

(ii) strongly base

(iii) strongly acidic

(iv) weakly acid

(v) weakly basic

Arrange the pH in the increasing order of H+ ions configuration.

10. Discuss briefly the reactions occurring when a concentrated solution of sodium chloride (brine) is electrolyzed?

11. Explain how is washing soda produced using sodium chloride as one of the raw materials?

12. (a) What is a salt? Give the names and formula of any two salts. Also name the acids and bases from which these salts may be obtained.

(b) What is meant by hydrated and anhydrous salts? Explain with example.

13. (a) What is plaster of paris? Write its chemical formula.

(b) How is plaster of paris prepared? Write the chemical equation of the reaction involved.

(c) Explain why plaster of paris should be stored in a moisture proof container.

(d) State two important uses of plaster of paris.

14. (a) What is bleaching powder? Write its chemical formula.

(b) How is bleaching powder prepared? Write the chemical equation of the reaction involved.

(c) State two important uses of bleaching powder.

15. (a) What happens when zinc granules are heated with sodium hydroxide solution? Write chemical equation of the reaction which takes place.

(b) What happens when basses react with nonmetals oxides? Explain with the help of an example. What does this reaction tell us about the nature of non-metal oxides?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 2
ACIDS, BASES AND SALTS

1. The colour of neutral litmus solution is
a) red (b) blue (c) purple (d) yellow

2. Which of the following indicators is an olfactory indicator?
(a) litmus (b) vanilla (c) turmeric (d) phenolphthalein

3. Which one is suitable method to find the accurate pH value?
(a) pH meter (b) pH paper (c) Universal indicator (d) Litmus solution

4. Which one of the following statements is correct about universal indicator?
(a) It is a mixture of HCl and NaOH
(b) It is a mixture of many indicators
(c) It is a solution of phenolphthalein in alcohol
(d) It is a solution of phenolphthalein in water.

5. Which of the following properties are shown by dilute HCl?
(1) It turns blue litmus red
(2) It turns red litmus blue
(3) It reacts with zinc and a gas is evolved
(4) It reacts with solid sodium carbonate to give brisk effervescence
(a) 1 and 2 (b) 1 and 3 (c) 1, 3 and 4 (d) 2, 3 and 4

6. A teacher gave two test tubes – one containing water and the other containing sodium hydroxide solution to two students. Then he asked them to identify the test tube containing sodium hydroxide solution. Which one of the following can be used for correctly identifying the test tube containing the solution of sodium hydroxide?
(a) Blue litmus (b) Red litmus (c) Sodium carbonate solution (d) Dilute HCl

7. Metallic oxides are _____ in nature, but non-metallic oxides are _____ in nature. The information in which alternative completes the given statement?
(a) neutral, acidic (b) acidic, basic (c) basic, neutral (d) basic, acidic

8. When a drop of unknown solution X is placed on a strip of pH paper, a deep red colour is produced. This sample is which one of these?
(a) NaOH (b) HCl (c) Water (d) CH3COOH

9. A student tests a sample drinking water and reports its pH value as 6 at room temperature. Which one of the following might have been added in water?
(a) Calcium chloride (b) Sodium chloride (c) Sodium bicarbonate (d) Bleaching powder

10. Solid sodium bicarbonate was placed on a strip of pH paper. The color of the strip
(a) turned red (b) did not change (c) turned green and slightly yellow (d) turned pink

11. Four drops of red litmus solution were added to each of the following samples. Which one turns red litmus blue?
(a) Alcohol (b) Distilled water (c) Sodium hydroxide sol (d) HCl

12. The pH of which of the following samples can not be found directly using pH paper?
(a) Lemon juice (b) Dilute HCl (c) Solid sodium bicarbonate (d) Solution of a detergent.

13. Which of the following natural sources contains oxalic acid?
(a) lemon (b) orange (c) tomato (d) tamarind

14. The acid found in an ant sting is
(a) acetic acid (b) citric acid (c) tartaric acid (d) methanoic acid

15. To relieve pain caused due to acidity, we can take
(a) sour milk (b) lemon juice (c) orange juice (d) milk of magnesia

16. What are the products obtained when potassium sulphate reacts with barium iodide in an aqueous medium?
(a) KI and $BaSO_4$ (b) KI, Ba and SO_2 (c) K, I_2 and $BaSO_4$ (d) K, Ba, I_2 and SO_2

17. Which of the following salts is basic in nature?
(a) NH_4NO_3 (b) Na_2CO_3 (c) Na_2SO_4 (d) NaCl

18. Which of the following salts has the minimum pH value?
(a) $(NH_4)_2SO_4$ (b) $NaHCO_3$ (c) K_2SO_4 (d) NaCl

19. You are given four unknown solutions I, II, III, and IV. The pH values of these solutions are found to be 3, 7, 8, and 10 respectively. Among the given solutions, which solution has the highest hydrogen ion concentration?
(a) I (b) II (c) III (d) IV

20. Which one of the following is required to identify the gas evolved when dilute hydrochloric acid reacts with zinc metal?
(a) blue litmus paper (b) red litmus paper (c) a burning slinter (d) lime water

21. Zinc reacts with an acid as well as with a base to liberate hydrogen. On the basis of this what should be the nature of the zinc metal?
(a) basic (b) acidic (c) amphoteric (d) neutral

22. When you test the solutions of sodium bicarbonate, sodium hydroxide, hydrochloric acid and acetic acid with universal indicator, in which case would you get a red colour?
(a) sodium bicarbonate (b) hydrochloric acid (c) sodium hydroxide (d) acetic acid

23. The pH of a sample of pure water is 7 at room temperature. What is its pH when a pinch of solid sodium bicarbonate is dissolved in it?
(a) vary near to 7 (b) less than 7 (c) more than 7 (d) exactly 7

24. If an unknown solution turns blue litmus red, then the pH of the solution is more likely to be (a) 12 (b) 10 (c) 7 (d) 4

25. What is the pH of a 0.00001 molar HCl solution?
(a)1 (b)9 (c)5 (d)4

26. There are alternate acid base theories that define an acid as any species that can
{hint: According to Bronsted-Lowry theory, an acid is any species that can donate a proton to another species.}
(a) donate a proton (2) donate an electron (c) accept a proton (d) accept an electron

27. What happens when a solution of an acid is mixed with a solution of a base in a test tube?
(i) The temperature of the solution increases
(ii) The temperature of the solution decreases
(iii) The temperature of the solution remains the same
(iv) Salt formation takes place
(a) (i) only (b) (i) and (iii)
(c) (ii) and (iii) (d) (i) and (iv)

28. An aqueous solution turns red litmus solution blue. Excess addition of which of the following solution would reverse the change?
(a) Baking powder
(b) Lime
(c) Ammonium hydroxide solution
(d) Hydrochloric acid

29. During the preparation of hydrogen chloride gas on a humid day, the gas is usually passed through the guard tube containing calcium chloride. The role of calcium chloride taken in the guard tube is to
(a) absorb the evolved gas
(b) moisten the gas
(c) absorb moisture from the gas
(d) absorb Cl^- ions from the evolved gas

30. Compounds such as alcohols and glucose contain hydrogen but are not categorized as acids. Describe an activity to prove it.

31. Why does distilled water not conduct electricity, whereas rain water does?

32. Why do acids not show acidic behavior in the absence of water?

33. Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9, respectively, which solution is: a) neutral b) strongly alkaline? c) strongly acidic d) weakly acidic e) weakly alkaline
Arrange the pH in increasing order of hydrogen ion concentration.

34. What is a neutralization reaction? Give two examples.

35. What happens when an acid or base is mixed with water?

36. Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid is added to test tube A, while acetic acid is added to test tube B. The concentrations taken for both the acids are same in which test tube the reaction occur more vigorously and why?

37. Fresh milk has a pH of 6. How does the pH change as it turns to curd? Explain your answer.

38. A milkman adds a very small amount of baking soda to fresh milk.
a) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?
b) Why does this milk take a long time to set as curd?

39. Why does tooth decay start when the pH of mouth is lower than 5.5?

40. How does the flow of acid rain water into a river make the survival of aquatic life in a river difficult?

41. Dry hydrogen chloride gas does not turn blue litmus whereas hydrochloric acid does. Why?

42. What is meant by "water of crystallization" of a substance? Describe an activity to demonstrate water of crystallization.

43. Plaster of paris should be stored in a moisture – proof container. Explain why?

44. What is baking powder? How does it make the cake soft and spongy?

45. Give two important uses of washing soda and baking soda.

46. WHO AM I?

- I can roughly measure pH value from 0-14.
- I am called antichlor and am used to remove excess chlorine from clothes when treated with bleaching powder.
- I am a product of gypsum and am used to making chalks and fire proof materials.
- I am a compound of calcium and can be used for disinfecting drinking water as well as for decolourisation.
- I give different smell in acid and base solution.
- I am an oxide capable of showing properties for both acids and bases.
- I am a covalent compound and conducts electricity in aqueous medium.
- I am a salt of potassium hydroxide and nitric acid.
- I am the term used when a solid becomes liquid when exposed to moist air.
- I am derived from tomato and turn blue litmus into red.

47. The colour of methyl orange indicator in acidic medium is: ( )
a) Yellow b) green c) orange d) red

48. The colour of phenolphthalein indicator in basic solution is: ( )
a) Yellow b) green c) pink d) orange

49. What is the colour methyl orange in alkaline medium? ( )
a) orange b) yellow c) red d) blue

50. A solution turns red litmus blue, its pH will be: ( )
a) 1 b) 4 c) 5 d) 10

51. A solution reacts with crushed egg-shells to give a gas that turns lime-water Milky, the solution contains: ( )
a) NaCl b) HCl c) LiCl d) KCl

52. Why is universal indicator a better one than litmus paper? ( )
a) Litmus paper can only be used for acids.
b) Litmus paper can only be used for alkalis.
c) Universal indicator goes green if something is neutral.
d) Universal indicator is useful for all ranges of pH of the solution.

53. Water soluble bases are known as? ( )
a) neutral b) base c) acid d) alkali

54. Which of one of the following pairs of substances when mixed together produces table salt. ( )
a) Sodium thiosulphate and sulpur dioxide
b) Hydro chloric acid and sodium hydroxide
c) Chlorine and oxygen
d) Nitric acid and sodium hydrogen carbonate

55. What colour would hydrochloric acid (pH=1) turn universal indicator. ( )
a) Orange b) purple c) yellow d) red

56. Which one of the following medicines is used for treating indigestion. ( )
a) Antibiotic b) analgesic c) antacid d) antiseptic

57. If magnesium reacts with hydrochloric acid, what gas is produced? ( )
a) Hydrogen b) oxygen c) carbon dioxide d) chlorine

58. Which of the following is the most accurate way of representing neutralization? ( )
a) Acid + base → neutral solution
b) Acid + base → salt + water
c) Acid + base → sodium chloride + hydrogen
d) Acid + base → acidic solution

59. Classify the following examples as acid, base or salt:

$Mg(OH)_2$	_____	KCl	_____	HCl	_____
H_3PO_4	_____	HBr	_____	$Al(OH)_3$	_____
KNO_2	_____	NaCl	_____		
$Ba(OH)_2$	_____	HFO_4	_____		

60. Fill in the following blanks:
- A _____ taste is a characteristic property of all acids in aqueous solution.
- Acids react with some metals to produce _____ gas
- Aqueous acid solutions conduct electricity because they have _____
- Acid reacts with base to produce a _____ and water.
- Acid turn methy orange to _____ colour.
- Bases tend to taste _____ and feel _____
- Aqueous basic solutions conduct electricity because they have _____.
- Bases react with _____ to produce a salt and _____
- Bases turn phenolphthalein to _____ colour.

61. Match the following:

a) Plaster of Paris	( )	1) $CaO\ Cl_2$
b) Gypsum	( )	2) $NaHCO_3$
c) Bleaching powder	( )	3) Na_2CO_3
d) Baking soda	( )	4) $CaSO_4 . ½\ H_2O$
e) Washing soda	( )	5) $CaSO_4 . 2\ H_2O$

62. Which of the following salts does not contain water of crystallisation?
(a) Blue vitriol
(b) Baking soda
(c) Washing soda
(d) Gypsum

63. Sodium carbonate is a basic salt because it is a salt of
(a) strong acid and strong base
(b) weak acid and weak base
(c) strong acid and weak base
(d) weak acid and strong base

64. Calcium phosphate is present in tooth enamel. Its nature is
(a) basic (b) acidic (c) neutral (d) amphoteric

65. A sample of soil is mixed with water and allowed to settle. The clear supernatant solution turns the pH paper yellowish-orange. Which of the following would change the colour of this pH paper to greenish-blue?
(a) Lemon juice
(b) Vinegar
(c) Common salt
(d) An antacid

66. Which of the following gives the correct increasing order of acidic strength?
(a) Water <Acetic acid <Hydrochloric acid
(b) Water <Hydrochloric acid <Acetic acid
(c) Acetic acid <Water <Hydrochloric acid
(d) Hydrochloric acid <Water <Acetic acid

67. If a few drops of a concentrated acid accidentally spills over the hand of a student, what should be done?
(a) Wash the hand with saline solution
(b) Wash the hand immediately with plenty of water and apply a paste of sodium hydrogencarbonate
(c) After washing with plenty of water apply solution of sodium hydroxide on the hand
(d) Neutralise the acid with a strong alkali

68. Sodium hydrogencarbonate when added to acetic acid evolves a gas. Which of the following statements are true about the gas evolved?
(i) It turns lime water milky
(ii) It extinguishes a burning splinter
(iii) It dissolves in a solution of sodium hydroxide
(iv) It has a pungent odour
(a) (i) and (ii) (b) (i), (ii) and (iii)
(c) (ii), (iii) and (iv) (d) (i) and (iv)

69. Common salt besides being used in kitchen can also be used as the raw material for making
(i) washing soda
(ii) bleaching powder
(iii) baking soda
(iv) slaked lime
(a) (i) and (ii) (b) (i), (ii) and (iv)
(c) (i) and (iii) (d) (i), (iii) and (iv)

70. One of the constituents of baking powder is sodium hydrogen carbonate, the other constituent is
(a) hydrochloric acid
(b) tartaric acid
(c) acetic acid
(d) sulphuric acid

71. To protect tooth decay we are advised to brush our teeth regularly. The nature of the tooth paste commonly used is
(a) acidic
(b) neutral
(c) basic
(d) corrosive

72. Which of the following statements is correct about an aqueous solution of an acid and of a base?
(i) Higher the pH, stronger the acid
(ii) Higher the pH, weaker the acid
(iii) Lower the pH, stronger the base
(iv) Lower the pH, weaker the base
(a) (i) and (iii) (b) (ii) and (iii)
(c) (i) and (iv) (d) (ii) and (iv)

73. The pH of the gastric juices released during digestion is
(a) less than 7
(b) more than 7
(c) equal to 7
(d) equal to 0

74. Which of the following phenomena occur, when a small amount of acid is added to water?
(i) Ionisation
(ii) Neutralisation
(iii) Dilution
(iv) Salt formation
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (ii) and (iv)

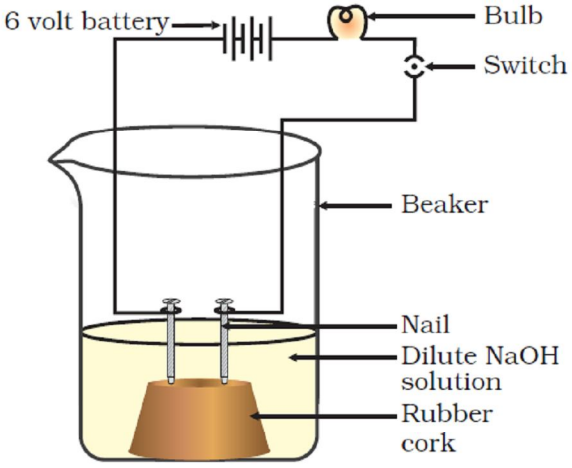
75. Which one of the following can be used as an acid–base indicator by a visually impared student?
(a) Litmus
(b) Turmeric
(c) Vanilla essence
(d) Petunia leaves

76. Which of the following substance will not give carbon dioxide on treatment with dilute acid?
(a) Marble
(b) Limestone
(c) Baking soda
(d) Lime

77. Which of the following is acidic in nature?
(a) Lime juice
(b) Human blood
(c) Lime water
(d) Antacid

78. In an attempt to demonstrate electrical conductivity through an electrolyte, the following apparatus (see below Figure) was set up. Which among the following statement(s) is(are) correct?
(i) Bulb will not glow because electrolyte is not acidic

(ii) Bulb will glow because NaOH is a strong base and furnishes ions for conduction.
(iii) Bulb will not glow because circuit is incomplete
(iv) Bulb will not glow because it depends upon the type of electrolytic solution
(a) (i) and (iii) (b) (ii) and (iv)
(c) (ii) only (c) (iv) only



79. Which of the following is used for dissolution of gold?
(a) Hydrochloric acid
(b) Sulphuric acid
(c) Nitric acid
(d) Aqua regia

80. Which of the following is not a mineral acid?
(a) Hydrochloric acid
(b) Citric acid
(c) Sulphuric acid
(d) Nitric acid

81. Which among the following is not a base?
(a) NaOH
(b) KOH
(c) NH_4OH
(d) C_2H_5 OH

82. Which of the following statements is not correct?
(a) All metal carbonates react with acid to give a salt, water and carbon dioxide
(b) All metal oxides react with water to give salt and acid
(c) Some metals react with acids to give salt and hydrogen
(d) Some non metal oxides react with water to form an acid

83. Which of the following is(are) true when HCl (g) is passed through water?
(i) It does not ionise in the solution as it is a covalent compound.
(ii) It ionises in the solution
(iii) It gives both hydrogen and hydroxyl ion in the solution
(iv) It forms hydronium ion in the solution due to the combination of hydrogen ion with water molecule
(a) (i) only (b) (iii) only
(c) (ii) and (iv) (d) (iii) and (iv)

84. Which of the following statements is true for acids?
(a) Bitter and change red litmus to blue
(b) Sour and change red litmus to blue
(c) Sour and change blue litmus to red
(d) Bitter and change blue litmus to red

85. Which of the following are present in a dilute aqueous solution of hydrochloric acid?
(a) $H_3O+ + Cl^-$
(b) $H_3O+ + OH^-$
(c) $Cl^- + OH^-$
(d) unionised HCl

86. Identify the correct representation of reaction occurring during chloralkali process
(a) $2NaCl(l) + 2H_2O(l) \rightarrow 2NaOH(l) + Cl_2(g) + H_2(g)$
(b) $2NaCl(aq) + 2H_2O(aq) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$
(c) $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(aq) + H_2(aq)$
(d) $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

87. What will be the action of the following substances on litmus paper? Dry HCl gas, Moistened NH3 gas, Lemon juice, Carbonated soft drink, Curd, Soap solution.

88. Name the acid present in ant sting and give its chemical formula. Also give the common method to get relief from the discomfort caused by the ant sting.

89. A student prepared solutions of (i) an acid and (ii) a base in two separate beakers. She forgot to label the solutions and litmus paper is not available in the laboratory. Since both the solutions are colourless, how will she distinguish between the two?

90. How would you distinguish between baking powder and washing soda by heating?

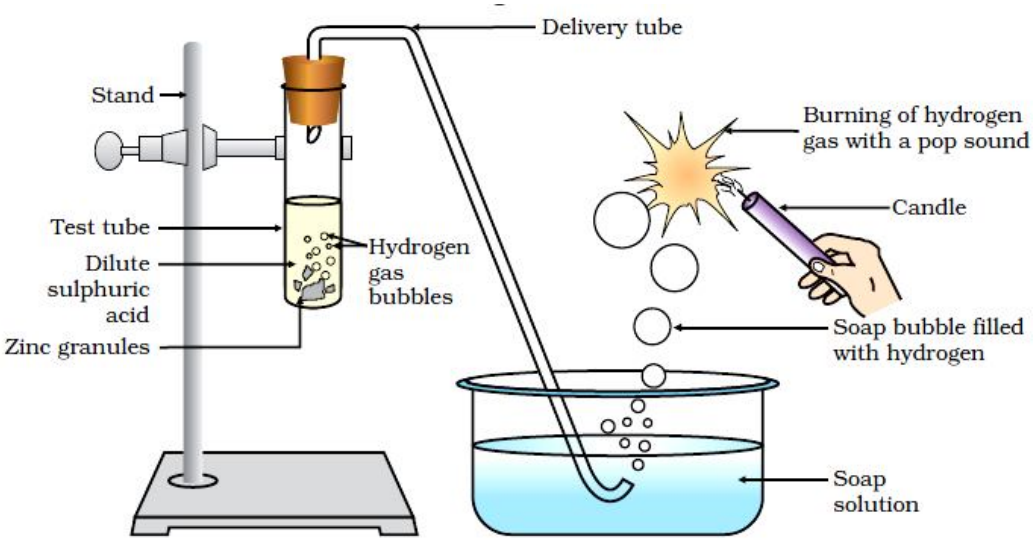
91. Salt - A commonly used in bakery products on heating gets converted into another salt B which itself is used for removal of hardness of water and a gas C is evolved. The gas C when passed through lime water, turns it milky. Identify A, B and C.

92. In one of the industrial processes used for manufacture of sodium hydroxide, a gas X is formed as by product. The gas X reacts with lime water to give a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y giving the chemical equation of the reactions involved.

93. What are strong and weak acids? In the following list of acids, separate strong acids from weak acids. Hydrochloric acid, citric acid, acetic acid, nitric acid, formic acid, sulphuric acid.

94. When zinc metal is treated with a dilute solution of a strong acid, a gas is evolved, which is utilised in the hydrogenation of oil. Name the gas evolved. Write the chemical equation of the reaction involved and also write a test to detect the gas formed.

95. In the following schematic diagram for the preparation of hydrogen gas as shown in below Figure, what would happen if following changes are made?



(a) In place of zinc granules, same amount of zinc dust is taken in the test tube
(b) Instead of dilute sulphuric acid, dilute hydrochloric acid is taken
(c) In place of zinc, copper turnings are taken
(d) Sodium hydroxide is taken in place of dilute sulphuric acid and the tube is heated.

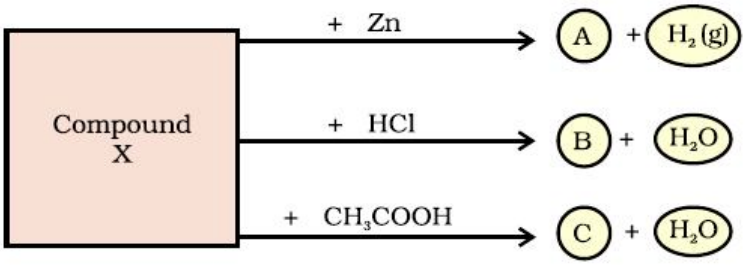
96. For making cake, baking powder is taken. If at home your mother uses baking soda instead of baking powder in cake,
(a) how will it affect the taste of the cake and why?
(b) how can baking soda be converted into baking powder?
(c) what is the role of tartaric acid added to baking soda?

97. A metal carbonate X on reacting with an acid gives a gas which when passed through a solution Y gives the carbonate back. On the other hand, a gas G that is obtained at anode during electrolysis of brine is passed on dry Y, it gives a compound Z, used for disinfecting drinking water. Identity X, Y, G and Z.

98. A dry pellet of a common base B, when kept in open absorbs moisture and turns sticky. The compound is also a by–product of chloralkali process. Identify B. What type of reaction occurs when B is treated with an acidic oxide? Write a balanced chemical equation for one such solution.

99. A sulphate salt of Group 2 element of the Periodic Table is a white, soft substance, which can be moulded into different shapes by making its dough. When this compound is left in open for some time, it becomes a solid mass and cannot be used for moulding purposes. Identify the sulphate salt and why does it show such a behaviour? Give the reaction involved.

100. Identify the compound X on the basis of the reactions given below. Also, write the name and chemical formulae of A, B and C.



CHAPTER – 3

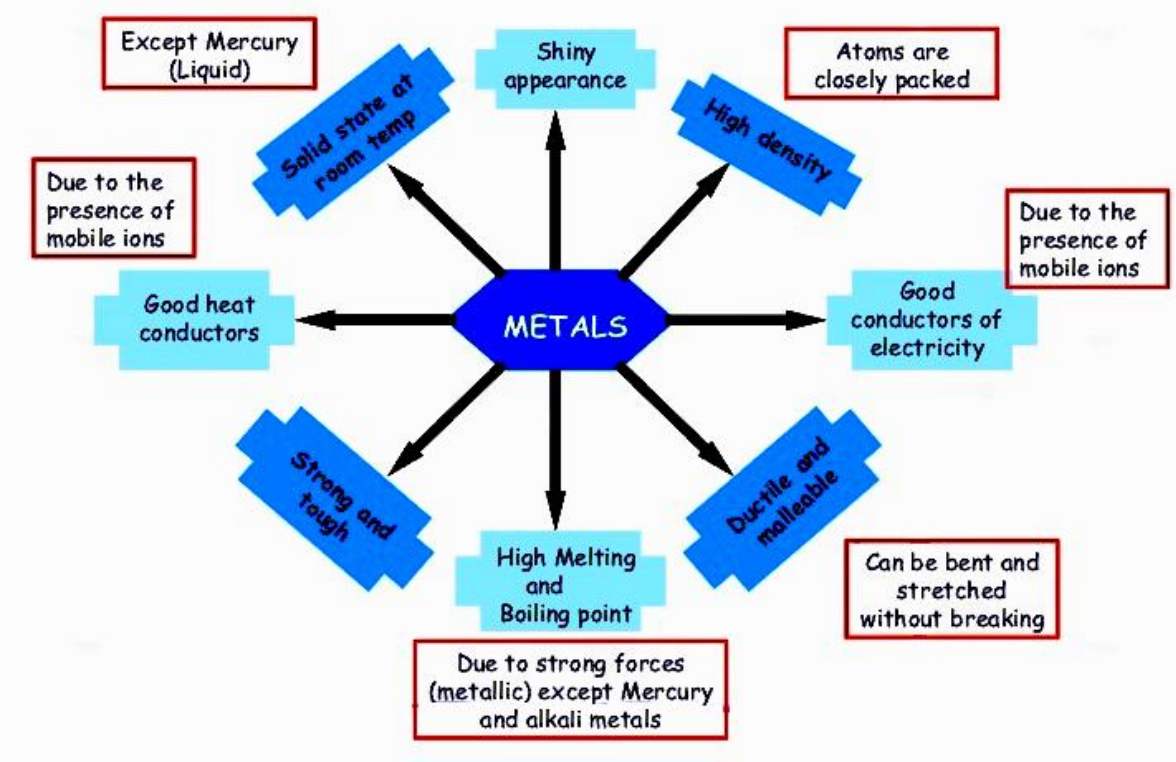
METALS AND NON-METALS

Metals occupy the bulk of the periodic table, while non-metallic elements can only be found on the right-hand-side of the Periodic Table . A diagonal line, drawn from boron (B) to polonium (Po), separates the metals from the nonmetals. Most elements on this line are metalloids, sometimes called semiconductors. This is because these elements exhibit electrical properties intermediate to both, conductors and insulators. Elements to the lower left of this division - line are called metals, while elements to the upper right of the division - line are called non-metals.

On the basis of their general physical and chemical properties, every element in the periodic table can be termed either a metal or a nonmetal.

PHYSICAL PROPERTIES OF METALS:

- **Physical state** - Metals are solids at room temperature e.g. sodium, aluminium, potassium, magnesium. There are exceptions to this. Mercury and gallium are metals but they are in liquid state at room temperature.
- **Luster** – Metals have a shining surface called luster when freshly prepared. They have a quality of reflecting light from their surface and they can be polished e.g. metals like gold, silver, copper show this property.
- **Malleability** - Metals can be beaten into thin sheets. This property is called malleability. Due to this property, metals can be rolled into sheets e.g. aluminium, copper, zinc can be beaten into sheets.
- **Ductility** - Metals can be drawn into thin wires. This property is called ductility. For example, 100 grams of silver can be drawn into a thin wire about 200 meters long.
- **Hardness** – Metals are generally hard e.g. iron, cobalt, nickel. There are few exceptions to this. Sodium and potassium are soft and they can be cut with a knife.
- **Sound:** Metals produce ringing sound, so, metals are called sonorous. Sound of metals is also known as metallic sound. This is the cause that metal wires are used in making musical instruments.
- **Conduction** – Generally, metals are good conductors of heat and electricity because they have free electrons. Silver and copper are the two best conductors . Relatively, lead and bismuth are poor conductors of heat and electricity.
- **Density** - Metals generally have high density and they are heavy. Iridium and osmium have the highest densities while lithium has the lowest density.
- **Melting and boiling point** – Metals usually have high melting point and boiling point. For example, iron, cobalt and nickel have high melting and boiling point. Tungsten has the highest melting point. There are some exceptions to this. For example , most of the alkali metals have low melting and boiling point.
- **Strength:** Most of the metals are strong and have high tensile strength. Because of this big structures are made using metals, such as copper and iron.
- **Color:** Most of the metals are grey in color. But gold and copper are exceptions.



INTEXT QUESTIONS PAGE NO. 40

Question 1: Give an example of a metal which

(i) is a liquid at room temperature. **(ii) can be easily cut with a knife.**

(iii) is the best conductor of heat. **(iv) is a poor conductor of heat.**

Answer : (i) Metal that exists in liquid state at room temperature → Mercury

(ii) Metal that can be easily cut with a knife → Sodium

(iii) Metal that is the best conductor of heat → Silver

(iv) Metals that are poor conductors of heat → Mercury and lead

Question 2: Explain the meanings of malleable and ductile.

Answer : Malleable: Substances that can be beaten into thin sheets are called malleable. For example, most of the metals are malleable.

Ductile: Substances that can be drawn into thin wires are called ductile. For example, most of the metals are ductile.

CHEMICAL PROPERTIES OF METALS

REACTION WITH OXYGEN:

Most of the metals form respective metal oxides when react with oxygen.

Metal + Oxygen → Metal oxide

Examples:

- Reaction of magnesium metal with oxygen: Magnesium metal gives magnesium oxide when reacts with oxygen. Magnesium burnt with dazzling light in air and produces lot of heat.

  $2Mg + O_2 \rightarrow 2MgO$

- Reaction of aluminium metal with oxygen: Aluminium metal does not react with oxygen at room temperature but it gives aluminium oxide when burnt in air.

  $4Al + 3O_2 \rightarrow 2Al_2O_3$

- Reaction of potassium with oxygen: Potassium metal forms potassium oxide when reacts with oxygen.

$4K + O_2 \rightarrow 2K_2O$

- Reaction of sodium with oxygen: Sodium metal forms sodium oxide when reacts with oxygen.

  $4Na + O_2 \rightarrow 2Na_2O$

  Lithium, potassium, sodium, etc. are known as alkali metals. Alkali metals react vigorously with oxygen.
- Reaction of Iron metal with oxygen: Iron does not react with oxygen at room temperature. But when iron is heated strongly in air, it gives iron oxide.

  $3Fe + 2O_2 \rightarrow Fe_3O_4$

  Iron fillings give sparkle in flame when burnt.
- Reaction of copper metal with oxygen: Copper does not react with oxygen at room temperature but when burnt in air, it gives copper oxide.

  $2Cu + O_2 \rightarrow 2CuO$
- Reaction of zinc metal with oxygen: Zinc does not react with oxygen at room temperature. But it gives zinc oxide when heated strongly in air.

  $2Zn + O_2 \rightarrow 2ZnO$

REACTION OF METALS WITH WATER:

Metals form respective metal hydroxide and hydrogen gas when react with water.

Metal + Water → Metal hydroxide + Hydrogen

Most of the metals do not react with water. However, alkali metals react vigorously with water.

Examples:

- Reaction of sodium metal with water: Sodium metal forms sodium hydroxide and liberates hydrogen gas along with lot of heat when reacts with water.

  $Na + H_2O \rightarrow NaOH + H_2$
- Reaction of aluminium metal with water: Reaction of aluminium metal with cold water is too slow to come into notice. But when steam is passed over aluminium metal; aluminium oxide and hydrogen gas are produced.

  $2Al + 3H_2O \rightarrow Al_2O_3 + 2H_2$
- Reaction of zinc metal with water: Zinc metal produces zinc oxide and hydrogen gas when steam is passed over it. Zinc does not react with cold water.

  $Zn + H_2O \rightarrow ZnO + H_2$
- Reaction of Iron with water: Reaction of iron with cold water is very slow and come into notice after a long time. Iron forms rust (iron oxide) when reacts with moisture present in atmosphere.

  Iron oxide and hydrogen gas are formed by passing of steam over iron metal.

  $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$
- Reaction of potassium metal with water: Potassium metal forms potassium hydroxide and liberates hydrogen gas along with lot of heat when reacts with water.

  $K + H_2O \rightarrow KOH + H_2$
- Reaction of calcium metal with water: Calcium forms calcium hydroxide along with hydrogen gas and heat when reacts with water.

  $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$
- Reaction of magnesium metal with water: Magnesium metal reacts with water slowly and forms magnesium hydroxide and hydrogen gas.

  $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$
- When steam is passed over magnesium metal, magnesium oxide and hydrogen gas are formed.

  $Mg + H_2O \rightarrow MgO + H_2$

REACTION OF METALS WITH DILUTE ACID:

Metals form respective salts when react with dilute acid.

Metal + dil. acid → Metal salt + Hydrogen

Examples:

- Reaction of aluminium with dilute hydrochloric acid: Aluminium chloride and hydrogen gas are formed.

  $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

- Reaction of zinc with dilute sulphuric acid: Zinc sulphate and hydrogen gas are formed when zinc reacts with dilute sulphuric acid. This method is used in laboratory to produce hydrogen gas.

  $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

- Reaction of sodium metal with dilute acid: Sodium metal gives sodium chloride and hydrogen gas when react with dilute hydrochloric acid.

  $2Na + 2HCl \rightarrow 2NaCl + H_2$

- Reaction of potassium with dilute sulphuric acid: Potassium sulphate and hydrogen gas are formed when potassium reacts with dilute sulphuric acid.

  $2K + H_2SO_4 \rightarrow K_2SO_4 + H_2$

- Reaction of magnesium metal with dilute hydrochloric acid: Magnesium chloride and hydrogen gas are formed when magnesium reacts with dilute hydrochloric acid.

  $Mg + 2HCl \rightarrow MgCl_2 + H_2$

  Copper, gold and silver are known as noble metals. These do not react with water or dilute acids.

WEIGHT (Light → Heavy)

Metal		Reaction with AIR	Reaction with WATER	Reaction with ACIDS
Potassium	K	Burn vigorously to form metal oxides	React with **cold water H_2O (l)** to form $H_{2\,(g)}$ and (metal)$OH_{(aq)}$	Strong reaction with **diluted acid (aq)** to form **$H_{2\,(g)}$**. Metal replaces H in compound to form a salt.
Sodium	Na			
Calcium	Ca	Burn with decreasing vigour down the series to form metal oxides	Only reacts with **steam $H_2O(g)$** to form $H_{2\,(g)}$ and metal oxide	
Magnesium	Mg			
Aluminium	Al			
Zinc	Zn			
Iron	Fe			
Lead	Pb	React slowly (when heated) to form an oxide layer	No reaction	React with **concentrated acid (l)**. Metal replaces H to make a salt. Some of the acid decomposes into **$NO_{2\,(g)}$** and **$H_2O_{\,(l)}$**.
Copper	Cu			
Mercury	Hg			
Silver	Ag	No reaction		No reaction
Gold	Au			

METAL OXIDES: CHEMICAL PROPERTIES

Metal oxides are basic in nature. Aqueous solution of metal oxides turns red litmus blue.

REACTION OF METAL OXIDES WITH WATER:

Most of the metal oxides are insoluble in water. Alkali metal oxides are soluble in water. Alkali metal oxides give strong base when dissolved in water.

Examples:

- Reaction of sodium oxide with water: Sodium oxide gives sodium hydroxide when reacts with water.

  $Na_2O + H_2O \rightarrow 2NaOH$

- Reaction of magnesium oxide with water: Magnesium oxide gives magnesium hydroxide with water.

  $MgO + H_2O \rightarrow Mg(OH)_2$

- Reaction of potassium oxide with water: Potassium oxide gives potassium hydroxide when reacts with water.

  $K_2O + H_2O \rightarrow 2KOH$

- Reaction of zinc oxide and aluminium oxide: Aluminium oxide and zinc oxide are insoluble in water. Aluminium oxide and zinc oxide are amphoteric in nature. An amphoteric substance shows both acidic and basic character. It reacts with base like acid and reacts with acid like a base.

  When zinc oxide reacts with sodium hydroxide, it behaves like an acid. In this reaction, sodium zicate and water are formed.

  $ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$

- Zinc oxide behaves like a base when reacts with acid. Zinc oxide gives zinc chloride and water on reaction with hydrochloric acid.

  $ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

- In similar way aluminium oxide behaves like a base when reacts with an acid and behaves like an acid when reacts with a base.
- Aluminium oxide gives sodium aluminate along with water when reacts with sodium hydroxide.

  $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

- Aluminium oxide gives aluminium chloride along with water when it reacts with hydrochloric acid.

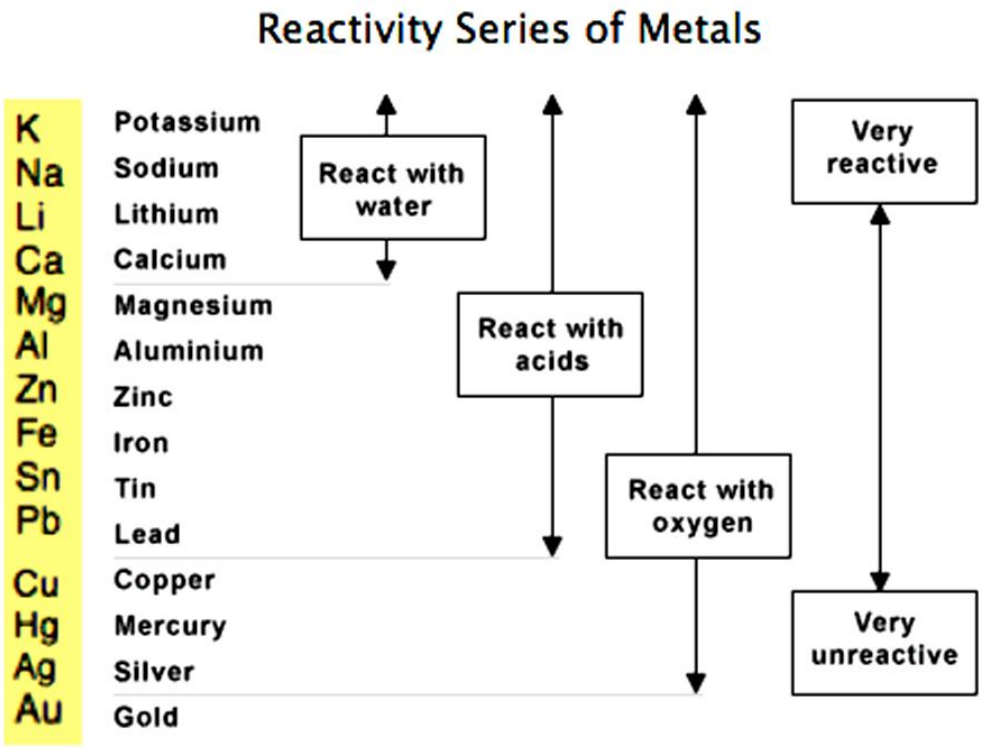
  $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

REACTIVITY SERIES OF METALS

A series of metallic elements arranged in the increasing or decreasing order of their reactivity is called a reactivity series of metals.

In the reactivity series, copper, gold, and silver are at the bottom and hence least reactive. These metals are known as noble metals.

The most active metal, potassium, is at the top of the list and the least reactive metal, gold, is at the bottom of the list. Although hydrogen is a non-metal it is included in the activity series due to the fact that it behaves like a metal in most chemical reactions i.e., the hydrogen ion has a positive charge [H^+] like other metals.



Following points become evident from the activity series of metals.

- The higher the metal in the series, the more reactive it is i.e., its reaction is fast and more exothermic.
- This also implies that the reverse reaction becomes more difficult i.e., the more reactive a metal, the more difficult it is to extract it from its ore. The metal is also more susceptible to corrosion with oxygen and water.
- The reactivity series can be established by observation of the reaction of metals with water, oxygen or acids.
- Within the general reactivity or activity series, there are some periodic table trends:
  a) Down Group 1(I) the "Alkali Metals", the activity increases Cs > Rb > K > Na > Li.
  b) Down Group 2(II) the activity increases e.g., Ca > Mg.
  c) In the same period, the Group 1 metal is more reactive than the group II metal and the group II metal is more reactive than the Group III metal and all three are more reactive than the "Transition Metals". e.g., Na > Mg > Al (in Period 3) and K > Ca > Ga > Fe/Cu / Zn etc. (in Period 4)

REACTION OF METALS WITH SOLUTION OF OTHER METAL SALTS:

Reaction of metals with solution of other metal salt is displacement reaction. In this reaction more reactive metal displace the less reactive metal from its salt.

Metal A + Salt of metal B → Salt of metal A + Metal B

Examples:

Iron displaces copper from copper sulphate solution.

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

Similarly, aluminium and zinc displace copper from the solution of copper sulphate.

$2Al + 3CuSO_4 \rightarrow Al_2(SO_4)_3 + 3Cu$

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

In all the above examples, iron, aluminium and zinc are more reactive than copper. That's why they displace copper from its salt solution.

When copper is dipped in the solution of silver nitrate, it displaces silver and forms copper nitrate.

$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

In this reaction copper is more reactive than silver and hence displace silver from silver nitrate solution forming copper nitrate.
Silver metal does not react with copper sulphate solution. Because silver is less reactive than copper and not able to displace copper from its salt solution.
$Ag + CuSO_4 \rightarrow$ No reaction
Similarly, when gold is dipped in the solution of copper nitrate, no reaction takes place. Because copper is more reactive than gold.
$Au + CuSO_4 \rightarrow$ No reaction
In similar way no reaction takes place when copper is dipped in the solution of aluminium nitrate. Because copper is less reactive than aluminium.
$Al(NO_3)_3 + Cu \rightarrow$ No reaction

PHYSICAL PROPERTIES OF NON-METALS

- **Physical state –** Non-metals can exist in solid or liquid or gaseous state at room temperature. . For example, carbon, sulphur, phosphorus, iodine are in solid state, bromine is in liquid state while oxygen, nitrogen, chlorine are in gaseous state at room temperature.

- **Luster** – Non-metals do not have luster. They do not reflect light from their surface. (exception – diamond and iodine) Non-metals have dull appearance. For example, sulphur, phosphorus and carbon show this property.

- **Malleability** - Non-metals are non-malleable. If solids, they are brittle i.e. they break or shatter on hammering. For example, coal, sulphur, phosphorus are brittle.

- **Ductility** – Non-metals can not be drawn into thin wires. So they are not ductile.

- **Hardness** – Non-metals are usually not hard. They are soft. For example, coal, sulphur and phosphorus are soft. Diamond is exception to this. It is the hardest substance known.

- **Sonority:** Non-metals are not sonorous, i.e. they do not produce a typical sound no being hit.

- **Conduction** - Non- metals are usually poor conductors of heat and electricity. However, carbon in the form of gas carbon and graphite is exception to this. These forms of carbon are good conductors of electricity.

- **Density –** Non- metals which are gases have low density. Solid non-metals have low to moderate density. They are medium light. For example, sulphur, phosphorus and boron have densities 1.82, 2.07 and 2.34 respectively. . However, diamond has high density which is about 3.5.

- **Melting and boiling point –** Non-metals usually have low melting and boiling points. For example, phosphorus, sulphur, and iodine have melting points 440, 1150 and 1140 C respectively and boiling points 2800 , 4450 and 1840C respectively. . However, carbon, silicon and boron possess very high melting and boiling points.

- **Tensile strength** – Non-metals have low tensile strength i.e. they have no tenacity.

- **Color:** Non-metals are of many colors.

Physical Properties	Metals	Non-Metals
Malleability and Ductilily	Metals are malleable. They can be beaten into thin sheets. They are also ductile and can be drawn into wire (except a few metals like Na, K etc.)	Non-metals are neither malleable nor ductile. For e.g. coal, (carbon) and sulphur
Metallic Lusture	All the metals show metallic lusture.	They do not show any metallic lusture.
Hardness	Metals are generally hard	Non-metals are soft in comparison to metals
Physical state	They exist in solid and liquid states	Non-metals exist in solid, liquid and gaseous states.
Sonorous	Metals are sonorous and produce characteristic metallic sound when struck (e.g school bell)	They are non sonorous
Density	High density	Low density
Electrical conductivity	Good conductor of electricity	Bad conductor of electricity

CHEMICAL PROPERTIES OF NON-METALS

REACTION OF NON-METALS WITH OXYGEN:

Non-metals form respective oxide when react with oxygen.

Non-metal + Oxygen → Non-metal oxide

Examples:

- When carbon reacts with oxygen, carbon dioxide is formed along with production of heat.

  $C + O_2 \rightarrow CO_2 + Heat$

- When carbon is burnt in insufficient supply of air, it forms carbon monoxide. Carbon monoxide is a toxic substance. Inhaling of carbon monoxide may prove fatal.

  $2C + O_2 \rightarrow 2CO + Heat$

- Sulphur gives sulphur dioxide when react with oxygen. Sulphur caught fire when exposed to air.

  $S + O_2 \rightarrow SO_2$

- When hydrogen reacts with oxygen it gives water.

  $2H_2 + O_2 \rightarrow 2H_2O$

NON-METAL OXIDE:

Non-metal oxides are acidic in nature. Solution of non-metal oxides turns blue litmus red.

Examples:

- Carbon dioxide gives carbonic acid when dissolved in water.

  $CO_2 + H_2O \rightarrow H_2CO_3$

- Sulphur dioxide gives sulphurous acid when dissolved in water.

  $SO_2 + H_2O \rightarrow H_2SO_3$

- Sulphur dioxide gives sulphur trioxide when it reacts with oxygen.

  $2SO_2 + O_2 \rightarrow 2SO_3$

- Sulphur trioxide gives sulphuric acid when dissolved in water.

  $SO_3 + H_2O \rightarrow H_2SO_4$

REACTION OF NON-METAL WITH CHLORINE:

Non metals give respective chloride when they react with chlorine gas.

Non-metal + Chlorine $\rightarrow$ Non-metal chloride

Examples:

- Hydrogen gives hydrogen chloride and phosphorous gives phosphorous trichloride when react with chlorine.

  $H_2 + Cl_2 \rightarrow 2HCl$

  $P_4 + 6Cl_2 \rightarrow 4PCl_3$

REACTION OF METAL AND NON-METAL

Many metals form ionic bonds when they react with non-metals. Compounds so formed are known as ionic compounds.

Ions: Positive or negative charged atoms are known as ions. Ions are formed because of loss or gain of electrons. Atoms form ion to obtain electronic configuration of nearest noble gas, this means to obtain stable configuration.

Positive ion: A positive ion is formed because of loss of electrons by an atom. Following are some examples of positive ions.

Examples:

- Sodium forms sodium ion because of loss of one electron. Because of loss of one electron; one positive charge comes over sodium.

  $Na \rightarrow Na^+ + e^-$

- Similarly; potassium gets one positive charge by loss of one electron.

  $K \rightarrow K^+ + e^-$

- Magnesium forms positive ion because of loss of two electrons. Two positive charges come over magnesium because of loss of two electrons.

  $Mg \rightarrow Mg^{++} + 2e^-$

- Similarly calcium gets two positive charges over it by loss of two electrons.

  $Ca \rightarrow Ca^{++} + 2e^-$

Negative ion: A negative ion is formed because of gain of electron. Some examples are given below.

Examples:

- Chlorine gains one electron in order to achieve stable configuration. After loss of one electron chlorine gets one negative charge over it forming chlorine ion.

  $Cl + e^- \rightarrow Cl^-$

- Similarly, fluorine gets one negative charge over it by gain of one electron forming chloride ion; in order to achieve stable configuration.

  $F + e^- \rightarrow F^-$

- Oxygen gets two negative charge over it by gain of two electrons forming oxide ion; in order to obtain stable configuration.

$$O + 2e^- \rightarrow O^{--}$$

USES OF METALS

Metals find number of applications. Some of them are given below.

- Zinc metal is used for galvanizing iron , in anti corrosion material, in medicinal fields and in alloys.
- Iron is used as a construction material in bridges, houses, ships etc. Iron, in the form of steel is used for making domestic utensils.
- Tin is used for soldering, for preparing foils, for metal coatings to prevent chemical action and corrosion, for panel lighting etc.
- Lead is used in making water pipes, in pigments, batteries, in alloys etc.
- Titanium finds extensive use in aircraft industries
- Pure metals, which display zero resistance to electrical currents, are called superconductors. Hg, Nb are examples of superconductors. They become superconductors below a critical temperature of 4.2 K and 9.2 K respectively. Superconductors have many applications in research and industry.
- Almost all metals including Zr, Ti find wide applications in atomic and space programmes and experiments.
- Mercury is used in thermometers.
- Silver, gold and platinum are precious metals and they are used in making ornaments.
- Radioactive metals like uranium and plutonium are used in nuclear power plants to produce atomic energy via nuclear fission.

USES OF NON - METALS

Non - metals find number of applications. Some of them are given below.

- Sulphur is used in making compounds like sulpha drugs, sulphuric acid, in matches, in gun powder , for vulcanization of rubber etc.
- Boron, in the form of compound borax, is used in making skin ointments.
- Phosphorus is used in making crackers.
- Oxygen is used for respiration.
- Chlorine, in the form of bleaching powder, is used for purification of water.
- Carbon is used as a fuel, as electrodes (graphite), as a reducing agent in metallurgy.
- Oxygen, hydrogen and nitrogen are used by all living things, they are the 'building blocks' of life.
- Iodine is used to prevent thyroid problems.
- Bromine is used in the preparation of dyes.
- Some compounds of fluorine (such as sodium fluoride, stannous fluoride) are added to toothpastes to prevent dental decays or formation of cavities.

INTEXT QUESTIONS PAGE NO. 46

Question 1: Why is sodium kept immersed in kerosene oil?

Answer : Sodium and potassium are very reactive metals and combine explosively with air as well as water. Hence, they catch fire if kept in open. Therefore, to prevent accidental fires and accidents, sodium is stored in kerosene oil.

Question 2: Write equations for the reactions of
(i) iron with steam
(ii) calcium and potassium with water
Answers:

(i) $3Fe_{(s)} + 4H_2O_{(g)} \longrightarrow Fe_3O_{4(aq)} + 4H_{2(g)}$

Iron Steam Iron(II,III)oxide Hydrogen

(ii) $Ca_{(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)} + H_{2(g)} + Heat$

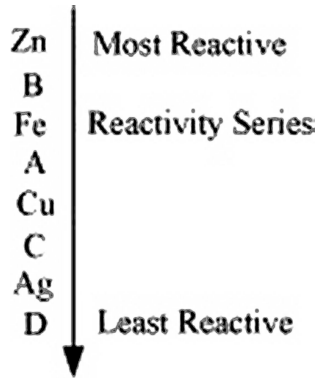
$2K_{(s)} + 2H_2O_{(l)} \longrightarrow 2KOH_{(aq)} + H_{2(g)} + Heat$

Calcium/ Potassium Water Calcium Hydroxide/ Potassium hydroxide Hydrogen

Question 3: Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows.

Metal	Iron(II) sulphate	Copper(II) sulphate	Zinc sulphate	Silver nitrate
A	No reaction	Displacement		
B	Displacement		No reaction	
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

Use the Table above to answer the following questions about metals A, B, C and D.
(i) Which is the most reactive metal?
(ii) What would you observe if B is added to a solution of copper (II) sulphate?
(iii) Arrange the metals A, B, C and D in the order of decreasing reactivity.
Answer: Explanation
A + FeSO4 → No reaction, i.e., A is less reactive than iron
A + CuSO4 →Displacement, i.e., A is more reactive than copper
B + FeSO4 → Displacement, i.e., B is more reactive than iron
B + ZnSO4 →No reaction, i.e., B is less reactive than zinc
C + FeSO4 → No reaction, i.e., C is less reactive than iron
C + CuSO4 →No reaction, i.e., C is less reactive than copper
C + ZnSO4 →No reaction, i.e., C is less reactive than zinc
C + AgNO3 → Displacement, i.e., C is more reactive than silver
D + FeSO4/CuSO4/ZnSO4/AgNO3 →No reaction, i.e., D is less reactive than iron, copper, zinc, and silver
From the above equations, we obtain:



(i) B is the most reactive metal.
(ii) If B is added to a solution of copper (II) sulphate, then it would displace copper.
B + CuSO4 →Displacement
(iii) The arrangement of the metals in the order of decreasing reactivity is:
B > A > C > D

Question 4: Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute H2SO4.
Answer: Hydrogen gas is evolved when dilute hydrochloric acid is added to a reactive metal. When iron reacts with dilute H2SO4, iron (II) sulphate with the evolution of hydrogen gas is formed.

$$Fe_{(s)} + H_2SO_{4(aq)} \longrightarrow FeSO_{4(aq)} + H_{2(g)}$$

Question 5: What would you observe when zinc is added to a solution of iron (II) sulphate? Write the chemical reaction that takes place.
Answer: Zinc is more reactive than iron. Therefore, if zinc is added to a solution of iron (II) sulphate, then it would displace iron from the solution.

$$Zn_{(s)} + FeSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Fe_{(s)}$$

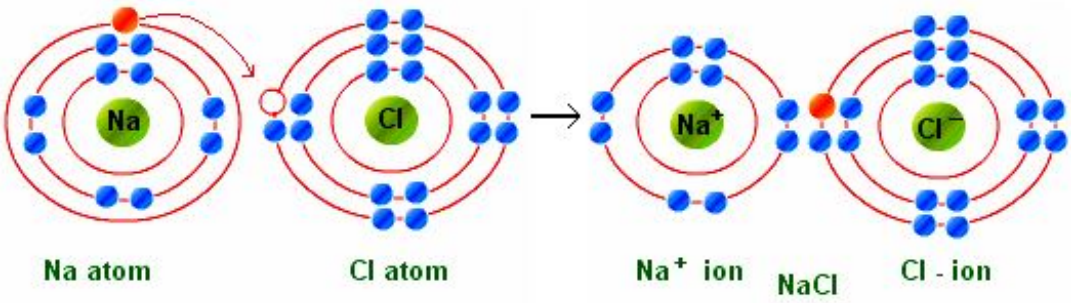
IONIC BONDS
Ionic bonding is the complete transfer of valence electron(s) between atoms. It is a type of chemical bond that generates two oppositely charged ions. In ionic bonds, the metal loses electrons to become a positively charged cation, whereas the nonmetal accepts those electrons to become a negatively charged anion. Ionic bonds require an electron donor, often a metal, and an electron acceptor, a nonmetal.

Ionic bonding is observed because metals have few electrons in their outer-most orbitals. By losing those electrons, these metals can achieve noble gas configuration and satisfy the octet rule. Similarly, nonmetals that have close to 8 electrons in their valence shells tend to readily accept electrons to achieve noble gas configuration. In ionic bonding, more than 1 electron can be donated or received to satisfy the octet rule. The charges on the anion and cation correspond to the number of electrons donated or received. In ionic bonds, the net charge of the compound must be zero.

FORMATION OF IONIC BOND:
The positive ions (cations) and negative ions (anions) that are formed experience the electrostatic forces and get attracted to form chemical bond. As this bond is between charged particles known as ions, it is called *ionic bond*. Sometimes based on the forces being electrostatic, the bond is also called *the electrostatic bond.* As the valence concept has been explained in terms of electrons, it is also called the *electrovalent bond*.

Thus, we can define ionic bond as follows: The electrostatic attractive force that keeps cation and anion together to form a new electrically neutral entity is called '*ionic bond'*.

EXAMPLES
FORMATION OF SODIUM CHLORIDE (NaCl):
In sodium chloride; sodium is a metal (alkali metal) and chlorine is non-metal.
Atomic number of sodium = 11
Electronic configuration of sodium: 2, 8, 1
Number of electrons in outermost orbit = 1
Valence electrons = Electrons in outermost orbit = 1
Atomic number of chlorine = 17
Electronic configuration of chlorine: 2, 8, 7
Electrons in outermost orbit = 7
Therefore, valence electrons = 7

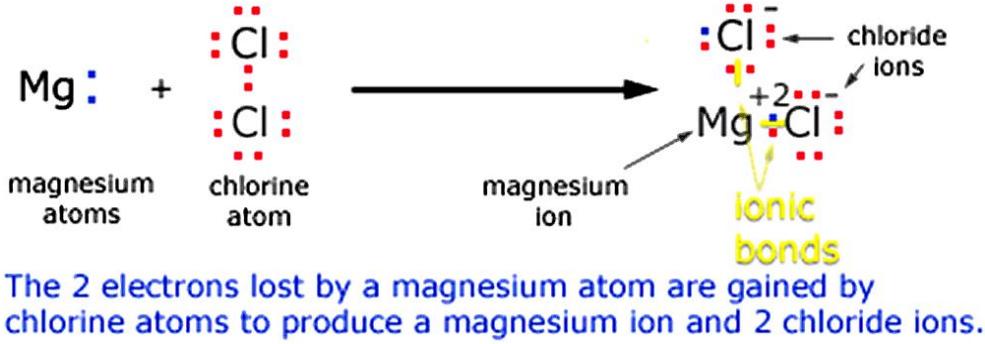


Sodium has one valence electron and chlorine has seven valence electrons. Sodium requires losing one electron to obtain stable configuration and chlorine requires gaining one electron in order to obtain stable electronic configuration. Thus, in order to obtain stable configuration sodium transfers one electron to chlorine.

After loss of one electron sodium gets one positive charge (+) and chlorine gets one negative charge after gain of one electron. Sodium chloride is formed because of transfer of electrons. Thus, ionic bond is formed between sodium and chlorine. Since, sodium chloride is formed because of ionic bond, thus it is called ionic compound. In similar way; potassium chloride (KCl) is formed.

FORMATION OF MAGNESIUM CHLORIDE ($MgCl_2$):

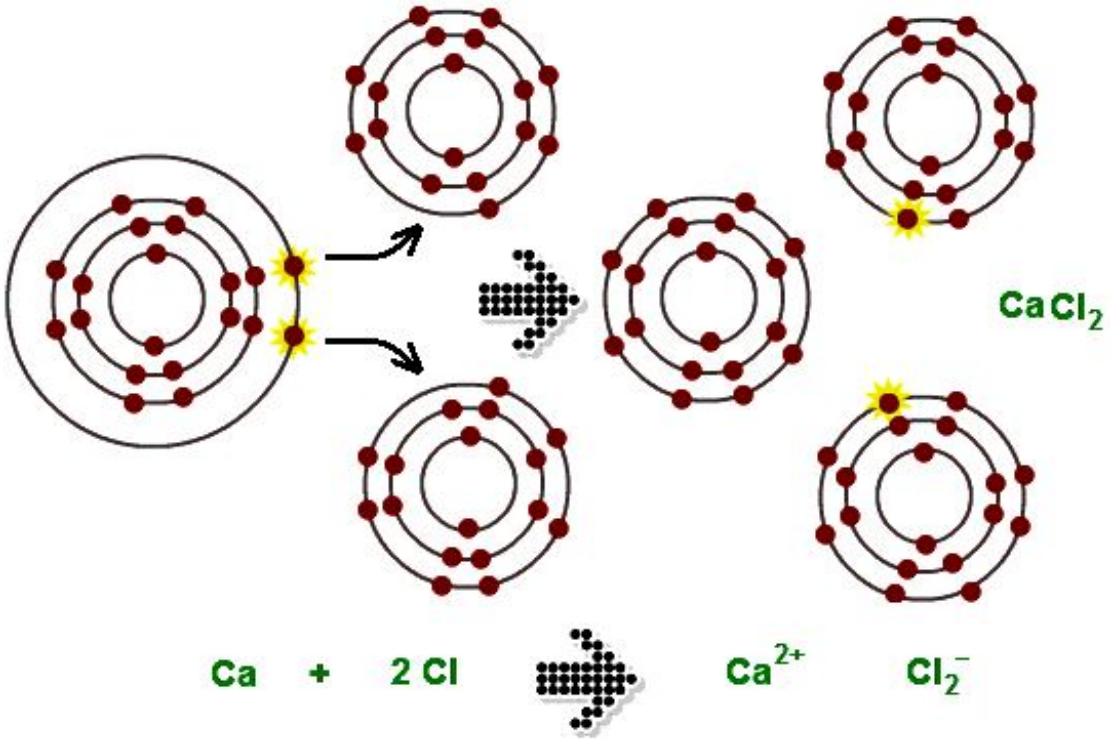
The atomic number of magnesium is 12
Electronic configuration of magnesium: 2, 8, 2
Number of electrons in outermost orbit = 2
Valence electron = 2
Atomic number of chlorine = 17
Electronic configuration of chlorine: 2, 8, 7
Electrons in outermost orbit = 7
Therefore, valence electrons = 7



Magnesium loses two electrons in order to obtain stable electronic configuration. Each of the two chlorine atoms gains one electron lost by magnesium to obtain stable electronic configuration. The bonds so formed between magnesium and chlorine are ionic bonds and compound (magnesium chloride) is an ionic compound.

FORMATION OF CALCIUM CHLORIDE: ($CaCl_2$):

Atomic number of calcium is 20.
Electronic configuration of calcium: 2, 8, 8, 2
Number of electrons in outermost orbit = 2
Valence electron = 2
Valence electrons of chlorine = 7
Calcium loses two electrons in order to achieve stable electronic configuration. Each of the two chlorine atoms on the other hand gains one electron losing from calcium to get stability. By losing of two electrons calcium gets two positive charges over it. Each of the chlorine atoms gets one positive charge over it.



The bonds formed in the calcium chloride are ionic bonds and compound (calcium chloride) is an ionic compound. In similar way; Barium chloride is formed.
Formation of Calcium oxide (CaO):
Valence electron = 2
Atomic number of oxygen is 8
Electronic configuration of oxygen is: 2, 6
Number of electrons in outermost orbit = 6
Valence electron = 6
Calcium loses two electrons and gets two positive charges over it in order to get stability. Oxygen gains two electrons; lost by calcium and thus gets two negative charges over it.

Bond formed between calcium oxide is ionic bond. Calcium oxide is an ionic compound. In similar way; magnesium oxide is formed.

PROPERTIES OF IONIC COMPOUND:

- ***Physical nature*:** Ionic compounds are solids and are somewhat hard because of the strong force of attraction between the positive and negative ions. These compounds are generally brittle and break into pieces when pressure is applied.

- ***Melting and Boiling points*:** Ionic compounds have high melting and boiling points. This is because a considerable amount of energy is required to break the strong inter-ionic attraction.

- ***Solubility*:** Electrovalent compounds are generally soluble in water and insoluble in solvents such as kerosene, petrol, etc.

- ***Conduction of Electricity*:** The conduction of electricity through a solution involves the movement of charged particles. A solution of an ionic compound in water contains ions, which move to the opposite electrodes when electricity is passed through the solution. Ionic compounds in the solid state do not conduct electricity because movement of ions in the solid is not possible due to their rigid structure. But ionic compounds conduct electricity in the molten state. This is possible in the molten state since the elecrostatic forces of

attraction between the oppositely charged ions are overcome due to the heat. Thus, the ions move freely and conduct electricity.

INTEXT QUESTIONS PAGE NO. 49

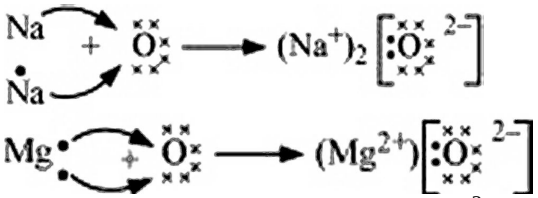
Question 1: (i) Write the electron-dot structures for sodium, oxygen and magnesium.
(ii) Show the formation of Na_2O and MgO by the transfer of electrons.
(iii) What are the ions present in these compounds?
Answer: (i) The representation of elements with valence electrons as dots around the elements is referred to as electron-dot structure for elements.

(a) Sodium (2, 8, 1) = $\dot{Na}$

(b) Oxygen (2, 6) = $:\ddot{O}:$

(c) Magnesium (2, 8, 2) = $\ddot{Mg}$

(ii)



(iii) The ions present in Na_2O are Na^+ and O^{2-} ions and in MgO are Mg^{2+} and O^{2-} ions.

Question 2: Why do ionic compounds have high melting points?
Answer: Ionic compounds have strong electrostatic forces of attraction between the ions. Therefore, it requires a lot of energy to overcome these forces. That is why ionic compounds have high melting points.

OCCURENCE AND EXTRACTION OF METALS

Metals occur in nature in free as well as combined form. Metals having low reactivity show little affinity for air, moisture, carbon dioxide or other non-metals present in nature. Such metals may remain in elemental or native (free) state in nature. Such metals are called "noble metals" as they show the least chemical reactivity. For example gold, silver, mercury and platinum occur in free state.

On the other hand, most of the metals are active and combine with air, moisture, carbon dioxide and non-metals like oxygen, sulphur, halogens, etc. to form their compounds, like oxides, sulphides, carbonates, halides and silicates. i.e., they occur in nature in a combined state.

A naturally occurring material in which a metal or its compound occurs is called a *mineral*. A mineral from which a metal can be extracted economically is called an *ore*.

An ore is that mineral in which a metal is present in appreciable quantities and from which the metal can be extracted economically.

Metals found at the bottom of reactivity series are least reactive and they are often found in nature in free-state; such as gold, silver, copper, etc. Copper and silver are also found in the form of sulphide and oxide ores.

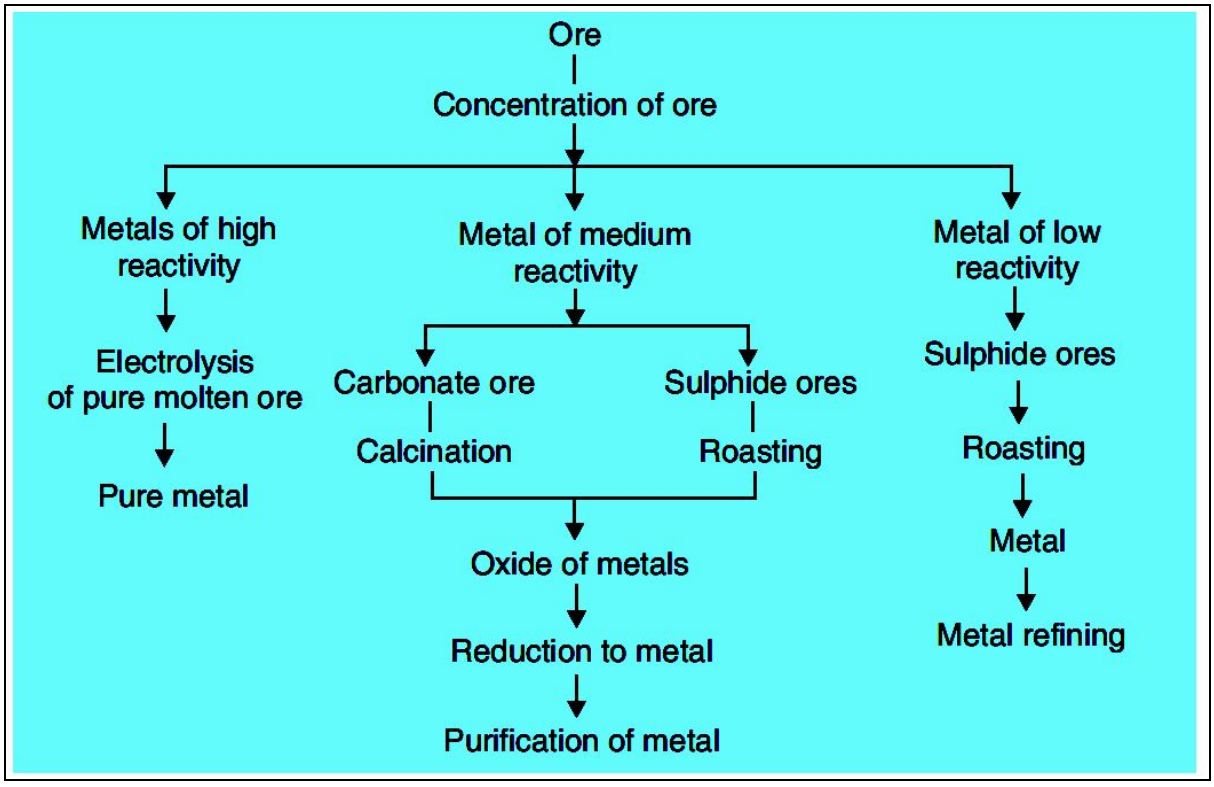
Metals found in the middle of reactivity series, such as Zn, Fe, Pb, etc. are usually found in the form of oxides, sulphides or carbonates.

Metals found at the top of the reactivity series are never found in free-state as they are very reactive, e.g. K, Na, Ca, Mg and Al, etc.
Many metals are found in the form of oxides because oxygen is abundant in nature and is very reactive.

TABLE : SOME IMPORTANT ORES

Type of Ore	Metals (Common Ores)
Native Metals	Gold (Au), silver (Ag)
Oxide ores	Iron (Haematite, Fe_2O_3); Aluminium (Bauxite, $Al_2O_3 . 2H_2O$); Tin (Cassiterite, SnO_2); Copper (Cuprite, Cu_2O); Zinc (Zincite, ZnO); Titanium (Ilmenite, $FeTiO_3$, Rutile, TiO_2)
Sulphide ores	Zinc (Zinc blende, ZnS); Lead (Galena, PbS); Copper (Copper glance, Cu_2S); Silver (Silver glance or Argentite, Ag_2S); Iron (Iron pyrites, FeS_2)
Carbonate ores	Iron (Siferite, $FeCO_3$); Zinc (Calamine, $ZnCO_3$) , Lead (Cerrusite, $PbCO_3$)
Sulphate ores	Lead (Anglesite, $PbSO_4$)
Halide ores	Silver (Horn silver, AgCl); Sodium (Common salt or Rock salt, NaCl); Aluminium (Cryolite, Na_3AlF_6)
Silicate ores	Zinc (Hemimorphite, $2ZnO.SiO_2.H_2O$)

EXTRACTION OF METALS
Metals can be categorized into three parts on the basis of their reactivity: most reactive, medium reactive and least reactive.



CONCENTRATION OF THE ORE:
Ores that are mined from the earth are usually contaminated with large amount of impurities such as soil and sand etc.

Concentration or Dressing means, simply getting rid of as much of the unwanted rocky material as possible before the ore is converted into the metal. The impurities like clay are called *gangue.*

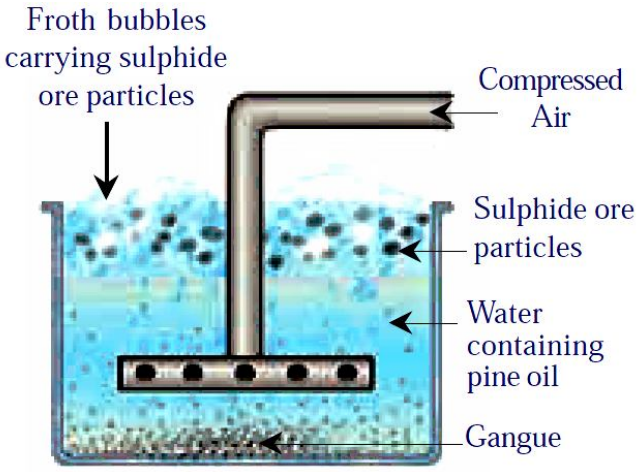
Enrichment of the ore: Physical methods are used to enrich the ore. In many cases, it is possible to separate the metal compound from unwanted rocky material by physical means. A common example of this involves ***froth flotation.***

The physical methods adopted in dressing the ore (or) enriching the ore depends upon difference between physical properties of ore and gangue.

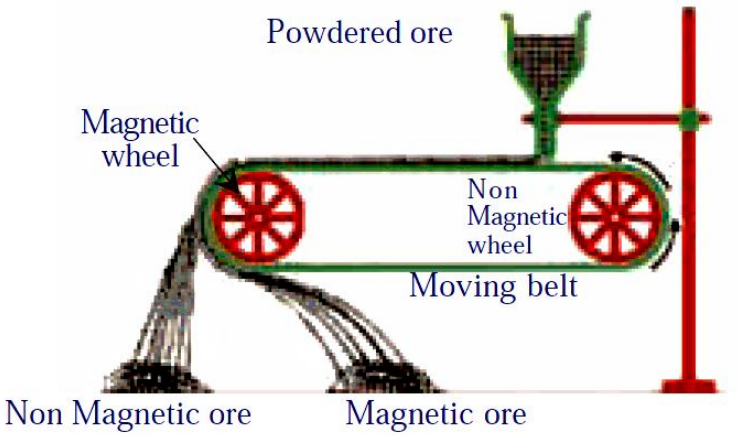
METHODS USED TO ENRICH THE ORE
Hand picking
If the ore particles and the impurities are different in one of the properties like colour, size etc. Then using that property the ore particles are handpicked separating them from other impurities.

Washing
Ore particles are crushed and kept on a slopy surface. They are washed with controlled flow of water. Less densive impurities are carried away by water flow, leaving the more densive ore particles behind.

Froth flotaton
This method is mainly useful for sulphide ores which have no wetting property whereas the impurities get wetted. The ore with impurities is finely powdered and kept in water taken in a flotation cell. Air under pressure is blown to produce froth in water. Froth so produced, takes the ore particles to the surface whereas impurities settle at the bottom. Froth is separated and washed to get ore particles.



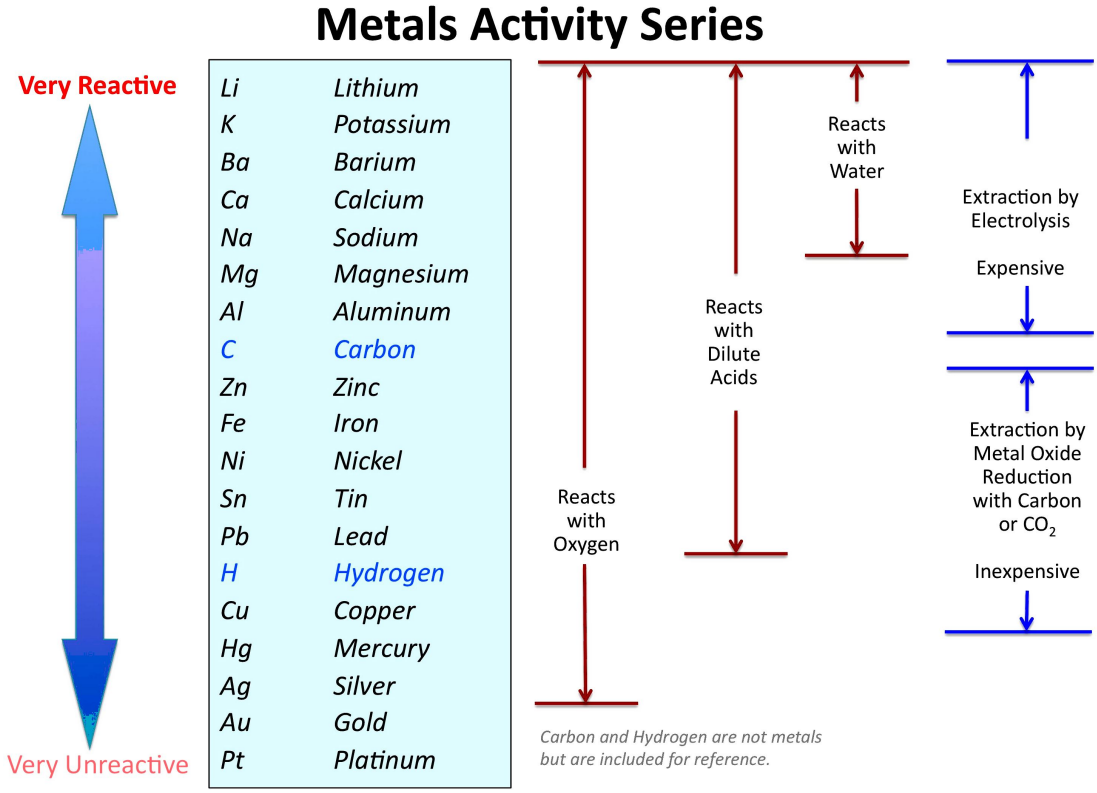
Magnetic separation
If the ore or impurity, one of them is magnetic and the other non-magnetic they are separated using electromagnets.



EXTRACTION OF CRUDE METAL FROM THE ORE:
After concentration and dressing of ore that obtained earth, we get a concentrated or enriched ore. To extract metal from this enriched ore it is converted into metallic oxide by reduction reaction. Then this metallic oxide further reduced to get a metal with certain impurities.

Extraction of the metal from its ores depends on the reactivity of the metal.
Arrange the metal in decreasing order of their reactivity is known as *activity series*. The classification of the metals on the basis of their reactivity:

EXTRACTION OF METALS AT THE TOP OF THE ACTIVITY SERIES:
(K, Na, Ca, Mg and Al). Simple chemical reduction methods like heating with C, CO etc to reduce the ores of these metals are not feasible. The temperature required for the reduction is too high and more expensive. To make the process economical, electrolysis methods are to be adopted. Again the electrolysis of their aqueous solutions also is not feasible because water in the solution would be discharged at the cathode in preference to the metal ions.
The only method viable is to extract these metals by electrolysis of their fused compounds. For example to extract Na from NaCl, fused NaCl is electrolysed with steal cathode (-) and graphite anode (+). The metal (Na) will be deposited at cathode and chloride liberated at the anode. At Cathode $2Na^{+} + 2e^{-}$ '! 2Na; and At Anode $2Cl^{-}$ '! $Cl_2 + 2e^{-}$



<table>
<tr><th>Metals</th><th>Action of Oxygen</th><th>Reaction with cold water</th><th>Reaction with steam</th><th>Reaction with dilute strong Acids</th><th>Reaction with chlorine on heating</th></tr>
<tr><td>K</td><td rowspan="2">Form Na_2O, K_2O in limited supply of O_2 but form peroxides in excess of O_2</td><td rowspan="2">K to Mg displace H_2 from coldwater with decreasing reactivity {K violently but Mg very slowly}</td><td rowspan="2">K to Fe displace H_2 with steam without decreasing reactivity. {K very violently but Fe very slowly}</td><td rowspan="3">K to Pb displace H_2 from dilute strong acids with decreasing reactivity. {K-explosively, Mg-very vigorously, Fe-steadily, Pb-very slowly}</td><td rowspan="11">All metals react with Chlorine on heating toform their respective Chlorides but with decreasing reactivity from top to bottom. This is understood from the heat evolved when the metal reacts with one mole of Chlorine gas to form Chloride.

KCl, NaCl, $CaCl_2$, $MgCl_2$, Al_2Cl_3, $ZnCl_2$, $FeCl_3$, $PbCl_2$, $CuCl_2$, $HgCl_2$, AgCl, $PtCl_3$ and $AuCl_3$ are formed</td></tr>
<tr><td>Na</td></tr>
<tr><td>Ca</td><td rowspan="5">Burn with decreasing vigour to form oxides CaO, MgO, Al_2O_3, ZnO, Fe_2O_3</td><td rowspan="6">From Al to Au do not displace H_2 from cold water</td></tr>
<tr><td>Mg</td></tr>
<tr><td>Al</td></tr>
<tr><td>Zn</td></tr>
<tr><td>Fe</td></tr>
<tr><td>Pb</td><td rowspan="3">Don't burn, but only form a surface layer of oxide PbO, CuO, HgO</td><td rowspan="3">From Pb to Au donot displace H_2 from steam</td></tr>
<tr><td>Cu</td></tr>
<tr><td>Hg</td></tr>
<tr><td>Ag</td><td rowspan="3">Don't burn or oxidise even on the surface</td><td rowspan="3">Cu to Au do not displace H_2 from dilute strong acids</td></tr>
<tr><td>Pt</td></tr>
<tr><td>Au</td></tr>
</table>

B) EXTRACTION OF METALS IN THE MIDDLE OF THE ACTIVITY SERIES:
(Zinc, iron, tin, lead and copper): The ore of these metals are generally present as Sulphides or Carbonates in native. Therefore prior to reduction of ores of these metals, they must be converted into metal oxides. **Sulphide** ores are converted into oxides by heating them strongly in excess of air. This process is known as *roasting.* Generally the sulphide ores are roasted to convert them into oxides before reducing them to metal.

Eg: $2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

The metal oxides are then reduced to the corresponding metal by using suitable reducing agent such as carbon

(i) **Reduction of metal oxides with carbon**: The oxides are reduced by coke in a closed furnace which gives the metal and carbon monoxide (CO).
Eg: $PbO + C \rightarrow Pb + CO$ at 1400^0C

(ii) **Reduction of oxide ores with CO**. Eg: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3O_2$ in blast furnace

(iii) **Auto (self) reduction of sulphide ores:** In the extraction of Cu from its sulphide ore, the ore is subjected partial roasting in air to give its oxide.
$2Cu_2S + 3O_2 \rightarrow 2Cu2O + 2SO2$
When the supply of air is stopped and the temperature is raised. The rest of the sulphide reacts with oxide and forms the metal and SO2.
$2Cu_2O + Cu_2S \rightarrow 6Cu + 2SO_2$

(iv) Reduction of ores (compounds) by more reactive metals.
Eg: $TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$ at 850^0C
$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$ at 850^0C

Thermite process: When highly reactive metals such as sodium, calcium, aluminium etc., are used as reducing agents, they displace metals of lower reactivity from the compound. These displacement reactions are highly exothermic. The amount of heat evolved is so large that the metals produced in molten state. This type of reaction is used in thermite process. The reaction of Iron (III) oxide (Fe2O3), with aluminium is used to join railings of railway tracks or cracked machine parts. This reaction is known as the **thermite reaction**.

$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe + Heat$

$2Al + Cr_2O_3 \rightarrow Al_2O_3 + 2Cr + Heat$

C) EXTRACTION OF METALS AT THE BOTTOM OF THE ACTIVITY SERIES (AG, HG ETC)
Metals at bottom of the activity series are often found in free state. They reactivity with other atoms is very low. The oxides of these metals can be reduced to metals by heat alone and sometimes by displacement from their aqueous solutions.

(i) When cinnabar (HgS) whch is an ore of mercury, heated in air, it is first converted into (HgO) then reduced to mercury on further heating.
Eg: $2HgS + 3O_2 \rightarrow 2HgO + 2SO_2 \rightarrow 2HgO \rightarrow 2Hg + O_2$ on heating

(ii) Displacement from aqueous solutions:
Eg: $Ag_2S + 4CN^- \rightarrow 2[Ag(CN)_2]^- + S^{2-}$
$2[Ag(CN)_2]^-(aq) + Zn(s) \rightarrow [Zn(CN)_4]^{2-}(aq) + 2Ag(s)$
Here Ag_2S is dissolved in say KCN solution to get dicyanoargentate (I) ions. From these ions Ag is precipitated by treating with Zn dust powder.

PURIFICATION OF THE CRUDE METAL:
The metal obtained by the reduction of the ore is usually contaminated with impurities like unchanged ore, other metals present in the ore and non metals from the anions in the ore.
For example, the (blister) copper obtained from its sulphide ore is a compound of copper iron pyrites ($CuFeS_2$). It contains some copper sulphide, iron and sulphur. It is purified by suitable methods including electrolysis. The process of obtaining the pure metal from the impure metal

is called refining of the metal. Refining of the metal involves several types of processes. Some refining methods are given below:

a) Distillation
b) Poling
c) Liquation
d) Electrolysis etc.

The process that has to be adopted for purification of a given metal depends on the nature of the metal and its impurities?

a) Distillation: This method is very useful for purification of low boiling metals like zinc and mercury whether contain high boiling metals as impurities. The extracted metal in the molten state is distilled to obtain the pure metal as distillate.

b) Poling: The molten metal is stirred with logs (poles) of green wood. The impurities are removed either as gases or they get oxidized and form scum (slag) over the surface of the molten metal. Blister copper is purified by this method. The reducing gases, evolved from the wood, prevent the oxidation of copper.

c) Liquation: In this method a low melting metal like tin can be made to flow on a slopy surface to separate it from high melting impurities.

d) Electrolytic refining: In this method, the impure metal is made to act as anode. A strip of the same metal in pure form is used as cathode. They are put in a suitable electrolytic bath containing soluble salt of the same metal. The required metal gets deposited on the cathode in the pure form. The metal, constituting the impurity, goes as the anode mud.

The reactions are:

Anode: $M \rightarrow M^{n+} + ne^-$

Cathode: $M^{n+} + ne^- \rightarrow M$ (M = pure metal)

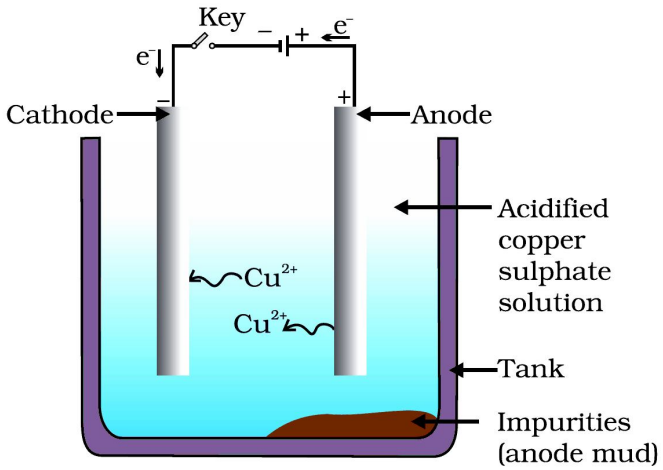
Where n = 1,2,3, ...

We use this electrolytic method to refine copper.

For this an impure copper is taken as anode and pure copper strips are taken as cathode. The electrolyte is a acidified solution of copper sulphate. As a result of electrolysis copper in pure form is transferred from the anode to the cathode.

Anode: $Cu \rightarrow Cu^{2+} + 2e^-$

Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$



The suitable impurities go into the solution, where as insoluble impurities from the blister copper deposited at the bottom of anode as anode mud which contains antimony.

Selenium, tellurium, silver, gold and platinum; recovery of these elements may meet the cost of refining.

Zinc may also be refined this way.

CORROSION

Most of the metals keep on reacting with the atmospheric air. This leads to formation of a layer over the metal. In the long run, the underlying layers of the metal keep on getting lost due to conversion into oxides or sulphides or carbonate, etc. As a result, the metal gets eaten up. This process is called corrosion.

Rusting of Iron: Rusting of iron is the most common form of corrosion. When iron articles; like gate, grill, fencing, etc. come in contact with moisture present in air, the upper layer of iron turns into iron oxide. Iron oxide is brown-red in color and is known as rust. This phenomenon is called rusting of iron.

If rusting is not prevented in time, the whole iron article would turn into iron oxide. This is also known as corrosion of iron. Rusting of iron gives huge loss every year.

Prevention of Rusting: For rusting, iron must come in contact with oxygen and water. Rusting is prevented by preventing the reaction between atmospheric moisture and the iron article. This can be done by painting, greasing, galvanization, electroplating, etc.

METHODS OF PREVENTION OF CORROSION

There are various methods of preventing corrosion and rusting of iron. Our main concern is to know the various methods to prevent the rusting of iron because iron is a strategic metal as it plays a very important role in the development of a nation. Some of the important methods of prevention of corrosion are as follows:

a) Painting

This is a common method of preventing iron from rusting. You might have observed that your parents paint iron gate in the garden and iron grills in your house. This painting prevents rusting by providing a coating over iron objects.

b) Oiling and greasing

To put a layer of oil and grease on the iron objects also prevents them from rusting. Iron parts of various machines and vehicles are oiled and greased to prevent rusting and to minimize friction.

c) Galvanization

In this method we put a layer of zinc metal on the iron objects and this process is known as **galvanization.** This method is used on large scale for making galvanized iron sheets for making boxes and for roof covering. Galvanised iron sheets are used to make drum, trunks and other iron containers. Galvanised iron sheets are also used for building roofs and manhole covers. In brief, galvanization prevents rusting in a big way.

d) Alloying

This is a very good method for improving the quality of different metals. In this method a particular metal with other metal or non-metal is mixed in a fixed proportion to improve its quality like resistance towards corrosion, strength , hardness, shining and high tensile strength. For example iron metal can not be used for making utensils because it will rust but when it is mixed with nickel and chromium metal it becomes **stainless steel**.

INTEXT QUESTIONS PAGE NO. 55

Question 1: Metallic oxides of zinc, magnesium and copper were heated with the following metals.

Metal	Zinc	Magnesium	Copper
Zinc oxide			
Magnesium oxide			
Copper oxide			

In which cases will you find displacement reactions taking place?
Answer :

Answer:

Metal	**Zinc**	**Magnesium**	**Copper**
Zinc oxide	No reaction	Displacement	No reaction
Magnesium oxide	No reaction	No reaction	No reaction
Copper oxide	Displacement	Displacement	No reaction

Question 2: Which metals do not corrode easily?
Answer: More reactive a metal is, more likely it is to be corroded. Therefore, less reactive metals are less likely to get corroded. This is why gold plating provides high resistance to corrosion.

Question 3: What are alloys?
Answer: Alloys are homogeneous mixtures of two or more elements. The elements could be two metals, or a metal and a non-metal. An alloy is formed by first melting the metal and then dissolving the other elements in it. For example, steel is an alloy of iron and carbon.

EXERCISE QUESTIONS PAGE NO. 56 and 57

Question 1: Which of the following pairs will give displacement reactions?
(a) NaCl solution and copper metal
(b) $MgCl_2$ solution and aluminium metal
(c) $FeSO_4$ solution and silver metal
(d) $AgNO_3$ solution and copper metal.
Answer : (d) $AgNO_3$ solution and copper metal

Question 2: Which of the following methods is suitable for preventing an iron frying pan from rusting?
(a) Applying grease
(b) Applying paint
(c) Applying a coating of zinc
(d) all of the above.
Answer : (c) Applying a coating of zinc (We can also apply grease and paint to prevent iron from rusting. However, in case of iron frying pan, grease and paint cannot be applied because when the pan will be heated and washed again and again, the coating of grease and paint would get destroyed.)

Question 3: An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be
(a) calcium
(b) carbon
(c) silicon

(d) iron
Answer : (a) The element is likely to be calcium.

Question 4: Food cans are coated with tin and not with zinc because
(a) zinc is costlier than tin.
(b) zinc has a higher melting point than tin.
(c) zinc is more reactive than tin.
(d) zinc is less reactive than tin.
Answer : (c) Food cans are coated with tin and not with zinc because zinc is more reactive than tin.

Question 5: You are given a hammer, a battery, a bulb, wires and a switch.
(a) How could you use them to distinguish between samples of metals and non-metals?
(b) Assess the usefulness of these tests in distinguishing between metals and non-metals.
Answer : (a) With the hammer, we can beat the sample and if it can be beaten into thin sheets (that is, it is malleable), then it is a metal otherwise a non-metal. Similarly, we can use the battery, bulb, wires, and a switch to set up a circuit with the sample. If the sample conducts electricity, then it is a metal otherwise a non-metal.

(b) The above tests are useful in distinguishing between metals and non-metals as these are based on the physical properties. No chemical reactions are involved in these tests.

Question 6: What are amphoteric oxides? Give two examples of amphoteric oxides.
Answer : Those oxides that behave as both acidic and basic oxides are called amphoteric oxides. Examples: aluminium oxide (Al_2O_3), zinc oxide (ZnO)

Question 7: Name two metals which will displace hydrogen from dilute acids, and two metals which will not.
Answer : Metals that are more reactive than hydrogen displace it from dilute acids. For example: sodium and potassium. Metals that are less reactive than hydrogen do not displace it. For example: copper and silver.

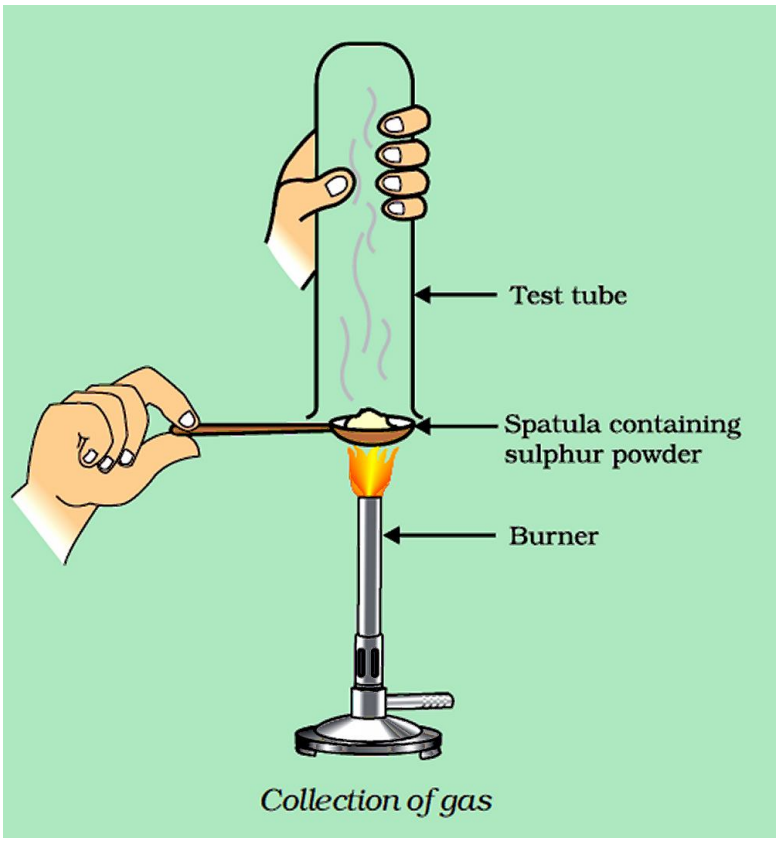
Question 8: In the electrolytic refining of a metal M, what would you take as the anode, the cathode and the electrolyte?
Answer : In the electrolytic refining of a metal M:
Anode → Impure metal M
Cathode → Thin strip of pure metal M
Electrolyte → Solution of salt of the metal M

Question 9: Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it, as shown in figure below.
(a) What will be the action of gas on
(i) dry litmus paper?
(ii) moist litmus paper?
(b) Write a balanced chemical equation for the reaction taking place.

Answer :

(a) (i) There will be no action on dry litmus paper.

(ii) Since the gas is sulphur dioxide (SO_2), it turns moist blue litmus paper to red because sulphur dioxide reacts with moisture to form sulphurous acid.



(b)

$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$$

Sulphur dioxide

$$SO_{2(g)} + H_2O_{(l)} \longrightarrow H_2SO_{3(aq)}$$

Sulphurous acid

Question 10: State two ways to prevent the rusting of iron.
Answer : Two ways to prevent the rusting of iron are:
(i) Oiling, greasing, or painting: By applying oil, grease, or paint, the surface becomes water proof and the moisture and oxygen present in the air cannot come into direct contact with iron. Hence, rusting is prevented.
(ii) Galvanisation: An iron article is coated with a layer of zinc metal, which prevents the iron to come in contact with oxygen and moisture. Hence, rusting is prevented.

Question 11: What type of oxides are formed when non-metals combine with oxygen?
Answer : Non-metals combine with oxygen to form acidic oxides.
For example:

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

(Acidic in nature)

Question 12: Give reasons
(a) Platinum, gold and silver are used to make jewellery.
(b) Sodium, potassium and lithium are stored under oil.
(c) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.
(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction.

Answer : (a) Platinum, gold, and silver are used to make jewellery because they are very lustrous. Also, they are very less reactive and do not corrode easily.

(b) Sodium, potassium, and lithium are very reactive metals and react very vigorously with air as well as water. Therefore, they are kept immersed in kerosene oil in order to prevent their contact with air and moisture.

(c) Though aluminium is a highly reactive metal, it is resistant to corrosion. This is because aluminium reacts with oxygen present in air to form a thin layer of aluminium oxide. This oxide layer is very stable and prevents further reaction of aluminium with oxygen. Also, it is light in weight and a good conductor of heat. Hence, it is used to make cooking utensils.

(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction because metals can be easily extracted from their oxides rather than from their carbonates and sulphides.

Question 13: You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.
Answer : Copper reacts with moist carbon dioxide in air to form copper carbonate and as a result, copper vessel loses its shiny brown surface forming a green layer of copper carbonate. The citric acid present in the lemon or tamarind neutralises the basis copper carbonate and dissolves the layer. That is why, tarnished copper vessels are cleaned with lemon or tamarind juice to give the surface of the copper vessel its characteristic lustre.

Question 14: Differentiate between metal and non-metal on the basis of their chemical properties.
Answer :

Metals	Non-metals
Metals are electropositive.	Non-metals are electronegative.
They react with oxygen to form basic oxides.	They react with oxygen to form acidic or neutral oxides.
These have ionic bonds.	These have covalent bonds.
They react with water to form oxides and hydroxides. Some metals react with cold water, some with hot water, and some with steam.	They do not react with water.
They react with dilute acids to form a salt and evolve hydrogen gas. However, Cu, Ag, Au, Pt, Hg do not react.	They do not react with dilute acids. These are not capable of replacing hydrogen.
They react with the salt solution of metals. Depending on their reactivity, displacement reaction can occur.	These react with the salt solution of non-metals.
They act as reducing agents (as they can easily lose electrons).	These act as oxidising agents (as they can gain electrons).

Question 15: A man went door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used?

Answer : He must have dipped the gold metal in the solution of aqua regia − a 3:1 mixture of conc. HCl and conc. HNO3. Aqua regia is a fuming, highly corrosive liquid. It dissolves gold in it. After dipping the gold ornaments in aqua regia, the outer layer of gold gets dissolved and the inner shiny layer appears. That is why the weight of gold ornament reduced.

Question 16: Give reasons why copper is used to make hot water tanks and not steel (an alloy of iron).

Answer : Copper does not react with cold water, hot water, or steam. However, iron reacts with steam. If the hot water tanks are made of steel (an alloy of iron), then iron would react vigorously with the steam formed from hot water.

$$\underset{\text{Iron}}{3Fe} + \underset{\text{Steam}}{4H_2O} \longrightarrow \underset{\text{Iron (II, III) oxide}}{Fe_3O_4} + \underset{\text{Hydrogen}}{4H_2}$$

That is why copper is used to make hot water tanks, and not steel.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 3
METALS AND NON-METALS

1. Which metal is the best conductor of electricity?

2. Which metal is poorest conductor of electricity?

3. Which metal is best conductor of heat ?

4. Which metal other than mercury is liquid at room temperature?

5. Which metal is poorest conductor of heat?

6. What is the nature of oxides of metal?

7. What is the nature of oxides of non- metal?

8. Which non-metal conduct electricity?

9. Graphite, allotrope of carbon conduct electricity.

10. Which non-metal is lusturous?

11. Why metals are hard and have high melting point?

12. What is an amalgam?

13. What are the constituents of solder?

14. Name the green coloured compound which appears on the surface of copper utensils?

15. Why the item made of silver turns black when exposed to air?

16. Why do silver ornaments loose their shine when kept for some time?

17. Name a metal other than aluminium that is covered with an oxide film layer.

18. Name one metal and one non-metal which exists in liquid state at room temperature?

19. Name a non-metal which is lustrous and a metal which is non-lustrous.

20. Name two metal which have very low melting point.

21. If copper metal is heated over a flame, it develops a coating. What is the colour and composition of this coating?

22. Why is sodium metal kept immersed in kerosene oil?

23. Name one metal which react with very dilute HNO_3 to evolve hydrogen gas.

24. A non-metal X exists in two different forms Y and Z. Y is the hardest natural substance, whereas Z is a good conductor of electricity. Identify X, Y, and Z.

25. An element A form two oxides AO and AO2.The oxide AO is neutral whereas the oxide AO_2 is acidic in nature. Would you call element A a metal or non-metal.

26. In the refining of silver the recovery of silver from silver nitrate solution involves displacement by copper metal. Give the reason for the same.

27. Name two metals which are both ductile as well as malleable.

28. The reaction of iron (III) oxide Fe_2O_3 with aluminium is used to join cracked iron parts of machines.

29. Give reason for the following: (a) Ionic compounds conduct electricity in the molten state.

30. Give reason for the following: Metals can be given different shapes according to our needs.

31. How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?

32. Which reducing agent is used in the reduction of alumina?

33. What are metalloids?

34. Why are titanium and chromium classified as strategic metals?

35. Which one of the following metals does not react with oxygen even at high temperatures?(i) Calcium (ii) Gold (iii) Sodium

36. Give reasons for the following : Addition of some silver to pure gold for making ornaments.

37. Give reason for the following: Alumina is dissolved in molten cryolite for electrolysis to obtain aluminum metal.

38. Write the chemical equation to represent the reaction taking place between sodium metal and cold water.

39. Why is tungsten metal selected for making filaments of incandescent lamp bulbs?

40. Name a metal which offer higher resistance to the passage of electricity than copper.

41. Write the chemical equation for the reaction of hot aluminium with steam.

42. How does the metal magnesium differ from the metal calcium in their reaction with water?

43. What is seen to happen when a piece of sodium metal is dropped into water?

44. What are amphoteric oxides? Give an example.\

45. Name two metals that react with dil.HNO_3 to evolve H_2 gas ?

46. Why metals like potassium and sodium catch fire when treated with water?

47. Why sodium is kept immersed in kerosene oil?

48. Which gas is produced when dil. HCl is added to a reactive metal? Write the chemical reaction when iron reacts with dil. H_2SO_4?

49. What would you observe when zinc is added to a solution of iron(II) sulphate ?write the chemical reaction that takes place.

50. Why ionic compounds have high melting points?

51. What do you mean by roasting? How it is different from calcination? In which types of ores roasting is done?

52. Define :- (i) Ore, (ii) Mineral.

53. Name two metals which are found in nature in the free state.

54. Define :- (i) Enrichment of Ores (ii) Gangue.

55. Write short notes on electrolytic refining of metals.

56. Name the conditions which are essential for corrosion.

57. What is Galvanisation? Write its use.

58. Write suitable example, explain how a metal low in the activity series can be extracted?

59. Write three properties of ionic compounds.

60. What is anodizing? What is its use?

61. What is aqua regia? What is its use?

62. What do you mean by thermite reaction? What is its use?

63. Why active metals do not liberate H2 gas when treated with dil. HNO3?

64. Sometimes the ore itself acts as a reducing agent. Give an example.

65. An alkali metal A gives a compound B (molecular mass=40) on reacting with water .The compound B gives a soluble compound C on treatment with aluminium oxide. Identify A, B, and C and give the reaction involved.

66. An element A burns with golden flame in air .It reacts with another element B, atomic number 17 to give a product C .An aqueous solution of product C on electrolysis gives a compound D and liberates hydrogen .Identify A, B, C and D. Also write down the equations for the reactions involved.

67. A metal which is used in thermite process, when heated with oxygen gives an oxide B, which is amphoteric in nature .Identify the metal and its ore and give the reaction involved.

68. Give reasons

(i) Copper is used to make hot water tanks but steel is not.
(ii) Tarnished copper vessels being cleaned with lemon or tamarind juice.
(iii) Metal sulphides occur mainly in rocks but metal halides occur mostly in sea and lake waters.
(iv) A salt which does not conduct electricity in the solid state becomes a good conductor in molten state
(v) Why ionic compounds have high melting points?
(vi) Why sodium is kept immersed in kerosene oil?
(vii) Why metals like potassium and sodium catch fire when treated with water?
(viii) Why metals are hard and have high melting point?

69. A metal M does not liberate hydrogen from acids but reacts with oxygen to give a black colour product. Identify M and black coloured product and also explain the reaction of M with oxygen.

70. Given below are the steps for extraction of copper from its ore .Write the reaction involved

(i)Roasting of copper (I) sulphide.

(ii)Reduction of copper (I) oxide with copper (1) sulphide.
(iii) Draw a neat and well labelled diagram for electrolytic refining of copper.

71. A metal is found in liquid state in nature .It is less reactive than hydrogen .It occurs as sulphide ore .Describe the reactions how can we extract this metal from its ore .Name the ore also.

72. Explain why

(i) Aluminium cannot be extracted by reducing alumina with carbon.
(ii)Concentrated HNO_3 can be stored in aluminum containers.
(iii)Aluminium is used for making transmission wires.
(iii) 24 carat gold cannot be used for making ornaments.

73. Which of the following property is generally not shown by metals?
(a) Electrical conduction
(b) Sonorous in nature
(c) Dullness
(d) Ductility

74. The ability of metals to be drawn into thin wire is known as
(a) ductility
(b) malleability
(c) sonorousity
(d) conductivity

75. Aluminium is used for making cooking utensils. Which of the following properties of aluminium are responsible for the same?
(i) Good thermal conductivity
(ii) Good electrical conductivity
(iii) Ductility
(iv) High melting point
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (i) and (iv)

76. Which of the following property is generally not shown by metals?
(a) Electrical conduction
(b) Sonorous in nature
(c) Dullness
(d) Ductility

77. The ability of metals to be drawn into thin wire is known as
(a) ductility
(b) malleability

(c) sonorousity
(d) conductivity

78. Aluminium is used for making cooking utensils. Which of the following properties of aluminium are responsible for the same?
(i) Good thermal conductivity
(ii) Good electrical conductivity
(iii) Ductility
(iv) High melting point
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (i) and (iv)

79. Which one of the following metals do not react with cold as well as hot water?
(a) Na
(b) Ca
(c) Mg
(d) Fe

80. Which of the following oxide(s) of iron would be obtained on prolonged reaction of iron with steam?
(a) FeO
(b) Fe_2O_3
(c) Fe_3O_4
(d) Fe_2O_3 and Fe_3O_4

81. What happens when calcium is treated with water?
(i) It does not react with water
(ii) It reacts violently with water
(iii) It reacts less violently with water
(iv) Bubbles of hydrogen gas formed stick to the surface of calcium
(a) (i) and (iv) (b) (ii) and (iii)
(c) (i) and (ii) (d) (iii) and (iv)

82. Generally metals react with acids to give salt and hydrogen gas. Which of the following acids does not give hydrogen gas on reacting with metals (except Mn and Mg)?
(a) H_2SO_4
(b) HCl
(c) HNO_3
(d) All of these

83. The composition of aqua-regia is

(a) Dil.HCl	:	Conc. HNO3
3	:	1
(b) Conc.HCl	:	Dil. HNO3
3	:	1
(c) Conc.HCl	:	Conc.HNO3
3	:	1
(d) Dil.HCl	:	Dil.HNO3
3	:	1

84. Which of the following are not ionic compounds?
(i) KCl
(ii) HCl

(iii) CCl4
(iv) NaCl
(a) (i) and (ii) (b) (ii) and (iii)
(c) (iii) and (iv) (d) (i) and (iii)

85. Which one of the following properties is not generally exhibited by ionic compounds?
(a) Solubility in water
(b) Electrical conductivity in solid state
(c) High melting and boiling points
(d) Electrical conductivity in molten state

86. Which of the following metals exist in their native state in nature?
(i) Cu
(ii) Au
(iii) Zn
(iv) Ag
(a) (i) and (ii) (b) (ii) and (iii)
(c) (ii) and (iv) (d) (iii) and (iv)

87. Metals are refined by using different methods. Which of the following metals are refined by electrolytic refining?
(i) Au
(ii) Cu
(iii) Na
(iv) K
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (iii) and (iv)

88. Silver articles become black on prolonged exposure to air. This is due to the formation of
(a) Ag_3N
(b) Ag_2O
(c) Ag_2S
(d) Ag_2S and Ag_3N

89. Galvanisation is a method of protecting iron from rusting by coating with a thin layer of
(a) Gallium
(b) Aluminium
(c) Zinc
(d) Silver

90. Stainless steel is very useful material for our life. In stainless steel, iron is mixed with
(a) Ni and Cr
(b) Cu and Cr
(c) Ni and Cu
(d) Cu and Au

91. If copper is kept open in air, it slowly loses its shining brown surface and gains a green coating. It is due to the formation of
(a) $CuSO_4$
(b) $CuCO_3$
(c) $Cu(NO_3)_2$
(d) CuO

92. Generally, metals are solid in nature. Which one of the following metals is found in liquid state at room temperature?
(a) Na
(b) Fe
(c) Cr
(d) Hg

93. Which of the following metals are obtained by electrolysis of their chlorides in molten state ?
(i) Na
(ii) Ca
(iii) Fe
(iv) Cu
(a) (i) and (iv) (b) (iii) and (iv)
(c) (i) and (iii) (d) (i) and (ii)

94. Generally, non-metals are not lustrous. Which of the following nonmetal is lustrous?
(a) Sulphur
(b) Oxygen
(c) Nitrogen
(d) Iodine

95. Which one of the following four metals would be displaced from the solution of its salts by other three metals?
(a) Mg
(b) Ag
(c) Zn
(d) Cu

96. 2 mL each of concentrated HCl, HNO_3 and a mixture of concentrated HCl and concentrated HNO_3 in the ratio of 3 : 1 were taken in test tubes labelled as A, B and C. A small piece of metal was put in each test tube. No change occurred in test tubes A and B but the metal got dissolved in test tube C respectively. The metal could be
(a) Al
(b) Au
(c) Cu
(d) Pt

97. An alloy is
(a) an element
(b) a compound
(c) a homogeneous mixture
(d) a heterogeneous mixture

98. An electrolytic cell consists of
(i) positively charged cathode
(ii) negatively charged anode
(iii) positively charged anode
(iv) negatively charged cathode
(a) (i) and (ii) (b) (iii) and (iv)
(c) (i) and (iii) (d) (ii) ad (iv)

99. During electrolytic refining of zinc, it gets
(a) deposited on cathode
(b) deposited on anode
(c) deposited on cathode as well as anode
(d) remains in the solution

100. An element A is soft and can be cut with a knife. This is very reactive to air and cannot be kept open in air. It reacts vigorously with water. Identify the element from the following
(a) Mg
(b) Na
(c) P
(d) Ca

101. Alloys are homogeneous mixtures of a metal with a metal or nonmetal. Which among the following alloys contain non-metal as one of its constituents?
(a) Brass
(b) Bronze
(c) Amalgam
(d) Steel

102. Which among the following statements is incorrect for magnesium metal?
(a) It burns in oxygen with a dazzling white flame
(b) It reacts with cold water to form magnesium oxide and evolves hydrogen gas
(c) It reacts with hot water to form magnesium hydroxide and evolves hydrogen gas
(d) It reacts with steam to form magnesium hydroxide and evolves hydrogen gas

103. Which among the following alloys contain mercury as one of its constituents?
(a) Stainless steel
(b) Alnico
(c) Solder
(d) Zinc amalgam

104. Reaction between X and Y, forms compound Z. X loses electron and Y gains electron. Which of the following properties is not shown by Z?
(a) Has high melting point
(b) Has low melting point
(c) Conducts electricity in molten state
(d) Occurs as solid

105. The electronic configurations of three elements X, Y and Z are X — 2, 8; Y — 2, 8, 7 and Z — 2, 8, 2. Which of the following is correct?
(a) X is a metal
(b) Y is a metal
(c) Z is a non-metal
(d) Y is a non-metal and Z is a metal

106. Although metals form basic oxides, which of the following metals form an amphoteric oxide?
(a) Na
(b) Ca
(c) Al
(d) Cu

107. Generally, non-metals are not conductors of electricity. Which of the following is a good conductor of electricity?
(a) Diamond
(b) Graphite
(c) Sulphur
(d) Fullerene

108. Electrical wires have a coating of an insulting material. The material, generally used is
(a) Sulphur
(b) Graphite
(c) PVC
(d) All can be used

109. Which of the following non-metals is a liquid?
(a) Carbon
(b) Bromine
(c) Phosphorus
(d) Sulphur

110. Which of the following can undergo a chemical reaction?
(a) $MgSO_4 + Fe$
(b) $ZnSO_4 + Fe$
(c) $MgSO_4 + Pb$
(d) $CuSO_4 + Fe$

111. Iqbal treated a lustrous, divalent element M with sodium hydroxide. He observed the formation of bubbles in reaction mixture. He made the same observations when this element was treated with hydrochloric acid. Suggest how can he identify the produced gas. Write chemical equations for both the reactions.

112. During extraction of metals, electolytic refining is used to obtain pure metals.
(a) Which material will be used as anode and cathode for refining of silver metal by this process?
(b) Suggest a suitable electrolyte also.
(c) In this electrolytic cell, where do we get pure silver after passing electric current?

113. Why should the metal sulphides and carbonates be converted to metal oxides in the process of extraction of metal from them?

114. Generally, when metals are treated with mineral acids, hydrogen gas is liberated but when metals (except Mn and Mg), treated with HNO3, hydrogen is not liberated, why?

115. Compound X and aluminium are used to join railway tracks.
(a) Identify the compound X
(b) Name the reaction
(c) Write down its reaction.

116. When a metal X is treated with cold water, it gives a basic salt Y with molecular formula XOH (Molecular mass = 40) and liberates a gas Z which easily catches fire. Identify X, Y and Z and also write the reaction involved.

117. A non-metal X exists in two different forms Y and Z. Y is the hardest natural substance, whereas Z is a good conductor of electricity. Identify X, Y and Z.

118. The following reaction takes place when aluminium powder is heated with MnO2

$$3\ MnO_2\ (s) + 4\ Al\ (s) \rightarrow 3\ Mn\ (l) + 2\ Al_2O_3\ (l) + Heat$$

(a) Is aluminium getting reduced?
(b) Is MnO2 getting oxidised?

119. What are the constituents of solder alloy? Which property of solder makes it suitable for welding electrical wires?

120. A metal A, which is used in thermite process, when heated with oxygen gives an oxide B, which is amphoteric in nature. Identify A and B. Write down the reactions of oxide B with HCl and NaOH.

121. A metal that exists as a liquid at room temperature is obtained by heating its sulphide in the presence of air. Identify the metal and its ore and give the reaction involved.

122. Give the formulae of the stable binary compounds that would be formed by the combination of following pairs of elements.
(a) Mg and N_2
(b) Li and O_2
(c) Al and Cl_2
(d) K and O_2

123. What happens when
(a) $ZnCO_3$ is heated in the absence of oxygen?
(b) a mixture of Cu_2O and Cu_2S is heated?

124. A non-metal A is an important constituent of our food and forms two oxides B and C. Oxide B is toxic whereas C causes global warming
(a) Identify A, B and C
(b) To which Group of Periodic Table does A belong?

125. Give two examples each of the metals that are good conductors and poor conductors of heat respectively.

126. Name one metal and one non-metal that exist in liquid state at room temperature. Also name two metals having melting point less than 310 K (37°C)

127. An element A reacts with water to form a compound B which is used in white washing. The compound B on heating forms an oxide C which on treatment with water gives back B. Identify A, B and C and give the reactions involved.

128. An alkali metal A gives a compound B (molecular mass = 40) on reacting with water. The compound B gives a soluble compound C on treatment with aluminium oxide. Identify A, B and C and give the reaction involved.

129. Give the reaction involved during extraction of zinc from its ore by
(a) roasting of zinc ore
(b) calcination of zinc ore

130. A metal M does not liberate hydrogen from acids but reacts with oxygen to give a black colour product. Identify M and black coloured product and also explain the reaction of M with oxygen.

131. An element forms an oxide A_2O_3 which is acidic in nature. Identify A as a metal or non-metal.

132. A solution of $CuSO_4$ was kept in an iron pot. After few days the iron pot was found to have a number of holes in it. Explain the reason in terms of reactivity. Write the equation of the reaction involved.

133. A non-metal A which is the largest constituent of air, when heated with H2 in 1:3 ratio in the presence of catalyst (Fe) gives a gas B. On heating with O2 it gives an oxide C. If this oxide is passed into water in the presence of air it gives an acid D which acts as a strong oxidising agent.
(a) Identify A, B, C and D
(b) To which group of periodic table does this non-metal belong?

134. Give the steps involved in the extraction of metals of low and medium reactivity from their respective sulphide ores.

135. Explain the following
(a) Reactivity of Al decreases if it is dipped in HNO3
(b) Carbon cannot reduce the oxides of Na or Mg
(c) NaCl is not a conductor of electricity in solid state whereas it does conduct electricity in aqueous solution as well as in molten state
(d) Iron articles are galvanised.
(e) Metals like Na, K, Ca and Mg are never found in their free state in nature.

136. Given below are the steps for extraction of copper from its ore.
Write the reaction involved.
(a) Roasting of copper (1) sulphide
(b) Reduction of copper (1) oxide with copper (1) sulphide.
(c) Electrolytic refining

137. Draw a neat and well labelled diagram for electrolytic refining of copper

138. Of the three metals X, Y and Z. X reacts with cold water, Y with hot water and Z with steam only. Identify X, Y and Z and also arrange them in order of increasing reactivity.

139. An element A burns with golden flame in air. It reacts with another element B, atomic number 17 to give a product C. An aqueous solution of product C on electrolysis gives a compound D and liberates hydrogen. Identify A, B, C and D. Also write down the equations for the reactions involved.

140. Two ores A and B were taken. On heating ore A gives CO_2 whereas, ore B gives SO_2. What steps will you take to convert them into metals?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 3
METALS AND NON-METALS

1. Which of the following can be beaten into thin sheets?

(a) Zinc (b) Phosphorus (c) Sulphur (d) Oxygen

2. Which of the following statements is correct?

(a) All metals are ductile.

(b) All non-metals are ductile.

(c) Generally, metals are ductile.

(d) Some non-metals are ductile.

3. Which of the following is not a metal?

(a) copper

(b) sulphur

(c) aluminium

(d) iron

4. The substance that will be flattened on beating with a hammer is

(a) crystal of iodine

(b) lump of sulphur

(c) piece of coal

(d) zinc granule

5. Arun has learnt that non-metals on beating with a hammer are generally broken into pieces. Which of the following is a nonmetal?

(a) iron nail

(b) aluminium wire

(c) copper plate

(d) piece of coal

6. Materials which can be drawn into wires are called ductile. Which of the following is not a ductile material?

(a) silver

(b) copper

(c) sulphur

(d) aluminium

7. Metals are generally hard. Which of the following metals is an exception and can be cut with a knife?

(a) iron

(b) sodium

(c) gold

(d) magnesium

8. Metals are generally solid. Which of the following metals is in the liquid state at room temperature?

(a) mercury

(b) silver

(c) aluminium

(d) sodium

9. Metals generally react with dilute acids to produce hydrogen gas. Which one of the following metals does not react with dilute hydrochloric acid?

(a) magnesium

(b) aluminium

(c) iron

(d) copper

10. Which of the following reacts with cold water vigorously?

(a) carbon

(b) sodium

(c) magnesium

(d) sulphur

11. The metal which produces hydrogen gas on reaction with dilute hydrochloric acid as well as sodium hydroxide solution is

(a) copper

(b) iron

(c) aluminium

(d) sodium

12. Which of the following non-metals reacts and catches fire on exposure to air?

(a) phosphorus

(b) nitrogen

(c) sulphur

(d) hydrogen

13. Generally metallic oxides are basic and non-metallic oxides are acidic in nature. Solution of which of the following oxides in water will change the colour of blue litmus to red?

(a) sulphur dioxide

(b) magnesium oxide

(c) iron oxide

(d) copper oxide

14. Which of the following property is not responsible for copper to be used as electrical conduction wires?

(a) ductility

(b) colour

(c) good conductor of electricity

(d) it is solid

15. Fill in the blanks :

(a) Phosphorus is very _____ non-metal.

(b) Metals are _____ conductors of heat and _____.

(c) Iron is _____ reactive than copper.

(d) Metals react with acids to produce _____ gas.

16. A substance is malleable, ductile and electropositive in nature. What type of substance is it?

17. What property of a metal makes it possible to draw it into wires?

18. Why are metals good conductors?

19. Name the metal which is commonly used for making cooking utensils

20. Fill in the blanks:

(a) _____ is liquid metal

(b) _____ is only liquid Non metals

(c) _____, _____ and _____ are soft metal

(d) _____ is the hardest natural substance

(e) _____ and _____ are have low melting points. They melt in the palm of the hand

(f) Metals can be beaten into thin sheets so they are called _____

(g) Non metals are bad conductors of electricity except _____

(h) Metals react with oxygen to form _____ oxides

(i) Some metal oxides show acidic and basic properties. They are called _____. Eg :- Aluminum oxide, Zinc oxide etc.

(j) $Al_2O_3 + 6HCl \rightarrow$ _____ $+ 3H_2O$

(k) $Al_2O_3 + NaOH \rightarrow$ _____ $+ H_2O$

(l) _____ and _____ does not react with oxygen even at high temperature.

(m) Metals like potassium and sodium react vigorously with oxygen and catch fire if kept in open. Hence they are stored in _____ to prevent burning.

(n) Magnesium reacts only with _____ water to form magnesium hydroxide and hydrogen.

(o) Metals like aluminium, iron and zinc react only with _____ to form the metal oxides and hydrogen.

(p) _____ gas is not evolved when metals react with nitric acid (HNO_3) because it is a strong oxidising agent

(q) A more reactive metal displaces a _____ reactive metal from its salt solution

(r) The arranging of metals in the decreasing order of their reactivity is called _____ series of metals.

(s) Metals lose electrons and become positive ions. So they are called _____ elements

(t) Non metals _____ electrons and become negative ions. So they are called electro negative elements

(u) _____ are compounds formed by the transfer of electrons from a metal to a non metal.

(v) If one of the metals in an alloy is mercury, it is called an _____

(w) _____ is the damage caused to metals due to the reaction of metals with oxygen, moisture, carbon dioxide etc.

(x) Some elements show properties of both metals and non metals. They are called _____

(y) _____ is a mixture of concentrated nitric acid and concentrated hydrochloric acid in the ratio 1:3.

21. Name one electrovalent compounds in each case in which ;

(i)One atom combines with one other atom

(ii)One atom combines with two other atoms

(iii)One atom combines with three other atoms

22. Give reasons for the following :

(a) Aluminium foils are used to wrap food items.

(b) Immersion rods for heating liquids are made up of metallic substances.

(c) Copper cannot displace zinc from its salt solution.

(d) Sodium and potassium are stored in kerosene.

23. Can you store lemon pickle in an aluminium utensil? Explain.

24. Write the electron dot structure for oxygen and magnesium.

25. Show the formation of Na2O and CaO by the transfer of electrons.

26. Write an activity to show that ionic compounds are good conductors of electric current in their aqueous solution.

27. Why is aluminum extracted from alumina by electrolytic reduction and not by reducing with carbon?

28. Why is ZnO called an amphoteric oxide? Give the support to your answer. Give equation for the following

(a) Iron is heated with steam.

(b) Magnesium reacts with water.

(c) iron reacts with dil.HCl

29. What would you observe when zinc is added to a solution of iron (II) sulphate? Write the chemical reaction that takes places.

30. A trivalent metal X is manufactured by the process of electrolysis, It is the most abundant metal in the earth's crust. Identify the metal and state its two uses.

31. Which gas is always produced when a metal reacts with a dilute Write chemical reaction when iron reacts with dil. H_2SO_4.

32. What is the activity series of metals? Rearrange the following metals in an increasing order of reactivity: Aluminum, Zinc, Mercury.

33. What is meant by the term 'enrichment of ore' ? name four Methods generally used for enrichment of ores.

34. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.

35. Write a balanced chemical equation for the reaction of the following metals with water: (i) Ca (ii) Zn (iii) Fe

36. Define the terms:(i) Mineral (ii) Ore and (iii) Gangue

37. Explain how the following metals are obtained from their compounds by the reaction process:

(i) Metal 'X' , which is low in reactivity series.

(ii) Metal 'Y', which is middle in reactivity series.

(iii) Metal 'Z' which is high up in the reactivity series.

38. Give reasons:

(a) The surface of some metals acquires a dull appearance when exposed to air for a long time.

(b) A salt which does not conduct electricity in the solid state becomes a good conductor in molten state

39. What will happen if a :

(i) Strip of zinc is immersed in a solution of copper sulphate.

(ii) Strip of copper is kept immersed in a solution of silver nitrate

40. Explain why: (i) Conc. HNO3 can be stored in aluminium container.

(ii) Aluminium is used for making transmission wires.

(iii) 24 carat gold can not be used for making ornaments.

(iv) Aluminium is used for making cooking utensils.

(v) Metals generally do not form compounds with hydrogen.

41. An element X on reacting with O_2 forms X_2O.This Oxide dissolves in water and turns blue litmus paper red. Predict the nature of element whether it is a metal or a non metal.

42. An element E combines with O_2 to form an oxide E_2O, which is a good conductor of electricity. i) How many electrons will be present in the outer most shell of E? ii) Write the formula of the compound formed when it combines with Chlorine.

43. What happens when

(a) Dilute sulphuric acid is poured on a copper plate?

(b) Iron nails are placed in copper sulphate solution?

Write word equations of the reactions involved.

44. Saloni took a piece of burning charcoal and collected the gas evolved in a test tube.

(a) How will she find the nature of the gas ?

(b) Write down word equations of all the reactions taking place in this process.

45. One day Reeta went to a jeweller's shop with her mother. Her mother gave old gold jewellery to the goldsmith to polish. Next day when they brought the jewellery back, they found that there was a slight loss in its weight. Can you suggest a reason for the loss in weight?

46. Name two soft metals which can be cut with a knife.

47. Which non-metal is essential for our life and all living beings inhale it during breathing?

48. Name two major non-metals which are present in fertilisers and enhance the growth of plants.

49. Which non-metal is used to disinfect water?

50. A purple coloured non-metal forms a brown solution in alcohol which is applied on wounds as an antiseptic. Name the nonmetal.

51. Zinc sulphate forms a colourless solution in water. Will you observe any colour on adding copper turning in it?

52. Why are bells made of metals?

53. Which liquid metal is used for making thermometers?

54. Which of the following metals can displace the other two metals from their salt solutions?

zinc, iron, copper

55. Arun bought a statue made of copper. To her surprise it acquired a dull green coating after a couple of months. Explain the reason.

56. Find out the names of three metals and three non-metals from the box given below:

A	X	T	M	S	P	K	L	G
X	T	S	U	L	P	H	U	R
I	L	R	H	M	N	D	I	L
C	I	R	O	N	S	E	J	K
A	L	U	M	I	N	I	U	M
R	M	U	Q	T	R	S	T	U
B	N	P	C	O	P	P	E	R
O	X	Y	G	E	N	V	W	X
N	Y	Z	T	A	B	G	H	K

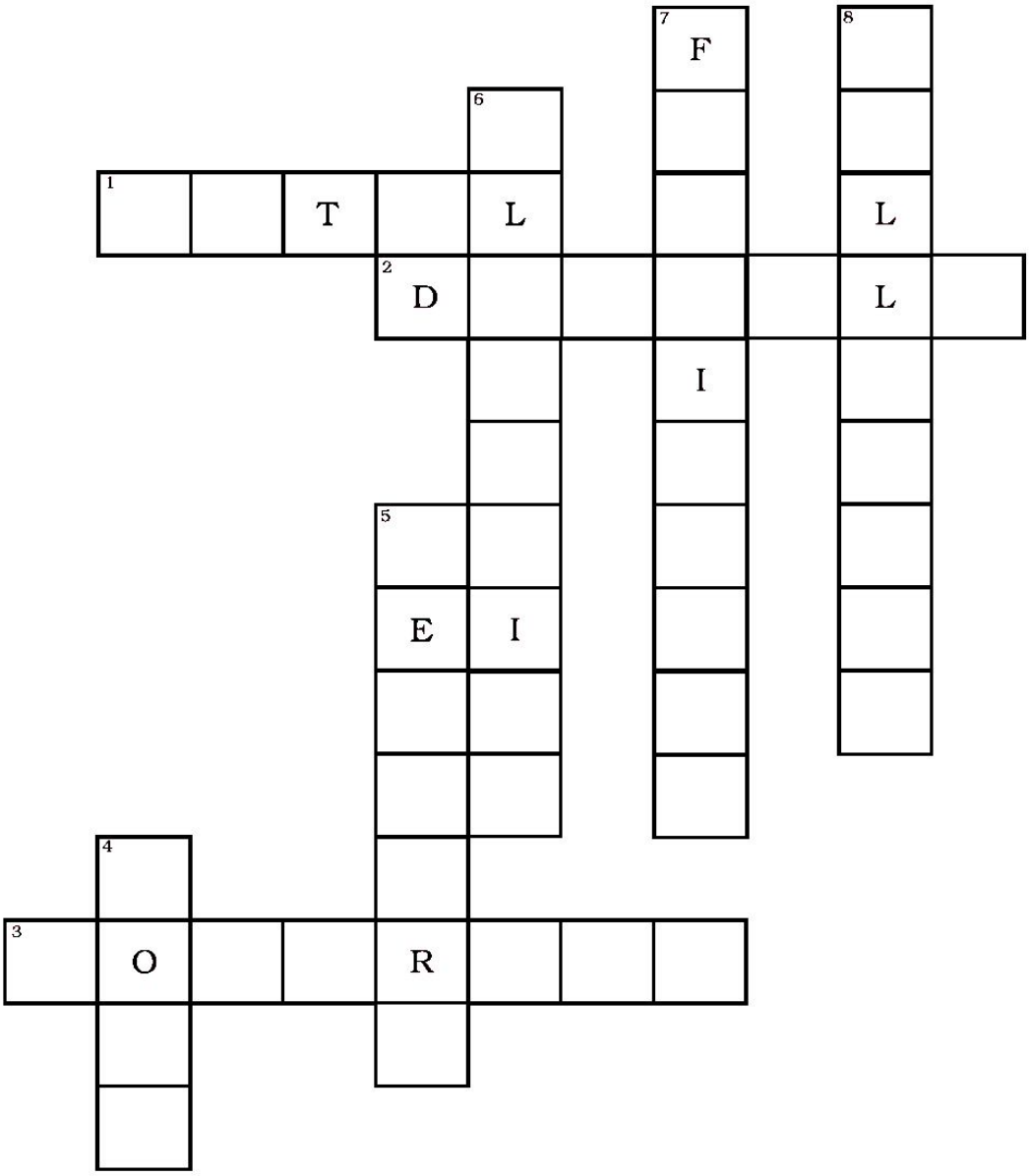
57. Fill in the blanks to complete the following paragraph.

(a) The name of the product formed in the reaction of sulphur and
(b) _____ is sulphur dioxide gas. When sulphur dioxide is
(c) dissolved in_____, sulphurous acid is formed. The
(d) sulphurous acid turns _____ litmus paper to _____.
(e) Generally oxides of _____ are acidic in nature.

After completing the paragraph write two questions which you can raise on the basis of this information.

58. Arun prepared a blue coloured solution of copper sulphate in beaker A and placed an iron nail in it. Mahesh prepared a yellowish green solution of ferrous sulphate in beaker B and placed a copper wire in it. What changes will they observe in the two beakers after an hour?

59. Complete the crossword given in below with the help of the clues.



Across

1. Which is generally hard, ductile, malleable and sonorous.
2. A metal is called so it can be drawn into wires.
3. Metal bells are used because of this property.

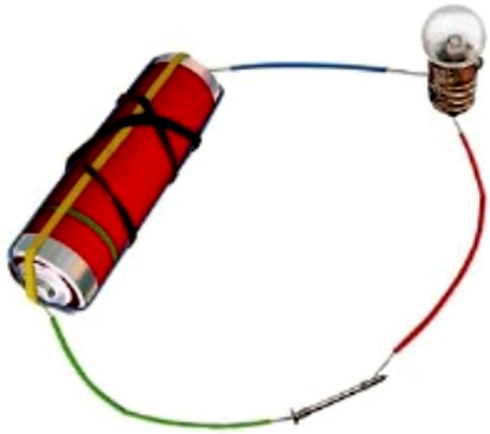
Down

4. A metal generally used for making jewellery.
5. A metal which is liquid at room temperature.
6. A metal which reacts with acid as well as base to form hydrogen gas.
7. Substances used to enhance the growth of plants.
8. Property by virtue of which metals can be beaten into thin sheets.

60. A doctor prescribed a tablet to a patient suffering from iron deficiency. The tablet does not look like iron. Explain.

61. Iron is more reactive than copper. Can you write an activity to show this?

62. In the given figure you find that the bulb glows when an iron nail is placed between two ends of wire. Complete the following sentences on the bases of this fact.



(a) _____ is a metal.
(b) Metals are good _____ of electricity.

63. If in the above figure iron nail is replaced by a wooden stick, will the bulb glow or not? Justify your answer.

64. Why is sodium kept preserved in kerosene?

65. What is the activity series of metals? Arrange the metals Zn, Mg, A;, Cu and Fe in decreasing order of reactivity.

CHAPTER – 4

CARBON AND ITS COMPOUND

CARBON: INTRODUCTION

Carbon is the fourth most abundant element in the universe by mass. It is also the second most abundant element in the human body after oxygen. It is the 15th most common element in the Earth's crust. Carbon was discovered in prehistory and it was known to the ancients. They used to manufacture charcoal by burning organic material.

Carbon is a non-metal. It belongs to the fourteenth group or IV A group in the modern periodical table. The elements of this group have four electrons in the valence shell.

Atomic Number: 6
Electronic configuration: 2, 4
Valence electrons: 4
Property: Non-metal

Compounds having carbon atoms among the components are known as carbon compounds. Previously, carbon compounds could only be obtained from a living source; hence they are also known as organic compounds.

BONDING IN CARBON: COVALENT BOND

Bond formed by sharing of electrons is called covalent bond. Two of more atoms share electrons to make their configuration stable. In this type of bond, all the atoms have similar rights over shared electrons. Compounds which are formed because of covalent bond are called COVALENT COMPOUNDS.

FORMATION OF COVALENT BONDS

1. **Covalent band** is the chemical bond formed through the **sharing of electrons between two non-metal atoms**.
2. Compounds which have covalent bonds are called **covalent compounds**.
3. Examples of covalent compounds or molecules are chlorine, Cl_2, carbon dioxide, CO_2, ammonia, NH3, water, H2O, and tetrachloromethane (carbon tetrachloride), CCl_4.
4. During the formation of covalent molecules, **each non-metal covalent atom** provides one, two or three electrons to be **shared** with other atoms. The bond formed is called a covalent bond.
5. Through this process, each non-metal atom in covalent molecules will achieve **stable electron arrangement**.
6. The type of covalent bond formed in a covalent compound depends on the number of electron pairs shared between non-metal atoms.

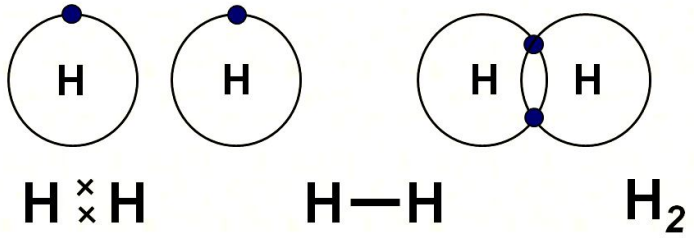
Covalent bonds are of three types: Single, double and triple covalent bond.

SINGLE COVALENT BOND

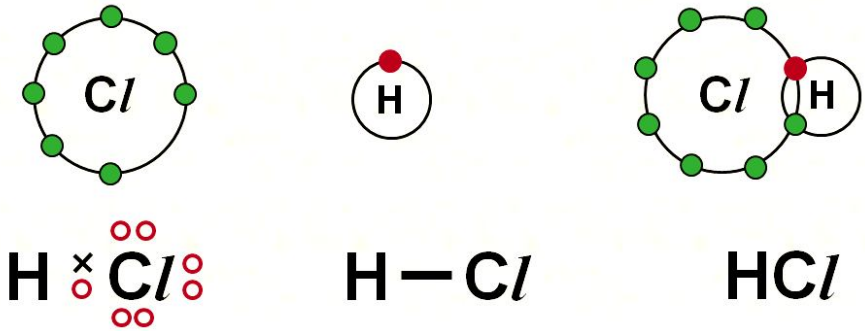
1. A single covalent bond is the covalent bond formed through the **sharing of a pair of electrons between two non-metal atoms**.

2. Each non-metal atom contributes one electron for sharing to achieve a **stable electron arrangement**.
3. Example of single covalent compound are chlorine gas, Cl_2, hydrogen chloride, HCl, water, H_2O, methane, CH_4, ammonia, NH_3, and tetrachloromethane, CCl_4.
4. Single covalent bonds can also be formed between different non-metal atoms.

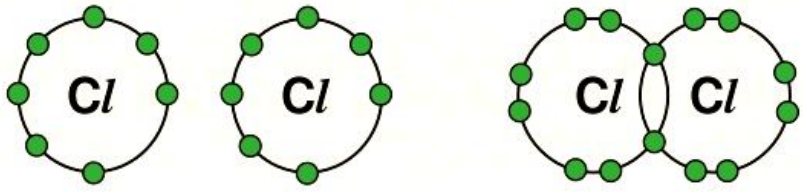
Formation of hydrogen molecule (H_2)
Atomic Number of H = 1
Electronic configuration of H = 1
Valence electron of H = 1
Hydrogen forms a duet, to obtain stable configuration. This configuration is similar to helium (a noble gas).
Since, hydrogen has one electron in its valence shell, so it requires one more electron to form a duet. So, in the formation of hydrogen molecule; one electron from each of the hydrogen atoms is shared.



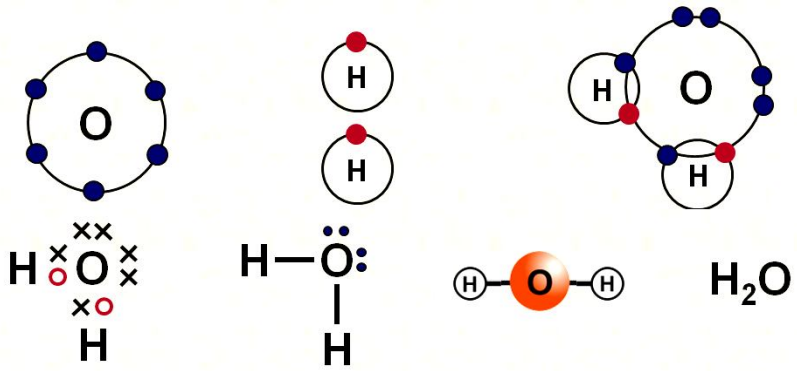
Formation of hydrogen chloride (HCl):
Valence electron of hydrogen = 1
Atomic number of chlorine = 17
Electronic configuration of chlorine: 2, 8, 7
Electrons in outermost orbit = 7
Valence electron = 7



Formation of chlorine molecule (Cl_2):
Valence electron of chlorine = 7



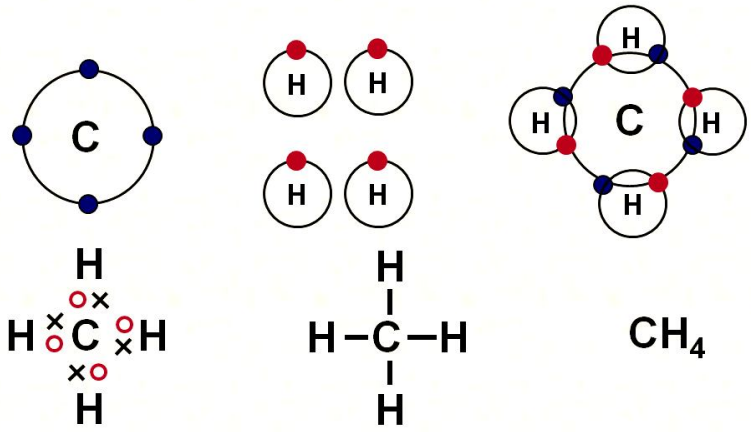
Formation of water (H_2O)
Valence electron of hydrogen = 1
Atomic number of oxygen = 8
Electronic configuration of oxygen = 2, 6
Valence electron = 6



Formation of Methane (CH_4)

Valence electron of carbon = 4

Valence electron of hydrogen = 1

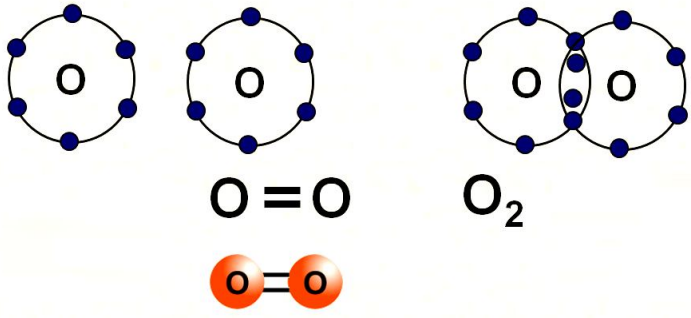


DOUBLE COVALENT BOND

1. Double covalent bond is the type of covalent bond formed through the **sharing of two pairs of electrons between two non-metal atoms**.
2. Examples of molecules which have double covalent bonds are oxygen, O2, and carbon dioxide, CO2.
3. During the formation of double bond, each **non-metal atom contributes two pairs of electrons to be shared** to achieve a **stable electron arrangement**.

Formation of oxygen molecule (O_2):

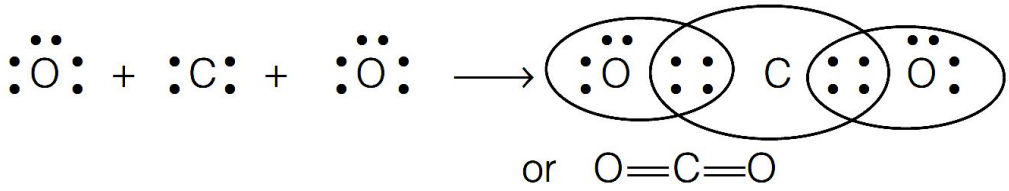
Valence electron of oxygen = 2



- In the formation of oxygen molecule, two electrons are shared by each of the two oxygen atoms to complete their stable configuration.

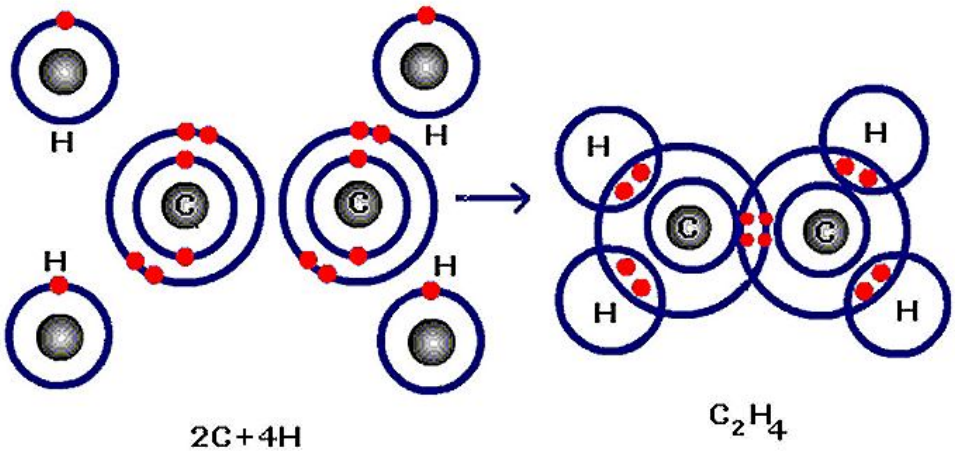
- In oxygen, the total number of shared electrons is four, two from each of the oxygen atoms. So a double covalent bond is formed.

Formation of Carbon dioxide (CO_2):
Valence electron of carbon = 4
Valence electron of oxygen = 6



In carbon dioxide two double covalent bonds are formed.

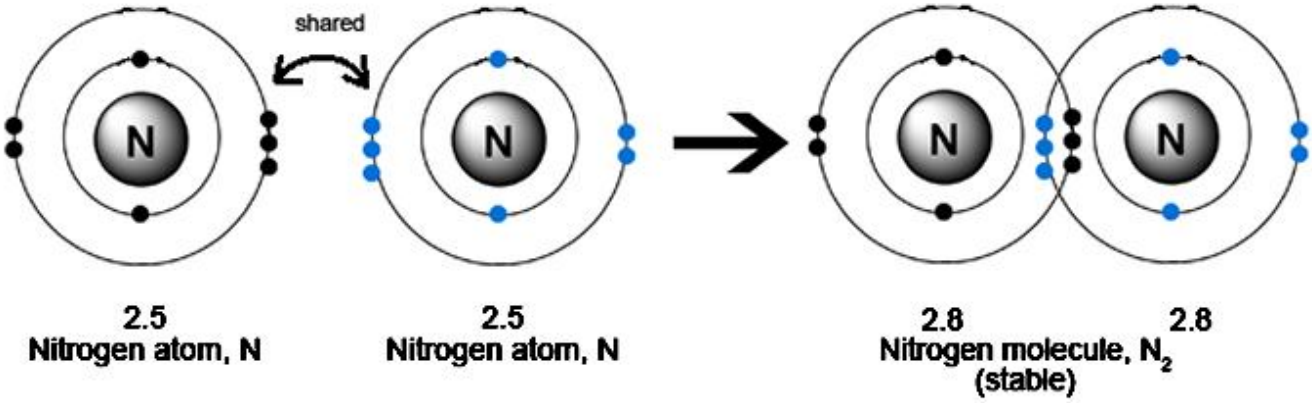
Formation of Ethylene (C_2H_4):
Valence electron of carbon = 4
Valence electron of hydrogen = 1



TRIPLE COVALENT BOND

1. The triple covalent bond is the type of covalent bond formed through the **sharing of three pairs of electrons between two non-metal atoms**.
2. Example of molecule which has triple covalent bonds is the nitrogen molecule, N2.

Formation of Nitrogen (N_2):
Atomic number of nitrogen = 7
Electronic configuration of nitrogen = 2, 5
Valence electron = 5



In the formation of nitrogen, three electrons are shared by each of the nitrogen atoms. Thus one triple bond is formed because of the sharing of total six electrons.

Properties of Covalent Bond:

- Intermolecular force is smaller.
- Covalent bonds are weaker than ionic bond. As a result, covalent compounds have low melting and boiling points.
- Covalent compounds are poor conductor of electricity as no charged particles are formed in covalent bond.
- Since, carbon compounds are formed by the formation of covalent bond, so carbon compounds generally have low melting and boiling points and are poor conductor of electricity.

ALLOTROPY

Allotropy is defined as the property by which an element can exist in more than one form that are physically different but chemically similar.

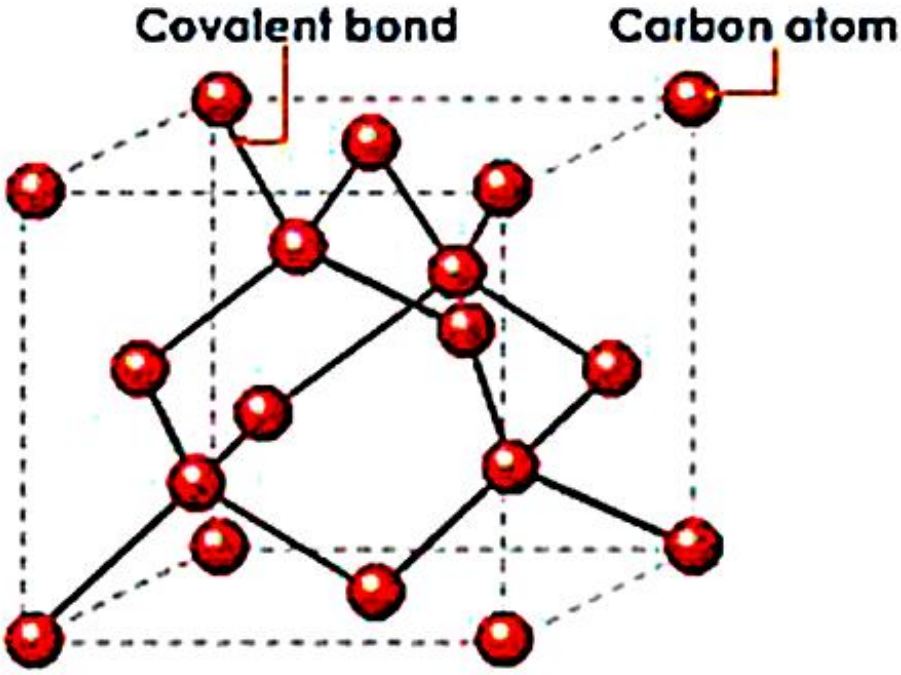
Allotropes of carbon

Carbon exists in three allotropic forms. They are crystalline form (diamond and graphite), amorphous form (coke,charcoal) and fullerene.

In diamond each carbon atom is bonded to four other carbon atoms forming a rigid three dimensional structure , accounting for it's hardness and rigidity.

General properties of diamond are

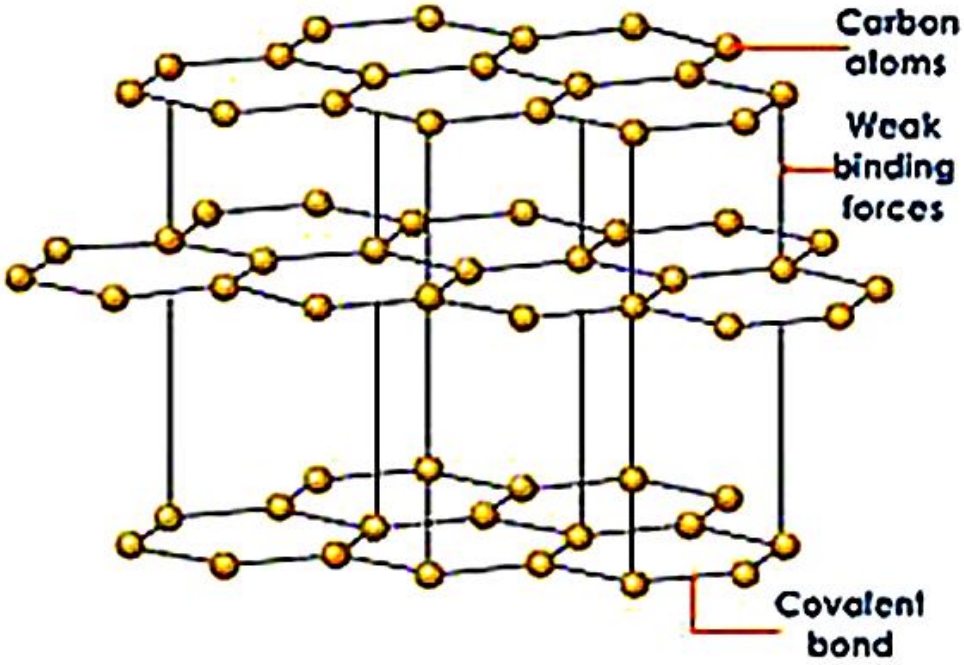
- It is a colourless transparent substance with extraordinary brilliance due to its high refractive index.
- It is quite heavy.
- It is extremely hard (hardest natural substance known).
- It does not conduct electricity (because of the absence of free electrons).
- It has high thermal conductivity and high melting point.
- It burns on strong heating to form carbon dioxide.



In graphite each carbon atom is bonded to three other carbon atoms in the same plane giving hexagonal layers held together by weak **vander Waals forces** accounting for softness.

General properties of graphite are

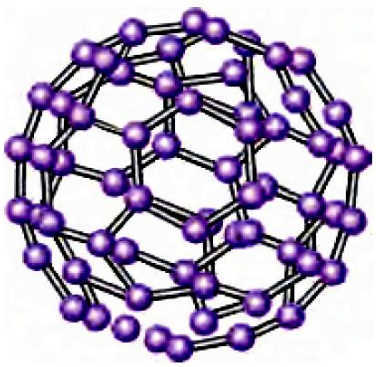
- ☞ It is a greyish black opaque substance.
- ☞ It is lighter than diamond, feels soft and slippery to touch.
- ☞ It is a good conductor of electricity (due to the presence of free electrons) but bad conductor of heat.
- ☞ It burns on strong heating to form carbon dioxide.



Fullerenes form another type of carbon allotropes. The first one was identified to contain 60 carbon atoms
in the shape of a football. (C-60). Since this looks like the geodesic dome designed by the US architect
Buck Minster Fuller, it is named as Buck Minster Fullerene.

General Properties of fullerenes are

- ☞ These are dark solids at room temperature.
- ☞ These are neither too hard nor too soft.
- ☞ These are the purest allotrophic forms of carbon because of the absence of free valencies or surface bonds.
- ☞ On burning, these produce only carbon dioxide gas.



Fullerene

Foot ball

VERSATILE NATURE OF CARBON

Initially, compounds of carbon could only be obtained from living sources and there was no way of synthesizing them. Hence, carbon compounds are also known as organic compounds. Carbon forms a large number of compounds. So far, formulae of about 3 million carbon compounds are known.

Cause of formation of such a large number of compounds by carbon:

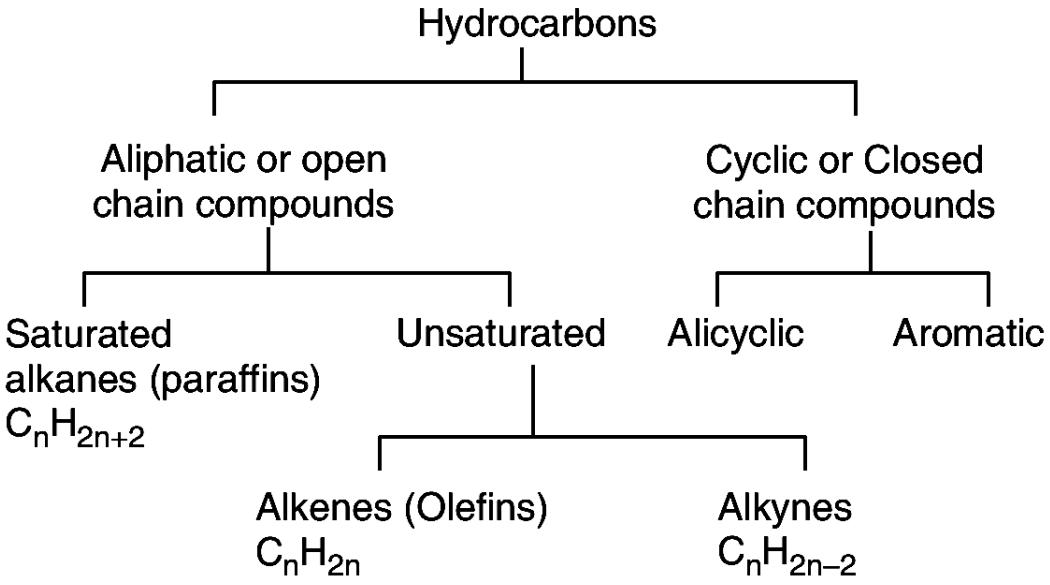
- ☞ Carbon can form bonds with other carbon atoms. This property of carbon is known as CATENATION. Because of catenation, carbon can form a long chain; while making bond with other carbon atoms. Carbon can make single, double and triple bonds by catenation.
- ☞ Carbon can form branched chain; along with straight chain; while combining with carbon atoms, i.e. because of the property of catenation.
- ☞ Due to the valency of four, carbon is capable of bonding or pairing with four other carbon atoms or with the atoms of some other monovalent elements. It also forms compounds with oxygen, nitrogen, sulphur, hydrogen and many other elements. This gives rise to compounds with specific properties which depend on the element other than carbon present in the molecule.
- ☞ Bonds which carbon forms with other elements are very strong thus, making these compounds very stable. The main reason for such strong bond formation is the small size of carbon. As a result, the shared pair of electrons are tightly held by the nucleus.

ORGANIC COMPOUNDS

The compounds of carbon except its oxides, carbonates and hydrogen carbonate salts, are known as ***organic compounds.*** These compounds were initially extracted from natural substances and was believed that some vital force was necessary for the synthesis of these compounds (vital force theory).

HYDROCARBONS

(Hydrogen + Carbon = Hydrocarbon) Compounds formed because of the combination of hydrogen and carbon are known as hydrocarbons. These are regarded as the **parent organic compounds** and all other compounds are considered to be derived from them by the replacement of one or more hydrogen atoms by other atoms or groups of atoms.
Hydrocarbons can be divided into various classes as shown in below:



ALIPHATIC HYDROCARBONS

The word aliphatic is derived from the Greek word aleiphar meaning fat. Aliphatic hydrocarbons were named so because they were derived from fats and oils. Hydrocarbons can be *acyclic* compounds, which are straight chain compounds, or cyclic compounds, which have rings of carbon atoms.

AROMATIC HYDROCARBONS

The word aromatic is derived from the word *aroma* meaning fragrance. The aromatic compounds have a characteristic smell. Structurally, they include benzene and its derivative.
The *aliphatic hydrocarbons* can be divided into two categories: **saturated hydrocarbons** and **unsaturated hydrocarbons.** In *saturated hydrocarbons*, carbon atoms are linked to each other by single bonds whereas in *unsaturated hydrocarbons*, multiple bond (double and triple bonds) are present between
carbon atoms.

SATURATED HYDROCARBONS

Alkanes
General formula = C_nH_{2n+2} Suffix : ane
These are the organic compounds which contain carbon – carbon single bond. These were earlier named as **paraffins**(Latin : meaning little affinity) due to their least chemical reactivity. According to IUPAC system, these are named as ***alkanes*** (ane is suffix with root word).

UNSATURATED HYDROCARBONS

These are hydrocarbons which contain carbon to carbon double bonds or carbon to carbon triple bonds in
their molecules.These are further classified into two types: ***alkenes and alkynes.***

i)***Alkenes***: ***General formula:*** **C_nH_{2n}** ***Suffix :*** **ene**
The hydrocarbons containing atleast one carbon to carbon double bond are called ***alkenes.***They have the general formula C_nH_{2n} .These were previously called ***olefins*** (Greek : olefiant – oil forming) because the lower gaseous members of the family form oily products when treated with chlorine.

In IUPAC system, the name of alkene is derived by replacing suffix "**ane"** of the correspding alkane by "**ene"**. For example,

In higher alkenes, the position of the double bond, can be indicated by assigning numbers 1, 2, 3, 4, ……to the carbon atoms present in the molecule.

Alkene	Common name	IUPAC name
$CH_2 = CH_2$	Ethylene	Ethene
$CH_3CH = CH_2$	Propylene	Propene
$CH_3CH_2–CH=CH_2$	α-Butylene	But–1–ene
$CH_3CH = CHCH_3$	β-Butylene	But–2–ene

ii) ***Alkynes***: ***General formula:*** C_nH_{2n-2} ***Suffix :*** **yne**

The hydrocarbons containing carbon to carbon triple bond are called ***alkynes***. Alkynes are named in the same way as alkenes i.e., by replacing suffix **ane** of alkane by **yne.** In higher members, the position of triple bond is indicated by giving numbers 1, 2, 3, 4, ….to the carbon atom in the molecule.

Alkyne	Common name	IUPAC name
$HC \equiv CH$	Acetylene	Ethyne
$H_3C - C \equiv CH$	Methyl acetylene	Propyne
$H_3C - C \equiv C - CH_3$	Dimethyl acetylene	But–2-yne
$H_3C - CH_2 - C \equiv CH$	Ethyl acetylene	But–1–yne

HOMOLOGOUS SERIES

A homologous series is a group or a class of organic compounds having similar structure and similar chemical properties in which the successive compounds differ by a CH_2 group.

Characteristics of homologous series

- Each member of the series differs from the preceeding or succeeding member by a common difference of CH_2 and by a molecular mass of 14 amu (amu = atomic mass unit).
- All members of homologous series contain same elements and the same functional groups.
- All members of homologous series have same general molecular formula.
  e.g **Alkane = C_nH_{2n+2}**
  Alkene = C_nH_{2n}
  Alkyne = C_nH_{2n-2}
- The members in homologous series show a regular gradation in their physical properties with respect to increase in molecular mass.
- The chemical properties of the members of the homologous series are similar.
- All members of homologous series can be prepared by using same general method.

IMPORTANCE OF HOMOLOGOUS SE RIES

- It helps to predict the properties of the members of the series that are yet to be prepared.
- Knowledge of homologous series gives a systematic study of the members.
- The nature of any member of the family can be ascertained if the properties of the first member are known.

FUNCTIONAL GROUP

Functional group may be defined as an atom or group of atoms or reactive part which is responsible for the characteristic properties of the compounds.

The chemical properties of organic compounds are determined by the functional groups while their physical properties are determined by the remaining part of the molecule.

CLASSIFICATION OF ORGANIC COMPOUNDS BASED ON FUNCTIONAL GROUP

1. ALCOHOLS

Alcohols are carbon compounds containing **–OH** group attached to alkyl group. The general formula of alcohol is **R-OH** where '**R** ' is an **alkyl group** and **–OH** is the **functional group**.
The IUPAC name of alcohol is derived by replacing **–e**, in the word **alkane,** by the suffix **–ol**. Hence we get the name **alkanol**.

Molecular formula	Common name	IUPAC name
CH_3OH	Methyl alcohol	Methanol
CH_3-CH_2-OH	Ethyl alcohol	Ethanol
CH_3- CH_2-CH_2-OH	n-Propyl alcohol	1-Propanol
CH_3-CH-CH_3 OH	Isopropyl alcohol or secondary propyl alcohol	2-Propanol
CH_3- CH_2-CH_2-CH_2-OH	n-Butyl alcohol	1-Butanol
CH_3-CH-CH_2-OH CH_3	Isobutyl alcohol	2-Methyl-1-propanol

2. ALDEHYDES

Aldehydes are carbon compounds containing -**CHO** group attached to alkyl group or hydrogen atom. The general formula of aldehydes is **R – CHO** where **'R'** is an **alkyl group** or **hydrogen atom** and **– CHO** is the **functional group**.
The IUPAC name of aldehyde is derived by replacing **–e**, in the word alkane, by the suffix **–al**. Hence we get the name **"alkanal"**.

Molecular formula	Common name	IUPAC name
HCHO	Formaldehyde	Methanal
CH_3- CHO	Acetaldehyde	Ethanal
CH_3- CH_2- CHO	Propionaldehyde	Propanal
CH_3- CH_2-CH_2- CHO	Butyraldehyde	Butanal

3. KETONES

Ketones are carbon compounds containing carbonyl **– CO –** group attached to two alkyl groups. The general formula of ketone is **R-CO-R'** where **R** and **R'** are **alkyl groups** and **– CO –** is the **functional group**.
The IUPAC name of ketone is derived by replacing **–e**, in the word alkane, by the suffix **-one**. Hence we get the name **"alkanone"**.

Molecular formula	Common name	IUPAC name
CH_3COCH_3	Dimethyl ketone (Acetone)	Propanone
$CH_3COCH_2CH_3$	Ethyl methyl ketone	Butanone
$CH_3CH_2COCH_2CH_3$	Diethyl ketone	3-Pentanone

4. CARBOXYLIC ACIDS

Carboxylic acids are carbon compounds containing **–COOH** group attached to a hydrogen atom or alkyl group. The general formula of acid is **R-COOH** where **'R'** is a **hydrogen atom** or **alkyl group** and **–COOH** is the **functional group**.

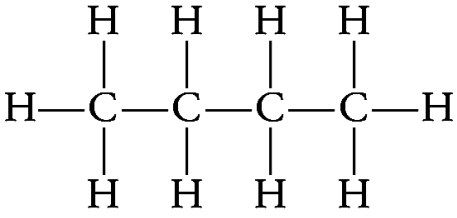
The IUPAC name of acid is derived by replacing – e, in the word alkane, by the suffix –oic acid. Hence we get the name **"alkanoic acid"**.

Molecular formula	Common name	IUPAC name
HCOOH	Formic acid	Methanoic acid
CH_3-COOH	Acetic acid	Ethanoic acid
CH_3- CH_2-COOH	Propionic acid	Propanoic acid
CH_3- CH_2-CH_2-COOH	n-Butyric acid	Butanoic acid

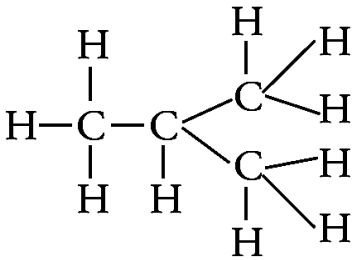
ISOMERISM

Carbon compounds or organic compounds with same molecular formula can show different structures and hence, different properties. This phenomenon is called **isomerism** and compounds are called ***isomers***.

For example, following two arrangements are possible for butane, an alkane with four C atoms (C_4H_{10})



Straight chain structure



Branched chain structure

Such pair of isomers is called ***chain isomers*** and the isomerism is called ***chain isomerism.*** Thus, ***chain isomers*** are the compounds that have same molecular formula but differ in the arrangement of carbon chains.

NOMENCLATURE OF CARBON COMPOUNDS

In general, the names of organic compounds are based on the name of basic carbon chain modified by a prefix (phrase before) or suffix (phrase after) showing the name of the functional group.

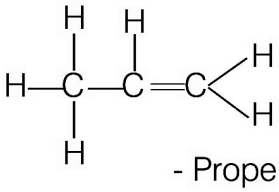
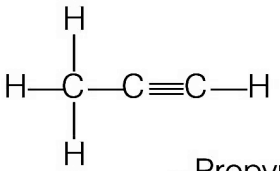
Following steps are used to write the name of an organic compound

***Step* 1** Count the number of carbon atoms in the given compound and write the root word for it (Root word upto 10 carbon atoms are tabulated below.)

Root Words for Carbon Atoms

No. of C atoms		Root word	No. of C atoms		Root word
1	(C_1)	Meth	6	(C_6	Hex
2	(C_2)	Eth	7	(C_7)	Hept
3	(C_3)	Prop	8	(C_8)	Oct
4	(C_4)	But	9	(C_9)	Non
5	(C_5)	Pent	10	(C_{10})	Dec

Prefix and Suffix of Different Functional Groups

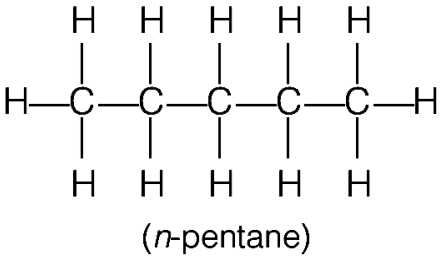
Functional Group	Prefix/Suffix	Example
Alcohol	Suffix -ol	C_3H_7OH – Proane–e+ol Propanol
Aldehyde	Suffix -al	CH_3CHO – Ethane–e+al= Ethanal
Ketone	Suffix -one	CH_3COCH_3 - Propane–e+one Propanone
Carboxylic acid	Suffix -oic acid	CH_3COOH - Acetic acid/ Ethanoic acid
Halogen	Prefix -chloro, bromo, etc.	CH_3Cl - Chloromethane C_2H_5Br - Bromoethane
Double bond (alkenes)	Suffix -ene	 - Propene
Triple bond (alkynes)	Suffix -yne	 - Propyne

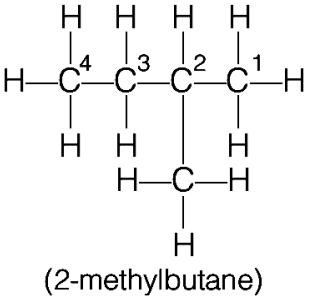
***Step* 2** If the compound is saturated, add suffix 'ane' to the root word, but if is unsaturated, add suffix 'ene' and 'yne' for double and triple bonds respectively.
For example, $CH_3CH_2CH_3$ contains three C atoms so root word is 'prop' and it contains only single
bonds, so suffix used is 'ane'. Hence, the name of this compound is propane.
Similarly, the compound $CH_3CH == CH_2$ is named as propene as here suffix 'ene' is used for double bond.
***Step* 3** If functional group is present in the compound, it is indicated by adding its suffix (which are given in the table above).

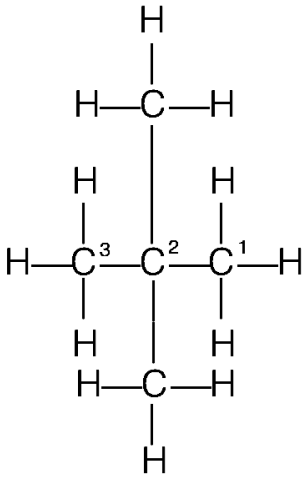
- *Prefix 'iso' and 'neo' represent the presence of one or two carbon atoms respectively as side chain.*
- *If the functional group is named as a suffix, the final 'e' of alkane (or alkene or alkyne) is substituted by appropriate suffix.*
- *If the functional group and subtituents are not present at first carbon, then their location is indicated by digits* 1,2,3... .

INTEXT QUESTIONS PAGE NO. 68

Q1. How many structural isomers can you draw for pentane?
Ans:
Pentane (C_5H_{12}) has a skeleton of five carbon atoms. It can exist as straight chain as well as two branched chains. The possible structural isomers have been shown below.


(*n*-pentane)

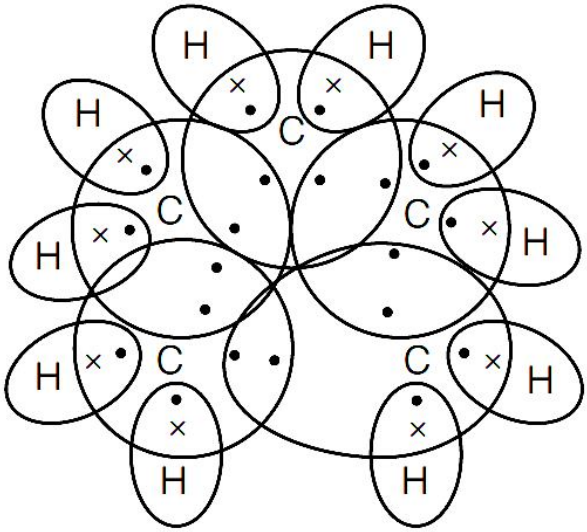

(2-methylbutane)


(2, 2-dimethyl propane)

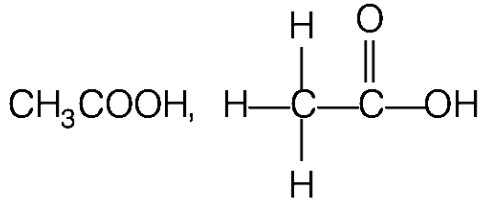
Q2. What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?
Ans:
The two features of carbon that give rise to a large number of compounds are as follows:
(i) Catenation − It is the ability to form bonds with other atoms of carbon.
(ii) Tetravalency − With the valency of four, carbon is capable of bonding with four other atoms.

Q3. What will be the formula and electron dot structure of cyclopentane?
Ans:
General formula of cycloalkane = C_nH_{2n}
In cyclopentane $n = 5$,
$\therefore$ Formula of cyclopentane, $C_5H_{5\times 2} = C_5H_{10}$

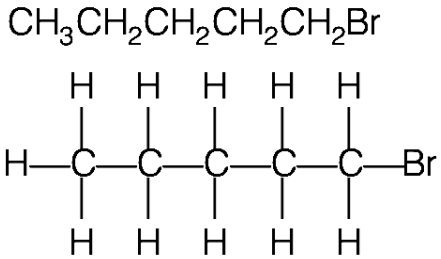
Electron dot structure of cyclopentane



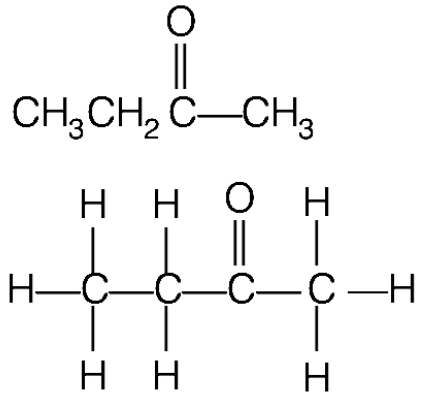
Q4. Draw the structures for the following compounds.
(i) Ethanoic acid (ii) Bromopentane*
(iii) Butanone (iv) Hexanal.
Are structural isomers possible for bromopentane?
Ans:
(i) Ethanoic acid



(ii) Bromopentane

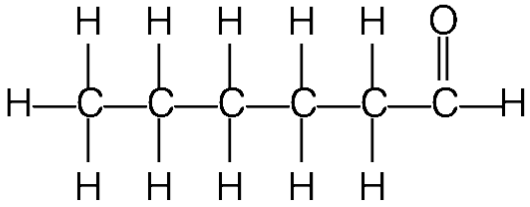


(iii) Butanone



(iv) Hexanal.

$CH_3CH_2CH_2CH_2CH_2CHO$



Yes, isomers of bromopentane are

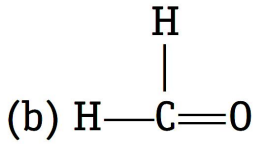
(i) $CH_3CH_2CH_2CH_2CH_2Br$
1-bromopentane

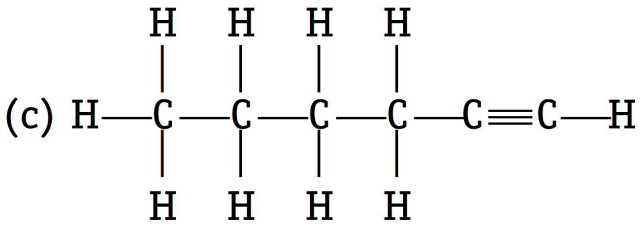
(ii) $CH_3CH_2CH_2CHCH_3$ (Br)
2-bromopentane

(iii) $CH_3CH_2CHCH_2CH_3$ (Br)
3-bromopentane

Q5. How would you name the following compounds?

(a) $CH_3—CH_2—Br$

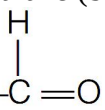




Ans:

(a) $CH_3 – CH_2 – Br$

Bromoethane (because for two carbons, root word is 'eth')



Formaldehyde or methanal (because for single carbon, root word is 'meth')

(c) $CH_3CH_2CH_2CH_2CHC{\equiv}C$,

1-hexyne (because for 6 carbons, root word is 'hex' and for triple bond suffix is 'yne'.)

CHEMICAL PROPERTIES OF CARBON COMPOUNDS

COMBUSTION

All the carbon compounds burn in oxygen and yield carbon dioxide and water vapour. Heat and light are also released during this process. This reaction is called **combustion**.

(i) $C + O_2 \rightarrow CO_2$ + heat and light

(ii) $CH_4 + O_2 \rightarrow CO_2 + H_2O$ + heat and light

(iii) $CH_3CH_2OH + O_2 \rightarrow CO_2 + H_2O$ + heat and light

Further, once carbon and its compounds ignite, they keep on burning without the requirement of additional energy. That's why these compounds are used as fuels.

Saturated hydrocarbons give a clean flame due to their complete combustion whereas, unsaturated hydrocarbons give a yellow flame with lots of black smoke as they do not undergo complete combustion.

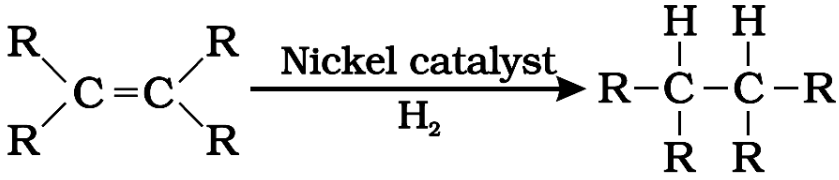
OXIDATION

Oxidation is a process of intake of oxygen and removal of hydrogen. Those substances which are capable of providing oxygen to other substances are called oxidising agents. *e.g.,* alk. $KMnO_4$ and acidified $K_2Cr_2O_7$ can both behave as oxidising agents.

$$CH_3CH_2OH \xrightarrow[\text{alk. } KMnO_4 + \Delta]{\text{Acidic } K_2Cr_2O_7 + \Delta} CH_3COOH + H_2O$$

ADDITION REACTION

The reaction in which a reagent adds completely on a substance without the removal of small molecules are called ***addition reactions***. ***For example,*** addition of hydrogen (in the presence of catalysts like **Palladium or Nickel**) to unsaturated hydrocarbons, yields saturated hydrocarbons **(Hydrogenation)**.



Hydrogenation (addition of hydrogen) of vegetable oil (which are unsaturated compounds) in the presence of nickel catalyst gives ghee (saturated compounds). This process is called ***hardening of oils***.

$$\text{Vegetables oils} \xrightarrow[H_2\ 200^\circ C]{\text{Ni catalyst}} \text{Ghee}$$

SUBSTITUTION REACTION

The reactions in which a reagent substitutes (replaces) an atom or a group of atoms from the reactant (substrate) are called ***substitution reactions.*** These are generally shown by saturated compounds and benzene.

Most of the saturated hydrocarbons are fairly inert and unreactive in the presence of most reagents. So, presence of sunlight is necessary for their substitution reactions.

When chlorine is added to hydrocarbons at a rapid rate, in the presence of sunlight, Cl replaces H atom one by one.

FUELS AND FLAMES

FUELS

Those carbon compounds which have stored energy in them and burn with heat and light are called ***fuels***. The released energy (heat or light) is utilised for various purposes like for cooking food, running machines in factories, etc. In fuels, the carbon can be in free state as present in coal, coke and charcoal or in combined state as present in petrol, LPG, kerosene, petroleum, natural gas, etc. Those fuels which were formed by the decomposition of the remains of the pre-historic plants and animals (fossils) burried under the earth long ago, are called ***fossils fuels***.

For example, coal, petroleum and natural gas.

COAL

It is a complex mixture of compounds of carbon, hydrogen and oxygen and some free carbon alongwith traces of nitrogen and sulphur.

It was formed by the decomposition of plants and trees buried under the earth millions of years ago.

PETROLEUM

It is a dark viscous foul smelling oil and is also known as **rock oil** or **black gold.** It was formed by the decomposition of the remains of extremely small plants and animals buried under the sea millions of years ago.

FLAME

A flame is the region where combustion (or burning) of gaseous substances takes place. *Depending upon the amount of oxygen available and burning of fuels, flames are of following two types*

(i) **Blue or Non-luminous Flame**

When the oxygen supply is sufficient, the fuels burn completely producing a blue flame. Since, light is not produced during this type of combustion, so the flame is called ***non-luminous*** (non-light giving flame), *e.g.*, burning of LPG in gas stove.

(ii) **Yellow or Luminous Flame**

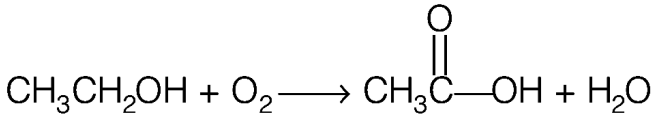
In the insufficient supply of air, the fuels burn incompletely and produce yellow flame. The colour of the flame is yellow because of the presence of unburnt carbon particles. This flame produces light so also known as ***luminous flame.*** *e.g.*, burning of wax vapours.

INTEXT QUESTIONS PAGE NO. 71

Q1. Why is the conversion of ethanol to ethanoic acid an oxidation reaction?

Ans:

Since the conversion of ethanol to ethanoic acid involves the addition of oxygen to ethanol, it is an oxidation reaction.



Q2. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

Ans:

When ethyne is burnt in air, it gives a sooty flame. This is due to incomplete combustion caused by limited supply of air. However, if ethyne is burnt with oxygen, it gives a clean flame with temperature 3000°C because of complete combustion. This oxy-acetylene flame is used for welding. It is not possible to attain such a high temperature without mixing oxygen. This is the reason why a mixture of ethyne and air is not used.

SOME IMPORTANT CARBON COMPOUNDS – ETHANOL AND ETHANOIC ACID

Almost all the compounds are useful to us in a number of ways. Most of the fuels, medicines, paints, explosives, synthetic polymers, perfumes and detergents are basically organic compounds. In fact, organic chemistry has made our life colourful and also comfortable.
Two commercially important compounds are ethanol and ethanoic acid

ETHANOL (C_2H_5OH)

Ethanol or ethyl alcohol or simply alcohol is one of the most important members of the family of alcohols.

(1) Manufacture of ethanol from molasses

Molasses is a dark coloured syrupy liquid left after the crystallization of sugar from the concentrated sugar cane juice. Molasses still contain about 30% of sucrose which can not be separated by crystallization. It is converted into ethanol by the following steps:

(i) Dilution

Molasses is first diluted with water to bring down the concentration of sugar to about 8 to 10 percent.

(ii) Addition of ammonium salts

Molasses usually contains enough nitrogenous matter to act as food for yeast during fermentation. If the nitrogen content of the molasses is poor, it may be fortified by the addition of ammonium sulphate or ammonium phosphate.

(iii) Addition of yeast

The solution from step (ii) is collected in large ' fermentation tanks ' and yeast is added to it. The mixture is kept at about 303K for a few days.During this period, the enzymes invertase and zymase present in yeast, bring about the conversion of sucrose into ethanol.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose — Glucose Fructose

$$C_6H_{12}O_6 \xrightarrow{\text{zymase}} 2C_2H_5OH + 2CO_2\uparrow$$

Glucose or Fructose — Ethanol

The fermented liquid is technically called wash.

☞ **FERMENTATION is t**he slow chemical change taking place in an organic compound by the action of enzymes leading to the formation of smaller molecules.

(iv) Distillation of wash

The fermented liquid containing 15 to 18 percent alcohol and the rest of the water, is now subjected to fractional distillation. The main fraction drawn, is an aqueous solution of ethanol which contains 95.5% of ethanol and 4.5% of water. This is called rectified spirit. This mixture is then heated under reflux over quicklime for about 5 to 6 hours and then allowed to stand for 12 hours. On distillation of this mixture, pure alcohol (100%) is obtained. This is called absolute alcohol.

PROPERTIES OF ETHANOL

PHYSICAL PROPERTIES

(i) Ethanol is a clear liquid with burning taste.
(ii) Its boiling point is 351K which is higher than corresponding alkane.
(iii) It is completely miscible with water in all proportions.

CHEMICAL PROPERTIES

(i) DEHYDRATION

(a) Intra molecular dehydration : Ethanol, when heated with excess conc. H_2SO_4 at 443 K undergoes intra molecular dehydration (i.e. removal of water within a molecule of ethanol).

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443K]{Conc.H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2}+H_2O$$

(b) Inter molecular dehydration : When excess of alcohol is heated with conc. H_2SO_4 at 413K two molecules condense by losing a molecule of water to form ether (i.e. removal of water from two molecules of ethanol).

$$C_2H_5\text{- }OH + HO\text{- }C_2H_5 \xrightarrow[413K]{Conc.H_2SO_4} \underset{\text{Diethyl ether}}{C_2H_5\text{-}O\text{-}C_2H_5}+H_2O$$

(ii) Reaction with sodium : Ethanol reacts with sodium metal to form sodium ethoxide and hydrogen gas.

$$2C_2H_5OH + 2Na \longrightarrow \underset{\text{sodium ethoxide}}{2C_2H_5ONa} + H_2\uparrow$$

(iii) Oxidation : Ethanol is oxidized to ethanoic acid with alkaline $KMnO_4$ or acidified $K_2Cr_2O_7$

$$CH_3CH_2OH \xrightarrow{Oxidation} \underset{\text{Ethanoic acid}}{CH_3COOH} +H_2O$$

During this reaction, orange colour of $K_2Cr_2O_7$ changes to green. Therefore, this reaction can be used for the **identification of alcohols**.

(iv) Esterificaiton : Ethanol reacts with ethanoic acid in the presence of conc.H_2SO_4 (catalyst) to form ethyl ethanoate and water. The compound formed by the reaction of an alcohol with carboxylic acid is known as ester (fruity smelling compound) and the reaction is called esterification.

$$\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \xrightarrow{conc.H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

(v) Dehydrogenation : When the vapour of ethanol is passed over reduced copper catalyst at 573 K, it is dehydrogenated to acetaldehyde.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[573\ K]{Cu} \underset{\text{Acetadehyde}}{CH_3CHO}+H_2$$

USES OF ETHANOL

- As an anti-freeze in automobile radiators.
- As a preservative for biological specimen.
- As an antiseptic to sterilize wounds in hospitals.
- As a solvent for drugs, oils, fats, perfumes, dyes, etc.
- In the preparation of methylated spirit (mixture of 95% of ethanol and 5% of methanol), rectified spirit (mixture of 95.5% of ethanol and 4.5% of water), power alcohol (mixture of petrol and ethanol) and denatured sprit (ethanol mixed with pyridine).
- In cough and digestive syrups.

EVIL EFFECTS OF CONSUMING ALCOHOL

- If ethanol is consumed, it tends to slow down metabolism of our body and depresses the central nervous system.
- It causes mental depression and emotional disorder.
- It affects our health by causing ulcer, high blood pressure, cancer, brain and liver damage.
- Nearly 40% accidents are due to drunken drive.
- Unlike ethanol, intake of methanol in very small quantities can cause death.
- Methanol is oxidized to methanal (formaldehyde) in the liver and methanal reacts rapidly with the components of cells.
- Methanal causes the protoplasm to get coagulated, in the same way an egg is coagulated by cooking. Methanol also affects the optic nerve, causing blindness.

ETHANOIC ACID (CH_3COOH)

Ethanoic acid is most commonly known as acetic acid and belongs to a group of acids called carboxylic acids. Acetic acid is present in many fruits and sour taste of fruits is because of this acid.

PREPARATION OF ETHANOIC ACID

Ethanol on oxidation in the presence of alkaline potassium permanganate or acidified potassium dichromate gives ethanoic acid.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{\text{Oxidation}} \underset{\text{Ethanoic acid}}{CH_3COOH} + H_2O$$

PROPERTIES OF ETHANOIC ACID

PHYSICAL PROPERTIES

(i) Ethanoic acid is a colourless liquid and has a sour taste.
(ii) It is miscible with water in all proportions.
(iii) Boiling point (391 K) is higher than corresponding alcohols, aldehydes and ketones.
(iv) On cooling, pure ethanoic acid is frozen to form ice like flakes. They look like glaciers, so it is called glacial acetic acid.

CHEMICAL PROPERTIES

(i) Ethanoic acid is a weak acid but it turns blue litmus to red.
(ii) **Reaction with metal**
Ethanoic acid reacts with metals like Na, K, Zn, etc to form metal ethanoate and hydrogen gas.

$$2CH_3COOH + Zn \longrightarrow (CH_3COO)_2Zn + H_2\uparrow$$

$$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2\uparrow$$

(iii) **Reaction with carbonates and bicarbonates**.
Ethanoic acid reacts with carbonates and bicarbonates and produces brisk effervescence due to the evolution of carbon dioxide.

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2\uparrow + H_2O$$

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2\uparrow + H_2O$$

(iv) **Reaction with base**
Ethanoic acid reacts with sodium hydroxide to form sodium ethanoate and water.

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

(v) **Decarboxylation (Removal of CO_2)**

When sodium salt of ethanoic acid is heated with soda lime (Solid mixure of 3 parts of NaOH and 1 part of CaO) methane gas is formed.

$$CH_3COONa \xrightarrow{NaOH\ /\ CaO} CH_4 \uparrow + Na_2CO_3$$

USES OF ETHANOIC ACID

- For making vinegar which is used as a preservative in food and fruit juices.
- As a laboratory reagent.
- For coagulating rubber from latex.
- In the preparation of dyes, perfumes and medicine.

INTEXT QUESTIONS PAGE NO. 74

Q1. How would you distinguish experimentally between an alcohol and a carboxylic acid?
Ans:

Sodium bicarbonate test ($NaHCO_3$ test)

Alcohol + $NaHCO_3$ → No effervescence

Acid + $NaHCO_3$ → Brisk effervescence

The sample which produces brisk effervescence when treated with $NaHCO_3$ due to release of CO_2 is a carboxylic acid.

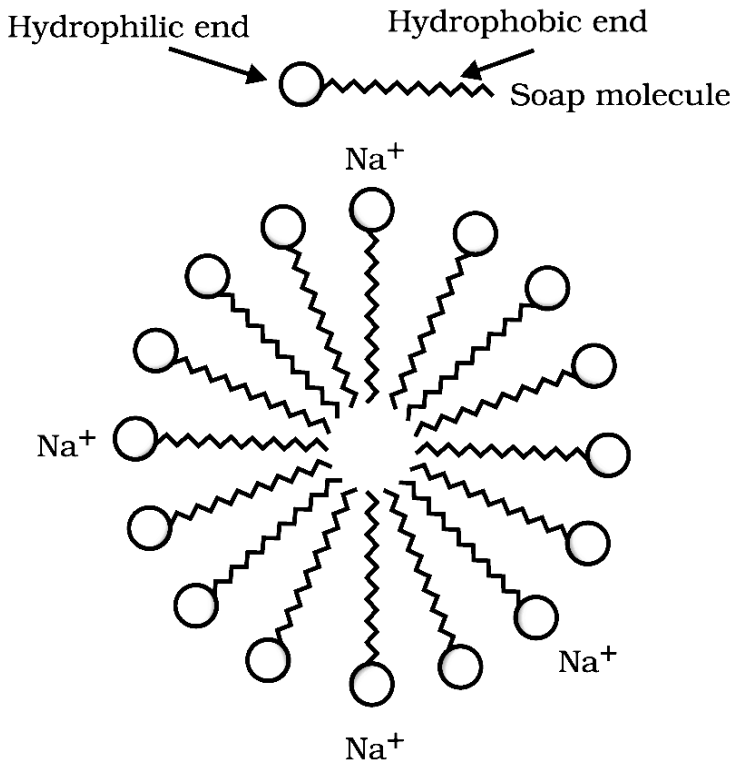
Q2. What are oxidising agents?
Ans:

Those substances which are capable of providing oxygen to other substances are called oxidising agents. *e.g.*, alk. $KMnO_4$ and acidified $K_2Cr_2O_7$ can both behave as oxidising agents.

$$CH_3CH_2OH \xrightarrow[\text{alk. } KMnO_4 + \Delta]{\text{Acidic } K_2Cr_2O_7 + \Delta} CH_3COOH + H_2O$$

SOAPS AND DETERGENTS

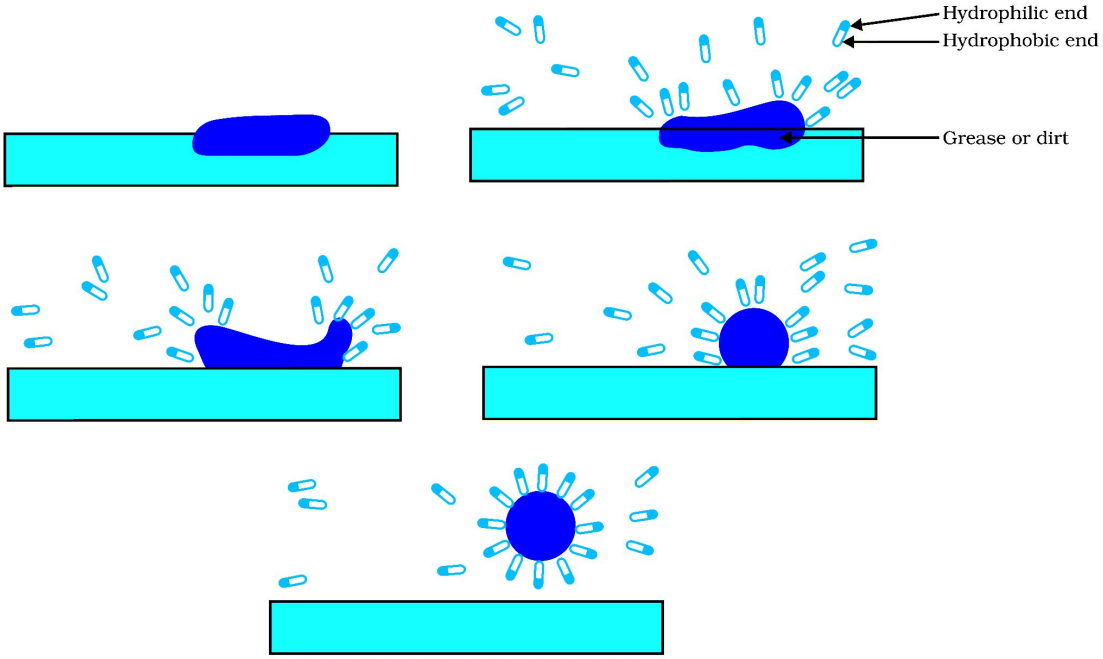
Most dirt is oily in nature and as you know, oil does not dissolve in water. The molecules of soap are sodium or potassium salts of long-chain carboxylic acids. The ionic-end of soap dissolves in water while the carbon chain dissolves in oil. The soap molecules, thus form structures called micelles (see the below figure) where one end of the molecules is towards the oil droplet while the ionic-end faces outside. This forms an emulsion in water. The soap micelle thus helps in dissolving the dirt in water and we can wash our clothes clean.



MICELLES

Soaps are molecules in which the two ends have differing properties, one is hydrophilic, that is, it dissolves in water, while the other end is hydrophobic, that is, it dissolves in hydrocarbons. When soap is at the surface of water, the hydrophobic

'tail' of soap will not be soluble in water and the soap will align along the surface of water with the ionic end in water and the hydrocarbon 'tail' protruding out of water. Inside water, these molecules have a unique orientation that keeps the hydrocarbon portion out of the water. This is achieved by forming clusters of molecules in which the hydrophobic tails are in the interior of the cluster and the ionic ends are on the surface of the cluster. This formation is called a micelle.



Soap in the form of a micelle is able to clean, since the oily dirt will be collected in the centre of the micelle. The micelles stay in solution as a colloid and will not come together to precipitate because of ion-ion repulsion. Thus, the dirt suspended in the micelles is also easily rinsed away. The soap micelles are large enough to scatter light. Hence a soap solution appears cloudy.

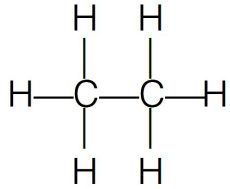
INTEXT QUESTIONS PAGE NO. 76

Q1. Would you be able to check if water is hard by using a detergent?
Ans:
Detergents are ammonium or sulphonate salts of long chain carboxylic acids. Unlike soap, they do not react with calcium and magnesium ions present in hard water to form scum. They give a good amount of lather irrespective of whether the water is hard or soft. This means that detergents can be used in both soft and hard water. Therefore, it cannot be used to check whether the water is hard or not.

Q2. People use a variety of methods to wash clothes. Usually after adding the soap, they 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes?
Ans:
A soap molecule has two parts namely hydrophobic and hydrophilic. With the help of these, it attaches to the grease or dirt particle and forms a cluster called micelle. These micelles remain suspended as a colloid. To remove these micelles (entrapping the dirt), it is necessary to agitate clothes.

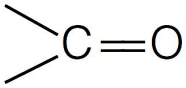
EXERCISE QUESTIONS PAGE NO. 77 and 78

Q1. Ethane, with the molecular formula C_2H_6 has
(a) 6 covalent bonds.
(b) 7 covalent bonds.
(c) 8 covalent bonds.
(d) 9 covalent bonds.
Ans:
(b) Structure of C_2H_6 is



It is clear that it has 7 covalent bonds.

Q2. Butanone is a four-carbon compound with the functional group
(a) carboxylic acid.
(b) aldehyde.
(c) ketone.
(d) alcohol.
Ans: (c) In butanone, the function group is ketone (one)

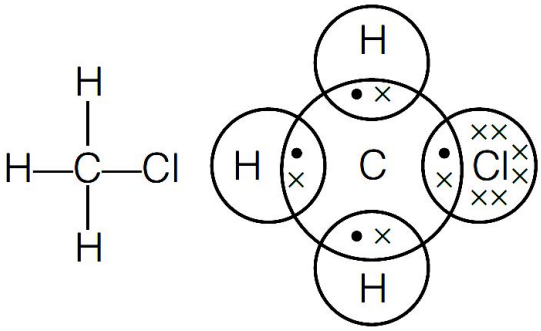


Q3. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that
(a) the food is not cooked completely.
(b) the fuel is not burning completely.
(c) the fuel is wet.
(d) the fuel is burning completely.
Ans: (b) The unburnt particles of the fuel present in smoke blacken the vessel from outside.

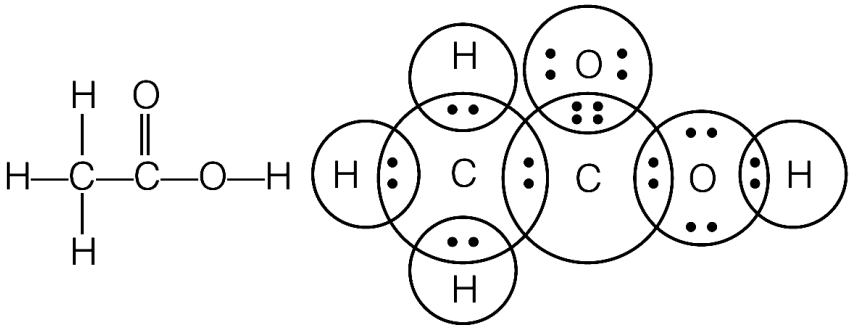
Q4. Explain the nature of the covalent bond using the bond formation in CH_3Cl.
Ans:
Atomic number of
C = 6; H = 1; Cl = 17
Electronic configuration

	K	*L*	*M*
C	2	4	
Cl	2	8	7
H	1		

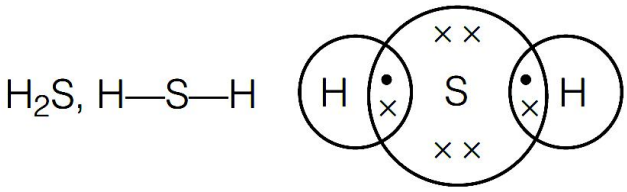
C needs 4 electrons to complete its octet, H needs 1 and Cl needs 1 electron.
∴ C shares its 4 electrons with each of the 3 H-atoms and 1 with chlorine atom. It thus forms 4 covalent bonds as shown.



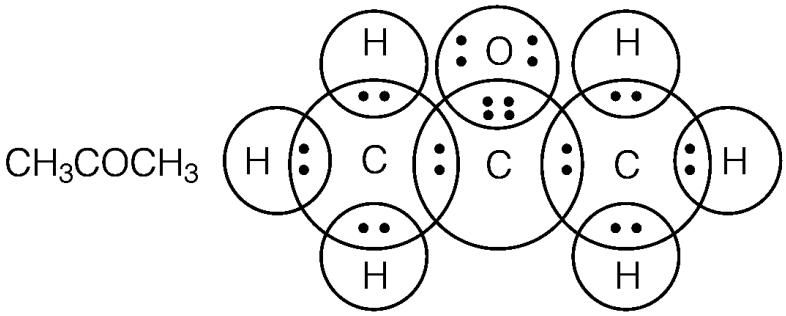
Q5. Draw the electron dot structures for
(a) ethanoic acid.
(b) H_2S.
(c) propanone.
(d) F_2 .
Ans:
(a) ethanoic acid.



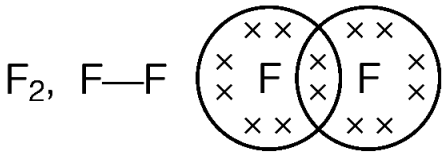
(b) H_2S.



(c) propanone.



(d) F_2 .



Q6. What is an homologous series? Explain with an example.
Ans:
A homologous series is a series of carbon compounds that have different numbers of carbon atoms but contain the same functional group.
Example of homologous series

Alkane series C_nH_{2n+2}
CH_4 Methane, C_2H_6 Ethane
C_3H_8 Propane, C_4H_{10} Butane C_5H_{12} Pentane

It can be noticed that there is a difference of $-CH_2$ unit between each successive compound.

Q7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties?
Ans:

I. Distinction based on physical properties

1. **Smell** Ethanoic acid has a pungent smell. Ethanol has a pleasant smell.
2. **Melting point** Ethanol has lower melting point (150 K) than ethanoic acid (290 K).
3. **Physical state** Ethanoic acid is solid (glacial acetic acid) in winters but ethanol is always a liquid.

II. Distriction based on chemical properties

(i) **Action with sodium hydrogen carbonate** On adding a small amount of sodium hydrogen carbonate to ethanoic acid, carbon dioxide gas is evolved with brisk effervescence. However, no such reaction noticed in case of ethanol.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2 \uparrow + H_2O$$

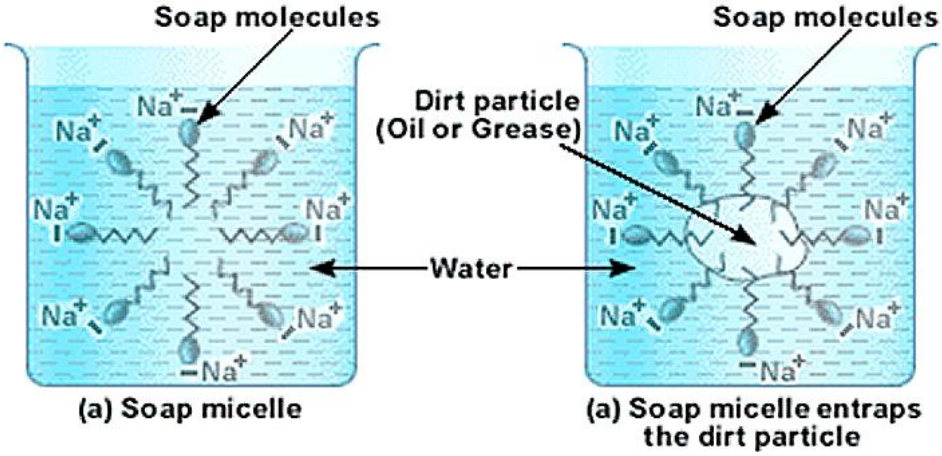
(ii) **Action with caustic alkalies** Ethanoic acids reacts with both sodium hydroxide (NaOH) and potassium hydroxide (KOH) to form corresponding salt and water. Ethanol fails to react with either of these.

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$
$$CH_3COOH + KOH \longrightarrow CH_3COOK + H_2O$$

Q8. Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Ans:

A soap is a sodium or potassium salt of long chain fatty acids. It has one polar end and one non-polar end. The polar end is hydrophilic in nature i.e., this end is attracted towards water. The non-polar end is hydrophobic but lipophilic, i.e., it is attracted towards hydrocarbons. When soap is added to water, soap molecules arrange themselves in a cluster to keep the non-polar portion out of water such that the non-polar ends are in the interior of the cluster and the polar ends are on the surface of the cluster. Since the dirt present on clothes is organic in nature and insoluble in water, the hydrophobic ends of the clusters attach themselves to the dirt. This cluster formation in which the dirt is entrapped is the micelle. Micelle formation does not occur in alcohol because the alkyl chain of soap becomes soluble in alcohol.



Q9. Why are carbon and its compounds used as fuels for most applications?

Ans:

Carbon burns in oxygen (air) to form carbon dioxide and water.

During this reaction a large amount of heat and light are released. Further, once ignited carbon and its compounds keep on burning without the requirement of additional energy. Hence, they are used as fuels.

$$C + O_2 \longrightarrow CO_2 + \text{heat} + \text{light}$$

Q10. Explain the formation of scum when hard water is treated with soap.
Ans:
Soap does not work properly when the water is hard. A soap is a sodium or potassium salt of long chain fatty acids. Hard water contains salts of calcium and magnesium. When soap is added to hard water, calcium and magnesium ions present in water displace sodium or potassium ions from the soap molecules forming an insoluble substance called scum. A lot of soap is wasted in the process.
Reaction taking place are shown below.

$$Ca^{2+} + 2RCOONa \longrightarrow (RCOO)_2Ca + 2Na^+$$

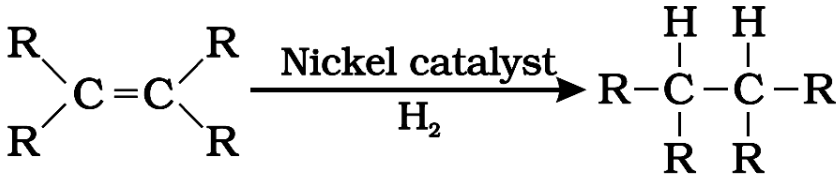
(Hard water) (Soap) (Calcium salt ppt.)

$$Mg^{2+} + 2RCCONa \longrightarrow (RCOO)_2Mg + 2Na^+$$

(Hard water) (Soap) (Magnesium salt ppt.)

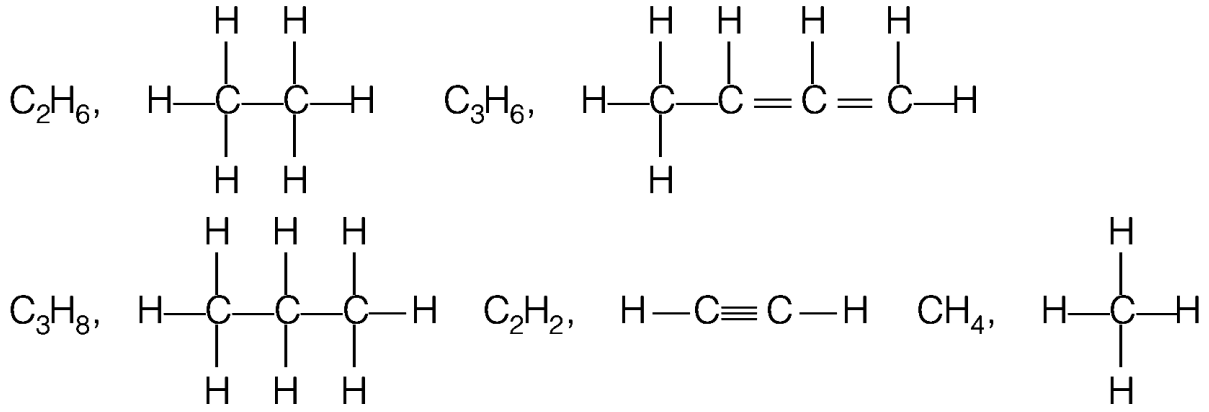
Q11. What change will you observe if you test soap with litmus paper (red and blue)?
Ans:
Since soap is basic in nature, it will turn red litmus blue. However, the colour of blue litmus will remain blue.

Q12. What is hydrogenation? What is its industrial application?
Ans:
Hydrogenation is the process of addition of hydrogen. Unsaturated hydrocarbons are added with hydrogen in the presence of palladium and nickel catalysts to give saturated hydrocarbons.



This reaction is applied in the hydrogenation of vegetables oils, which contain long chains of unsaturated carbons.

Q13. Which of the following hydrocarbons undergo addition reactions:
C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4.
Ans:
Unsaturated hydrocarbons containing double/ triple bond undergo addition reactions.



So, C_3H_6 and C_2H_2 will undergo addition reactions.

Q14. Give a test that can be used to differentiate chemically between butter and cooking oil.

Ans:

Butter contains saturated compounds while cooking oil contains unsaturated compounds. Since unsaturated compounds are oxidised by alkaline $KMnO_4$ with disappearance of its pink colour.

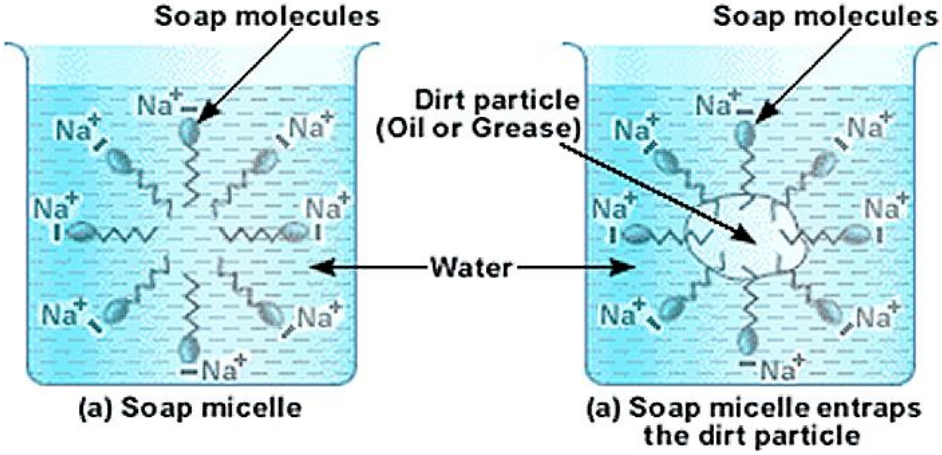
$\therefore$ When cooking oil is treated with a few drops of alkaline $KMnO_4$, pink colour of $KMnO_4$ disappears. With butter however, the pink colour $KMnO_4$ does not disappear

Q15. Explain the mechanism of the cleaning action of soaps.

Ans:

Cleansing action of soaps:

The dirt present on clothes is organic in nature and insoluble in water. Therefore, it cannot be removed by only washing with water. When soap is dissolved in water, its hydrophobic ends attach themselves to the dirt and remove it from the cloth. Then, the molecules of soap arrange themselves in micelle formation and trap the dirt at the centre of the cluster. These micelles remain suspended in the water. Hence, the dust particles are easily rinsed away by water.



ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 4
CARBON AND ITS COMPOUND

1. Which of the following is not a saturated hydrocarbon ?

i) Cyclohexane.

ii) Benzene.

iii) Butane

iv) isobutene

2. The bond between two identical non metallic atom has a pair of electron ?

i) un equally shared between two atoms.

ii) Transferred completely from one atom to another.

iii) With identical spins

iv) Unequally shared between them.

3. Covalent compounds are generally

i) Soluble in water

ii) Insoluble in water

iii) Ionize in water

iv) Hydrolyse in water

4. Propane with the molecular formula C_3H_8 has

i) 7covalent bonds

ii) 8 covalent bonds

iii) 9 covalent bonds

iv) 10 Covalent bonds.

5. A hydrocarbon reacts with ammonical cuprous chloride solution to form a red precipitate .The hydrocarbon is

i)ethane

ii)ethene

iii)butane

iv)1-propyne

6. Which of the following substance is added to denature Ethanol ?

i)methanol ii)pyridine

iii)copper sulphate iv)all of them

7. Which of the following is not an allotropic form of carbon

i)fluorine ii)fullerene

iii)diamond iv)graphite

8. Which of the following represents the correct decreasing order of hydrogen atoms ?

i)alkanes , alkenes , alkynes

ii)alkanes , alkaynes , alkenes

iii)alkenes , alkynes , alkanes

iv)alkynes , alkanes , alkenes

9. Detergents are sodium or potassium salts of long chain of ;-

i)aldehydes

ii)ketones

iii)carboxylic acid

iv)sulphonic acid

10. Which of the following represents the structure of N_2 Mmolecule ?

i) N≡ N

ii) N = N

iii) N - N

iv) None of the above

11. In double covalent bond there is sharing of

i) 2 electrons

ii) 4 electrons

iii) 6 electrons

iv) 3 electrons

12. Cation is formed when

i) atom gains electrons

ii) atom loses electrons

iii) proton is lost by the atom

iv) atom shared by electrons

13. The total no. of electrons that take part in forming a bond in N_2 is

i) 2

ii) 4

iii) 6

iv) 10

14. Which of the following has the weakest carbon-carbon strength?

i)C_2H_2

ii)C_2H_4

iii)C_2H_6

iv)all have the same bond strength

15. Which of the following salt when dissolved in water produce hard water.

i) calcium sulphate

ii) magnesium bicarbonate

iii) calcium chloride

iv) any of the above

16. Which of the following is not a saturated hydrocarbon ?

i) cyclohexane

ii) benzene

iii) butane

iv) isobutane

17. The bond between two identical nonmetallic atom has a pair of electron ?

i) unequally shared between two atoms

ii) transferred completely from one atom to another

iii) With identical spins

iv) Equally shared between them

18. Covalent compounds are generally –

i) Soluble in water

ii) insoluble in water

iii) Ionize in water

iv) hydrolyse in water

19. Propane with molecular formula C_3H_8 has –

i) 7 covalent bonds

ii) 8 covalent bonds

iii) 9 covalent bonds

iv) 10 covalent bonds

20. A hydrocarbon reacts with ammonical cuprous chloride solution to form a red precipitate, the hydrocarbon is –

i) Ethane

ii) ethane

iii) butane

iv) 1-propyne

21. Which of the following substance is added to denature Ethanol?

i) Methanol ii) pyridine

iii) copper sulphate iv) all of these

22. Which of the following is not an allotropic form of carbon ?

i) fluorine

ii) fullerene

iii) diamond

iv) graphite

23. Which of the following represents the correct deceasing order of hydrogen atoms ?

i) alkanes, alkenes, alkynes

ii) alkanes, alkynes, alkenes

iii) alkenes, alkynes, alkanes

iv) alkynes, alkanes, alkenes

24. Detergents are sodium or potassium salts of long chain of :

i) aldehydes

ii) ketones

iii) carboxylic acid

iv) sulphonic acid

25. In double covalent bond there is a sharing of

i) 2 electrons

ii) 4 electrons

iii) 6 electrons

iv) 3 electrons

26. Cation is formed when

i) atom gains electrons

ii) atom losses electrons

iii) proton is lost by the atom

iv) atom shared by electrons

27. The total number of electrons that take part in forming a bond in N_2 is

i) 2

ii) 4

iii) 6

iv) 10

28. Which of the following has the weakest carbon-carbon strength ?

i) C_2H_2

ii) C_2H_4

iii) C_2H_6

iv) all have the same bond strength

29. Which of the following salt when dissolved in water produce hard water ?

i) calcium sulphate

ii) magnesium bicarbonate

iii) calcium chloride

iv) any of the above.

30. The two colours seen at the extreme ends of the pH charts are:-

i) red and blue

ii)red and green

iii) green and blue

iv) orange and green

31. Carboxylic acids on heating with P_2O_5 gives:-

i) ethers

ii) alcohol

iii) carbonyl compounds

iv) anhydrides

32. Synthetic flavours contain:-

i) unsaturated acids

ii) esters

iii) dilute carboxylic acids

iv) hydroxyl acids

33. Out of the following which one is used as preservative for pickle and sauces:-

i) esters ii) acetone

iii) aldehyde iv) acetic acid

34. Brisk effervescences produced when a pinch of Na_2CO_3 is added to CH_3COOH is due to the formation of :-

i) H_2 gas ii) CO_2 gas

iii) CO gas iv) CH_4 gas

35. When an acetic acid reacts with an alcohol in the presence of conc. H_2SO_4:-

i) esters are formed ii) ketones are formed

iii) aldehydes are formed iv) none of these

36. Sodium bi carbonate solution is added to dilute Ethanoic acid. It is observed that:-

i) a gas evolves

ii) a solid settles at the bottom

iii) the mixture becomes vapour

iv) the colour of the mixture becomes light Yellow

37. Ethanoic acid was added to sodium bicarbonate sol. And the gas evolved was tested with a burning splinter. The following four observations were reported:-

1) the gas burns with the pop sound and the flame gets extinguished.

2) the gas does not burn out but the splinter burns with a pop sound

3) the flame extinguishes and the gas does not burn

4) the gas burns with a blue flame and the splinter burns brightly.

The correct observation is reported in:-

i) 1

ii) 2

iii) 3

iv) 4

38. 2ml of ethanoic acid was taken in each test tube 1 and 2 .A red litmus paper was introduced in test tube 1 and a pH paper was introduced in test tube 2. The experiment was performed by 4 students A, B, C, D and they reported their observation as given in the table. Student action on red action on litmus PH paper

A) Turned blue turned pink

B) Remains unchanged turned green

C) Turned blue turned blue

D) Remains unchanged turned pink

The correct observation is reported in

i) A

ii) B

iii) C

iv) D

39. Acetic acid was added to a solid X kept in a Test tube. A colourless, odourless gas Y was evolved. The gas was passed through the lime water, which turned milky. It concludes that:-

i) solid X is NaOH and the gas Y is CO_2

ii) solid X is Na_2CO_3 and the gas Y is CO_2

iii) solid X is sodium acetate and the gas y is CO_2

iv) solid X is sodium chloride and the gas Y is CO_2

40. Why is carbon tetravalent?

41. The formula of a hydrocarbon is C_nH_{2n}. Name the family to which it belongs and also predicts its nature.

42. What is the valency of carbon in CH_3-CH_3, CH_2=CH_2 and HC=CH ?

43. Out of butter and ground nut oil , which is unsaturated in Nature?

44. Why is high temperature not favourable for alcoholic fermentation?

45. Name a cyclic unsaturated hydrocarbon, containing three double bonds?

46. What is the difference in the molecular mass of any two adjacent homologues?

47. Which has triple bond ; C_2H_4 ,C_3H_6 and C_3H_4 ?

48. Which substance is added to denature ethyl alcohol?

49. Which ions are responsible for making water hard?

50. Name the catalyst commonly used in hydrogenation of oil to form fats?

51. Write the name and molecular formula of alcohol derived from butane ?

52. Which gas is evolved when sodium carbonate or bicarbonate is added to ethanoic acid?

53. What is SCUM ?

54. What are hydrophobic and hydrophilic parts in soaps?

55. How much percentage of earth's crust constitutes carbon element ?

56. What do you mean by covalency ?

57. What is covalent bond ?

58. What is functional group ?

59. What is organic chemistry ?

60. What name is given to the reaction which take place when Ethanoic acid reacts with ethanol in the presence of conc. Sulphuric acid ? Name the products obtained in this reaction.

61. What is bromination ? Write the structural formula of product obtained on bromination of propene.

62. Define covalency ?

63. Write the structural formula of the isomers of n-butane?

64. Name the organic acid present in vinegar. Write its Chemical formula also.

65. The structural formula of an ester is $HCOOCH_2CH_2CH_3$ write the formula of acid and the alcohol from which it is made ?

66. What happens when ethanol reacts with

(i) sodium

(ii) potassium permanganate solution.

67. Which of the following hydrocarbons undergo addition reactions : C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4.

68. What is hydrogenation? Write its industrial application.

69. Give a test that can be used to differentiate between butter and cooking oil ?

70. Give the names of the functional group;-

(i) –CHO

(ii) -C=O

(iii) –OH

(iv) –COOH

71. Explain the following terms :

a) Etherification

b) Saponification

c) Dehydration

72. An organic compound A having molecular fomula $C_2H_4O_2$ reacts with Sodium metal Na evolves a gas B which readily catches fire. A also reacts with Ethanol in the presence of concentrated Sulphuric acid to form a sweet smelling substance C in making perfumes.

a) Identify the compounds A, B and C.

b) Write balanced chemical equation to represent the conversion of

(i). Compound A to compound B.

(ii). Compound A to compound C.

73. Give the name of the following :

a) An Aldehyde derived from Ethane.

b) Ketone derived from Butane.

c) The compound obtained by the Oxidation of Ethanol by Chromic anhydride.

74. Write chemical equations of the reactions of Ethanoic acid with :

a) Sodium

b) Sodium Carbonate

c) Ethanol in the presence of conc. H_2SO_4.

75. Give a test to distinguish between:

a) Ethane and Ethene

b) Ethanol with Ethanoic acid.

c) Soaps and detergents.

76. Complete the following reactions:

a) $H_2C=CH_2 + H_2O\ H_2SO_4$

b) $HC\equiv CH + Br_2$

c) $C_2H_5OH + Na$

d) $CH_3COOH + C_2H_5OH$

77. Two carbon compounds A and B have the molecular formula C3H8 and C3H6 respectively. Which one of the two each most likely to show addition reaction? Justify your

answer. Explain with the help of a chemical equation, how an addition is useful in vegetable Ghee industry.

78. What substance should be oxidised to prepare acetic acid (CH_3COOH)? How can ethanol and Ethanoic acid be differentiated?

79. Write down the difference between soap and detergents.

80. An organic compound A is widely used as a preservative in pickles and has a molecular formula $C_2H_4O_2$. This compound reacts with ethanol to form a sweet smelling compound B.

i) Identify the compound A.

ii) Write the chemical equation for its reaction with Ethanol to form compound B.

iii) How can we get compound A back from B?

iv) Name the process and write corresponding chemical equation.

v) Which gas is produced when compound A reacts with washing soda? Write the chemical equation

81. An organic compound X with a molecular formula C_2H_6O undergoes oxidation with in presence of alkaline $KMnO_4$ to form a compound Y. X on heating in presence of Conc. H_2SO_4 at 443K gives Z.which on reaction with H_2O in presence of H_2SO_4 gives back `X.` `Z` reacts with Br_2 (aq) and decolorizes it. Identify X, Y, & Z.and write the reactions involved.

82. An organic compound 'A' is widely used as a preservative in pickles and has a molecular formula $C_2H_2O_2$. This compound reacts with ethanol to form a sweet smelling compound 'B.

(i) Identify the compound 'A'

(ii) Write the chemical equation for its reaction with ethanol to form compound 'B'. (iii) How can we get compound 'A' back from 'B'?

(iv) Name the process and write corresponding chemical equation.

(v) Which gas is produced when compound 'A' reacts with washing soda? Write the chemical equation.

83. Hydrocarbon `X` and `Y` having molecular formulae C_3H_8 and C_3H_6 respectively. Both are burnt in different spatula on the bunsen flame. Indicate the color of the flame produced by `X` and `Y`. Identify `X` and `Y`. Write the structural formulae.

84. A compound `X` has molecular formula C_4H_{10}. It undergoes substitution reaction readily than addition reaction. It burns with blue flame and is present in LPG. Identify `X` and give the balanced equation for its combustion and substitution reaction with C_{l2} in presence of sunlight.

85. `A` compound works well with hard water. It is used for making shampoos & products for cleaning clothes. A is not 100% biodegradable and causes water pollution. `B` does not work well with hard water. It is 100% biodegradable and does not create water pollution. Identify A & B.

86. An organic compound P with molecular formula C_2H_6O is an active ingredient of all alcoholic drinks. It is also used in medicines such as tincture iodine, cough syrups. Identify `P`. Drop a small piece of sodium into the test tube containing `P`.A new compound `Q` is formed with the evaluation of colorless and odorless gas Name the gas evolved and compound `Q` write the chemical reaction.

87. A cyclic compound `X` has molecular formula C_6H_6. It is unsaturated and burns with sooty flame. Identify `X` and write its structural formula. Will it decolorize bromine water or not and why?

88. An organic compounds `A` is a constituent of antifreeze and has the molecular formula C_2H_6O. upon reaction with alkaline $KMnO_4$, the compound `A` is oxidized to another `B` with formula $C_2H_6O_2$. Identify the compound A` and `B`. Write the chemical equation for the reaction which leads to the formulation of `B`

89. Two compounds `X` and `Y` have the same formula $C_2H_4O_2$. One of them reacts with sodium metal to liberate H_2 and CO_2 with $NaHCO_3$. Second one does not reacts with Na metal and $NaHCO_3$ but undergo hydrolysis with NaOH to form salt of carboxylic acid and compound `Z` which is called wood spirit. Identify `X`, `Y`, and `Z` and write chemical equation for the reaction involved.

90. A compound `X` with molecular formula C_2H_4 burns with a sooty flame. It decolourise bromine water. Identify `X`. Will it dissolve in water or not? Will it conduct electricity in aq. Solution? Will it have high melting point or low melting point ?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 4
CARBON AND ITS COMPOUND

1. Carbon exists in the atmosphere in the form of

(a) carbon monoxide only

(b) carbon monoxide in traces and carbon dioxide

(c) carbon dioxide only

(d) coal

2. Which of the following statements are usually correct for carbon compounds? These

(i) are good conductors of electricity

(ii) are poor conductors of electricity

(iii) have strong forces of attraction between their molecules

(iv) do not have strong forces of attraction between their molecules

(a) (i) and (iii) (b) (ii) and (iii)

(c) (i) and (iv) (d) (ii) and (iv)

3. A molecule of ammonia (NH_3) has

(a) only single bonds

(b) only double bonds

(c) only triple bonds

(d) two double bonds and one single bond

4. Buckminsterfullerene is an allotropic form of

(a) phosphorus

(b) sulphur

(c) carbon

(d) tin

5. Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of

(a) Addition reaction

(b) Substitution reaction

(c) Displacement reaction

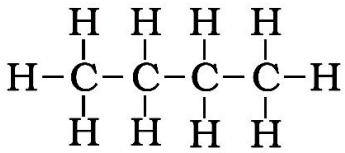
(d) Oxidation reaction

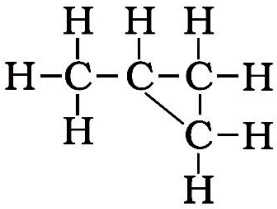
6. In which of the following compounds, — OH is the functional group?

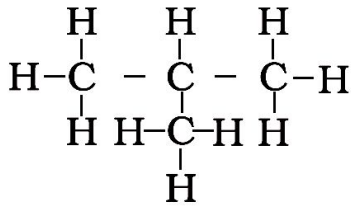
(a) Butanone (b) Butanol

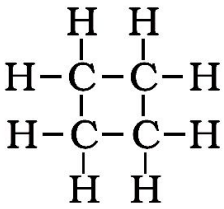
(c) Butanoic acid (d) Butanal

7. Which of the following are correct structural isomers of butane?

(i) 

(iii) 

(ii) 

(iv) 

(a) (i) and (iii) (b) (ii) and (iv)

(c) (i) and (ii) (d) (iii) and (iv)

8. In the below given reaction, alkaline KMnO4 acts as

$$CH_3 - CH_2 - OH \xrightarrow{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3 - COOH$$

(a) reducing agent

(b) oxidising agent

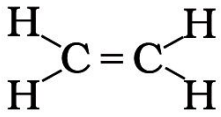
(c) catalyst

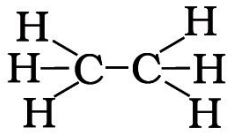
(d) dehydrating agent

9. Structural formula of ethyne is

(a) $H - C \equiv C - H$

(b) $H_3 - C \equiv C - H$

(c) 

(d) 

10. The soap molecule has a

(a) hydrophilic head and a hydrophobic tail

(b) hydrophobic head and a hydrophilic tail

(c) hydrophobic head and a hydrophobic tail

(d) hydrophilic head and a hydrophilic tail

11. Which of the following is the correct representation of electron dot structure of nitrogen?

(a) :N̈ : N̈:

(b) :Ṅ : : Ṅ:

(c) :N̈ : Ṅ:

(d) :N ⋮⋮ N:

12. Identify the unsaturated compounds from the following

(i) Propane

(ii) Propene

(iii) Propyne

(iv) Chloropropane

(a) (i) and (ii) (b) (ii) and (iv)

(c) (iii) and (iv) (d) (ii) and (iii)

13. Chlorine reacts with saturated hydrocarbons at room temperature in the

(a) absence of sunlight

(b) presence of sunlight

(c) presence of water

(d) presence of hydrochloric acid

14. In the soap micelles

(a) the ionic end of soap is on the surface of the cluster while the carbon chain is in the interior of the cluster.

(b) ionic end of soap is in the interior of the cluster and the carbon chain is out of the cluster.

(c) both ionic end and carbon chain are in the interior of the cluster

(d) both ionic end and carbon chain are on the exterior of the cluster

15. Pentane has the molecular formula C_5H_{12}. It has

(a) 5 covalent bonds

(b) 12 covalent bonds

(c) 16 covalent bonds

(d) 17 covalent bonds

16. Ethanol reacts with sodium and forms two products. These are

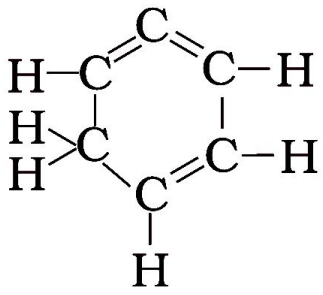
(a) sodium ethanoate and hydrogen

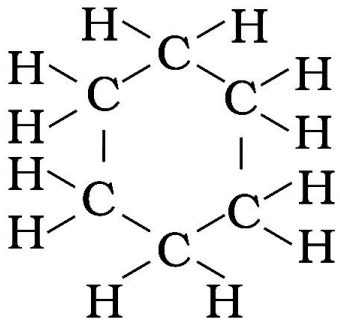
(b) sodium ethanoate and oxygen

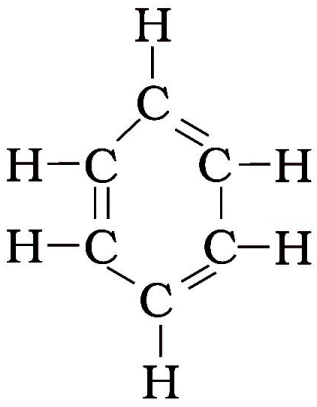
(c) sodium ethoxide and hydrogen

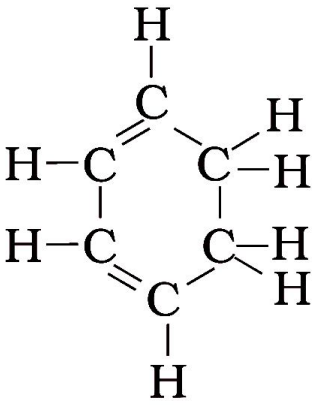
(d) sodium ethoxide and oxygen

17. Structural formula of benzene is:

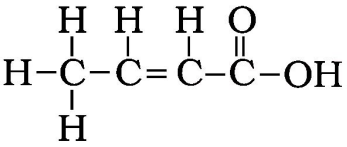
(a) 

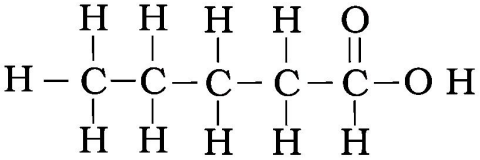
(b) 

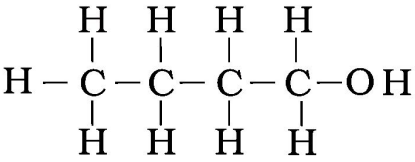
(c) 

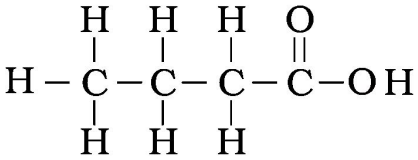
(d) 

18. The correct structural formula of butanoic acid is

(a) 

(b) 

(c) 

(d) 

19. Vinegar is a solution of

(a) 50% – 60% acetic acid in alcohol

(b) 5% – 8% acetic acid in alcohol

(c) 5% – 8% acetic acid in water

(d) 50% – 60% acetic acid in water

20. Mineral acids are stronger acids than carboxylic acids because

(i) mineral acids are completely ionised

(ii) carboxylic acids are completely ionised

(iii) mineral acids are partially ionised

(iv) carboxylic acids are partially ionised

(a) (i) and (iv) (b) (ii) and (iii) (c) (i) and (ii) (d) (iii) and (iv)

21. Carbon forms four covalent bonds by sharing its four valence electrons with four univalent atoms, e.g. hydrogen. After the formation of four bonds, carbon attains the electronic configuration of

(a) helium

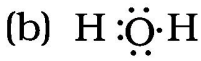
(b) neon

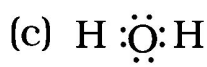
(c) argon

(d) krypton

22. The correct electron dot structure of a water molecule is

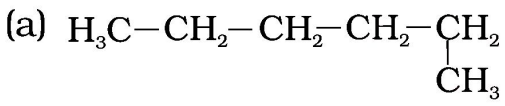
(a) 

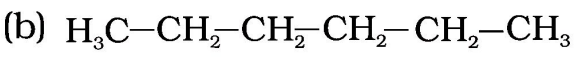
(b) 

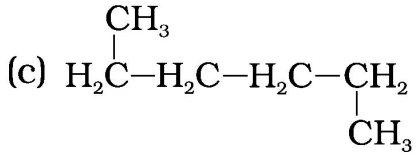
(c) 

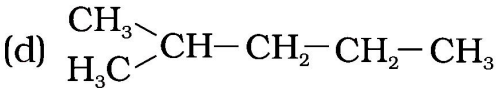
(d) 

23. Which of the following is not a straight chain hydrocarbon?

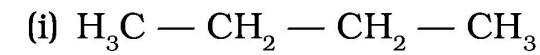
(a) 

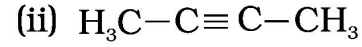
(b) 

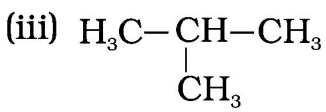
(c) 

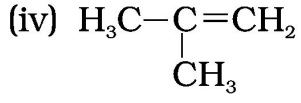
(d) 

24. Which among the following are unsaturated hydrocarbons?

(i) 

(ii) 

(iii) 

(iv) 

(a) (i) and (iii) (b) (ii) and (iii)

(c) (ii) and (iv) (d) (iii) and (iv)

25. Which of the following does not belong to the same homologous series?

(a) CH_4 (b) C_2H_6

(c) C_3H_8 (d) C_4H_8

26. The name of the compound $CH_3 — CH_2 — CHO$ is

(a) Propanal

(b) Propanone

(c) Ethanol

(d) Ethanal

27. The heteroatoms present in $CH_3 — CH_2 — O — CH_2— CH_2Cl$ are

(i) oxygen

(ii) carbon

(iii) hydrogen

(iv) chlorine

(a) (i) and (ii) (b) (ii) and (iii)

(c) (iii) and (iv) (d) (i) and (iv)

28. Which of the following represents saponification reaction?

(a) $CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$

(b) $CH_3COOH + C_2H_5OH \xrightarrow{H_2SO_4} CH_3\ COOC_2H_5 + H_2O$

(c) $2CH_3COOH + 2Na \rightarrow\ 2CH_3\ COONa + H_2$

(d) $CH_3COOC_2H_5 + NaOH \rightarrow CH_3\ COONa + C_2\ H_5OH$

29. The first member of alkyne homologous series is

(a) ethyne

(b) ethene

(c) propyne

(d) methane

30. Draw the electron dot structure of ethyne and also draw its structural formula

31. Why detergents are better cleansing agents than soaps? Explain.

32. Name the functional groups present in the following compounds

(a) $CH_3\ CO\ CH_2\ CH_2\ CH_2\ CH_3$

(b) $CH_3\ CH_2\ CH_2\ COOH$

(c) $CH_3\ CH_2\ CH_2\ CH_2\ CHO$

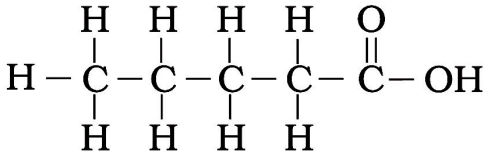
(d) $CH_3\ CH_2\ OH$

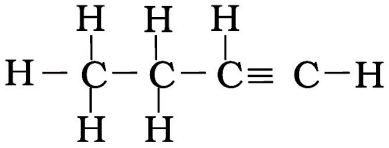
33. How is ethene prepared from ethanol? Give the reaction involved in it.

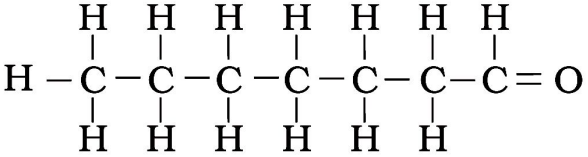
34. Intake of small quantity of methanol can be lethal. Comment.

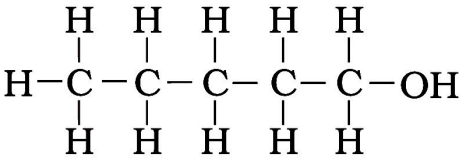
35. A gas is evolved when ethanol reacts with sodium. Name the gas evolved and also write the balanced chemical equation of the reaction involved.

36. Write the names of the following compounds

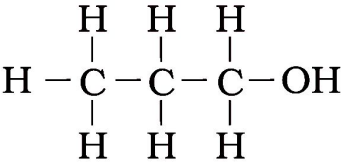
(a) 

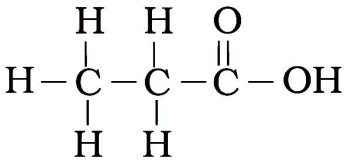
(b) 

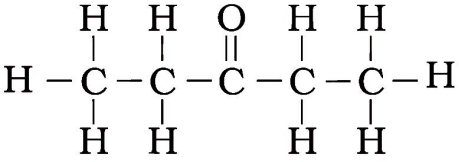
(c) 

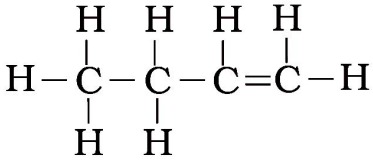
(d) 

37. Identify and name the functional groups present in the following compounds.

(a) 

(b) 

(c) 

(d) 

38. A compound X is formed by the reaction of a carboxylic acid $C_2H_4O_2$ and an alcohol in presence of a few drops of H_2SO_4. The alcohol on oxidation with alkaline $KMnO_4$ followed by acidification gives the same carboxylic acid as used in this reaction. Give the names and structures of (a) carboxylic acid, (b) alcohol and (c) the compound X. Also write the reaction.

39. Ethene is formed when ethanol at 443 K is heated with excess of concentrated sulphuric acid. What is the role of sulphuric acid in this reaction? Write the balanced chemical equation of this reaction.

40. Carbon, Group (14) element in the Periodic Table, is known to form compounds with many elements. Write an example of a compound formed with

(a) chlorine (Group 17 of Periodic Table)

(b) oxgygen (Group 16 of Periodic Table)

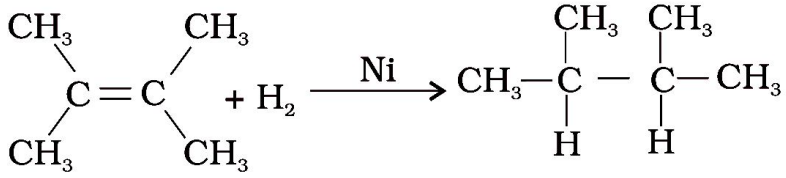
41. In electron dot structure, the valence shell electrons are represented by crosses or dots. (a) The atomic number of chlorine is 17. Write its electronic configuration (b) Draw the electron dot structure of chlorine molecule.

42. Catenation is the ability of an atom to form bonds with other atoms of the same element. It is exhibited by both carbon and silicon. Compare the ability of catenation of the two elements. Give reasons.

43. Unsaturated hydrocarbons contain multiple bonds between the two C-atoms and show addition reactions. Give the test to distinguish ethane from ethene.

44. Write the structural formulae of all the isomers of hexane.

45. What is the role of metal or reagents written on arrows in the given chemical reactions?

(a) 

(b) $CH_3\,COOH + CH_3\,CH_2\,OH \xrightarrow{\text{Conc. } H_2SO_4} CH_3\,COOC_2\,H_5 + H_2O$

(c) $CH_3\,CH_2\,OH \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} CH_3\,COOH$

46. A salt X is formed and a gas is evolved when ethanoic acid reacts with sodium hydrogencarbonate. Name the salt X and the gas evolved. Describe an activity and draw the diagram of the apparatus to prove that the evolved gas is the one which you have named. Also, write chemical equation of the reaction involved.

47. What are hydrocarbons? Give examples.

48. Give the structural differences between saturated and unsaturated hydrocarbons with two examples each.

49. What is a functional group? Give examples of four different functional groups.

50. Name the reaction which is commonly used in the conversion of vegetable oils to fats. Explain the reaction involved in detail.

51. Write the formula and draw electron dot structure of carbon tetrachloride.

52. What is saponification? Write the reaction involved in this process.

53. Esters are sweet-smelling substances and are used in making perfumes. Suggest some activity and the reaction involved for the preparation of an ester with well labeled diagram.

54. A compound C (molecular formula, $C_2H_4O_2$) reacts with Na – metal to form a compound R and evolves a gas which burns with a pop sound. Compound C on treatment with an alcohol A in presence of an acid forms a sweet smelling compound S (molecular formula, $C_3H_6O_2$). On addition of NaOH to C, it also gives R and water. S on treatment with NaOH solution gives back R and A. Identify C, R, A, S and write down the reactions involved.

55. Draw the possible isomers of the compound with molecular formula C_3H_6O and also give their electron dot structures.

56. How would you bring about the following conversions? Name the process and write the reaction involved.

(a) ethanol to ethene.

(b) propanol to propanoic acid.

Write the reactions.

57. Explain the given reactions with the examples

(a) Hydrogenation reaction

(b) Oxidation reaction

(c) Substitution reaction

(d) Saponification reaction

(e) Combustion reaction

58. An organic compound A on heating with concentrated H_2SO_4 forms a compound B which on addition of one mole of hydrogen in presence of Ni forms a compound C. One mole of compound C on combustion forms two moles of CO_2 and 3 moles of H_2O. Identify the compounds A, B and C and write the chemical equations of the reactions involved.

59. Define Allotropy.

60. What is vinegar ?

61. What is combustion ?

62. How can you differentiate saturated and unsaturated Hydrocarbon on the basis of burning behaviour ?

63. Give two advantages of synthetic detergents over soaps ?

64. What are substitution reactions ?

65. Differentiate between diamond and graphite.

66. Discuss the method of preparation of soap in the laboratory.

67. Write five ill effects of alcohol drinking.

68. Differentiate between ionic compounds and covalent compounds.

69. Give some important properties of ethanol (ethyl alcohol).

70. Give five main advantages of synthetic detergents over soaps.

71. Write important uses of (a) ethanol and (b) ethanoic acid.

72. What happens when ethanol reacts with (i) sodium (ii) potassium permanganate solution.

73. An organic acid 'X' is a liquid which often freezes during winter time in cold countries, has the molecular formula, $C_2H_4O_2$. On warming it with ethanol in the presence of a few drops of concentrated sulphuric acid, a compound 'Y' with a sweet smell is formed (i) Identify 'X' and 'Y'. (ii) Write a chemical equation for the reaction involved.

74. Write name of the following –

i. Alkaline earth metal belonging to the third period

ii. The alkali metal atom having largest atomic radius

iii. The halogen atom belonging to fourth period

iv. The element having lowest ionization energy

v. The element having second lowest electronegativity

75. Organic compound 'x' of molecular formula $C_2H_4O_2$ gives brisk effervescence with sodium bi carbonate . give name and molecular formula of x with balanced equation

76. Soaps are not considered as effective cleansing agent. Why?

77. How does melting and boiling points of hydrocarbon change with the increase in molecular mass ?

78. Write down the relevant chemical equation involved in decolourisation.

79. A compound X has molecular formula C3H4 one mole of X reacts with 2 moles of hydrogen to yield a compound Y deduce the structure of X and Y.

80. What is dehydration reaction? Give one example.

81. What is hydrolysis?

82. Why doesn't soap form micelles in ethanol as they form in water?

83. Three elements X,Y and Z belong to 17TH group but to 2nd 3th and 4th period respectively. Number of valance electrons in X is 7Find the number of valance electrons in X and Z.

84. What is the use of oxyacetylene flame?

85. What is observed on adding 5% solution of alkaline potassium permanganate solution drop by drop to some warm ethanol taken in testube.

86. Write the name of the compound formed during chemical reaction.

87. How would you distinguish experimentally between an alcohol and a carboxylic acid on the basis of a chemical property?

88. Why are vegetable oils healthy as compared to vegetable ghee ? how are vegetable oils converted into vegetable ghee name the process.

89. When acetic acid reacts with X, a salt is formed which on reaction with soda lime gives a gas Y. Identify X and Y

90. "Alkenes form a homologous series" Explain.

91. Why does Ethanoic acid called glacial acetic acid? (Imp.)

92. Why is the conversion of ethanol to ethanoic acid an oxidation reaction? (Imp.)

93. A mixture of ethyne and oxygen is burnt for welding. Can you tell why a mixture of ethyne and air is not used? (Imp.)

94. Why is the conversion of ethanol to ethanoic acid considered an oxidation reaction?

95. Who was the first to suggest the classification of chemical compounds into inorganic compounds and organic compounds?

96. Why are the compounds of carbon studied as a separate branch of chemistry?

97. Compounds like calcium carbide, carbon monoxide, carbon dioxide, calcium carbonate etc., are considered as inorganic compounds although they have carbon atoms in their molecule. Give reason.

98. Why compounds like B-B, Si-Si, and S-S do not exist in nature?

99. What is "Buckminster fullerene"? And why it is called so?

100. Name the first organic compound obtained from an inorganic source in the laboratory. Who synthesized it?

CHAPTER – 5

PERIODIC CLASSIFICATION OF ELEMENTS

In the beginning of 18th century Joseph Louis Proust stated that hydrogen atom is the building material and atoms of all other elements are simply due to the combination of number of hydrogen atoms. (It is to be noted that at his time the atomic weight of all elements were given as whole numbers and the atomic weight of hydrogen was taken as one.)

DOBEREINER'S TRIADS

A German chemist Johann Wolfgang Dobereiner (1829) noted that there were groups of elements with three elements known as *triads.* Elements in each group or a triad possess with similar chemical properties. Dobereiner discovered that "the relative atomic mass of the middle element in each triad was close to the average of the relative atomic masses of the other two elements". This statement is called the *Dobereiner's law of Triads.*

Dobereiner's Triads.

Group	Elements and their Atomic Mass			Arithmetic mean of Atomic mass
A	Lithium(Li)	Sodium(Na)	Potassium(K)	$\frac{7.0+39.0}{2}=23.0$
	7.0	23.0	39.0	
B	Calcium (Ca)	Strontium(Sr)	Barium(Ba)	$\frac{40.0+137.0}{2}=88.5$
	40.0	87.5	137.0	
C	Chlorine(Cl)	Bromine(Br)	Iodine(I)	$\frac{35.0+127.0}{2}=81.0$
	35.0	80.0	127.0	
	55.8	58.9	58.6	

☞ In this table, atomic mass of sodium is equal to arithmetic mean of atomic masses of lihtium and potassium. Similarly, atomic mass of strontium is equal to arithmetic mean of atomic masses of calcium and barium.

LIMITATION OF DOBEREINER'S TRIADS:

☞ All the then known elements could not be arranged in the form of triads.
☞ The law failed for very low mass or for very high mass elements. In case of F, Cl, Br, the atomic mass of Cl is not an arithmetic mean of atomic masses of F and Br.
☞ As the techniques improved for measuring atomic masses accurately, the law was unable to remain strictly valid.

NEWLANDS' LAW OF OCTAVES

Newlands law of octaves states that when elements are arranged in the ascending order of their atomic masses they fall into a pattern in which their properties repeat at regular intervals. Every eighth element starting from a given elements resembles in its properties to that of the starting element.

LIMITATION OF NEWLANDS' OCTAVES:

☞ Newlands' Octaves could be valid upto calcium only; as beyond calcium, elements do not obey the rules of Octaves.
☞ Newlands' Octaves was valid for lighter elements only.
☞ It appears that Newlands did not expect the discovery of more elements than 56 which were discovered till his time.

- More than one element had to be placed in some of the groups; in order to place the elements having similar properties in one group. But in order to do so, he also put some dissimilar elements in same group.
- Iron; which has similar property as cobalt and nickel, was placed far from them.
- Cobalt and nickel were placed in the group with chlorine and fluorine in spite of having different properties.
- In spite of above limitations; Newlands was the first scientist who arranged the elements in order of their increasing relative atomic masses.

Newlands' Arranged Elements in Octaves:

H	F	Cl	Co/Ni	Br	Pd	I	Pt/Ir
Li	Na	K	Cu	Rb	Ag	Cs	Tl
G	Mg	Ca	Zn	Sr	Cd	Ba/V	Pb
Bo	Al	Cr	Y	Ce/La	U	Ta	Th
C	Si	Ti	In	Zn	Sn	W	Hg
N	P	Mn	As	Di/Mo	Sb	Nb	Bi
O	S	Fe	Se	Ro/Ru	Te	Au	Os

INTEXT QUESTIONS PAGE NO. 81

Q1. Did Dobereiner's triads also exist in the columns of Newlands' Octaves? Compare and find out.
Ans:
Yes. Lithium, sodium and potassium; beryllium; magnesium and calcium are two triads that also exist in the columns of Newland's octaves.

Q2. What were the limitations of D bereiner's classification?
Ans:
Please see above notes

Q3. What were the limitations of Newlands' Law of Octaves?
Ans:
Please see above notes

MENDELEEV'S PERIODIC TABLE

Mendeleef arranged the elements known at that time in a chart in a systematic order in the increasing order of their atomic weights. He divided the chart into 8 vertical columns known as *groups*. Each group is divided into A, B sub groups. Each column contained elements of similar chemical properties.

The elements in the first column, for example, react with oxygen to form compounds with the general formula R_2O. For example, Li, Na and K when react with oxygen form compounds like Li_2O, Na_2O and K_2O respectively.

Elements of the second column react with oxygen to form compounds with the general formula RO. For example, Be, Mg and Ca when react with oxygen form BeO, MgO and CaO.
Mendeleef tried to explain the similarities of elements in the same group in terms of their common valency.

THE PERIODIC LAW:

Based on Mendeleeff's observations regarding the properties of elements in the periodic table, a law known as the *periodic law* of the properties of elements was proposed.

"The law states that the physical and chemical properties of the elements are a periodic function of their atomic weights."

SALIENT FEATURES AND ACHIEVEMENTS OF THE MENDELEEFF'S PERIODIC TABLE:

1. Groups and sub-groups: There are eight vertical columns in Mendeleeff's periodic table called as *groups.* They are represented by Roman numerals I to VIII. Elements present in a given vertical column (group) have similar properties. Each group is divided into two sub-group 'A' and 'B'. The elements within any sub-group resemble each other to great extent. For example, sub-group IA elements called 'alkali metals' (Li, Na, K, Rb, Cs, Fr) resemble each other very much.
2. Periods: The horizontal rows in Mendeleeff's periodic table are called *periods*. There are seven periods in the table, which are denoted by Arabic numerals 1 to 7. A period comprises the entire range of elements after which properties repeat themselves.
3. Predicting the properties of missing elements: Based on the arrangement of the elements in the table he predicted that some elements were missing and left blank spaces at the appropriate places in the table.

   Mendeleef believed that some new elements would be discovered definitely. He predicted the properties of these new additional elements in advance purely depending on his table. His predicted properties were almost the same as the observed properties of those elements after their discovery.

   He named those elements tentatively by adding the prefix '***eka***' (*eka is a Sanskrit numeral means one*) to the name of the element immediately above each empty space. The predicted the properties of elements namely eka-aluminium, eka-boron, eka-aluminium and eka-silicon were close to the observed properties of Scandium, Gallium and Germanium respectively which were discovered later.

Properties of some elements as predicted and discovered latter

Property	Eka-aluminium (Predicted)	Gallium (Actual)	Eka-silicon (Predicted)	Germanium (Actual)
Atomic Mass	68	69.7	72	72.61
Density	5.9 g/cm^3	5.94 g/cm^3	5.5 g/cm^3	5.35 g/cm^3
Melting point	Low	30.2^0C(Low)	High	947^0C(High)
Formula of chloride	$EaCl_3$	$GaCl_3$	$EsCl_4$	$GeCl_4$
Formula of oxide	Ea_2O_3	Ga_2O_3	EsO_2	GeO_2

4. Correction of atomic mass: the correct placement of elements in Mendeleeff's periodic table helped in correcting the atomic masses of some elements like, Beryllium, Indium, Gold.
   For example, At the time of Mendeleef, beryllium was given atomic weight 13.5.
   Atomic weight = equivalent weight × valency

The equivalent weight of Be was found experimentally as 4.5 and its valency was understood as 3. Therefore atomic weight of beryllium was given as 4.5 × 3 = 13.5. With this atomic weight it had to be placed in a wrong group in the table. He said that its valency should be only 2 and then its atomic weight then would be 4.5 × 2 = 9. If atomic weight of 'Be' is 9 it would fit in the second group and its properties practically are similar to Mg, Ca etc., of the second group elements. He also helped in the calculation of the correct atomic weights of 'Indium' and 'Gold' in this manner.

5. Some anomalous series of elements like 'Te' and 'I' were observed in the table. The anomalous series contained element with more atomic weight like 'Te' (127.6 u) placed before the element with less atomic weight like 'I' (126.9 u). Mendeleeff accepted minor inversions in the order of increasing atomic weight when these inversions resulted in elements being placed in the correct groups.

It was the extraordinary thinking of Mendeleeff that made the chemists to accept the periodic table and recognise Mendeleeff more than anyone else as the originator of the periodic law.

LIMITATIONS OF MENDELEEFF'S PERIODIC TABLE:

1. *Position of hydrogen:* The position of hydrogen in the table is not certain because it can be placed in group IA as well as in group VIIA as it resembles both with alkali metals of IA group and halogens of VIIA group.
2. ***Anomalous pair of elements:*** Certain elements of highest atomic mass precede those with lower atomic mass.

   For example, *tellurium* (atomic mass 127.6) precedes *iodine* (atomic mass 126.9).

   Cobalt and *nickel: argon* and *potassium* which were placed in table by deviating the basis of classification (placement in ascending order of atomic masses).

   For example, *potassium* (atomic mass 39) placed after *argon* (atomic mass 40).

   Similar situation was found in pairs of *cobalt* and *nickel* and *tellurium, iodine.*
3. *Dissimilar elements placed together:* elements with dissimilar properties were placed in same group as sub-group A and sub-group B. For example, alkali metal like Li, Na, K etc., of IA group have little resemblance with coinage metals like Cu, Ag, Au of IB group.
4. S*ome similar elements separated:* some similar elements like 'copper and mercury' and 'silicon and thalium' etc are placed in different groups of the periodic table.
5. ***Position of isotopes:*** isotopes of elements are placed in the same position in the table.

INTEXT QUESTIONS PAGE NO. 85

Q1. Use Mendeléev's Periodic Table to predict the formulae for the oxides of the following elements:

K, C, AI, Si, Ba.

Ans:

Oxygen is a member of group VIA in Mendeleef's Periodic Table. Its valency is 2. Similarly, the valencies of all the elements listed can be predicted from their respective groups. This can help in writing the formulae of their oxides.

(i) **Potassium (K)** is a member of group IA. Its valency is 1. Therefore , the formula of its oxide is K_2O .

(ii) **Carbon (C)** is a member of group IVA. Its valency is 4. Therefore, the formula of its oxide is C_2O_4 or CO_2.

(iii) **Aluminium (Al)** belongs to groups IIIA and its valency is 3. The formula of the oxide of the element is Al_2O_3.

(iv) **Silicon (Si)** is present in group IVA after carbon. Its valency is also 4. The formula of its oxide is Si_2O_4 or SiO_2.

(v) **Barium (Ba)** belongs to group IIA and the valency of the element is 2. The formula of the oxide of the element is Ba_2O_2 or BaO.

Q2. Besides gallium, which other elements have since been discovered that were left by Mendeléev in his Periodic Table? (any two)
Ans:
Scandium and germanium are the two elements that had been left by Mendeleef.

Q3. What were the criteria used by Mendeléev in creating his Periodic Table?
Ans:
The criteria used by Mendeleef were
(i) Physical and chemical properties of the elements.
(ii) Atomic masses in increasing order.

Q4. Why do you think the noble gases are placed in a separate group?
Ans:
Noble gases are also called inert gases because they have a complete octet and hence, are very stable. They do not react with other elements due to their stability. Since they all are unreactive, have complete octet and similar behaviour so they are placed in a separate group .

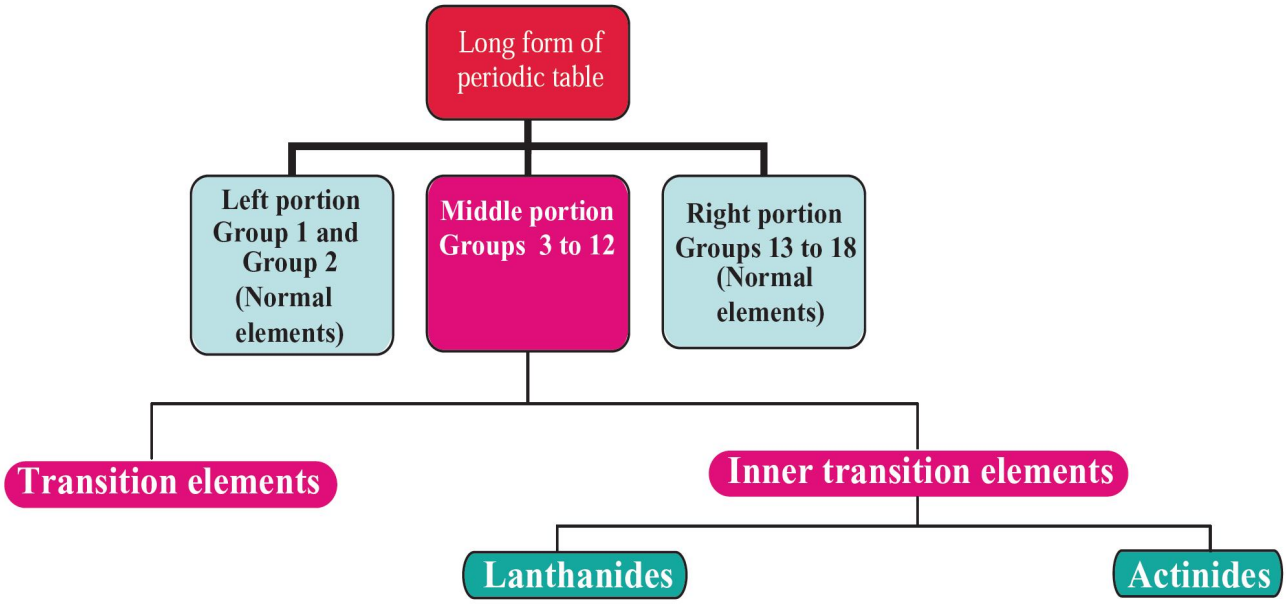
THE MODERN PERIODIC TABLE

Based on the modern periodic law, a number of forms of periodic table have been proposed from time to time but general plan of the table remained the same as proposed by Mendeleev. The table which is most commonly used and which is based upon the **electronic configuration of elements** is called the **long form of the periodic table**. This is called the **modern periodic table.**

Long form of the periodic table is a chart of elements in which the elements have been arranged in the increasing order of their atomic numbers. This table consists of **horizontal rows called periods and vertical columns called groups**.

- ☞ The modern periodic table has also been divided into four blocks known as s,p,d and f blocks.

Different portions of long form of periodic table



STUDY OF PERIODS

The **horizontal rows are called periods**. There are **seven** horizontal rows in the periodic table.

- **First period** (Atomic number 1 and 2): This is the shortest period. It contains only two elements (hydrogen and helium).
- **Second period** (Atomic number 3 to 10): This is a short period. It contains eight elements (lithium to neon).
- **Third period** (Atomic number 11 to 18): This is also a short period. It contains eight elements (sodium to argon).
- **Fourth period** (Atomic number 19 to 36): This is a long period. It contains eighteen elements (potassium to krypton). This includes 8 normal elements and 10 transition elements.
- **Fifth period** (Atomic number 37 to 54): This is also a long period. It contains 18 elements (rubidium to xenon). This includes 8 normal elements and 10 transition elements.
- **Sixth period** (Atomic number 55 to 86): This is the longest period. It contains 32 elements (ceasium to radon). This includes 8 normal elements, 10 transition elements and 14 inner transition elements (lanthanides).
- **Seventh period**(Atomic number 87 to 118): As like the sixth period, this period also can accomodate 32 elements. Till now only 26 elements have been authenticated by IUPAC.

STUDY OF GROUPS

- Vertical columns in the periodic table starting from top to bottom are called groups. There are 18 groups in the periodic table.
- First group elements are called alkali metals.
- Second group elements are called alkaline earth metals.
- Groups three to twelve are called transition elements .
- Group 1, 2 and 13 - 18 are called normal elements or main group elements or
- representative elements .
- Group 16 elements are called chalcogen family (except polonium).
- Group 17 elements are called halogen family.
- Group 18 elements are called noble gases or inert gases.

☞ The lanthanides and actinides which form part of the group 3 are called inner transition elements.

Modern Periodic Table

Metals	Metalloids	Non-metals

The zigzag line separates the metals from the non-metals.

PERIODS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H Hydrogen 1.0																	2 He Helium 4.0
2	3 Li Lithium 6.9	4 Be Beryllium 9.0											5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 19.0	10 Ne Neon 20.2
3	11 Na Sodium 23.0	12 Mg Magnesium 24.3											13 Al Aluminium 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulphur 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9
4	19 K Potassium 39.1	20 Ca Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.8	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.9	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.8
5	37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yttrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium (99)	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.3	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3
6	55 Cs Caesium 132.9	56 Ba Barium 137.3	57 La* Lanthanum 138.9	72 Hf Hafnium 178.5	73 Ta Tantalum 181.0	74 W Tungsten 183.9	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192. 2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Ti Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (210)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)	89 Ac** Actinium (227)	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	–	114 Uuq	–	Uuh	–	–

* Lanthanoides	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.5
** Actinoides	90 Th Thorium 232.0	91 Pa Protactinium (231)	92 U Uranium 238.1	93 Np Neptunium (237)	94 Pu Plutonium (242)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (245)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Femium (253)	101 Md Mendelevium (256)	102 No Nobelium (254)	103 Lr Lawerncium (257)

CHARACTERISTICS OF MODERN PERIODIC TABLE

CHARACTERISTICS OF PERIODS

In a period, the electrons are filled in the same valence shell of all elements.
As the electronic configuration changes along the period, the chemical properties of the elements also change.
Atomic size of the elements in a period decreases from left to the right.
In a period, the metallic character of the element decreases while their non-metallic character increases.

CHARACTERISTICS OF GROUPS

- The elements present in 2 and 18 groups differ in atomic number by 8,8,18,18,32.
- The elements present in 13 – 17 groups differ in atomic number by 8,18,18,32.
- The elements present in 4 – 12 groups differ in atomic number by 18,32,32.
- The elements present in a group have the same number of electrons in the valence shell of their atoms.
- The elements present in a group have the same valency.
- The elements present in a group have identical chemical properties.
- The physical properties of the elements in group such as melting point, boiling point, density vary
- gradually.
- Atomic radii of the elements present in a group increases downwards.

ADVANTAGES OF THE MODERN PERIODIC TABLE

- The table is based on a more fundamental property ie., atomic number.
- It correlates the position of the element with its electronic configuration more clearly.
- The completion of each period is more logical. In a period as the atomic number increases, the energy shells are gradually filled up until an inert gas configuration is reached.
- It is easy to remember and reproduce.
- Each group is an independent group and the idea of sub-groups has been discarded.
- One position for all isotopes of an element is justified, since the isotopes have the same atomic number.
- The position of eighth group (in Mendeleev's table) is also justified in this table. All transition elements have been brought in the middle as the properties of transition elements are intermediate between left portion and right portion elements of the periodic table.
- The table completely separates metals from non-metals. The nonmetals are present in upper right corners of the periodic table.
- The positions of certain elements which were earlier misfit (interchanged) in the Mendeleev's periodic table are now justified because it is based on atomic number of the elements.
- Justification has been offered for placing lanthanides and actinides at the bottom of the periodic table.

DEFECTS IN THE MODERN PERIODIC TABLE

- ☞ Position of hydrogen is not fixed till now.
- ☞ Position of lanthanides and actinides has not been given inside the main body of periodic table.
- ☞ It does not reflect the exact distribution of electrons of some of transition and inner transition elements.

INTEXT QUESTIONS PAGE NO. 90

Q1. How could the Modern Periodic Table remove various anomalies of Mendeléev's Periodic Table?

Ans:

1. The fundamental basis for Modern Periodic Table is atomic number and not atomic mass and hence, it is more accurate.
2. Properties of elements could be well explained when they were arranged according to their increasing atomic number in the Modern Periodic Table.
3. A separate group for noble gases could be created when noble gases were discovered.
4. Hydrogen has been given a unique position in the Modern Periodic Table at the top left corner because of its unique properties.

Q2. Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis for your choice?

Ans:

Magnesium (Mg) belongs to group 2 of Modern Periodic Table, known as alkaline earth metal family. The two other elements belonging to the same group are beryllium (Be) and calcium (Ca).

Calcium and magnesium; Beryllium and magnesium - This is because both of them have electronic configuration similar to Mg

Mg	*K*	*L*	*M*	
	2	8	**2**	
Ca	*K*	*L*	*M*	*N*
	2	8	8	**2**
Be	*K*	*L*		
	2	**2**		

These elements belong to the same group and hence, will show similar properties.

Q3. Name

(a) three elements that have a single electron in their outermost shells.

(b) two elements that have two electrons in their outermost shells.

(c) three elements with filled outermost shells.

Ans:

(a)	Li	Na	K
	2, 1	2, 8, 1	2, 8, 8,1
(b)	Mg	Ca	
	2, 8, 2	2, 8, 8, 2	
(c)	He	Ar	Ne
	2	2,8	2, 8, 8

Q4. (a) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements?

(b) Helium is an unreactive gas and neon is a gas of extremely low reactivity. What, if anything, do their atoms have in common?

Ans:

(a) Li, Na, and K have one electron in their outermost shell.

Li 2, 1 (Atomic number 3)
Na 2, 8, 1 (Atomic number 11)
K 2, 8, 8, 1 (Atomic number 19)

(b) They both have completely filled outer shell.

	K	*L*	
He	**2**		(Atomic number 2)
Ne	2	**8**	(Atomic number 10)

Q5. In the Modern Periodic Table, which are the metals among the first ten elements?

Ans:

Metals among the first ten elements are lithium and beryllium.

Q6. By considering their position in the Periodic Table, which one of the following elements would you expect to have maximum metallic characteristic?

Ga Ge As Se Be

Ans:

The position of the given elements in the Periodic Table is as.

Ga Ge As Se Br
(Most metallic) → (Least metallic)

On moving from left to right in a period, size decreases due to increase in effective nuclear charge and hence, tendency to lose electron, *i.e.*, metallic character decreases. Thus Ga has maximum metallic characteristic or metallic nature.

EXERCISE QUESTIONS PAGE NO. 91 and 92

Q1. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic Table.

(a) The elements become less metallic in nature.
(b) The number of valence electrons increases.
(c) The atoms lose their electrons more easily.
(d) The oxides become more acidic.

Ans:

(c) On moving from left to right, the atomic number increases and hence, the nuclear charge increases. With the increase of nuclear charge, the force binding the electron increases so the atom lose the electrons with more difficulty, not easily.

Q2. Element X forms a chloride with the formula XCl2, which is a solid with a high melting point. X would most likely be in the same group of the Periodic Table as

(a) Na (b) Mg (c) AI (d) Si

Ans:

(b) The formula of chloride is XCl_2 that means the valency of the element X is 2. The element having valency 2 will present in group 2. Out of given choices magnesium (Mg) belongs to group 2.

Q3. Which element has
(a) two shells, both of which are completely filled with electrons?
(b) the electronic configuration 2, 8, 2?
(c) a total of three shells, with four electrons in its valence shell?
(d) a total of two shells, with three electrons in its valence shell?
(e) twice as many electrons in its second shell as in its first shell?
Ans:
(a) Noble gases are the elements which have completely filled shells. The noble gas with two shells is Ne having atomic number 10 and electronic configuration 2, 8 both of which are completely filled.

(b) Electronic configuration 2, 8, 2 suggests that atomic number is 12 (2 + 8 + 2), magnesium (Mg) has atomic number 12.
(c) The element with three shells and form electrons in the valence shell will have electronic configuration 2, 8, 4. The atomic number of this element is 14 (2 + 8 + 4) so it will belong to group 14 hence, it is silicon (Si).

(d) Element with two shells with 3 electrons in the valence shell will exist in second period and will have the electronic configuration 2,3. The atomic number of this element will be 5 (2 + 3). So, it will be bron (B).

(e) The element has two shells. we know that first shell can have only 2 electrons, so according to the question there will be 4 electrons (double the number of electrons in first shell). The electronic configuration will be 2, 4 , so the atomic number is 6. Hence, the element is carbon (C).

Q4. (a) What property do all elements in the same column of the Periodic Table as boron have in common?
(b) What property do all elements in the same column of the Periodic Table as fluorine have in common?
Ans:
(a) All elements of 13th group, in which boron is present, have 3 electrons in their valence shell (2, 8, 3).
(b) Fluorine belongs to 17th group. All elements of this group have 7 electrons in their valence shell (2, 8, 7). They all show a valency of 1 in their compounds.

Q5. An atom has electronic configuration 2, 8, 7.
(a) What is the atomic number of this element?
(b) To which of the following elements would it be chemically similar? (Atomic numbers are given in parentheses.) N(7) F(9) P(15) Ar(18)
Ans:
(a) Atomic number of atom = 2 + 8 + 7 =17
(b) It will be similar to fluorine which is also having 7 electrons in its valence shell [F (2, 7)].

Q6. The position of three elements A, B and C in the Periodic Table are shown below –

Group 16	*Group 17*
---	---
---	**A**
---	---
B	**C**

(a) State whether A is a metal or non-metal.
(b) State whether C is more reactive or less reactive than A.
(c) Will C be larger or smaller in size than B?

(d) Which type of ion, cation or anion, will be formed by element A?
Ans:
(a) Since, *A* belongs to group 1 valence electrons so it is a non-metal because it will gain electron to complete its octet.

(b) *C* lies below *A* and in the same group. As we move down in a group, the size increases and electronegative character decreases. With the increase in electronegative character, the electron adapting tendency and hence the reactivities decrease so, *C* is less reactive than *A*.

(c) *C* is smaller than *B* in size because as we move left to right in a period atomic size decreases.

(d) As discussed in part (a) that element *A* has a tendency to gain electron to complete its octet. It needs to take up one electron, so it will form anion (A^-).

Q7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the Periodic Table. Write the electronic configuration of these two elements. Which of these will be more electronegative? Why?
Ans:
(a) Electronic configuration of nitrogen and phosphorus:

	K	*L*	*M*
N	2,	5	
P	2,	8,	5

(b) N will be more electronegative than P as electronegativity decreases on going down a group in case of non-metals.

Q8. How does the electronic configuration of an atom relate to its position in the Modern Periodic Table?
Ans:
The number of valence electrons in an atom of an element tells us the group number. *e.g.,* Na has atomic number 11

Electronic configuration of Na (11) =	*K*	*L*	*M*
	2	8	1

It has one electron in its last shell, thus it belongs to group I of the Periodic Table.
The number of shells in its electronic configuration tells the period number *e.g.,* Na shows 3 shells *K, L, M* so it belongs to 3rd period of the Periodic Table.

Q9. In the Modern Periodic Table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium?
Ans:

At. no. of element	Electronic configuration
	K L M N O
12	2 8 **2**
19	2 8 8 1
21	2 8 8 3
38	2 8 18 8 **2**

From the electronic configuration written above we can see that element with atomic number 12 and 38 have 2 electrons in their last shell like calcium. So, they will resemble Ca in their physical and chemical properties.

Q10. Compare and contrast the arrangement of elements in Mendeléev's Periodic Table and the Modern Periodic Table.

Ans:

Mendeleev's periodic table	Modern periodic table
1. Elements are arranged in the increasing order of their atomic masses.	**1.** Elements are arranged in the increasing order of their atomic numbers.
2. There are a total of 7 groups (columns) and 6 periods (rows).	**2.** There are a total of 18 groups (columns) and 7 periods (rows).
3. Elements having similar properties were placed directly under one another.	**3.** Elements having the same valence shell are present in the same period while elements having the same number of valence electrons are present in the same group.
4. The position of hydrogen could not be explained.	**4.** Hydrogen is placed above alkali metals.
5. No distinguishing positions for metals and non-metals.	**5.** Metals are present at the left hand side of the periodic table whereas non-metals are present at the right hand side.

ASSIGNMENT QUESTIONS SET – 1
CHAPTER – 5
PERIODIC CLASSIFICATION OF ELEMENTS

1. The property of an element in the periodic table depends on its, _____.

i) atomic size

ii) atomic mass

iii) electronic configuration

iv) number of protons

2. An element has configuration 2, 8, 1. It belongs to, _____.

i). 1 group and 3rd period

ii). 3 group and 1st period

iii). 1 group and 8th period

iv). 17 group and 3rd period

3. The number of electrons in the valence shell is equal to its _____.

i). atomic mass

ii). group number

iii). period number

iv). atomic volume

4. The non-metallic element present in the third period other than sulphur and chlorine is

i). oxygen

ii). fluorine

iii). nitrogen

iv). phosphorus

5. At the end of each period the valence shell is _____.

i). incomplete

ii). half filled

iii). singly occupied

iv). completely filled

6. The family of elements having seven electrons in the outermost shell is _____.

i). alkali metals

ii). alkaline earth metals

iii). halogens

iv). noble gases

7. Which of the following factors does not affect the metallic character of an element?

i). Atomic size

ii). Ionisation potential

iii). Electronegativity

iv). Atomic radius

8. The family of elements to which potassium belongs is _____.

i). alkali metals

ii). alkaline earth metals

iii). halogens

iv). noble gases

9. The modern periodic table is given by _____

i). Mendeleev

ii). Einstein

iii). Bohr

iv). Mosley

10. Elements belonging to groups 1 to 17 are called _____.

i). noble gases

ii). normal elements

iii). transition elements

iv). inner transition elements

11. A liquid non-metal is _____.

i). phosphorous

ii). mercury

iii). bromine

iv). nitrogen

12. The first alkali metal is _____.

i). hydrogen

ii). lithium

iii). sodium

iv). francium

13. A purple coloured solid halogen is _____.

i). chlorine

ii). bromine

iii). iodine

iv). astatine

14. Lanthanides and actinides are also called _____.

i). normal elements

ii). transition elements

iii). noble gases

iv). inner transition elements

15. The family of elements to which calcium belongs is _____.

i). alkali metals

ii). alkaline earth metals

iii). halogens

iv). noble gases

16. The least reactive element in group 17 is _____.

i). fluorine

ii). chlorine

iii). bromine

iv). iodine

17. The valency of chlorine with respect to oxygen is _____.

i). 1

ii). 3

iii). 5

iv). 7

18. The number of shells in the elements of 3rd period is _____.

i). 1

ii). 2

iii). 3

iv). 0

19. Four elements along a period have atomic number (11, 13, 16 and 17). The most metallic among these has an atomic number of _____.

i). 11

ii). 12

iii). 16

iv). 17

20. Six elements A, B, C, D, E and F have the following atomic numbers (A = 12, B = 17, C = 18, D = 7, E = 9 and F = 11). Among these elements, the element, which belongs to the 3rd period and has the highest ionisation potential, is _____.

i). A

ii). B

iii). C

iv). F

21. A factor that affects the ionisation potential of an element is _____.

i). atomic size

ii). electron affinity

iii). electro-negativity

iv). neutrons

22. The element, which has the highest electron affinity in the 3rd period is _____.

i). Na

ii). Mg

iii). Si

iv). Cl

23. The element, which has zero electron affinity in the 3rd period is _____.

i). Al

ii). P

iii). Ar

iv). S

24. The statement that is not true about electron affinity is

i). It causes energy to be released

ii). It causes energy to be absorbed

iii). It is expressed in electron volts

iv). It involves formation of an anion

25. Down a group, the electron affinity _____.

i). increases

ii). decreases

iii). remains same

iv). increases and then decreases

26. Name an element with five electrons in the outer shell.

27. Name an element which tends to lose two electrons.

28. Name an element that would tend to gain two electrons.

29. Name the group having a non metal liquid as well as non metal gas at room temperature.

30. Name the group having element with zero valency.

31. Name the metalloid present in group 14.

32. What is the name given to group of three similar elements by Dobereiner?

33. State "Newlands law of Octaves" for classification of elements.

34. Name the fundamental property used by Mendeleev as the basis of classification.

35. How many groups and periods are there in the Modern periodic table?

36. What was the prediction of Mendeleev regarding the gaps in his periodic table?

37. How is valence of an element determined?

38. What will be the valence of an element having atomic number 16?

39. How does valence vary in going down a group?

40. Why inert gases have zero valences?

41. What would be the valence of an atom containing 8 electrons in its outermost shell?

42. How does the electronegative character of elements vary along a period of the periodic table?

43. The present classification of elements is based on which fundamental property of elements?

44. Among first ten elements in the modern periodic table name the metals present.

45. Metals are on which side of Modern periodic table?

46. State Mendeleev's periodic law.

47. Name two elements, other than Gallium, whose existence was predicted by Mendeleev.

48. State Modern Periodic law.

49. Write the name given to the vertical columns in a periodic table.

50. What name is given to the horizontal rows in a periodic table?

51. Why does silicon is classified as Metalloid?

52. State two limitations of Newland's law of Octaves.

53. Name the scientist who proposed modern periodic law? On which fundamental property of elements it is based?

54. Why could no fixed position be given to hydrogen in Mendeleev's Periodic table?

55. What are metalloids? Give two examples.

56. In group 1 of periodic table three elements X, Y and Z have atomic radii 133 pm , 95pm and 65pm respectively giving a reason, arrange them in the increasing order of their atomic number in the group.

57. In modern periodic table, the isotopes of Chlorine Cl-35 and Cl-37 having different atomic masses will be kept in different slots or they would be assigned same position on the basis of their chemical properties? Give reason in support of your answer.

58. Nitrogen (At no. 7) and Phosphorus (At no. 15) belong to group 15 of the periodic table:-

(i) Write the electronic configuration of the two.

(ii) Predict whether they are metallic or nonmetallic in nature.

59. How and why does the atomic size vary as you go down a group?

60. Why was Dobereiner system of classification of elements into triads not found to be useful?

61. State three merits of Modern periodic table.

62. What are amphoteric oxides? Choose the amphoteric oxide from among the following oxides :– Na_2O, ZnO, Al_2O_3, CO_2, H_2O

63. Study the variation in the atomic radii of first group elements given below and arrange them in increasing order :–

Group I element	Na	Li	Rb	Cs	K
Atomic Radii P.M		86	152	244	262	231

64. An element X has the electronic configuration as 2, 8, 7 :–

(a) What is the atomic number of the element?

(b) What will be the formula of its compound formed with Na?

(c) What is the name given to the family of this element?

65. How do you calculate the valence of the element from its electronic configuration? What is the valence of Mg with atomic number 12 and sulphur with atomic number 16? How does the valence vary in going down in a group?

66. Atomic radii of the elements of the period II are as follows:–

Period II elements :		Be	B	O	N	C	Li
Atomic Radius :	111	88	66	74	77	152	

(i) Arrange them in decreasing order of their atomic radii.

(ii) How does the atomic size vary on moving from left to right in a period? Explain why?

(iii) How will the tendency to lose electrons will vary on moving from left to right in this period II?

67. Oxygen (O, 8) and sulphur (S, 16) belong to group 16 of the periodic table:-

(i) Write the electronic configuration and valence of these two elements?

(ii) Which among these will be more electronegative? Why?

68. Two elements 'A' and 'B' belong to group 1 and 2 respectively in the same period. Compare them with respect to :–

(a) Number of valence electrons. (b) Valency

(c) Metallic character (d) Size of atom

(e) Formulae of their oxides.

69. What is periodicity?

70. Who showed for the first time that there is periodicity in properties of elements?

71. Are the properties of elements placed in a group same?

72. Give reason for the need of classification of elements.

73. Hydrogen can be placed in group 1 and group 7 of periodic table. Why?

74. Name two elements whose properties were correctly predicted by Mendeleev. Mention their present day name.

75. State Mendeleev's periodic law. Why did he leave gaps in his periodic table?

76. An element Z is of second group of the periodic table. Write the formula of its oxide.

77. Noble gases did not find a place in Newland's Octaves. Explain.

78. Give formula for the following:

(i) bromide of element X of second group.

(ii) oxide of element Y of third group.

(iii) chloride of element Z of fourth group.

79. How many elements are present in (i) Second period (ii) Six period

80. Name (i) A Non metal solid at room temperature (ii) A Metal liquid at room temperature

81. Arrange the following elements in the decreasing order of metallic character.

(i) Si, Be, Mg, Na, P

(ii) B, Al, Mg, K

82. How in modern periodic table position of elements in groups and periods is decided?

83. Why metallic character decreases across a period and increases down a group?

84. Among the elements of second period 'Li' to 'Ne' pick out the element.

(i) with the largest atomic radius

(ii) that is the most reactive non metal

(iii) that is the most reactive metal

(iv) which is a metalloid.

85. Elements A, B, C, D, E have following electronic configurations-

A: 2,3

B: 2,8,3

C: 2,8,5

D: 2,8,7

E: 2,8,8,2

(i) Which of these belong to same group?

(ii) Which of these belong to same period?

ASSIGNMENT QUESTIONS SET – 2
CHAPTER – 5
PERIODIC CLASSIFICATION OF ELEMENTS

1. Upto which element, the Law of Octaves was found to be applicable

(a) Oxygen

(b) Calcium

(c) Cobalt

(d) Potassium

2. According to Mendeleev's Periodic Law, the elements were arranged in the periodic table in the order of

(a) increasing atomic number

(b) decreasing atomic number

(c) increasing atomic masses

(d) decreasing atomic masses

3. In Mendeleev ’s Periodic Table, gaps were left for the elements to be discovered later. Which of the following elements found a place in the perioidc table later

(a) Germanium

(b) Chlorine

(c) Oxygen

(d) Silicon

4. Which of the following statement (s) about the Modern Periodic Table are incorrect

(i) The elements in the Modern Periodic Table are arranged on the basis of their decreasing atomic number

(ii) The elements in the Modern Periodic Table are arranged on the basis of their increasing atomic masses

(iii) Isotopes are placed in adjoining group (s) in the Periodic Table

(iv) The elements in the Modern Periodic Table are arranged on the basis of their increasing atomic number

(a) (i) only (b) (i), (ii) and (iii)

(c) (i), (ii) and (iv) (d) (iv) only

5. Which of the following statements about the Modern Periodic Table is correct:

(a) It has 18 horizontal rows known as Periods

(b) It has 7 vertical columns known as Periods

(c) It has 18 vertical columns known as Groups

(d) It has 7 horizontal rows known as Groups

6. Which of the given elements A, B, C, D and E with atomic number 2, 3, 7, 10 and 30 respectively belong to the same period?

(a) A, B, C

(b) B, C, D

(c) A, D, E

(d) B, D, E

7. The elements A, B, C, D and E have atomic number 9, 11, 17, 12 and 13 respectively. Which pair of elements belong to the same group?

(a) A and B

(b) B and D

(c) A and C

(d) D and E

8. Where would you locate the element with electronic configuration 2,8 in the Modern Periodic Table?

(a) Group 8

(b) Group 2

(c) Group 18

(d) Group 10

9. An element which is an essential constituent of all organic compounds belongs to

(a) group 1

(b) group 14

(c) group 15

(d) group 16

10. Which of the following is the outermost shell for elements of period 2?

(a) K shell

(b) L shell

(c) M shell

(d) N shell

11. Which one of the following elements exhibit maximum number of valence electrons?

(a) Na (b) Al

(c) Si (d) P

12. Which of the following gives the correct increasing order of the atomic radii of O, F and N ?

(a) O, F, N (b) N, F, O

(c) O, N, F (d) F, O, N

13. Which among the following elements has the largest atomic radii?

(a) Na

(b) Mg

(c) K

(d) Ca

14. Which of the following elements would lose an electron easily?

(a) Mg

(b) Na

(c) K

(d) Ca

15. Which of the following elements does not lose an electron easily?

(a) Na (b) F

(c) Mg (d) Al

16. Which of the following are the characteristics of isotopes of an element?

(i) Isotopes of an element have same atomic masses

(ii) Isotopes of an element have same atomic number

(iii) Isotopes of an element show same physical properties

(iv) Isotopes of an element show same chemical properties

(a) (i), (iii) and (iv) (b) (ii), (iii) and (iv)

(c) (ii) and (iii) (d) (ii) and (iv)

17. Arrange the following elements in the order of their decreasing metallic character

Na, Si, Cl, Mg, Al

(a) Cl > Si >Al > Mg >Na

(b) Na >Mg >Al >Si > Cl

(c) Na > Al > Mg > Cl > Si

(d) Al > Na> Si > Ca> Mg

18. Arrange the following elements in the order of their increasing nonmetallic character

Li, O, C, Be, F

(a) F < O < C < Be < Li

(b) Li < Be < C < O< F

(c) F < O < C < Be < Li

(d) F < O < Be < C < Li

19. What type of oxide would Eka– aluminium form?

(a) EO_3 (b) E_3O_2

(c) E_2O_3 (d) EO

20. Three elements B, Si and Ge are

(a) metals (b) non-metals

(c) metalloids (d) metal, non-metal and metalloid respectively

21. Which of the following elements will form an acidic oxide?

(a) An element with atomic number 7

(b) An element with atomic number 3

(c) An element with atomic number 12

(d) An element with atomic number 19

22. The element with atomic number 14 is hard and forms acidic oxide and a covalent halide. To which of the following categories does the element belong?

(a) Metal (b) Metalloid

(c) Non-metal (d) Left-hand side element

23. Which one of the following does not increase while moving down the group of the periodic table?

(a) Atomic radius

(b) Metallic character

(c) Valence

(d) Number of shells in an element

24. On moving from left to right in a period in the periodic table, the size of the atom.

(a) increases (b) decreases

(c) does not change appreciably (d) first decreases and then increases

25. Which of the following set of elements is written in order of their increasing metallic character?

(a) Be Mg Ca

(b) Na Li K

(c) Mg Al Si

(d) C O N

26. The three elements A, B and C with similar properties have atomic masses X, Y and Z respectively. The mass of Y is approximately equal to the average mass of X and Z. What is such an arrangement of elements called as? Give one example of such a set of elements.

27. Elements have been arranged in the following sequence on the basis of their increasing atomic masses.

F, Na, Mg, Al, Si, P, S, Cl, Ar, K

(a) Pick two sets of elements which have similar properties.

(b) The given sequence represents which law of classification of elements?

28. Can the following groups of elements be classified as Dobereiner's triad ?

(a) Na, Si, Cl (b) Be, Mg, Ca

Atomic mass of Be 9; Na 23; Mg 24; Si 28; Cl 35; Ca 40

Explain by giving reason.

29. In Mendeleev 's Periodic Table the elements were arranged in the increasing order of their atomic masses. However, cobalt with atomic mass of 58.93 amu was placed before nickel having an atomic mass of 58.71 amu. Give reason for the same.

30. "Hydrogen occupies a unique position in Modern Periodic Table". Justify the statement.

31. Write the formulae of chlorides of Eka-silicon and Eka-aluminium, the elements predicted by Mendeleev.

32. Three elements A, B and C have 3, 4 and 2 electrons respectively in their outermost shell. Give the group number to which they belong in the Modern Periodic Table. Also, give their valencies.

33. If an element X is placed in group 14, what will be the formula and the nature of bonding of its chloride?

34. Compare the radii of two species X and Y. Give reasons for your answer.

(a) X has 12 protons and 12 electrons

(b) Y has 12 protons and 10 electrons

35. Arrange the following elements in increasing order of their atomic radii.

(a) Li, Be, F, N (b) Cl, At, Br I

36. Identify and name the metals out of the following elements whose electronic configurations are given below.

(a) 2, 8, 2 (b) 2, 8, 1

(c) 2, 8, 7 (d) 2, 1

37. Write the formula of the product formed when the element A (atomic number 19) combines with the element B (atomic number 17). Draw its electronic dot structure. What is the nature of the bond formed?

38. Arrange the following elements in the increasing order of their metallic character

Mg, Ca, K, Ge, Ga

39. Identify the elements with the following property and arrange them in increasing order of their reactivity

(a) An element which is a soft and reactive metal

(b) The metal which is an important constituent of limestone

(c) The metal which exists in liquid state at room temperature

40. Properties of the elements are given below. Where would you locate the following elements in the periodic table?

(a) A soft metal stored under kerosene

(b) An element with variable (more than one) valency stored under water.

(c) An element which is tetravalent and forms the basis of organic chemistry

(d) An element which is an inert gas with atomic number 2

(e) An element whose thin oxide layer is used to make other elements corrosion resistant by the process of " anodising"

41. An element is placed in 2nd Group and 3rd Period of the Periodic Table, burns in presence of oxygen to form a basic oxide.

(a) Identify the element

(b) Write the electronic configuration

(c) Write the balanced equation when it burns in the presence of air

(d) Write a balanced equation when this oxide is dissolved in water

(e) Draw the electron dot structure for the formation of this oxide

42. An element X (atomic number 17) reacts with an element Y (atomic number 20) to form a divalent halide.

(a) Where in the periodic table are elements X and Y placed?

(b) Classify X and Y as metal (s), non-metal (s) or metalloid (s)

(c) What will be the nature of oxide of element Y? Identify the nature of bonding in the compound formed

(d) Draw the electron dot structure of the divalent halide

43. Atomic number of a few elements are given below 10, 20, 7, 14

(a) Identify the elements

(b) Identify the Group number of these elements in the Periodic Table

(c) Identify the Periods of these elements in the Periodic Table

(d) What would be the electronic configuration for each of these elements?

(e) Determine the valency of these elements

44. In which form matter is present around us?

45. At present, how many elements are known to us?

46. The earliest attempt in classifying elements resulted in the formation of two groups of elements. What are they?

47. Who made the first attempt of classifying elements?

48. On what basis Dobereiner classified elements?

49. Dobereiner classified elements into how many groups?

50. What name was given to Dobereiner groups?

51. What is the total number of elements in Dobereiner groups?

52. How did John Newlands classify elements?

53. Name the first element of Newland's octaves.

54. Name the last element of Newland's octaves.

55. What is your observation from Newland's octaves?

56. What is Newland's Law of octaves?

57. Besides atomic masses, on what other basis were the elements arranged in the Mendleev's periodic table?

58. Which chemical property of an element was treated as one of the basic property for classifying elements and why?

59. What name is given to vertical columns in Mendleev's periodic table?

60. What name is given to horizontal rows in Mendleev's periodic table?

61. While developing the Periodic table, at few places Mendleev inverted the sequence of some elements i.e. he placed an element with slightly greater atomic mass before the element of lower atomic mass. Why did he do so?

62. Though the atomic mass of cobalt (58.9) is greater than nickel (58.7) yet Co is placed before Ni in Mendleev's periodic table. Why?

63. Which elements did not exist at the time of Mendleev's periodic classification? What name was given to these elements?

64. In what way hydrogen resembles alkali metals?

65. In what way hydrogen resembles halogens?

66. Why hydrogen cannot be given a fixed position in periodic table?

67. What is the first limitation of Mendleev's periodic table?

68. How isotopes of all the elements posed a challenge to Mendleev's periodic table?

69. Who proposed that atomic number is the more fundamental property for classifying elements?

70. In Modern periodic table, How do elements belonging to the same group resemble each other? Write two points.

71. Different elements have same number of shells, in group or in period?

72. First period of the Modern periodic table contains only two elements. Justify.

73. How many elements are present in second group of the periodic table? Justify.

74. "The valence electrons determine the kind and number of bonds formed by an element". Justify.

75. An element belongs to the first group and third period of the periodic table. What conclusion can you draw from its position ?

76. A metal M forms an oxide having the formula M2O3. It belongs to the third period and thirteenth group of the Modern periodic table. Write the atomic number and valency of the element.

77. What were the two major shortcomings of Mendleev's periodic table? How have these been removed in the modern periodic table?

78. Two elements X and Y have atomic numbers 12 and 16 respectively. Write the electronic configuration for these elements. To which period of the modern periodic table do these two elements belong? What type of bond will be formed between them and Why?

79. What were the two achievements of Mendleev's periodic table? What was the basis of classification of elements in it?

80. Atomic radius decreases in moving from left to right in a period. Why?

81. Atomic radius increases down the group. Why?

82. In the modern periodic table a zig-zag line separates metals from non-metals. What are these elements called and why?

83. X, Y and Z are the elements of a doberniers triad. If the atomic mass of X is 7and that of z is 39, what should be the atomic mass of Y?

84. A and B are the two elements having similar properties which obey Newlands law of octaves. How many elements are there in between A and B?

85. Why Na is greater in atomic size than Na+ ?

86. Why does ionization energy generally decrease going down a group or family?

87. An element X (2,8,2) combines separately with NO_3^- and $(SO4)^{2-}$, $(PO4)^{3-}$ radicals. Write the formulae of the three compounds so formed. To which group of the periodic table does the element 'X' belong? Will it form covalent or ionic compound? Why?

88. A metal M forms an oxide having the formula M_2O_3. It belongs to 3rd period in the modern periodic table. Write the atomic number and valency of the metal.

89. Which of the two elements A=2,8,1 B = 2,8,8,1 i s more electropositive?

90. How does the atomic size vary in going from A) Left to right in a period B) Top to Bottom in a group

91. An element has atomic number 13. In which group and period it should be placed?

92. How many periods and groups are there in the long from of P.T?

93. Why does the size of the atoms progressively become smaller when we move from sodium (Na) to chlorine (Cl) in the third period of the period table ?

94. Give symbols for A. A metal of group 2. B. A metal of group 13. C. Two non metals of group 16. D. Most reactive non- metal of group 17.

95. Explain Why-

(a) All the elements of a group have similar chemical properties.

(b) All the elements in a period have different chemical properties.

96. The atomic number of an element X is 17. Predict –

A. Its valency.

B. Nature of the elements.

C. Whether it is metal or non – metal.

D. Name of the element.

E. Relative size with respect to other members of its group.

97. The three elements predicted by mendeleev from the gaps in his periodic table were known as eka- boron, eka- aluminum, eka- silicon. What names were given to these elements when they were discovered later on?

98. The atomic numbers of Nitrogen, Oxygen and fluorine are 7, 8, and 9 respectively. Write the electronic configuration of each element and answer the following:

(a) Out of N, O and F which is most electronegative and which one is least electronegative?

(b) What is the number of valence electrons of F?

(c) What is the valency of each of N, O and F?