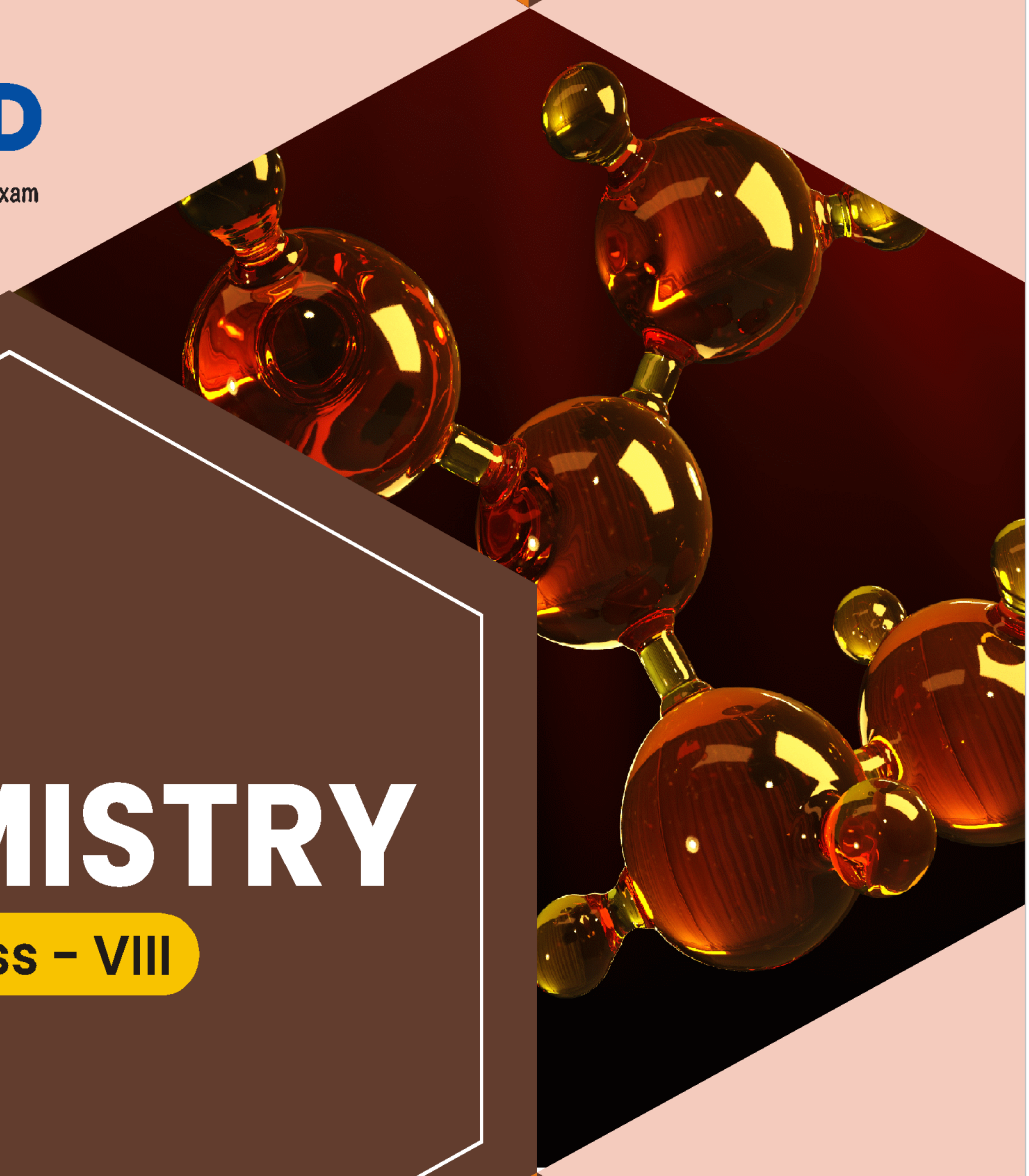
MATRIX OLYMPIAD

The Most Innovative Talent Recognition Exam



CHEMISTRY

Class - VIII

MATRIX

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Few words for the Readers

Dear Reader,

"*Matrix Olympiad is established to encourage school students to go a step further than their regular studies, and get a chance and exposure to competition on a wide scale. It also helps students enhance their learning of basic cognitive skills and deeper knowledge of subjects like Science, Mathematics, English, Mental Ability, Social Studies. "Matrix Olympiad helps students nurture their minds for higher targets of tomorrow and enables them to study School for JEE, NEET, CLAT, NDA, Olympiads , NSEJS, NTSE , STSE etc.*"

The above thought has been our guiding principle while designing and collating the study material for **Matrix Olympiad** . And hence, we hope that this particular material will be helpful towards your preparation for **Matrix Olympiad**.

Our team at **MATRIX** has put in their best efforts for making this particular module interesting and relevant for you. Additional efforts have been made to ensure that the content is easy to understand and error free to the extent possible. However, there might remain some inadvertent errors in answer keys and theoretical portion and we would welcome your valuable feedback regarding the same.
If there are any suggestions for corrections, please write to us at **smd@matrixacademy.co.in** and we would be highly grateful.

Finally, we would like to end this message by a famous quote by Ernest Hemingway - "*There is no friend as loyal as a book.*" So, please give your study material the time and attention it deserves, and it will surely help you reach newer heights in your fight with competition examinations.

With love and best wishes !
Team MATRIX

CONTENTS

SYNTHETIC FIBRES AND PLASTICS

1. INTRODUCTION

In order to fulfil his needs, man has been able to develop new materials from the materials already existing. This has become possible through the scientific knowledge and development of technology that has been achieved over the years. Scarcity and drawbacks of traditional natural materials has spurred development of new man made materials.

2. POLYMER & POLYMERISATION

Polymer : A polymer is a compound of high molecular mass formed by combination of a large number of small molecules.

Monomer : The small molecules which constitute the repeating units in a polymer are called monomer units.

Polymerisation : The process by which monomers are transformed into a polymer is called polymerisation.

$$n(\text{monomer}) \xrightarrow{\text{Polymerisation}} \underbrace{(\text{monomer})_n}_{\text{polymer}}$$

$\therefore$ where 'n' is a integer.

Types of polymers

- Synthetic Polymers — Eg. PP, PVC
- Natural Polymers — Eg. Cellulose, Protein

In this section, we will study common synthetic polymers -

(a) Fibres (b) Plastics

Plastics and synthetic fibres are categorized as a class of substance known as polymers. This is because they consist of many repeating molecular units or monomers.

3. FIBRES AND THEIR TYPES

3.1 FIBRES

- In daily life we use different things like shirt, socks etc. These things are made up of different kinds of fabrics made of different types of fibres.
- A thread or filament from which a cloth is made is called a fibre.

3.2 TYPES OF FIBRES

Fibres may be of three types -

(i) Natural Fibres (ii) Synthetic fibres (iii) Semi-synthetic fibres

(i) Natural fibres : Fibres obtained from plants and animals are known as natural fibres. Natural fibres are usually short fibres.

Example : Wool, cotton, silk (it can be obtained up to 1 km length)

(ii) Synthetic fibres : Fibres synthesized by human being are known as synthetic fibres. Synthetic fibres are continuous filament fibres.

All synthetic fibres are prepared from raw materials of petroleum origin called 'petrochemicals'.

Example : Nylon, polyester, acrylic, spandex etc.

Figure : Natural fibre and Synthetic fibre

♦ **Difference between Natural fibre and Synthetic fibre**

S.No.	Natural Fibre	Synthetic Fibre
(i)	It is obtained from nature.	It is completely manmade.
(ii)	The fibre structures cannot be changes.	The fibre structures can be changed.
(iii)	It is comfortable to wear.	It is not as comfortable as natural fibres.
(iv)	No chemicals are needed for processing.	Various chemical substances are required for processing.
(v)	It has its glowing natural colour.	Colours are added as required.
(vi)	It is environment friendly.	Some fabrics are harmful for the environment.

(iii) Semi synthetic fibres :

Modified natural fibres are known as semi - synthetic fibres.

Example : Rayon or Viscose.

ACTIVITY BASED LEARNING

• **Object : Study of relative tensile strength of different fibres of same thickness and same Length**

• **Method :** Take an iron stand with a clamp. Take a cotton thread of about 60 cm length. Tie it to the clamp so that it hangs freely from it as shown in figure. At the free end suspend a pan so that weight can be placed in it. Add weight one by one till the thread breaks. Note down the total weight required to break the thread.

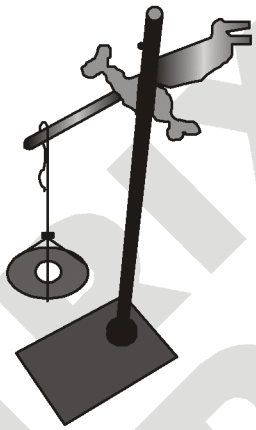


Figure : An iron stand with a thread hanging from the clamp

This weight indicates the strength of the fibre. Repeat the same activity with threads of wool, cotton, silk and nylon. Tabulate the data as shown in Table. Arrange the threads in order of their increasing strength.

• **Observation :**

S. No.	Types of Thread / Fibre	Weight required to break the Thread
1.	Wool	Minimum
2.	Cotton	More than wool (75g)
3.	Silk	More than cotton (150 g)
4.	Nylon	Maximum (375 g)

You may use a hook or a nail on the wall for hanging the fibres and a polythene bag at the other end. In place of weights you may use marbles (or pebbles) of similar size.

(Precaution : Note that all threads should be of the same length and almost of the same thickness.)

4. SYNTHETIC CLOTHING MATERIAL

Most synthetic fabrics can be used as clothing material. Nylon, rayon, polyester, acrylic and spandex etc. are some commonly used synthetic clothing fabrics.

4.1 RAYON

Rayon is the first man-made (semi-synthetic) fibre. It is composed of regenerated cellulose, a component of green plants. It can imitate the feel and the texture of silk, wool, cotton and linen. Rayon was first made in the USA and later on its method of preparation was modified in Europe.The process of making it in Europe is known as viscose process. The rayon thus obtained is known as viscose in Europe.

Figure : Rayon fibres of different colour

♦ **Properties :**

(i) It has tendency to absorb moisture. Because of its tendency to absorb moisture, rayon can absorb sweat. Therefore, it is generally preferred over other synthetic fabrics in summer.

(ii) It is shiny and lustrous and resembles to silk in appearance. So, it is also called artificial silk.

♦ **Uses :**

(i) Shirts, ties, linings etc. are made up of rayon fabric.

(ii) It is used in home furnishing materials (bed sheets, curtains, table clothes, sofa covers etc.) and bandages.

4.2 NYLON

It is the first fully synthetic fibre. It was prepared in 1931 using coal, water and air.

♦ **Properties :**

(i) Nylon is a high tensile strength fibre. It is elastic and so does not lose strength even after repeated use.

(ii) It is one of the light synthetic fibre. It is lustrous and easy to wash.

♦ **Uses :**

(i) It is used in making sarees, socks, stockings etc.

(ii) It is blended with wool to increase the strength.

Nylon Gear

Nylon Tent

Nylon umbrella

High Quality Nylon(Parachute)

Figure : Uses of Nylon fibres

Focus Point

- Nylon is an acronym obtained from the name of the cities New York (NY) and London (LON). Most common nylon is nylon-66. It's monomer units are adipic acid and hexamethylene diamine.

4.3 POLYESTER

It is made of repeating units of a chemical called ester which has fruit like smell. Most polyester fabrics have excellent wash and wear characteristics and therefore, require minimum care.

♦ **Properties :**

(i) It absorbs very little water and hence dry quickly after washing.

(ii) It is a strong, lightweight and elastic fabric.

(iii) It resists wrinkling and springs back into shape when creased.

♦ **Uses :**

(i) Polyester fibres are widely used in textile industry for making a variety of textiles such as sarees, dress materials, curtains etc.

(ii) Terrywool, a blend of Terylene (a type of polyester) and wool, is used for making suits.

(iii) Terrycot, a blend of Terrylene and cotton is commonly used for making skirts, shirts and other dress materials.

(iv) It is light weight and strong. This property makes it suitable for making light weight sails of the boats.

(v) Terylene is used for making conveyor belts as it is very elastic.

(vi) Polyester films (commonly known as mylar) are also used for making magnetic recording tapes in audio cassettes, video cassettes and floppy discs.

ACTIVITY BASED LEARNING

- **Object: Study the structure of various fibres.**
- **Materials required :** Fibres of various clothing materials, such as cotton, silk, wool, rayon, nylon, polyester etc.
- **Procedure :** Place fibres on a glass slide and observe them with the help of a magnifying glass (or a microscope)
- **observations:** Can you now explain, why certain clothes are smooth, whereas others are rough to touch?

OBSERVATIONS		
Fibre	**Structure**	**Smooth/Rough to touch**
Cotton	Short, uneven, folded, porous	Rough
Wool	Short, uneven, folded, porous	Rough
Silk	Long, even, straight, fine	Smooth
Nylon	Long, even, straight, fine	Smooth
Polyester	Long, even, straight, fine	Smooth

- **Conclusion :** The results show that

(i) Cotton and wool are rough because of uneven, folded and porous structure.

(ii) Nylon, silk, polyester are smooth because of long, even, straight and fine structure.

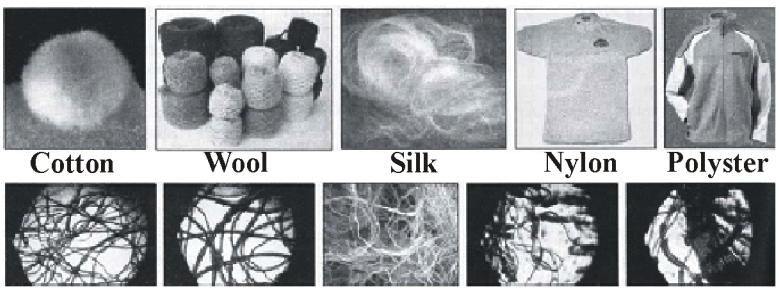


Figure : Different type of fibres

Focus Point

- Terylene is also called Dacron or Mylar.
- Elastane is a synthetic fibre which is highly elastic and stretchable. This fibre is great for movement so, it is used in a lot of sport uniforms
- Synthetic brush with selectd filaments is specially designed for water colour techniques. Its hair is extremely alternative to nautral hair. Because of its characteristics, its filaments perfectly absorb both water and paint. The synthetic fibre gives long-lasting resistance and elastcity to brush.

4.4 ACRYLIC

- Acrylic fabric closely resembles to wool in its properties. Acrylic fibers are synthetic fibres made from a polymer (polyacrylonitrile) with an average molecular weight of 100,000, about 1900 monomer units.
- Acrylic fibres are very useful in our daily lives .For a fibre to be called "acrylic" in the US, the polymer must contain at least 85% acrylonitrile monomer.
- Acrylic fibre are also known as ORLON or ACRILAN.

♦ **Properties :**

(i) It is warm, soft, light and flexible fibre. Acrylic yarn can be easily knitted.

(ii) It is cheaper than natural wool and is available in a variety of colours.

(iii) Resistance to damage by moths and chemical and highly resistance to sunlight.

♦ **Uses :**

(i) Acrylic fibre is used for making sweaters, socks and shawls.

(ii) It is used for making carpets and blankets.

(iii) Car tops, boat covers, filtration material.

4.5 SPANDEX

- Spandex is mixed with other fibre, such as cotton, to get stretch fabrics, which are used for making T-shirts and caps. It is the copolymer of polyester and polyurethane.
- ♦ **Properties :** These fibres have excellent elasticity. The high elasticity of these fibres make them suitable for use in clothes that require snug fitting, for example swimming costumes.
- ♦ **Uses :** It is used in the making of swimming costumes, caps, T-shirts, women wearing laggings, wrestler wearing etc.

4.6 KOROSEAL

- **Properties :** Koroseal is water proof as well as air proof. It has a trade name of high polymer of vinyl chloride.
- **Uses :** It is used for coating fabrics of silk, rayon or cotton to make them water proof. Water proof fabrics so obtained can be used on rainy days or as bathroom curtains and wall covering.

4.7 BLENDED FIBRES

Mixing of two different fibres results in the formation of blended fibres. More often, a synthetic fibre is mixed with a natural fibre. Two similar fibres, for example, both natural fibres, may also be mixed to form blended fabrics. A few examples of blended fibres are given in table below :

Fibres	Blended fibres
Polyester and cotton	Polycot
Polyester and wool	Terrywool
Cotton and wool	Cotswool

On the other hand, polythene and polypropylene are considered to be both macromolecules as well as polymers because they contain a large number of repeating structural units.

Focus Point

- Polycot is used to make curtains.
- Acrylic is also known as polyacrylonitrile (PAN) or 'Orlon' or 'Acrilan'.
- Monomer of acrylic fibre is a chemical, named as acrylonitrile.
- Spandex or lycra is another synthetic fibre, which is known for its high elasticity and used for snug fitting clothes like swimming costumes.

5. ADVANTAGES AND DISADVANTAGES OF SYNTHETIC FIBRES

Natural and synthetic fibres have their own advantages and disadvantages. For example, natural fibres are comfortable to wear as they retain moisture and breathe. However, they are not very strong. Also, they shrink when washed and are readily attacked by moth.

Synthetic fibres are very strong, do not shrink and are resistant to moth attack, though they are not very comfortable to wear. Hence, the best fibres are obtained by blending two types of fibres which combine the advantages of both and are free from their disadvantages.

Different properties of synthetic fibres like moisture absorbing capacity, tensile strength, elasticity etc. make synthetic fibres very advantageous but they need great care also.

5.1 ADVANTAGES OF SYNTHETIC FIBRES

(i) Most synthetic fibres can handle heavy loads without breaking : The ability to withstand loads is due to a property called tensile strength.

(ii) Most synthetic fibres are elastic : Elasticity refers to the ability of a material to regain its original shape, after it has been stretched or compressed.

(iii) Most synthetic fibres do not wrinkle easily : If wrinkled and released, they retain their original shape. Hence, people find them convenient to wash and wear.

In addition to these properties, synthetic fibres drawn from the spinneret can be made very fine and thin. Thus, the texture of the synthetic fibres produced is generally soft.

(ii) They are less expensive and readily available : Synthetic fibres are cheaper than natural fibre.

5.2 DISADVANTAGES OF SYNTHETIC FIBRES

(i) Most synthetic fibres can absorb very little moisture. They become sticky when the body sweat. On the other hand, most natural fibres absorb moisture readily. As a result when we sweat, the sweat is not trapped between the fibre and the skin. It keeps on evaporating from the fibre and we feel that our skin can breathe.

(ii) Most synthetic fibres melt very easily thus they should not be worn while working in the kitchen and in laboratory. They require very careful ironing.

Focus Point

- A nylon thread is stronger than steel wire.
- Toothbrush bristles are made up of nylon 6, 6.
- Ropes made of nylon and polyester are commonly used in cranes and elevators because of their high elasticity and tensile strength.
- Starch and cellulose are two very similar polymers. In fact, they are both made from the same monomer glucose and have the same repeating units of glucose.
- Rayon is produced by reprocessing of natural fibre cellulose. So, it is neither a truly synthetic fibre nor a natural fibre. It is semi-synthetic or artificial.
- Rayon is also known by the names viscose rayon and artificial silk in the textile industry.

ACTIVITY BASED LEARNING

- **Object : Activity determine effect of flame on different kinds of fibres.**
- **Materials required :**
  - (a) 10 cm long fibre of (i) cotton, (ii) rayon, (iii) wool, (iv) silk, (v) nylon (vi) polyester (vii) acrylic
  - (b) A spirit lamp or a candle
  - (c) Fire-tongs
  - (d) A plate made of china clay or glass
- **Method :**

Light the spirit lamp or the candle and place it on the table. Next to it place a plate of china clay or glass. Hold the cotton fibre in the fire-tongs and then hold it over the flame, till it catches fire. Shift the burning fibre over china clay plate and make observations till a small amount of it is left.

Drop this small burning fibre in the china plate.

Repeat the activity with the fibres of other materials. Your observations will be as listed under :

EFFECTS OF FLAME ON DIFFERENT KINDS OF FIBRES

S.NO	Fibre	Observations
1	Cotton	(i) Burns vigorously producing a large flame. (ii) The smell of burning fibre is like that of burning paper. (iii) Very little ash or beady residue is formed.
2	Rayon	(i) Burns vigorously producing a large flame. (ii) The smell of burning fibre is like that of burning paper. (iii) A hard black globular mass is left behind as residue.
3	Wool	(i) Burns poorly without any flame. (ii) The smell of burning fibre is like that of burning hair. (iii) The residue forms a kind of grey ball along the burning
4	Silk	(i) Burns poorly without any flame. (ii) The smell of burning fibre is like that of burning hair. (iii) The residue swells up to form black ash.
5	Nylon	(i) It melts and burns with difficulty. (ii) The fibre shrinks from flame, forming beady residue. (iii) The smell of burning fibre is like that of plastic.
6	Polyester	(i) It melts and burns with difficulty and produces black smoke. (ii) The fibre shrinks from flame, forming beady residue. (iii) The smell of burning fibre is like that of chemical odour.
7	Acrylic	(i) It produces a sooty flame. (ii) The fibre shrinks from flame forming black beads. (iii) The smell of burning fibre is like that of chemical odour.

6. PLASTIC

We use plastics and synthetic fibres everyday yet these have only been widely used in the past 50 years.
Plastics and synthetic fibres are man-made materials, this is why they are called SYNTHETIC.
Plastics are generally cheap to produce and have very useful properties such as lightness strength and durability.
In addition, plastics are easily moulded into a variety of shapes and are excellent insulators of both heat and electricity.

A plastic is a polymeric material which can be easily moulded or set into any desired shape and size.

♦ **Types of Plastics :**

All plastics do not have same type arrangement of monomer units.

(A) On the basis of structure they are classified as :

(i) Linear plastics : The monomer units are joined together to form long straight chains of polymer molecules. These chains are stacked over one another to give a well packed structure.

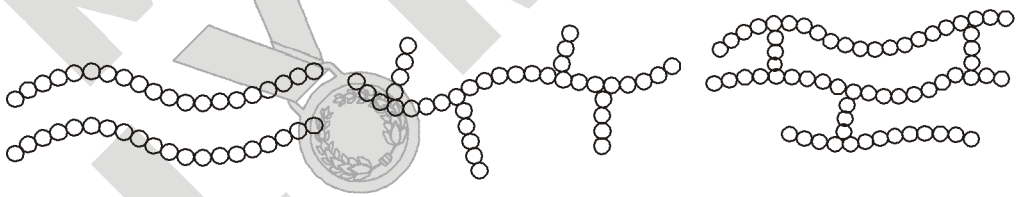
Eg : HDPE, PVC, polythene ,etc.

(ii) Branched chain plastics : The monomer units not only combine to produce the linear chain but also form branches of different length along the main chain.

Eg : HDPE, etc.

(iii) Cross-linked or three dimensional network plastics : The initially formed linear polymer chains are joined together to form a three - dimensional network structure. These polymers are hard and rigid.

Eg : Bakelite, melamine-formaldehyde etc.



Linear polymer **Branched chain polymer** **Cross -linked polymer**

Figure : Structure of different types of polymers

(B) On the basis of their reaction to heat.

(i) Thermoplastics : Thermoplastics can be melted by heating and there after moulded into desired shapes and sizes. These plastics soften on heating and become fluids, but on cooling they become hard. These are capable of undergoing such reversible changes on heating and cooling repeatedly.

Examples of thermoplastics are polyethene (polyethylene), polyvinylchloride (PVC), polystyrene etc.

Figure : Plastic bottles (Thermoplastic)

(ii) Thermosetting Plastics : Thermosetting plastics are harder and stronger than thermoplastics and can retain their shape and size even at high temperature. These polymers once set in a given shape on heating cannot be softened or melted on being reheated. These polymers undergo a permanent change upon melting and set to a solid which cannot be remelted. For example bakelite, melamine.

Some examples of thermosetting plastics:

(a) Melamine : Melamine is a thermosetting polymer. It is hard and a high polish polymer. Melamine is used for making unbreakable dinner-ware, and decorative objects.

Figure : Melamine dinner-ware (Thermosetting)

(b) Bakelite : Bakelite is also a thermosetting polymer. Once set into a shape, bakelite does not melt/soften and retains its shape. Bakelite is obtained by reacting phenol with formaldehyde in the presence of a catalyst.

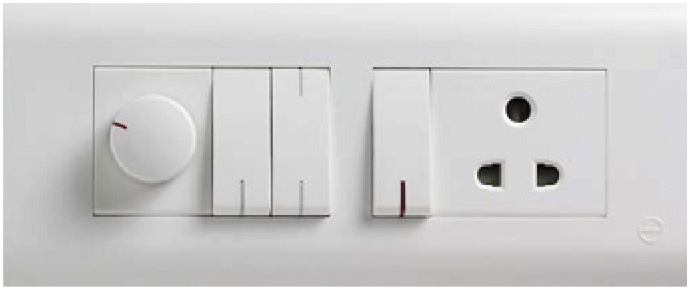


Figure :Bakelite Electric Switches (Thermosetting)

♦ **Properties :**

(i) Bakelite is hard and stiff.

(ii) Bakelite is an insulator.

♦ **Bakelite is used :**

(i) for making electrical switches and plugs.

(ii) for making gear wheels and table top laminates.

(iii) for making combs, fountain pen bodies, phonograph records.

Differences between thermoplastics and thermosetting plastics.

S.no.	Thermoplastics	Thermosetting Plastics
1.	They change their shape upon heating and cooling.	Once formed they do not undergo shape conversion upon heating and cooling
2.	Expensive	Cheap
3.	Recyclable	Not recyclable
4.	The best example is polythene which changes its shape upon heating and cooling.	The best example is the Bakelite once formed does not change its shape upon further heating.

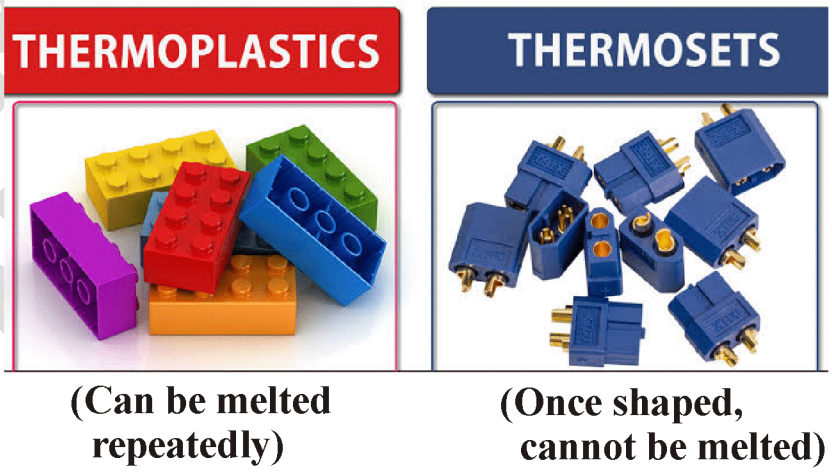


Figure : Thermoplastics and Thermosetting plastics

ACTIVITY BASED LEARNING

- **Object : To show that thermosetting plastic is poor conductor of heat**
- **Material required :** Sauce pan with a bakelite handle, water, gas stove, sauce pan made of steel with a steel handle
- **Procedure :**

  (i) Fill the stainless steel sauce pan, having steel handle half with water and keep it on a gas stove for five minutes. Put the gas off and try to touch the steel handle carefully.

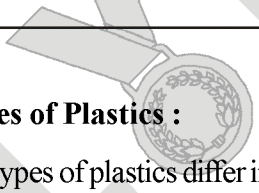
  (ii) Fill the steel sauce pan, with bakelite handle, half with water and keep it on a gas stove for five minutes. Put the gas off and try to touch the bakelite handle carefully.
- **Observations :**

  (i) It is difficult to remove the first sauce pan since the handle gets heated up.

  (ii) The second sauce pan can be touched and removed easily since does not get heated up.
- **Conclusion :** Bakelite is a thermosetting plastic which is poor conductor of heat.

Focus Point

- Bakelite, the first completely synthetic substance, is a thermosetting plastic. It was created by Leo Baekeland in 1907.



♦ **General Properties of Plastics :**

Although different types of plastics differ in some physical and chemical properties, the following properties are common to most of them

(i) Thermal Conductivity : 'Thermal' means 'heat'. Plastics (like bakelite etc.) are poor conductors of heat. This is why they are used -

- for making handles of cooking containers.
- in refrigerators (as plastic foam core) to prevent heat from outside to enter inside.
- in the thermal innerwear that people wear in extreme winters.
- for making containers and films used in microwaves ovens.

(ii) **Electrical Conductivity :** Plastics are poor conductors of electricity. This explains why they are used as covering materials in electrical appliances, cords, electrical outlets and wiring.

(iii) **Solubility in Water :** Plastics are insoluble in water and for this reason bottles, buckets and containers made of plastic are used for storing water and plastic tumblers and cups for drinking water.

(iv) **Effect of Flame :** Plastic polybags melting on accidentally coming in contact with a hot pan. This happens because plastics are inflammable.

(v) **Non - reactivity :** Plastics do not react with air and water. Unlike metals they are not corroded and thus are used as storage containers in which a variety of materials, including chemicals, can be stored.

(vi) Plastics are light, strong, durable and can be moulded in any desired shape and size.

♦ **General Characteristics of Plastics**

The plastics can be easily moulded. Following are the characteristics of plastics :

(i) **Chemical resistance :** Plastics are hardly affected by strong chemicals such as acids and alkalis. Contrary to it, all natural fibres such as cotton, wool, jute, silk, wood cellulose, etc. are affected by acids and alkalis.

(ii) **Weather resistance :** Plastics are non biodegradable, i.e., they do not affected by weather unlike natural fibres, such as cotton, wool, etc.

(iii) **Light weight :** Plastic materials weight far less as compared to natural fibres materials, such as wool, jute, etc.

(iv) **Toughness or Tensile strength :** Plastics can withstand lot of force without getting broken. For example, a thread of plastic can withstand a lot of weight as compared to a thread of cotton of same thickness.

(v) **Insulation :** Plastic materials are far better with respect to heat and electrical insulation. It is for the same reason that electric wires are covered with plastic insulation rather than cotton or silk insulation.

(vi) **Appearance :** Plastic material can be made as transparent as glass. Furthermore, they can be used for making large variety of household products.

♦ **Uses of Plastics :**

Plastics can be recycled, reused, coloured, melted, rolled into thin sheets or made into wires. Thus, they find a variety of uses, some of which are listed below :

S. No.	Monomer	Plastic (Polymers)	Uses
1.	Ethylene glycol and terephthalic acid	PET (Poly ethylene terephthalate)	Contains for microwave cooking carbonated beverage bottles and other containers.
2.	Ethylene or Ethene (C_2H_4)	HDPE (High density poly ethylene)	For packaging strong and corrosive household and Industrial chemical like bleaches, acids and liquid detergents.
3.	Vinyl Chloride ($CH_2 = CH–Cl$)	PVC (Poly vinyl dhloride)	PVC pipes for sanitary fitting (such as water pipes).
4.	Ethylene or Ethene (C_2H_4)	LDPE (Low density poly ethylene)	Polybags, grocery bags and packages of frozen foods and bread.
5.	Propylene or Propene	PP (Poly propylene)	Ketchup bottles, yoghurt containers, medicine bottles, automobile battery casings.
6.	Styrene or Vinyl benzene ($CH_2=CH–C_6H_5$)	PS (Polystyrene)	Thermocol, a form of PS, is used for making disposable cups and cups and packaging material for items like computers

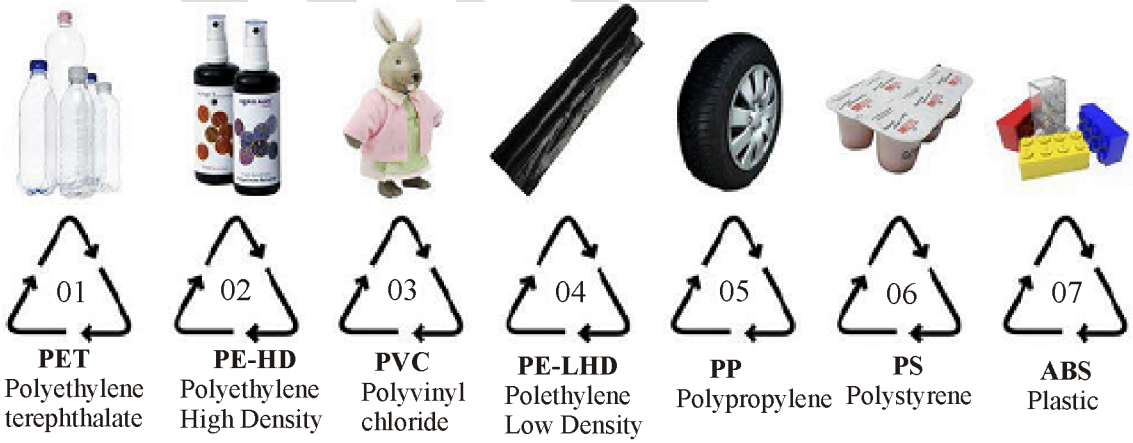


Figure : Uses of different plastics

Focus Point

- Teflon is the brand name of polytetrafluoroethylene (PTFE). It's monomer unit is tetrafluoro ethylene ($CF_2 = CF_2$) Teflon coatings are widely used in nonstick cooking pans and other cookwares.
- Teflon does not stick to materials easily and has a high melting point which makes it effective for the use in pans foreasy cooking and cleaning. Teflon is a type of plastic discovered by US based company DuPont in 1938.
- Teflon (Polytetrafluorothylene) is a special plastic on which oil and water do not stick. It is used for non-stick coating on cook wares.
- Although plastic catch fire easily, yet there are some fire-proof synthetic plastic, like melamine, which are used to coat the uniforms of firemen to make them fire resistant.
- High density polythylene (HDPE) is a polythylene thermoplastic made from petroleum. It is sometimes called 'alkaline' or 'polythene' when used for pipes with a high strength-to-density ratio, HDPE is used in the production of plastic bottles, corrosion resistant piping etc.
- Bakelite is an early plastic. It is a thermosetting phenol formaldehyde resin, formed from a condensation reaction of phenol and formaldehyde.
- Plastics have many uses in the medical field as well to include polymer in plants, however the field of plastic surgery is not named for use of plastic materials but rather the more generic meaning of the word plasticity with regard to the reshaping of flesh.

7. TYPES OF WASTES

Waste materials are of two types :

(i) Biodegradable (ii) Non - biodegradable

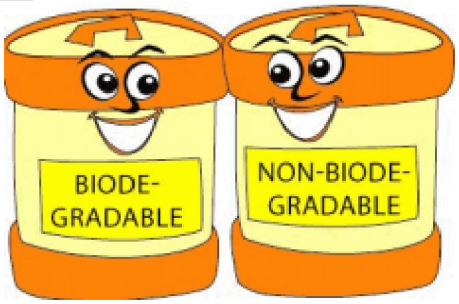


Figure : Types of waste

7.1 BIODEGRADABLE WASTES

Waste materials which can be decomposed into simpler and less harmful substances through natural processes, like action of micro - organisms are called biodegradable wastes. Different biodegradable wastes take different time to degenerate. Some examples of biodegradable wastes with the approximate time taken by them to degenerate are given below :

(i) Cotton cloth - 2 to 5 months

(ii) Woollen clothes - about an year

(iii) Kitchen wastes - 1 to 2 weeks

(iv) Paper - 10 to 30 days

(v) Wood - 10 to 15 years

7.2 NON- BIODEGRADABLE WASTES

Waste materials which are not easily decomposed by natural resources are called non - biodegradable wastes. e.g. Metal cans like those of tin, aluminium etc. take about 100 to 500 years to degenerate, plastic bags take several years to degenerate.

Figure : Biodegradable and Non-biodegradable wastes

♦ **Problems associated with plastic disposal:**

Despite of the many different uses of plastics, there are environmental and health hazards associated with their disposal. This is because plastics are non-biodegradable, i.e. they cannot be decomposed by micro-organism. Accumulation of plastics is considered a serious problem because most of the methods used to dispose them result in some type of pollution to the environment.

For e.g.

(i) If plastics are buried in soil, they cannot be decomposed by micro-organisms. This prevents rain water from seeping into earth. The water thus remains on the earth's surface, forming muddy puddles. This also affects the plants growing in the area as they do not get enough water from the soil.

(ii) Plastic wastes may end up in littering roadsides, floating in lakes and streams and collecting in ugly dumps. These provide homes for many disease - causing germs.

(iii) When wastes are dumped in water, they result in water pollution. They also pose a threat to aquatic life, as toxic substances present in plastics can cause death or reproductive failure in fish and other aquatic animals.

(iv) When plastics are burned, they produce toxic gases and smoke that cause air pollution.

(v) The polybags carelessly thrown here and there are responsible for the deaths of many animals, especially cows. The animals, in the process of eating food waste, swallow materials like plastic bags and wrappers of food which choke their respiratory system or form a lining in their stomach leading to their death.

♦ **Solutions of Problems Associated with Plastic Disposal :**

We can use two methods to reduce the hazards associated with the disposal of plastic waste.

(i) Reducing the usage of plastics:

Avoid the use of plastics as far as possible. Make use of bags made of cotton or jute when you go for shopping. The biodegradable and non–biodegradable wastes should be collected separately and disposed off separately.

(ii) Recycling of plastics:

Recycling of plastic involves collecting, sorting and processing plastic waste with an aim to reuse the material in manufacturing other products.

e.g. Polyester soft drink bottles could be melted down and the resulting molten material could be spun into fibres.

Two types of bins are made available by the municipality - a green bin and a blue bin to aid recycling of plastic garbage. Biodegradable wastes such as food items should be thrown into the green bin. Recyclable wastes such as plastic and glass, which cannot be degraded by microorganisms should be thrown into the blue bin.

Focus Point

- Scientists all over the world are trying to produce biodegradable (decomposed bymicroorganisms) photodegradable (decomposes in the presence of sunlight) plastics. Some example of biodegradable plastic are starch based biopolymer, Polyhydroxyalkanoates (PHA's) like Poly-3-hydroxy butyrate (PHB)
- To identify what type of plastic a particular product belongs to, numbers have been allotted to the different types of plastics. The principle followed is, the smaller the number, the easier it is to recycle.

Figure : Different type of Plastics

♦ 5 R Priniciple :

Plastic solution : The rule of "5 R" principle

 # 1 REFUSE
disposable plastic whenever and wherever is possible

 # 2 REDUCE
Your plastic footprint. Cut down your consumption of items that contain excessive plastic packaging and parts

 # 3 REFUSE
durable, non-toxic everyday items & choose glass, paper, steel wood, ceramic over plastic

 # 4 RECYCLE
what you can't refuse,reduce or reuse

 # 5 RAISE AWARENSESS
Spread out the words & take action in your community

Figure : Five - R Priniciple

♦ **Solid waste management**

Figure : Solid waste management

SYNTHETIC FIBRES AND PLASTICS

Synthetic fibres

The Fibres which are made by human beings are known as synthetic fibres.

Plastics

These are synthetic polymers

Disadvantages of synthetic materials

- Non-biodegradable : These are not decomposed by micro-organisms so cause water pollution, etc.
- Synthetic fibres are uncomfortable to wear in summers.
- Synthetic fibres melt at low temperature thus, if it catches fire, it gets stuck to the body.

Characteristics of synthetic fibres

Strength: Synthetic fibres can withstand a lot of force without breaking as compared to natural fibres.

Elasticity : Highly elastic, gets their original shape after releasing the pressure.

Water absorption : Nylon and polyester clothes absorb very little water.

Wrinkle resistance : Do not crumple more inert an not attacked by moths.

Types of synthetic fibres

Rayon : This is prepared by chemical treatment of wood pulp.
Uses : In making bed sheets or mixed with wool to make carpets.

Nylon : Prepared from coal, water and air. First fully synthetic fibre. Stronger than steel wire.
Uses : In making bed sheets or mixed with wool to make carpets.

Polyester : Made by repeating units of ester, e.g., terrylene, PET, etc.
Uses :
Terylene : As it does not wrinkle easily so used in making dresses.
PET: Used in making bottles, utensils, films, wires, etc.

Characteristics of plastics

- Poor conductor of electricity and heat.
- Light weight.
- More durable due to tensile strength and toughness.
- Not affected by air and water.

Types of synthetic fibres

- **Thermoplastics** : These plastics get deformed easily on heating and can be moulded into various shapes, e.g., PVC and polythene. Used in the manufacturing of toys, combs and various types of containers.
- **Thermosetting plastics** : These plastics can be moulded once and cannot be softened by heating again, e.g., bakelite and melamine.
- Bakelite is used for making electrical switches, handles of various utensils.
- Melamine is used for making floor tiles, kitchenwares, etc.

SOLVED EXAMPLES

SE1. What are biodegradable and non-biodegradable materials? Explain with examples.

Ans. **Biodegradable materials :** A material which gets decomposed through natural processes, such action by micro-organisms is called biodegradable material. For example : Paper, leaves, vegetables, fruits, etc.

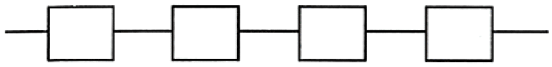
Non-biodegradable materials : A material which is not easily decomposed by natural processes, such as action of microorganisms is called non-biodegradable material. For example: Glass, copper, plastics, synthetic fibres, etc.

SE2. Draw diagrams to show

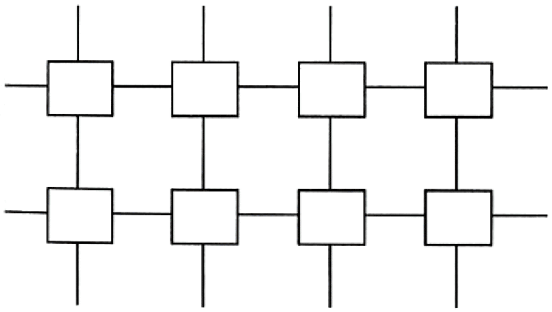
(a) Linear arrangement of units in plastics.

(b) Cross-linked arrangement of units in plastics.

Ans.



(a) Linear arrangement



(b) Cross-linked arrangement

SE3. Why is polyester quite suitable for making dress materials?

Ans. Polyester is a synthetic fibre which is quite suitable to make dresses and other clothes due to its properties. It does not wrinkle easily. It remains crisp and is easy to wash. It is light and durable. It takes very less time to dry up.

SE4. Though rayon has a silky shine, it is otherwise similar to cotton. Can you say why?

Ans. Rayon is a type of synthetic (man-made) that resembles silk in appearance. It is obtained from cellulose which is a naturally occurring polymer hence, it is closer to cotton.

SE5. Give scientific reasons for the following :

(a) Plastic containers used for microwave cooking are made of special plastic.

(b) Thermoplastics are not used for making sauce-pan handles.

(c) Bakelite is used to make plugs and sockets.

Ans. (a) Special plastic cookware is used in microwave ovens for cooking food. In microwave ovens, the heat supplied cooks the food but does not affect the plastic container.

(b) Though thermoplastics are also bad conductors of heat, they get deformed easily on heating. They will melt and bend if used as sauce-pan handles.

(c) Bakelite is a thermosetting polymer which is a good electrical insulator. It is therefore used to make plugs and sockets.

SE6. Teflon, that is used to make non-stick pans, is also used to make the wind screen wipers of cars. Why?

Ans. Teflon is chemically inert and heat resistant polymer. It is scratch proof, corrosion resistant and offers very low friction. Due to low friction, wind screen wipers do not scratch the glass on repeated movement against it.

SE7. What type of pollution is caused by the plastics?

Ans. Since plastics are non-biodegradable, they are not decomposed in nature by micro-organisms for several years hence they cause environmental pollution. If buried in the soil, it reduces soil fertility. Sometimes when they are mixed with the other garbage which is burnt, poisonous gases are given

out in the form of smoke. As the plastic is indigestible, animals die of choking if they eat it accidentally along with the other things.

SE8. Name five fibres and discuss their sources and uses.

Ans.

	Fibres	Source	Uses
1.	Jute	Plant	In making bags and mats
2.	Silk	Silkworm	In making dress material
3.	Wool	Sheep	In making winter clothing
4.	Cotton	Plant	In making dress material
5.	Coir	Plant	In making ropes and mats

SE9. Melamine and formica are two commonly used plastics. Find out what items are made from them and why are they useful for these items?

Ans. Melamine and formica are thermosetting polymers. Melamine is used for making unbreakable cups and crockery. Laminated plastics such as formica are made from layers of plastics sandwiched with another material, such as paper or wood and ressed into thin sheets. This form of plastic is resistant to heat.

SE10 Mention which kind of plastic, thermosetting or thermoplastic is most suitable for making the following:

Handle of a cooker, furniture, bucket, plug socket, combs, pipe for watering plants.

Ans.

Handle of a cooker	- Thermosetting
Furniture	- Thermoplastic
Bucket	- Thermoplastic
Plug socket	- Thermosetting
Combs	- Thermoplastic
Pipe for watering plants	- Thermoplastic

EXERCISE-I

ONLY ONE CORRECT TYPE

1. Plastics and synthetic fibres are made of large units called as -
   (A) nylon (B) rayon
   (C) monomers (D) polymers
2. The monomer units of the rayon are
   (A) cellulose (B) fructose
   (C) glucose (D) maltose
3. Which of the following is classified as polyester polymer?
   (A) Nylon -66 (B) Terylene
   (C) Bakelite (D) Melamine
4. Which polymer occur naturally?
   (A) Starch and nylon (B) Starch and cellulose
   (C) Protein and nylon (D) Protein and PVC
5. The natural polymer which contain glucose units :
   (A) cellulose (B) protein
   (C) fats (D) none of these
6. Which of the following is a natural fibre?
   (A) Polyethylene (B) PVC
   (C) Nylon (D) Wool
7. ..... is an example of synthetic fibre.
   (A) Wool (B) Cotton
   (C) Polyester (D) Silk
8. Which of the following fibres is also known as artificial silk ?
   (A) Nylon (B) Rayon
   (C) Polyester (D) Spandex
9. Which of the following is not a polyester fibre?
   (A) Terylene (B) Styrene
   (C) Terrycot (D) Terrywool
10. Which of the following fabrics closely resembles to wool in its properties ?
    (A) Orlon (B) Acrilan
    (C) Acrylic (D) All of these
11. The fibre which is semi-synthetic fibre.
    (A) Rayon (B) Nylon
    (C) Acrylic (D) Polyester
12. Polycot is made by blending polyester with____.
    (A) wool (B) terrylene
    (C) rayon (D) cotton
13. The fibre obtained from plant is -
    (A) silk (B) wool
    (C) cotton (D) nylon
14. The synthetic fibre that burns with a smell of burning paper is -
    (A) acrylic (B) polyester
    (C) nylon (D) rayon
15. Which of the following plastics is used in the making of thermocol ?
    (A) Polyethylene
    (B) High density polyethylene
    (C) Polypropylene
    (D) Polystyrene
16. To identify the type of plastic a specific number is allotted to plastic products. This number represent
    (A) durability of plastic product
    (B) electrical conductivity of plastic product
    (C) thermal resistance of plastic product
    (D) recycling of plastic product
17. Which of the following is used in automobile battery casings?
    (A) HDPE (B) PP
    (C) PVC (D) Polyester
18. Which out of the following is used for making disposable cups?
    (A) LDPE (B) PS
    (C) PP (D) PVC
19. Which of the following plastic is a thermosetting plastic ?
    (A) PVC (B) Polystyrene
    (C) Polyethylene (D) Bakelite
20. Non-stick cookwares have the coating of-
    (A) PET (B) teflon
    (C) acrylic (D) melamine
21. PVC (Poly vinyl chloride) and Polythene are –
    (A) thermosetting plastics (B) thermoplastics
    (C) natural fibres (D) synthetic fibres

22. Uniform of fireman is coated with -
(A) teflon (B) rayon
(C) PVC (D) melamine

23. The property due to which plastic is found in all shapes that it is -
(A) reusable (B) recyclable
(C) mouldable (D) stretchable

24. The material suitable to make buckets is -
(A) iron (B) brass
(C) wood (D) plastic

25. One of the best solution to get rid of non -biodegradable wastes is _____.
(A) burning (B) dumping
(C) burying (D) recycling

PARAGRAPH TYPE

Paragraph # 1

Nylon is the first synthetic fibre. Nylon is a standard name of a group of polyamide. Polymers containing the amide gropu – CONH. It is primarily used as a fibre and a strongest fibre. Nylon is a high tensile strength fibre. It is elastic and so does not lose strength even after repeated use.

1. The first fully synthetic fibre ?
(A) Acrylic (B) Polyester
(C) Nylon (D) Rayon

2. Which is the strongest fibre among the following ?
(A) Rayon (B) Nylon
(C) Acrylic (D) Cotton

3. Which functional group present in nylon ?
(A) $-\overset{\overset{O}{\|}}{C}-$ (B) $-\overset{\overset{O}{\|}}{C}-OH$
(C) $-\overset{\overset{O}{\|}}{C}-NH$ (D) $-\overset{\overset{O}{\|}}{C}-H$

Paragraph # 2

Thermosetting plastics are harder and stronger than thermoplastics and can retain their shape and size even at high temperature. These polymers once set in a given shape on heating cannot be softened or melted on being reheated. These polymers undergo a permanent change upon melting and set to a solid which cannot be remelted. For example bakelite, melamine.

1. Which plastics when moulded once, cannot be softened by heating such plastics are –
(A) Polythene (B) Thermo plastics
(C) Polyester (D) Thermosetting plastics

2. Thermosetting plastic is ?
(A) Reversible (B) Irreversible
(C) Both (A) and (B) (D) None of these

3. Which one is example of thermosetting plastic
(A) PVC (B) Polyethene
(C) Bakelite (D) None of these

MATCH THE COLUMN TYPE

1.

Column-I	**Column-II**
P. Polyster	(i) Sarees, dresses, suits, jacket, shirts etc.
Q. Spandex	(ii) Sweaters, socks, shawls.
R. Nylon	(iii) Shirts, tyres linining
S. Rayon	(iv) Sarees, socks, stocking etc.
T. Acrylic	(v) Swimming costumes, caps, T-shirts

(A) P → (i), Q → (v), R → (iv), S → (iii), T → (ii)
(B) P → (v), Q → (i), R → (iv), S → (iii), T → (ii)
(C) P → (iv), Q → (i), R → (v), S → (iii), T → (ii)
(D) P → (i), Q → (v), R → (iv), S → (ii), T → (iii)

1. **Column-I** **Column-II**

P. Cotton (i) Fibre obtained from wood

Q. Silk (ii) Natural polymer

R. Rayon (iii) Fibre obtained from petroleum

S. Nylon (iv) Fibre obtained from moth

(A) P → (i), Q → (ii), R → (iv), S → (iii)

(B) P → (ii), Q → (i), R → (iv), S → (iii)

(C) P → (ii), Q → (iv), R → (i), S → (iii)

(D) P → (i), Q → (iii), R → (iv), S → (ii)

EXERCISE-II

VERY SHORT ANSWER TYPE

1. Give two examples each of natural and synthetic fibre.
2. What are the sources of raw materials for synthetic fibre ?
3. Name the semi-synthetic fibre made of wood pulp.
4. What are natural fibres ?
5. Give other name of spandex ?
6. Who discovered bakelite ?
7. Write the brand name of poly tetra fluoro ethylene.?
8. Why teflon is used in making non-stick cooking pans?
9. Why is it dangerous to leave plastic bags near a burning gas stove ?
10. What is the full form of LDPE ?

SHORT ANSWER TYPE

1. What is polymerisation ?
2. Differentiate between synthetic and semi- synthetic fibre.
3. Why is rayon called artificial silk ?
4. Why are ropes made of nylon used in cranes and elevators ?
5. A strand of wool burns with the odour of burning hair while that of cotton burns with the odour of burning paper. Why ?

LONG ANSWER TYPE

1. Give two clothing-related applications of each of the following :
   (i) Nylon (ii) Polyester (iii) Acrylic.
2. Discuss the limitations associated with synthetic fibre.
3. Give reasons why :
   (a) Refrigerators and freezers have a plastic foam core ?
   (b) Electrical wires have a plastic covering ?
   (c) Cooking pans have plastic handles ?
4. What do the following stand for:
   PP, HDPE, PS and PVC ? List two uses of each.
5. What is plastic and explain types of plastics?

TRUE / FALSE TYPE

1. Natural fibres are obtained from plants and animals where as synthetic fibres are obtained by chemical processing of petrochemicals.
2. Plastics are eco-friendly.
3. Teflon is special plastic on which oil and water do not stick.
4. Plastics are generally good conductors of electricity.
5. PVC is mainly used for electrical and sanitary fittings.

FILL IN THE BLANKS TYPE

1. Synthetic fibres are also called as _____ fibres.
2. _____is the first synthetic thermosetting pastics.
3. _____doesn't stick to the material and can be easily used in non-stick pans and other cookware.
4. _____is a natural fibre, with continuous filaments which can stretch upto 1 km.
5. _____ is the first artificial fibre synthesized by human beings.

EXERCISE I					ANSWER KEY									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D	C	B	B	A	D	C	B	B	D	A	D	C	D	D
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
D	B	B	D	B	B	D	C	D	D					

FILL IN THE BLANKS

1.Filament 2.Bakelite 3. Teflon 4. Silk 5. Nylon

TRUE / FALSE

1. True 2.False 3. True 4. False 5. True

PARAGRAPH

1. C 2. B 3. C 4. D 5. B 6. C

MATCH THE COLUMN

1. A 2.C

SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : SYNTHETIC FIBRES AND PLASTICS)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In-Text Examples			
Solved Examples			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

NOTES :

1. In the status, put "completed" only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.

METALS AND NON-METALS

1. INTRODUCTION

There are 118 different elements known to us today. These elements are widely distributed in earth's crust in free state as well as in the combined form.

Approximate relative abundance of some elements in the earth's crust are :

Oxygen	46.6%	Silicon	27.7%
Aluminium	8%	Iron	5%
Calcium	3.6%	Sodium	2.8%
Potassium	2.8%	Magnesium	2.1%
Hydrogen	0.14%	Phosphorus	0.12%

Elements can be classified into metals and non-metals on the basis of their properties. A few elements have properties common to both metals and non-metals. These are called **semi-metals** or **metalloids**.

Metal are elements which are hard, lustrous, malleable, ductile and possess good electrical and thermal conductivity. Whereas, non-metals do not possess lustre, are bad conductors of heat and electricity, are non-malleable and non-ductile but are brittle.

♦ **Some uses of metals**

(i) In construction of buildings and bridges.

(ii) In making of coins.

(iii) In making utensils and kitchen containers.

(iv) In making of jewellery.

(v) In making of machine parts, automobiles, etc.

♦ **Some uses of non-metals**

(i) Oxygen is used for respiration by living things.

(ii) Nitrogen is the main constituent of fertilizers.

(iii) The food we eat consist of many non-metals like carbon, hydrogen, oxygen, nitrogen, sulphur, etc.

(iv) Carbon, in the form of graphite, is used as electrodes in electrolytic cells and dry cells.

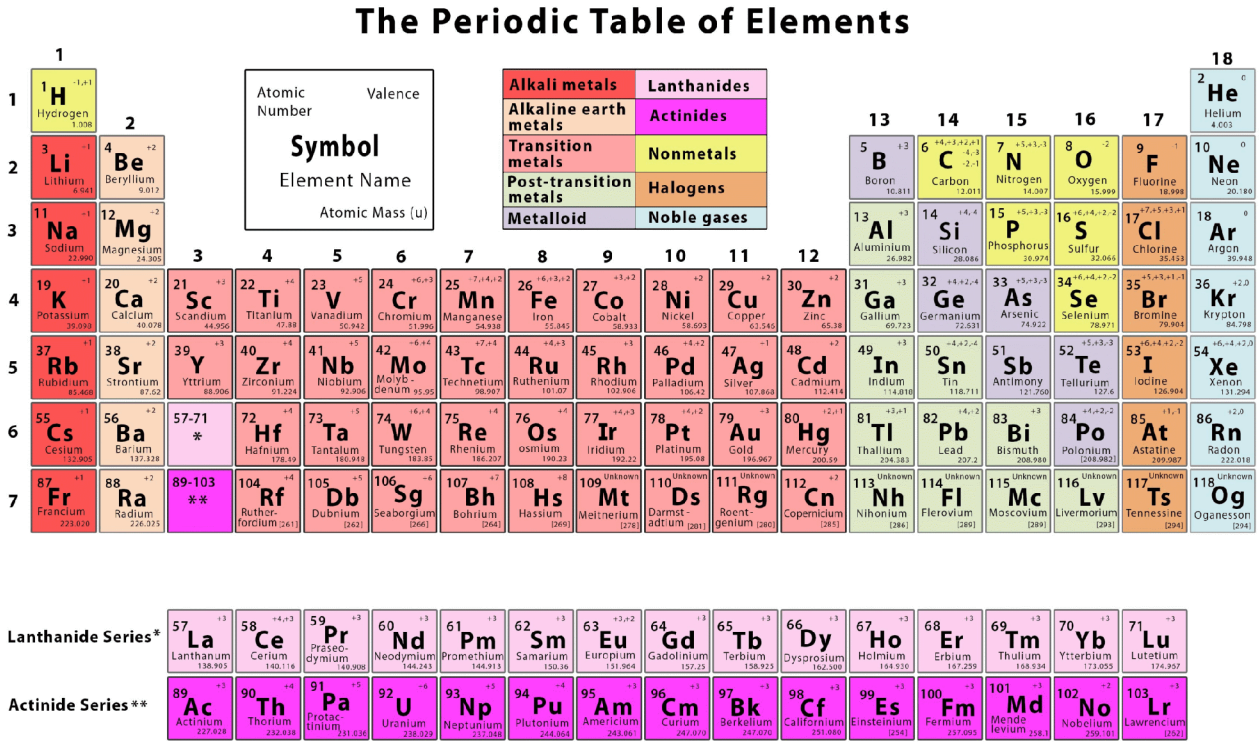


Figure : Periodic table

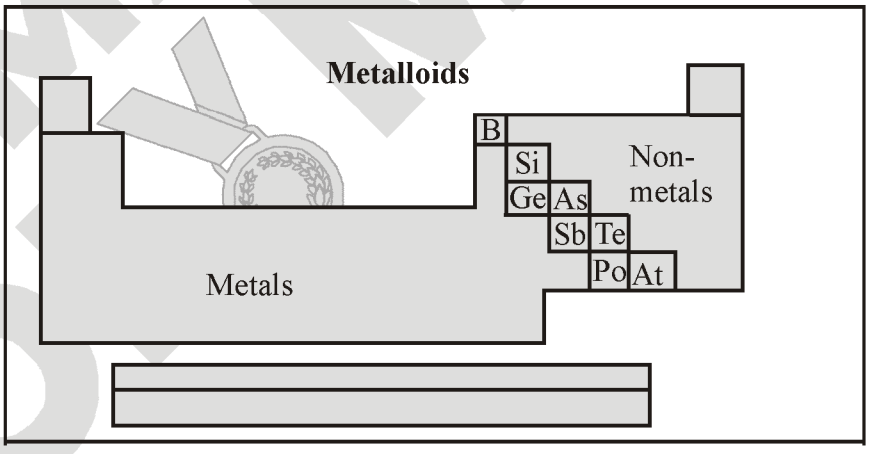


Figure : Position of metals, non–metals and metalloids in the periodic table.

2. OCCURENCE OF METALS AND NON METALS

Metals and non-metals occur in nature in free state as well as in combined state. The metals like gold, platinum, copper, silver are not affected by water and air and so these are found in free state. Most of the metals and non-metals are found in the form of compounds. These are associated with different types of impurities. The metals occur as oxides, sulphides, carbonates, halides, sulphates, silicates and phosphates.

Focus Point

- Aluminium is the most abundant metal whereas oxygen is the most abundant element on earth.

3. PHYSICAL PROPERTIES OF METALS AND NON-METALS

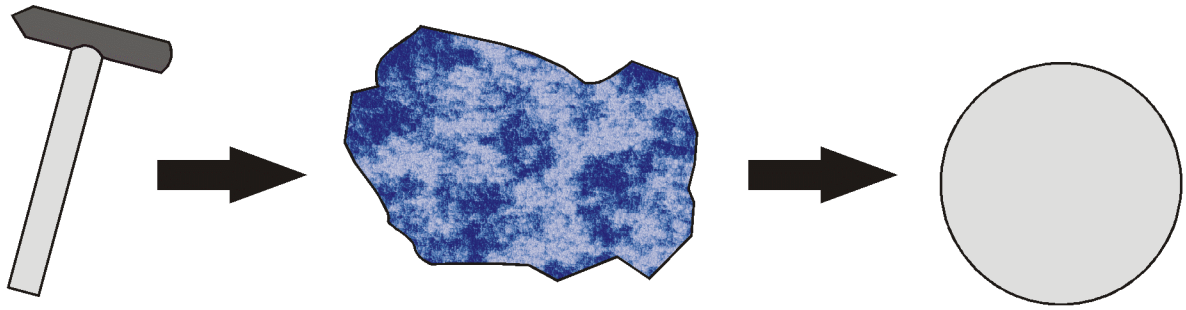
3.1 PHYSICAL PROPERTIES OF METALS

The important physical properties of metals are discussed below :

(i) Physical State : All metals (except mercury) are solid at room temperature. Mercury is liquid at room temperature and gallium, caesium and francium occur in liquid state in nature slightly above room temperature.

(ii) Metals are hard: Most of the metals are hard, but all metals are not equally hard. Metals like iron, copper, aluminium etc. are quite hard. They cannot be cut with a knife. Sodium and potassium are common exceptions which are soft and can be easily cut with a knife.

(iii) Metals are malleable : Metals are generally malleable. This means that the metals can be beaten with a hammer into very thin sheets without breaking. This property of metals is called **malleability**. Gold and silver are among the best malleable metals. Aluminium and copper are also highly malleable metals. All metals are not malleable. E.g. sodium, potassium & calcium are not malleable.



Gold is the most malleable metal

Figure : Malleability

ACTIVITY BASED LEARNING

- **Object : To show metals are malleable in nature**
- **Materials required :** Iron nail, coal piece, pencil lead, aluminium wire and a hammer.
- **Procedure :** Take all the materials one by one and beat them with the help of a hammer repeatedly and note the change in shape.

- **Observations :** Iron nail flattens. Coal piece breaks into small pieces and becomes powder. Pencil lead breaks into small pieces. Aluminium wire flattens.
- **Conclusion :** Iron nail and aluminium wire are metals, hence they are malleable while coal piece and pencil lead are non-metals hence they are brittle.

Focus Point

- Silver foils used for decorating sweets are made by gently hammering small pieces of silver because silver is a highly malleable metal. Aluminium foils used for packaging food articles are obtained by passing hot aluminium metal through very heavy stell roller.
- Thin aluminium foils are used for wrapping chocolates.
- Less reactive metals such as copper silver, gold, etc do not displace hydrogen from water.
- Copper, silver and gold are coinage metals.

(iv) Metals are ductile : It means that metals can be drawn (stretched) into thin wires. This property of metals is called **ductility**. Gold and silver are the most ductile metals. Copper, aluminium and tungsten are also very ductile, and therefore, these can be drawn into thin wires which are used in electrical wiring.
Metals like Na, K, Ca etc. are not ductile, while metals like Sn, Pb etc. are less ductile.

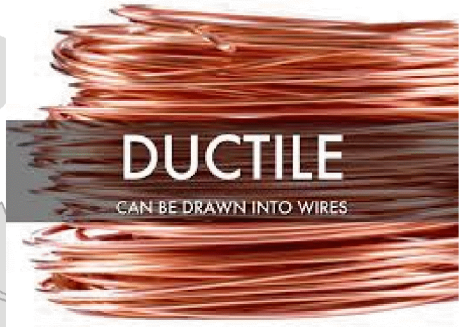


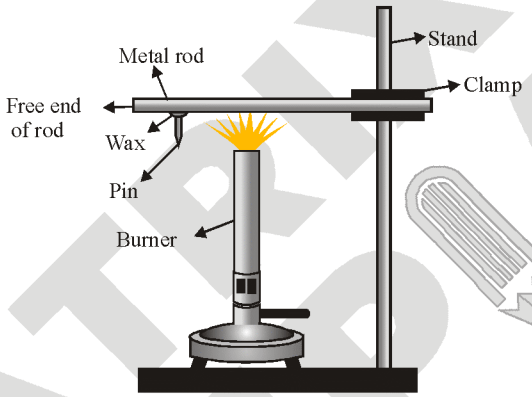
Figure : Ductility

(v) Metals are good conductors of heat :

All metals are good conductors of heat. The conduction of heat is called thermal conductivity. Silver is the best conductor of heat. Copper and aluminium are also good conductors of heat and therefore, they are used for making household utensils. Lead is the poorest conductor of heat. Mercury metal is also a good conductor of heat.

ACTIVITY BASED LEARNING

- **Objective : To show that metals are good conductor of heat.**
- **Preparation Materials Required :** A metal rod, pin, wax, burner and stand.
- **Procedure :** Clamp metal rod on a stand as shown in figure as below. Then fixed a pin to the free end of the rod with the help of wax. Now heat the metal rod with a candle or burner near its clamped end.



- **Observation :** After some time the other end will also become hot and wax will melt and nail will fall down.
- **Result :** This shows that metals are good conductors of heat.

(vi) Metals are good conductor of electricity :

Metals are also good conductors of electricity. The electrical and thermal conductivities of metals are due to the presence of free electrons in them. Among all the metals, silver is the best conductor of electricity. Copper and aluminium are the next best conductors of electricity. Since silver is expensive, therefore, copper and aluminium are commonly used for making electric wires.

ACTIVITY BASED LEARNING

- **Objective : To show that metal is a good conductor of electricity.**
- **Preparation Materials Required :** A dry cell, bulb, holder, connecting wires (copper wire), crocodile clips and a switch.
- **Procedure :** Set up all apparatus an electric circuit as shown in figure.

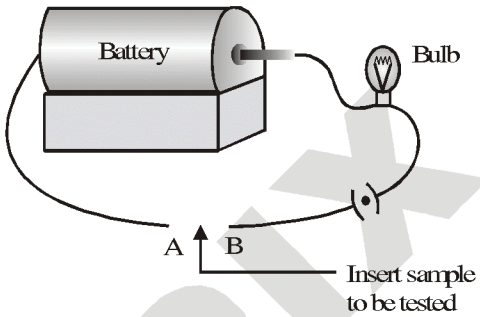


Figure : Electric circuit

- **Observation :** The bulb glows at once when switch is on.
- **Result :** This shows that copper metal conducts electric current, i.e, it is a good conductor of electricity.

(vii) Metals are lustrous and can be polished: Most of the metals have metallic lustre (shine) and they can be polished. The shining appearance of metals is also known as metallic lustre. For example, gold, silver and copper metals have metallic lustre.

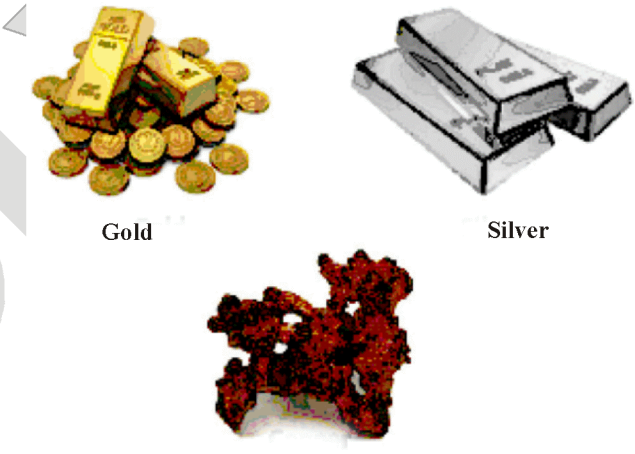


Figure : Lustrous items

(viii) Metals have high densities: Most of the metals are heavy and have high densities. For example, the density of mercury metal is very high (13.6 g cm^{-3}). However, there are some exception. Sodium, potassium, magnesium and aluminium have low densities. Densities of metals are generally proportional to their atomic masses.

Focus Point

- Osmium has maximum density (22.6 g cm^{-3}) among all elements.
- Diamond (an allotropic form of non-metal Carbon) is the HARDEST NATURAL substance known.
- Among metals Tungsten has highest melting point (3410°C) and Mercury has lowest melting point.

(ix) Metals have high melting and boiling points: Most of the metals (except sodium and potassium) have high melting and boiling points.

(x) Metals are rigid: Most of the metals are rigid and they have high tensile strength.

(xi) Metals are sonorous: Most of the metals are sonorous i.e., they make ringing sound when hit with an object.

Figure : Sonorous property of metals

(xii) Colour : Usually metals are white or silvery-grey in colour. But some metals have different colour. For example gold is yellow (yellow metal) and copper is reddish-brown.

3.2 PHYSICAL PROPERTIES OF NON-METALS

Non-metals are present on the right hand side of the periodic table (except Hydrogen).

The important physical properties of non-metals are listed below:

(i) Non-metals are brittle.

(ii) Non-metals are not ductile.

(iii) Non-metals are bad conductor of heat and electricity.

Exception: Graphite is a good conductor of electricity because of the presence of a free electrons. It is used as positive electrode in dry cells.

(iv) Non-metals are not lustrous and cannot be polished.

Exception: Graphite and Iodine are lustrous non-metals.

(v) Non-metals may be solid, liquid, or gases at room temperature.

Solids : Carbon, sulphur, iodine etc.

Gases : Oxygen, hydrogen, nitrogen etc.

Liquid : Bromine is the only non-metal which exists as a liquid at room temperature.

(vi) Non-metals are generally soft.

(vii) Non-metals have generally low melting and boiling points.

Exception: Graphite, another allotropic form of Carbon, has a melting point of about 3730°C. Other exceptions are C, B, Si which have high melting and boiling points.

Figure : Some common non-metals

(viii) Non-metals have low densities.

Exception: Iodine has high density and diamond which is almost as heavy as Al.

(ix) **Malleability :** Non-metals are not malleable i.e. sheets cannot be made from non-metals.

(x) **Tensile strength :** Non-metals have low tensile strength.

Exception: Carbon fibre is as tensile as steel.

(xi) **Sonorous :** Non-metals are non-sonorous, i.e., when struck with a hammer they do not produce ringing sound.

(xii)Colour : Chlorine is a greenish yellow gas, while bromine is brown in colour. Iodine is violet in colour,while oxygen and nitrogen are colourless gases.

Figure : Properties of non-metals

4 CHEMICAL PROPERTIES OF METALS AND NON-METALS

4.1 CHEMICAL PROPERTIES OF METALS

The atoms of the metals have usually 1, 2 or 3 electrons in their outermost shells. These outermost electrons are loosely held by their nuclei. Therefore, the metal atoms can easily lose their outermost electrons to form positively charged ions. For example, sodium metal can lose one electron from its outer most shell to form positively charged ion, Na^+. After losing the outermost electron, it gets stable electronic configuration of the noble gas (Ne : 2, 8). Similarly, magnesium can lose two electrons from its outermost shell to form Mg^{2+} ion and aluminium can lose its three outermost electrons to form Al^{3+} ion.

$Na \longrightarrow Na^+ + e^-$

(2, 8, 1) (2, 8)

$Mg \longrightarrow Mg^{2+} + 2e^-$

(2, 8, 2) (2, 8)

$Al \longrightarrow Al^{3+} + 3e^-$

(2, 8, 3) (2, 8)

Focus Point

- Iron is used about nine times more than all other metals put together.
- Iron is the constituent of haemoglobin and magnessium is the consituent of chlorophyll.

Since the metal atoms lose electrons and form positively charged ions, therefore, the metals are called electropositive elements.

Some of the important chemical properties of metals and non-metal are discussed below :

(A) Reaction of metal with oxygen

All the metals react with oxygen to form metal oxides which are basic in nature and some of them react with water to form alkaline solutions, which turn red litmus paper blue.

For example,

Sodium metal reacts with oxygen of air to form basic oxide called sodium oxide.

$$4Na + O_2 \longrightarrow \underset{\substack{\text{Sodium oxide}\\(\text{Basic})}}{2Na_2O}$$

Magensium ribbon react with oxygen on heating and from magnesium oxide.

$$2Mg + O_2 \longrightarrow 2MgO$$

Basic nature of metal oxides can be understood by following activity :

ACTIVITY BASED LEARNING

- **Object : To check the nature of magnesium oxide formed by reaction of burning magnesium ribbon in air.**
- **Materials required :** Magnesium ribbon, red and blue litmus papers and burner.
- **Procedure :** Burn magnesium ribbon in air and collect the ash. Dissolve the ash in water and test with red and blue litmus papers.

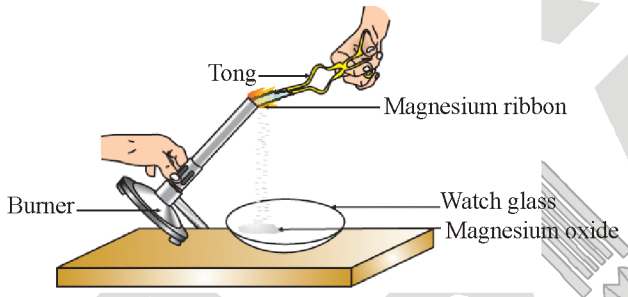


Figure : Burning of a magnesium ribbon in air and collection of magnesium oxide in a watch glass.

- **Observations :** Red litmus paper turns blue.
- **Conclusion :** Magnesium oxide formed by burning magnesium with oxygen is basic in nature.

Some more examples are given below representing that metals oxide are basic in nature.

$$Na_2O + H_2O \longrightarrow 2NaOH$$

Sodium hydroxide

$$K_2O + H_2O \longrightarrow 2KOH$$

Potassium hydroxide

Focus Point

- Aluminium oxide(Al_2O_3) and zinc oxide(ZnO), show basic as well as acidic behavior and are known as amphoteric oxides.
- Since sodium and potassium metals are higly reactive, they react vigorously with the oxygen (or air). They catch fire and start burning when kept open in the air. So, they are stored in kerosene to prevent their reaction with oxygen, moisture and CO_2 of air.
- Gold,platinum and silver do not react with oxygen (air).

(B) Reaction of metal with water

The reaction of a **metal** with water depends on the chemical reactivity of metal. Some metals react with cold water, some react with hot water. Some react only with steam whereas other do not react.

(i) Sodium reacts with water vigorously along with evolution of H_2 gas and heat.

$$2Na + \underset{\text{Cold water}}{2H_2O} \longrightarrow \underset{\text{Sodium hydroxide}}{2NaOH} + H_2$$

(ii) Magnesium reacts very slowly with cold water but reacts rapidly with boiling water. With boiling water, magnesium hydroxide[$Mg(OH)_2$] is formed but with steam magnesium oxide(MgO) is formed.

$$Mg + \underset{\text{Boiling water}}{2H_2O} \longrightarrow \underset{\text{Magnesium hydroxide}}{Mg(OH)_2} + H_2$$

This shows that magnesium is less reactive than sodium.

(iii) Zinc reacts rapidly only with steam.

$$Zn + \underset{\text{Steam}}{H_2O} \longrightarrow \underset{\text{Zinc oxide}}{ZnO} + H_2$$

This reaction shows zinc is less reactive than magnesium,

(iv) When steam is passed over red hot iron, iron oxide is formed and hydrogen gas [$H_2(g)$] is evolved (i.e. iron is less reactive metal).

$$\underset{\text{Red hot}}{3Fe} + \underset{\text{Steam}}{4H_2O} \longrightarrow \underset{\text{Iron oxide}}{Fe_3O_4} + 4H_2$$

ACTIVITY BASED LEARNING

- **Object : To compare the reactivity of some metals with water and arrange them in order of their increasing reactivity**
- **Materials required :** Small pieces of metals like sodium, magnesium, zinc, iron and copper, five test tubes, burner and test tube holder.
- **Procedure :** Put a small piece of each metal in different test tubes numbered 1 to 5. Add 5 mL of water in each test tube.

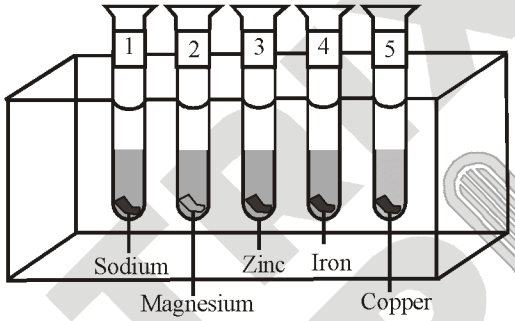


Figure : Reaction of metals in different test tube

- **Observations :** In test tube-1, in which sodium metal was taken, reaction takes place vigorously. A gas is evolved which burns with a pop sound.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$$

In test tube-2, in which Mg was taken, there is no reaction in cold water. When the test tube is heated, magnesium starts reacting and bubbles of hydrogen gas can be seen escaping from the test tube.

$$Mg + 2H_2O \xrightarrow{heat} Mg(OH)_2 + H_2\uparrow$$

In test tube-3, in which Zn was taken, reaction takes place only on boiling the water.

$$Zn + 2H_2O \xrightarrow{boil} Zn(OH)_2 + H_2\uparrow$$

In test tube-4, in which iron is taken, there is no reaction even when the water is boiled. Fe reacts slowly when it is heated with steam.
In test tube-5, which has copper and water, no reaction takes place even with steam.

- **Conclusion :** The reactivity order of the metals in the reaction with water is

$$Na > Mg > Zn > Fe > Cu.$$

(C) Reaction with acids

Reactive metals react with acids and produce hydrogen gas that bums with a 'pop' sound. Only less reactive metals such as copper, silver, gold etc. do not liberate hydrogen gas from dilute hydrochloric acid(HCl) and

dilute sulphuric acid H_2SO_4. For example,

(i) Sodium is highly reactive metal which react violently with dilute HCl acid to form sodium chloride and hydrogen gas.

$$2Na(s) + 2HCl(aq) \longrightarrow \underset{\text{Sodium chloride}}{2NaCl(s)} + H_2(g)$$

Similarly,

$$2Na(s) + H_2SO_4(aq) \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4(aq)} + H_2(g)$$

$$2Mg(s) + 2HCl\,(aq) \longrightarrow \underset{\text{Magnesium Chloride}}{MgCl_2(aq)} + H_2(g)$$

ACTIVITY BASED LEARNING

- **Object : To show the reaction of metals with acids.**
- **Materials required** : Zinc granules, dilute hydrochloric acid and burning splinter.
- **Procedure :** Take some zinc granules in a test tube. Add little dilute hydrochloric acid to it.
- **Observation :** A gas is seen coming out of the test tube in the form of bubbles. Bring a burning splinter near the mouth of the test tube. Splinter burns with a prop sound.

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

- **Conculstion :** Metals react with acids evolving hydrogen gas.

Focus Point

- Copper, silver, mercury, gold, nickel and platinum do not react with water or steam.
- Copper does not react with dil. HCl or dil H_2SO_4.

$Cu(s) + HCl\,(aq) \longrightarrow$ No reaction

$Cu(s) + H_2SO_4(aq) \longrightarrow$ No reaction

Therefore copper is even less reactive than iron.

(D) Reaction of Metals with salt solutions:

When a more reactive metal is placed in a salt solution of less reactive metal, then the more reactive metal displaces the less reactive metal from its salt solution. For example, we will take a solution of copper sulphate (blue coloured solution) and put a strip of zinc metal in the solution. It is observed that the blue colour of copper sulphate fades gradually and copper metal is deposited on the zinc strip. This means that the following reaction occurs :

$$\underset{\text{Zinc}}{Zn(s)} + \underset{\substack{\text{Copper}\\ \text{sulphate}\\ \text{(Blue solution)}}}{CuSO_4(aq)} \longrightarrow \underset{\substack{\text{Zinc sulphate}\\ \text{(Colourless solution)}}}{ZnSO_4(aq)} + \underset{\text{Copper}}{Cu(s)}$$

Here, zinc displaces copper from its salt solution.

However, if we take zinc sulphate solution and put a strip of copper metal in this solution, no reaction occurs.

$$\underset{\text{Zinc}}{ZnSO_4(aq)} + \underset{\text{Copper}}{Cu(s)} \longrightarrow \text{No reaction}$$

This means that copper cannot displace zinc metal from its solution. Thus, we can conclude that zinc is more

reactive than copper. However, if we put gold or platinum strip in the copper sulphate solution, then copper is not displaced by gold or platinum. Thus, gold and platinum are less reactive than copper.

ACTIVITY BASED LEARNING

- **Object : To compare the reactivity of the metals.**
- **Preparation Materials Required :** Test tubes, wire of copper, iron nail, copper sulphate, ferrous sulphate, thread.
- **Procedure :** Now dissolve copper sulphate in water in one test tube and ferrous sulphate in another test tube. Place iron nail in the blue coloured copper sulphate solution with the help of a thread and copper wire in the greenish colour ferrous sulphate solution as shown in figure as below.

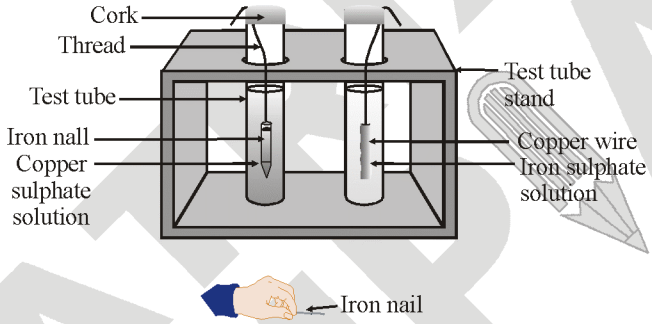


Figure : Reaction of metals with salt solutions

- **Observation :** The blue colour of copper sulphate has faded and becomes greenish. The green colour of the solution is due to the formation of iron (II) sulphate and copper is displaced. A reddish-brown coating is formed on the surface of iron nail. The reaction is represented by the chemical equation.

$$\underset{\text{Iron}}{Fe(s)} + \underset{\text{Copper sulphate solution}}{CuSO_4(aq)} \longrightarrow \underset{\text{Ferrous sulphate}}{FeSO_4(aq)} + Cu(s)$$

But the greenish colour of $FeSO_4$ do not change. That means no reaction take place.

- **Conclusion :** These activities show that iron metal is more reactive than copper.

♦ Reactivity series of metals:

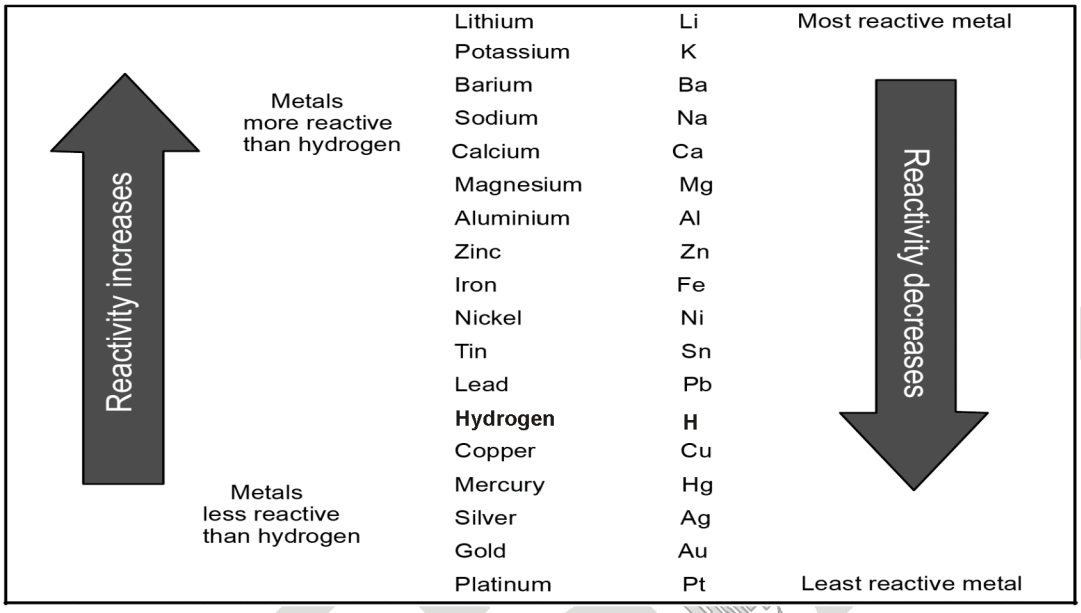
(a) Introduction :

We have learnt that some metals are chemically very reactive while others are less reactive or do not react at all. On the basis of reactivity of different metals with oxygen, water and acids as well as displacement reactions, the metals have been arranged in the decreasing order of their reactivities.

The arrangement of metals in order of decreasing reactivities is called reactivity series or activity series of metals. The activity series of some common metals is given in Table. In this table, the most reactive metal is placed at the

top whereas the least reactive metal is placed at the bottom. As we go down the series the chemical reactivity of metals decreases.

Reactivity series of metals



Focus Point

- If may be noted that hydrogen is not a metal but even then it has been placed in the reactivity series because hydorgen can also lose electron and form positive ion (H^+) like metals.

(b) Displacement of Hydrogen from Acids by Metals :

All metals above hydrogen in the reactivity series (i.e. more active than hydrogen) like zinc, magnesium, nickel etc. can liberate hydrogen from acids like HCl and H_2SO_4. These metals have greater tendency to lose electrons than hydrogen.

(c) Displacement of less reactive metal by more reactive metal :

In general, a more reactive metal (placed higher in the activity series) can displace the less reactive metal from its salt solution. For example, zinc, displaces copper from its salt solution.

$$Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$$

(c) Usefulness of Activity Series :

The activity series is very useful and it gives the following informations :

(i) The metal which is higher in the activity series is more reactive than the others. Lithium is the most reactive and platinum is the least reactive metal.

(ii) The metals which have been placed above hydrogen are more reactive than hydrogen and these can displace hydrogen from its compounds like water and acids to liberate hydrogen gas.

(iii) The metals which are placed below hydrogen are less reactive than hydrogen and these cannot displace hydrogen from its compounds like water and acids.

(iv) A more reactive metal (placed higher in the activity series) can displace the less reactive metal from its salt solution.

(v) Metals at the top of the series are very reactive and, therefore, they do not occur free in nature. The metals at the bottom of the series are least reactive and, therefore, they normally occur free in nature. For example, gold, present in the reactivity series is found in free state in nature.

Focus Point

- Metals more reactive than hydrogen lose electrons more readily than hydrogen and metals less reactive than hydrogen lose electrons less readily than hydrogen.

4.2 CHEMICAL PROPERTIES OF NON-METALS

Generally non-metals contain 4,5,6,7 electrons in their valence shell, so they can easily accept electrons to form negatively charged ions.

$Cl + 1\ e^- \longrightarrow Cl^-$

2,8,7 2,8,8

$S + 2e^- \longrightarrow S^{-2}$

2,8,6 2,8,8

Since non-metal atom lose electrons and form negatively charged ions, therefore, the metals are called electronegative elements.

(a) Reaction of non-metal with oxygen

Non metals react with oxygen to form acidic or neutral oxides.

Acidic oxides

The oxides of carbon, sulphur and phosphorus are acidic, which dissolve in water to form acid and they turn blue litmus paper red.

For example, Carbon reacts with oxygen of air to form **carbon dioxide** gas which dissolves in water to form an acid which is called **carbonic acid.**

$C(s) + O_2(g) \longrightarrow CO_2(g)$

$CO_2(s) + H_2O(l) \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3(aq)}$

Now we will discuss how non- metals reacts with oxygen.

ACTIVITY BASED LEARNING

- **Object : To show that non-metal oxides are acidic in nature.**
- **Maerial required :** Powdered sulphur, deflagrating spoon, water, red and blue, litmus paper, gas jar.
- **Procedure :** Take a small amount of sulphur in a deflagrating spoon and heat it. Put the spoon in a gas jar or a glass tumbler with a lid as soon as sulphur starts burning. Remove the spoon after some time and add some water into the jar and shake well. Checck the solution with red and blue litmus paper.
- **Observations :** Blue litmus paper turns red.
- **Conculsion :** Sulphur reacts with oxygen to form sulphur dioxide which when dissolved in water forms sulphurous acid when turns blue litmus red. It shows that non-metals oxdes are acidic in nature.

$$S + O_2 \longrightarrow SO_2$$
$$SO_2 + H_2O \longrightarrow \underset{\text{(Sulphurous acid)}}{H_2SO_3}$$

Focus Point

- Non-metal oxides are covalent in nature and are formed by the sharing of electrons.
- The non-metals are electron acceptors and so, they cannot give electrons to H^+ ions of acid and water to liberate hydrogen gas.

(B) Reaction with water :
Non-metals do not react with water or steam to give hydrogen gas. This is because non-metals cannot give electrons to reduce the hydrogen ions of water into hydrogen gas.

(C) Reaction of non-metals with acids : They do not react with acids because they are negative charged electron.

5. USES OF METALS AND NON-METALS

♦ **Uses of common metals**

(A) Aluminium

(i) Since aluminium is a good conductor of heat, corrosion-resistant and resistant to food acids, is extensively used for making cooking utensils.

(ii) It is corrosion resistant, light weight and good conductor of electricity. Due to these reasons, it is used for making cables and overhead transmission wires.

(iii) Due to its property of malleability, aluminium can be converted into very thin sheets called aluminium foils. These are used for packing various articles like chocolates, biscuits, cigarettes, medicines, photographic films soaps, tea leaves, etc.

(iv) As aluminium is a good reflector of heat, it is used to make roof tops in tall buildings to keep them cool.

(v) As aluminium is resistant to the action of air, water, many chemicals, etc., it is used to prepare window frames.

(vi) Due to its lightness, it is used for making light objects like bodies and parts of aeroplanes, ships, cars, etc.

(vii) Good reflecting property of aluminium is used in making concave mirrors in astronomical telescopes.

(B) Zinc

Zinc is bluish white or blue gray in colour and has density of 7.14 g /cm^3

(i) Zinc is used to galvanize iron to provide protection against rusting by giving a thin coat of zinc over the surface of iron articles.

(ii) Zinc is used as containers of dry cells (Leclanche cell)

(iii) Zinc dust is used for the manufacture of dye-stuffs, paints, drugs, face powders, etc.

(iv) Zinc oxide is extensively used as a pigment in paints, in medicine. Zinc sulphate is used in hides and calico printing.

(v) Zinc is extensively used to prepare useful alloys like brass, gun metal, german silver, etc.

(C) Magnesium

Magnesium is silver white in colour and has density of 1.74 g/cm^3.

(i) Magnesium is used in fire works.

(ii) It is used as reducing agent in the extraction of metals such as uranium and titanium.

(iii) It is used in the preparation of alloys such as duralumin and magnalium.

(iv) Magnesium is found in plants in chlorophyll.

(D) Lead

It is a soft silver grey metal having a density of 11.3 g/cm^3.

(i) It is used to make sinks, pipes, lead acid batteries, covers of underground electrical and telephone cables.

(ii) It is used to make protective screens for harmful rays like X-rays and γ -rays.

(iii) It is used in making alloys such as solder, type metal etc.

(E) Sodium

Sodium is a soft-white metal of density 0.968 g/cm^3.

(i) Sodium is used as reducing agent in the extraction of certain metals like uranium and titanium.

(ii) It is used in organic chemistry as a laboratory reagent.

(iii) It is used in the form of vapours in electric bulbs.

(iv) It is used to prepare an amalgam which is used as a reagent.

(F) Iron

Iron is a reddish brown metal of density 7.87 g/cm^3.

(i) It is used in making cars, trucks, and vans.
(ii) It is used in making steel.
(iii) It is used in making building supports.
(iv) It is used in making warships.
(v) It is used in making office supplies (staples, nails, and paper clips)
(vi) It is used in making computers
(vii) It is present in Haemoglobin in blood of human and it's deficiency in blood causes anaemia.

(G) Copper

Copper is a salmon-pink coloured metal with a density of 8.9 g/cm^3.

(i) It is used for the manufacture of electrical wires, cables and domestic utensils.
(ii) It is used for forming alloys like brass, bronze, german silver, gun metal, bell metal, etc.
(iii) It is used for making coins, jewellery and decorative articles.
(iv) It is used for electroplating and for making printed electronic circuits.
(v) It is used as fungicides and insecticides.

Focus Point

- In chromium plating, chromic acid solution (H_2CrO_4) is taken as electrolyte.
- Zirconium is used in making bullet proof alloys.
- Titanium is called a strategic metal because of the following reasons : The pure titanium is very strong, light and is resistant to corrosion and temperature. It has a melting point of 1670°C and boiling point of 3300°C. Due to these reasons, titanium is used in aerospace industry, for making military hard ware, in nuclear reactors, in chemical industry, for making marine equipments and for hardening steel. Because of its above mentioned unique properties and wide ranging applications. Titanium is called strategic metal.

♦ Uses of Noble Metals

(A) Uses of Silver

It is shining white, fairly heavy metal, which is best conductor of electricity and is highly malleable and ductile. Silver is put to the following uses :

(i) It is used for making silver ornaments.
(ii) It is used for making expensive utensils, such as tea pot, glasses, mugs, etc.
(iii) It is used for making coins.

(iv) Silver salts such as silver chloride, silver bromide and silver iodide are used for making photographic films as these salts are highly sensitive to light.

(v) Silver foils are used for decorating sweets and in the preparation of Ayurvedic medicines.

(B) Uses of Gold

It is a bright yellow metal, which is highly malleable and ductile. It is put to following uses:

(i) Gold is used as an index of wealth of a country. More the gold reserves of a country, more the wealth there is.

(ii) It is used for making ornaments.

(iii) It is used for making high value coins and medals.

(iv) It is used for covering the mainframe of artificial satellites.

(v) Gold foils are used in the preparation of Ayurvedic medicines.

(C) Uses of Platinum

Platinum is a silvery white metal. It is highly malleable and ductile. It is put to following uses :

(i) It is used for making expensive ornaments and watches.

(ii) It is used as a catalyst in the manufacture of sulphuric acid and nitric acid.

(iii) Platinum catalytic convertors use platinum as catalytic agent. It oxidizes carbon monoxide gas given out by the automobiles, to carbon dioxide gas. Thus, it helps in reducing carbon monoxide pollution.

(iv) It is used in chemical laboratories for detecting metallic ions present in a given salt.

♦ **Uses of common non-metals**

- Althought therer are fewer non-metals than metals, they have a lot of important uses.

(A) Fluorine

(i) The compound of fluorine - Freon is used as an important refrigerator gas. Freon has a formula - CCl_2F_2.

(ii) Fluorine compounds are used as insecticides and wood preservatives.

(iii) Fluorides of sodium and lithium serve as a flux in the soldering of aluminium.

(iv) Fluorine up to a concentration of one part per million in the drinking water prevents decaying of teeth.

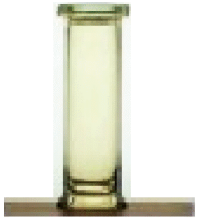
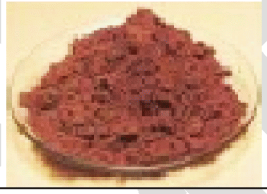
Non-metal	What it looks like	Use
Chlorine		Chlorine is used in swimming pools
Sulphur		Sulphur is used to make gun powder
Carbon		Carbon fibres are used in formula racing cars
Phosphorus		Phosphorus is used in safety matches

Figure : Uses of non-metals

(B) Chlorine

(i) It is used to bleach wood pulp in the paper industry, cotton and linen fabrics in the textile industry.

(ii) To kill bacteria in drinking water.

(iii) A compound of chlorine-bleaching powder ($CaOCl_2$) is used to disinfect the water in swimming pools.

(C) Bromine

(i) The compound ethylene dibromide is used as fumigant to kill insect pests in godowns.

(ii) Silver bromide is used to coat photographic films and plates.

(iii) Some bromine compounds have a nerve-soothing effect.

(D) Iodine

(i) An alcoholic solution of Iodine, known as Tincture of Iodine, is a well-known antiseptic.

(ii) Iodoform (CHI_3) is used in the drug industry.

(iii) Iodine in the form of iodized salt (NaI) is required for the proper functioning of thyroid gland.

(E) Sulphur

(i) It is used to make sulphur dioxide, sulphuric acid, black gun powder and insecticides.

(ii) It is used by the rubber industries in vulcanizing the rubber.

(iii) It is used for making skin ointments.

(F) Nitrogen

(i) It serves as raw material for the fertilizer and explosive industries.

(ii) It is used to create an inert atmosphere in metallurgical operations.

(iii) It is used in rooms which are meant for storing inflammable or explosive materials.

(iv) It is used in electric light bulbs to increase the life of the filament by preventing its oxidation. Argon is sometimes mixed with nitrogen in filling light bulbs.

(E) It controls the burning of fuel and oxidation of food at moderate rate.

(G) Oxygen

(i) It is necessary to sustain human life.

(ii) Cylinders of oxygen gas are used during mountain-climbing expeditions to help in respiration at high elevations.

(iii) It makes possible the production of high temperatures in oxy-hydrogen and oxy-acetylene torches.

(iv) In hospitals it is used to assist in the recovery of patients from lung diseases and pneumonia.

(v) It is essential for the combustion of fuels.

(H) Hydrogen

(i) It is used for hydrogenation of vegetable oils to form solid fats called Vanaspati Ghee.

(ii) Hydrogenation process is also used in the refining of petroleum products to increase the yield of gasoline.

(iii) It is used extensively in the production of ammonia and hydrochloric acid.

(iv) The high temperature produced by the flame of oxygen and hydrogen is used for cutting and welding metals.

(v) A mixture of hydrogen and helium is used for filling weather observation balloons.

(vi) It makes a good fuel as it does not cause any pollution on burning.

(I) Phosphorus

Phosphorus occurs in two allotropic forms namely white and red. The white phosphorus is highly reactive and poisonous as compared to red phosphorus. The white phosphorus on oxidation becomes yellow. The uses of phosphorus are :

(i) Phosphorus is used in match box. Red phosphorus is used in making striking surface of match boxes.

(ii) A compound of white phosphorus-tetra phosphorus trisulphide (P_4S_3) is used in making striking tip of match boxes.

(iii) White phosphorus in the form of Zinc phosphide is used in making rat poisons.

(iv) White phosphorus is also used in the manufacture of military grenades and bombs.

(v) It is used in making smoke bombs which produce smoke screen during war. It is also used in fire works.

(vi) It is used for making superphosphate which is used as a fertilizer.

(J) Silicon

(i) Purified Silicon is used for making solar cells, transistors and computer chips.

(ii) It is used for preparing silicon polymers (called silicones) which are heat resistant and water repellent.

(iii) Compounds of silicon are also very useful. For example -

(a) SiC (carborundum) is used for cutting and grinding tools.

(b) SiO_2 (Silica) is used for making glass and cement.

(c) Na_2SiO_3 (sodium silicate) which is also called water glass, is used for preserving eggs and for making silica gardens.

(d) Quartz crystals are used in watches.

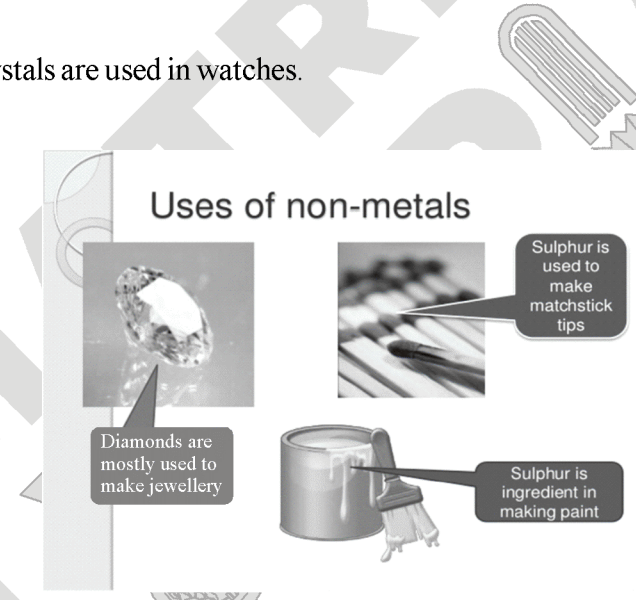


Figure : Uses of non-metals

Focus Point

- Liquid nitrogen is used in medical research to keep tissue samples frozen.
- Gold and silver amalgam are used in dentistry for filling tooth cavities.
- Gallium metal has such a low melting point (30°C) that it melts with the heat of a hand.
- Spherical droplets of mercury, a very dense liquid.

6. CORROSION OF METALS

Surface of many metals is easily attacked when exposed to atmosphere. They react with air or water present in the environment and form undesirable compounds on their surfaces. These undesirable compounds are generally oxides. Thus, corrosion is a process of deterioration of metal as a result of its reaction with air or water (present in environment) surrounding it.

(A) Corrosion of Iron :

Iron corrodes readily when exposed to moisture and gets covered with a brown flaky substance called rust. This is also called Rusting of Iron.

Chemically, the rust is hydrated iron (III) oxide ($Fe_2O_3.xH_2O$).

$$2Fe(s) + 3/2O_2(g) + xH_2O(l) \longrightarrow \underset{\text{hydrate ferric oxide}}{Fe_2O_3.xH_2O(s)}$$

Rusting is an oxidation process in which iron metal is slowly oxidized by the action of air (in presence of water). Therefore, rusting of iron takes place under the following conditions:

- Presence of air (or oxygen)
- Presence of water (moisture)
- More the reactivity of the metal, the more will be the possibility of the metal getting corroded.

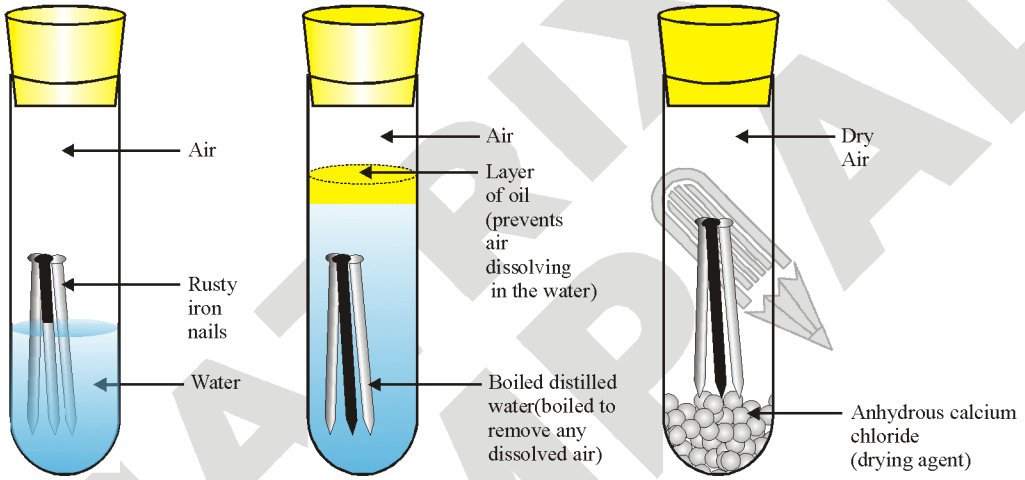
To understand that Rusting of iron requires both air and moisture, an activity is given below :

ACTIVITY BASED LEARNING

- **Object : To show that rusting of iron requires both air and water.**
- **Preparation materials required :** Test tubes, corks, iron nails, water, oil, anhydrous calcium chloride.
- **Procedure:** Take three test tubes and put one clean nail in each of three test tubes. Label these test tubes A, B and C.

Pour some water in test tube A so that about 2/3 of the nail is immersed in water and cork the test tube.

Pour some boiling distilled water in test tube B. Then pour 1 mL of oil and cork it.



Put some anhydrous $CaCl_2$ in test tube C and cork it. Now, have these test tubes for a few days and then observe.

- **Observation :**

(i) The nail in test tube A will rust due to nail is exposed to both air and moisture.

(ii) The nail in test tubes B and C are does not rust. Because test tube B contain boiling distilled water and oil which prevents air dissolving in the water.

(iii) In test tube C, the anhydrous $CaCl_2$ is drying agent which absorbed any moisture air.

- **Conclusion :** This activity clearly shows that both air and water must be necessary for rusting.

♦ Prevention of rusting :

(i) Corrosion of metals can be prevented by coating the metal surface with a thin layer of paint, varnish or grease.

(ii) Iron is protected from rusting by coating it with a thin layer of another metal which is more reactive than iron. This prevents the loss of electrons from iron because the active metal loses electrons in preference to iron. Zinc is commonly used for covering surface of iron. The process of covering iron with zinc is called galvanization. Iron is also coated with other metals such as tin known as tin coating.

(iii) By alloying : Some metals when alloyed with other metals become more resistant to corrosion. For example, when iron is alloyed with chromium and nickel, it forms stainless steel. This is resistant to corrosion and does not rust at all.

(iv) To decrease rusting of iron, certain antirust solutions are used. For example, solutions of alkaline phosphates are used as anti-rust solutions.

Focus Point

- Rusting is term used only in case of iron. If the rusted surface of iron is rubbed with a sand paper, the rust will appear again in a few days, this shows that the rust is formed by a chemical reaction and not by a physical process.

(B) Corrosion of Aluminium :

Due to the formation of a dull layer of aluminium oxide when exposed to moist air, the aluminium metal loses its shine very soon after use. This aluminium oxide layer is very tough and prevents the metal underneath from further corrosion (because moist air is not able to pass through this aluminium oxide layer). This means sometimes corrosion is useful.

(C) Corrosion of Copper :

When a copper object remains in damp air for a considerable time, then copper reacts slowly with carbon dioxide and water of air to form a green coating of basic copper carbonate [$CuCO_3.Cu(OH)_2$] on the surface of the object. Since copper metal is low in the reactivity series, the corrosion of copper metal is very, very slow.

$$\underset{\text{Copper}}{2Cu(s)} + \underbrace{CO_2(g) + O_2(g) + H_2O\ (l)}_{\text{From moist air}} \longrightarrow \underset{\substack{\text{Basic copper}\\ \text{carbonate (Green)}}}{CuCO_3.\ Cu(OH)_2}$$

(D) Corrosion of Silver :

Silver is a highly unreactive metal, so it does not reacts with oxygen of air easily. But, air usually contains a little of sulphur compounds such as hydrogen sulphide gas (H_2S), which reacts slowly with silver to form a black coating of silver sulphide (Ag_2S). Silver ornaments gradually turn black due to the formation of a thin silver sulphide layer on their surface and silver is said to be tarnished.

$$\underset{\text{Silver}}{2Ag(s)} + \underset{\text{Hydorgen sulphide}}{H_2S(g)} \longrightarrow \underset{\text{Silver sulphide}}{Ag_2S(s)} + H_2(g)$$

Focus Point

- The word metal comes from the Greek word 'metallon,' which means quarry or to mine or excavate.
- The most abundant metal in the universe is iron, followed by magnesium. The composition of the Earth is not entirely known, but the most abundant metal in the Earth's crust is aluminum. However, the Earth's core likely consists mainly of iron.
- The most commonly used metals are iron, aluminum, copper, zinc, and lead. Metals are used for an enormous number of products and purposes. They are valued for their ability to strength, electrical and thermal properties, ease of bending and drawing into wire, wide availability, and participation in chemical reactions.
- Although new metals are being produced and some metals were difficult to isolate in pure form, there were seven metals known to ancient man. These were gold, copper, silver, mercury, lead, tin, and iron.
- The tallest free-standing structures in the world are made of metals, primarily the alloy steel. They include the Dubai skyscraper Burj Kalifa, the Tokyo television tower Skytree, and the Shanghai Tower skyscraper.
- The only metal that is a liquid at ordinary room temperature and pressure is mercury. However, other metals melt close to room temperature. For example, you can melt the metal gallium in the palm of your hand.
- Aluminium is mostly used in making beverage cans and recycling one aluminium can save enough energy to run a TV for three hours.
- Precious metals have significant economic importance. Most of the precious metals are also noble metals, since its important for a currency to resist wear and tear. Eg. Gold and Silver.

7. ALLOY

An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal.

For example, iron is the most widely used metal. But it is never used in the pure form. This is because iron is very soft and stretches easily when hot. But when it is mixed with a small amount of carbon (about 0.5 to 1.5%), it becomes hard and strong. The new form of iron is called steel.

♦ Objectives of Alloy Making :

Alloys are generally prepared to have certain specific properties which are not possessed by the constituent metals. The main objects of alloy-making are:

(i) To increase resistance to corrosion : For example, stainless steel is prepared which has more resistance to corrosion than iron.

(ii) To modify chemical reactivity : The chemical reactivity of sodium is decreased by making an alloy with mercury which is known as sodium amalgam.

(iii) To increase the hardness : Steel, an alloy of iron and carbon is harder than iron.

(iv) To increase tensile strength : Magnalium is an alloy of magnesium and aluminium. It has greater tensile strength as compared to magnesium and aluminium.

(v) To lower the melting point : For example, solder is an alloy of lead and tin (50% Pb and 50% Sn). It has a low melting point and is used for welding electrical wires together.

♦ **Improving Properties of Metals by Formation of Alloys**

- Certain properties of the metals such as lustre, malleability, ductility, resistance to action by air and moisture etc. can be improved by the addition of small amounts of other metals or even non-metals. For example, pure gold (also called 24 carat gold) is very soft. It cannot be used for making jewellery. A small amount of silver or copper is mixed with it in order to improve its hardness, malleability and ductility. This is normally 22 carat gold and is used in making ornaments. It is prepared by melting the main constituting metal and then adding definite proportions of the other elements (metals or non-metals) also in the molten state. The molten mass is uniformly stirred and cooled to form a solid mass. This is known as alloy. The alloy in which mercury is one of the constiuents is known as **amalgam**.

S. No.	Alloy	Composition	Uses
1	Brass	Cu – 80%, Zn = 20%	Harder than pure Cu and Zn; used for making utensils, cartridges
2	Bronze	Cu = 90%, Sn – 10%	For making statues, medals, ships, coins, machines etc.
3	Solder	Sn = 50%, Pb = 50%	For joining metals, soldering wires, electronic components, etc.
4	Duralumin	Al = 95.5%, Cu – 50% Mn = 1%, Mg – 0.5%	In bodies of aircrafts, kitchen ware, automobile parts etc.
5	German silver	Cu = 60%, Zn = 20% Ni – 20%	For making utensils, ornaments.
6	Gun metal	Cu = 90%, Sn = 10%	Gears, castings, etc.
7	Bell metal	Cu = 78%, Sn = 22%	Bells, gongs, etc.
8	Magnalium	Al – 90%, Mg = 10%	Balance beams, light instruments.
9	Magnalium	Pb – 82%, Sb – 15% Sn = 3%	Casting type
10	Stainless steel	Fe = 73%, Cr – 18% Ni = 8%, rest carbon	Utensils, cutlery etc.

Comparision of Physical Properties of Metals and Non-metals

S. No.	Property	Metals	Non-metals
1.	Lustrous	Metals have lustre and can also be polished	Except iodine, non-metals do not have lustre and cannot be polished.
2.	Hardness	Metals (except sodium and potassium) are generally hard.	Non-metals are generally soft (except : diamond).
3.	Malleability and ductility	Metals are malleable (can be hammered into thin sheets) and ductile (can be drawn into wires)	Non-metals are neither malleable nor ductile. They are actually brittle.
4.	Conductivity	Metals are good conductors of heat and electricity.	Non-metals are bad conductor of heat and electricity (except graphite)
5.	Melting points and boiling points	Metals generally have high melting and boiling points. (except : mercury and gallium)	Non-metals have low melting and boiling points (except : carbon)
6.	Sonorosity	Metals are sonorous (i.e., produce ringing sound when hit with a hard object)	Non-metals are non-sonorous (i.e., do not produce ringing sound when hit with a hard object).
7.	Density	Metals generally have high density.	Non-metals generally have low density.
8.	Tensile strength	Metals generally have high tensile and hence cannot be easily broken.	Non-metals, generally, have low tensile strength and hence can be easily broken.
9.	Physical state	Metals are generally solid at room temperature.(except : mercury)	Non-metals are either solid or gas at room temperature(expect : bromine).

MATERIALS : METALS AND NON-METALS

Depending upon the physical and chemical properties materials are divided into different types.

Metals : Those elements which lose electrons to from positive ions.

Physical properties
- Physical state : hard solids
- Very high melting and boiling points
- These can be beaten into thin sheets, i.e., these are malleable.
- These can be drawn into wires i.e., these are ductile.
- Good conductors of heat and electricity.
- They have lustre .

Chemical properties
- Reaction with oxygen : Metals form basic oxides.
- React vigorously with water.
- React with acids release hydrogen.
- Can displace less reactive metals from their salt solution.

Uses
- In making electrical wires e.g., copper and aluminium.
- In making utensils e.g., aluminium
- For making jewellery e.g., silver, gold, platinum, etc.

Reactivity series and extraction of metals

Increasing reactivity

Potassium, Sodium, Calcium, Magnesium, Aluminium	Because of their high reactivity they are extracted by electrolysis of their molten chlorides or oxides.
Carbon	
Zinc, Iron, Lead	Moderately reactive metal are extracted by heating them with carbon. This is a "reduction reaction"
Copper, Mercury	Heating sulphide in air (reduction by heating only)
Silver, Platinum, Gold	Low reactive metals Found in free state (as metals)

Metals
Those elements which accept electrons to form negative ions.

Physical properties
- Physical state : solid, liquid or gas
- Neither malleable nor ductile
- Poor conductors of electricity and heat.
- Do not have lustre.

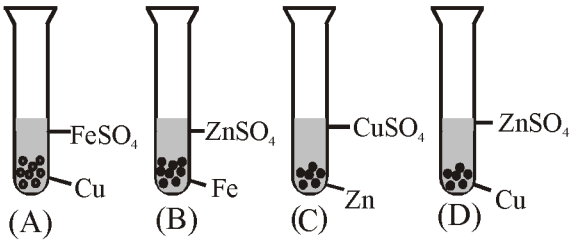
Chemical properties
- Reaction with oxygen :
- Non-metals form acidic oxides.
- Generally do not react with water.
- Do not react with acids.

Uses
- Non-metals are essential for our life.
- Used in fartilizers to enhance growth of plants.
- In water purification
- Used in crackers.

Metalloids : These are the elements which are less reactive than metals and more reactive than non-metals.These have intermediate properties.

SOLVED EXAMPLES

SE1. In the following four test tubes, some metals are in contact with certain salt solutions. After the experiment, in which of the test tubes does the solution become colourless and a powdery red mass is deposited at the bottom of the test tube?



Ans. In test tube (C), the blue solution of $CuSO_4$ becomes colourless. Zn will displace Cu from $CuSO_4$ solution. Cu will be deposited as red powder and a colourless solution of $ZnSO_4$ is obtained.

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

Blue Colourless Reddish brown

SE2. A silver spoon is kept immersed in an aqueous solution of copper sulphate. What change will take place?

Ans. Silver spoon will remain unaffected. Blue colour of copper sulphate will also not fade. This is because no chemical reaction takes place between silver and copper sulphate solution since silver is placed be low copper in the activity series.

SE3. A solution of copper sulphate was stored in an iron container. After a few days, some holes were seen in the iron container. Explain the observation.

Ans. Iron lies above copper in the activity series which means iron is more reactive than copper. Hence, copper is displaced by iron from copper sulphate solution. Iron gets dissolved in copper sulphate solution, creating holes in the container

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$

SE4. What happens when samples of metals and non-metals are mixed with acids?

Ans. Metals react with acids to produce hydrogen gas which burns with a pop sound. Non-metals do not react with acids since they cannot displace hydrogen from the acids.

SE5. Compare metals and non-metals on the basis of chemical properties.

Ans.

S. No.	Metals	Non-metals
1.	Metals react with oxygen to give oxides which are generally basic in nature.	Non-metal react with oxygen to give oxides which are acidic in nature.
2.	Metals react with water to produce oxides or hydroxides and hydrogen gas.	Non-metals do not react with water.
3.	Metals react with acids to give hydrogen gas.	Non-metals do not react with acid.
4.	More reactive metals displace less reactive metals from their salt solution.	Non-metals do not displace metals from their salt solution.

SE6. Name the metals present in the bases and non-metals present in the acids listed below:

(i) Slaked lime (ii) Magnesium hydroxide
(iii) Caustic soda (iv) Zinc hydroxide
(v) Sulphuric acid (vi) Nitric acid
(vii) Phosphoric acid (viii) Carbonic acid

Ans. (i) Slaked lime (Calcium hydroxide) : Calcium
(ii) Magnesium hydroxide : Magnesium
(iii) Caustic soda (Sodium hydroxide) : Sodium
(iv) Zinc hydroxide : Zinc
(v) Sulphuric acid : Sulphur

(vi) Nitric acid : Nitrogen

(vii) Phosphoric acid : Phosphorus

(viii) Carbonic acid : Carbon

SE7. Which of the following reactions cannot take place? Justify your answer.

(i) Iron + Zinc sulphate → Iron sulphate + Zinc

(ii) Copper + Silver nitrate → Copper nitrate + Silver

(iii) Zinc + Ferrous sulphate → Zinc sulphate + Iron

(iv) Iron + Copper sulphate→ Iron sulphate + Copper

Ans. Reaction (i) will not take place because iron is less reactive than zinc hence it cannot displace zinc from zinc sulphate. In other reactions, copper is more reactive than silver, zinc is more reactive than iron, iron is more reactive than copper, hence, all other reactions will take place.

SE8. Complete and balance the chemical equation for the following reactions :

(i) Sulphur + Oxygen →

(ii) Phosphorus + Oxygen →

(iii) Carbon + Oxygen →

(iv) Zinc + Oxygen →

(v) Sodium + Oxygen →

Ans. (i) $2S + 3O_2 \rightarrow 2SO_3$

(ii) $4P + 5O_2 \rightarrow 2P_2O_5$

(iii) $2C + O_2 \rightarrow 2CO$

(iv) $2Zn + O_2 \rightarrow 2ZnO$

(v) $4Na + O_2 \rightarrow 2Na_2O$

SE9. Explain reactions of sodium, magnesium and iron with water.

Ans. (i) Sodium reacts vigorously with cold water generating a lot of heat and catches fire.

$$\underset{\text{Sodium}}{Na} + \underset{\text{Water (cold)}}{2H_2O} \longrightarrow \underset{\text{Sodium hydroxide}}{2NaOH} + \underset{\text{Hydrogen gas}}{H_2}$$

(ii) Magnesium reacts with hot water to give magnesium hydroxide and hydrogen.

$$\underset{\text{Magnesium}}{Mg} + \underset{\text{Hot boiling water}}{2H_2O} \longrightarrow \underset{\text{Magnesium hydroxide}}{Mg(OH)_2} + \underset{\text{Hydrogen gas}}{H_2}$$

(iii) Iron in red hot state reacts with steam to give iron oxide and hydrogen.

$$\underset{\text{Iron red hot}}{3Fe} + \underset{\text{Steam}}{4H_2O} \longrightarrow \underset{\text{Iron oxide}}{Fe_3O_4} + \underset{\text{Hydrogen gas}}{4H_2}$$

SE10. (i) What is an alloy?

(ii) A light and strong alloy is required for making bodies of aircrafts what should be its constituents?

Ans. (i) An alloy is a homogeneous mixture of a metal with other metals or non-metals, which yields a substance with improved metallic properties.

(ii) The alloy is duralumin and its constituents are aluminium and copper with traces of manganese and magnesium.

SE11. Define the terms : galvanized iron and passive iron.

Ans. To prevent from corrosion, when an iron sheet is covered with a thin layer of zinc on its surface, it is called galvanized iron.

When iron is treated with concentrated nitric acid, a protective film of oxide is formed on its surface which prevents it from further corrosion by making it inactive. This iron is known as passive iron.

SE12. Are metals a renewable resources? If not, can they be recycled?

Ans. Metals are extracted from naturally occurring minerals in the earth's crust. No new minerals are formed in place of the used ones. Hence, metals are non-renewable resources. Metals like gold, silver, copper are recycled and not thrown away.

Recycling does not cause any change in strength or quality of the metal. Aluminium and steel cans which are thrown away after use, should also be recycled since metals are non-biodegradable.

SE13. Metal M occurs in earth's crust as its oxide M_2O_3. An alloy of this metal is used in making aircrafts. Name the metal M and its oxide.

Ans. Metal M is aluminium. Its oxide is Al_2O_3. Its alloy (duralumin) is used in making aircrafts. The composition of duralumin is Al = 95.5%, Cu = 3%, Mn = 1%, Mg = 0.5%. It is very light in weight and corrosion resistant.

SE14. Are metals a renewable resources? If not, can they be recycled?

Ans. Metals are extracted from naturally occurring minerals in the earth's crust. No new minerals are formed in place of the used ones. Hence, metals are non-renewable resources. Metals like gold, silver, copper are recycled and not thrown away. Recycling does not cause any change in strength or quality of the metal. Aluminium and steel cans which are thrown away after use, should also be recycled since metals are non-biodegradable.

SE15. Explain the reaction of sodium and water with the help of an activity.

Ans. Take a beaker, fill it half with water. Cut a small piece of sodium metal. Dry it using a filter paper and wrap it in a small piece of cotton. Put the piece of sodium wrapped in cotton into the beaker care fully. We observe that the beaker becomes hot immediately. We test the solution with red and blue litmus paper. It turns red litmus blue. This activity indicates thatsodium is highly reactive and it reacts vigorously with water with a lot of heat generation. The solution formed by the reaction is basic in nature due to formation of sodium hydroxide.

$$2Na + 2H_2O \rightarrow 2NaOH + H_2$$

EXERCISE-I

ONLY ONE CORRECT TYPE

1. The non-metal which is a liquid at room temperature is :
   (A) chlorine (B) bromine
   (C) iodine (D) carbon
2. The non-metal having a shining surface is :
   (A) sulphur (B) phosphorus
   (C) iodine (D) carbon
3. The non-metal which is a good conductor of electricity is :
   (A) diamond (B) iodine
   (C) graphite (D) silicon
4. Crabon is obtained from
   (A) Plants (B) Animals
   (C) Both (A) and (B) (D) None of these
5. Which among the following elements is a metalloid?
   (A) Beryllium (B) Barium
   (C) Boron (D) Bismuth
6. Coating iron with a thin layer of zinc, to prevent rusting is called -
   (A) galvanization (B) anodizing
   (C) crystallization (D) None of these
7. The only metal which is liquid at room temperature is:
   (A) bromine (B) mercury
   (C) both (A) & (B) (D) none of these
8. Which among the following is the poorest conductor of heat ?
   (A) Silver (B) Gold
   (C) Copper (D) Lead
9. Which among the following metals can be cut with a knife ?
   (A) Sodium (B) Copper
   (C) Aluminium (D) Iron
10. Which among the following metals are ductile?
    (A) Copper (B) Aluminium
    (C) Gold (D) All of these
11. The shining appearance of metals is called as :
    (A) malleability (B) lustre
    (C) ductility (D) conductivity
12. The best conductor of heat is :
    (A) silver (B) gold
    (C) copper (D) lead
13. The non-metal which has very high melting point is:
    (A) Sulphur (B) Graphite
    (C) Phosphorus (D) Tungsten
14. The most reactive metal among the following is :
    (A) copper (B) silver
    (C) potassium (D) calcium
15. The metal which reacts with water only when it is red hot & steam is passed over it is :
    (A) sodium (B) calcium
    (C) iron (D) magnesium
16. The metal which cannot be stored in packets is :
    (A) sodium (B) calcium
    (C) magnesium (D) zinc
17. The only non-metal included in the reactivity series of metals, is :
    (A) H (B) Cl
    (C) He (D) Br
18. The metal which is least reactive is :
    (A) Ag (B) Au
    (C) Cu (D) Pt
19. The oxides of metals are usually :
    (A) acidic (B) basic
    (C) neutral (D) amphoteric
20. Sulphur dioxide is
    (A) basic oxide (B) acidic oxide
    (C) neutral oxide (D) None of these

21. Out of copper, silver, iron and zinc the metal that can displace all others from their salt solutions is
(A) copper (B) silver
(C) iron (D) zinc

22. Which one of the following statements is correct
(A) Metals lose electrons to become positive ions
(B) Metals lose electrons to become negative ions
(C) Metals gain electrons to become positive ions
(D) Metals gain electrons to become negative ions

23. $2P + X \longrightarrow P_2S_5$.
In the above reaction X is -
(A) 5S (B) 3S
(C) 2S (D) S

24. Carbon monoxide is a/an -
(A) acidic oxide (B) basic oxide
(C) amphoteric oxide (D) neutral oxide

25. Oxide formed by an element X turns blue litmus red. Element X is -
(A) phosphorus (B) sodium
(C) iron (D) copper

PARAGRAPH TYPE

Paragraph # 1

Ductile means that metals can be drawn (stretched) into thin wires. This property of metals is called ductility. Gold and silver are the most ductile metals. Copper, aluminium and tungsten are also very ductile, and therefore, these can be drawn into thin wires which are used in electrical wiring. Metals like Na, K, Ca etc. are not ductile, while metals like Sn, Pb etc. are less ductile.

1. The property of metals by which it can be drawn wires is called ___.
(A) sonority (B) malleability
(C) ductility (D) lusture

2. Which metal has the highest ductility ?
(A) Silver (B) Potassium
(C) Iron (D) Aluminium

3. 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.

Paragraph # 2

Metals are good conductors of electricity. The electrical and thermal conductivities of metals are due to the presence of free electrons in them. Among all the metals, silver is the best conductor of electricity. Copper and aluminium are the next best conductors of electricity. Since silver is expensive, therefore, copper and aluminium are commonly used for making electric wires.

1. Which among the following is the best conductor of electricity ?
(A) Iron (B) Silver
(C) Lead (D) Copper

2. It allows current to pass throught them ?
(A) Iron (B) Wood
(C) Leather (D) Paper

3. Why are metals good conductors of electricity ?
(A) They have high melting point
(B) The gain electrons easily
(C) The presence of free electrons
(D) All of above

MATCH THE COLUMN

1.

Column-I	**Column-II**
P. Ductile	(i) The property of making ringing sound
Q. Malleable	(ii) A substance can be drawn into wires
R. Sonority	(iii) The substance can be beaten into thin sheets.
S.Tensile strength	(iv) Ability to withstand the longitudinal pull.

(A) P-(iii), Q-(ii), R-(i), S-(iv)
(B) P-(ii), Q-(iii), R-(iv), S-(i)
(C) P-(ii), Q-(i), R-(iii), S-(iv)
(D) P-(ii), Q-(iii), R-(i), S-(iv)

2.

Column-I	**Column - II**
P. Iron oxide	(i) Liquid metal
Q. Noble metal	(ii) Acidic oxidic
R. Sulphur dioxide	(iii) Gold
S. Mercury	(iv) Basic oxide

(A) P-(iii), Q-(ii), R-(iv), S-(i)
(B) P-(iv), Q-(iii), R-(ii), S-(i)
(C) P-(iv), Q-(ii), R-(i), S-(iii)
(D) P-(ii), Q-(iv), R-(iii), S-(i)

EXERCISE-II

VERY SHORT ANSWER TYPE

1. How many non metals are there in periodic table ?
2. What is composition of air?
3. What is the nature of metal oxide ?
4. What is colour of copper sulphate ?
5. Which is more reactive Zn or Fe ?
6. What is chemical formula of sodium oxide ?
7. Which is the most reactive metal in the reactivity series?
8. What is the nature of non metal oxide?
9. Which non metal is used for hydrogenation of vegetable oil ?
10. Which metal is used for galvanization?

SHORT ANSWER TYPE

1. Which property of metals makes them suitable for use in jewellery ?
2. What are the chemiical properties of metal.
3. What is lustre?
4. Name the gas produced, when metals react with acids.
5. What are displacement reactions ?

LONG ANSWER TYPE

1. Why is copper used for making electrical wires ? Give reasons.
2. Why immersion rods for heating liquids are made up of metallic substances ?
3. Why metals are used in making aeroplanes, bridges, satellites etc. ?
4. Write down the reactivity series of metals.
5. Difference between metal and non metal.

FILL IN THE BLANKS TYPE

1. The two classifications of elements are _____
2. Metals can produce sound when struck, this property of metals is known as_____.
3. _____ is the metal existing in liquid form at ordinary temperatures.
4. Metals react with mineral acids to form _____
5. _____ is a metal with poorest conduct electricity.

TRUE / FALSE TYPE

1. All metals react with other substance to form chemical compounds.
2. All the elements having one electron in their outermost shell are metals.
4. Nonmetals are good oxidizing agents.
5. Non metals have many different colours.

EXERCISE I					ANSWER KEY									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
B	C	C	C	C	A	B	D	A	D	B	A	B	C	C
16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
A	A	D	B	B	D	A	A	D	A					

FILL IN THE BLANKS

1. Metal and Non metal 2.Sonority 3. Mercury 4. Salt 5. Lead

TRUE / FALSE

1. False 2.False 3. True 4. True 5. True

PARAGRAPH

1. C 2.A 3. C 4. B 5. A 6.C

MATCH THE COLUMN

1. D 2. B

SELF PROGRESS ASSESSMENT FRAMEWORK

(CHAPTER : METALS AND NON-METALS)

CONTENT	STATUS	DATE OF COMPLETION	SELF SIGNATURE
Theory			
In-Text Examples			
Solved Examples			
Exercise I			
Exercise II			
Short Note-1			
Revision - 1			
Revision - 2			
Revision - 3			
Remark			

NOTES :

1. In the status, put "completed" only when you have thoroughly worked through this particular section.
2. Always remember to put down the date of completion correctly. It will help you in future at the time of revision.

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