Chapter 2

Metals and Non-metals

Points to study

2.1 Metals and Non-metals in nature.
2.2 Physical properties of Metal and & Non-metals.
- Physical properties of metals
- Physical properties of non-metals

2.3 Chemical properties of Metals.
2.4 Chemical properties of Non-metals.
2.5 Uses of Metals & Non-metals in daily life.
2.6 Nobel metals or Inert metals
2.7 Alloys

2.1 Metals and Non-metals in Nature :

We see many different types of substance in our daily life. Like wooden chair, coal, aluminium sheet, bronze utensils, soil etc. All these substances are made up of different elements. Some substances are solid, shining and hard while some others are dull, soft and porous. Let us understand. Try identifying substances on the basis of their lustre (shine) and tabulated data in Table 2.1

Activity 1

Table 2.1 Identification of substances on the basis of their Lustre.

S.NO.	Name of substances	Lustrous and non-lustrous
1.	Copper glass	.....
2.	Aluminium sheet	.....
3.	Coal powder	.....
4.	Soil	.....
5.	Wooden chair	.....

From these some are metal and some are non-metals. Those substances which are shiny are generally metals while which are dull are non-metals. On the earth crust some metals like gold, platinum and some are non metals like sulphur and hydrogen etc are found. They are found in Free states as elements or in combined form as their oxides carbonates, sulphates and etc. Examples are aluminium, iron, manganese oxide and phosphorous. Let us learn about more properties of metals and non-metals.

2.2 Physical properties of Metals and Non-metals

• Physical properties of Metals

1. Physical state :

Activity 2

What are iron chair, steel utensils, gold and silver jewellery made up of? These are made up of hard and solid metals. At room temperature all the metals are solid except Mercury which is liquid at room temperature.

Fig. 2.1 Metal in solid state

2. Colour :

Metals are generally grey in colour.

3. Lustre :

Activity 3

Rub rough metal with sand paper. What you see? You will see that it got shiny again. The reason for this is they all reflect light from their surfaces. Metals have special lustre which is known a metallic shine. Silver, gold, aluminium, copper etc. are all lustrous metals.

Fig. 2.2 Container made of lustrous metals

4. Hardness :

Activity 4

Try to cut an iron piece with the help of a knife. Is the iron pieces are cut easily with knife? No, because maximum metals are hard. They cannot be cut easily. All metals have difference in hardness. Sodium and potassium are easily cut like wood which shows that they are soft in texture.

5. Sonorous:

Activity 5

Take any metallic thing like steel plate, school bell, metal coin, aluminium sheet etc and strike it with any hard object. They produce a special metallic sound when stricken with any hard and strong object. This is called sonorous nature of metals. For this reason they are used as bells, instruments of music etc.

Fig. 2.3 Sonority in metals

6. Density:

Normally, the density of metals is high. Let us know.

Activity 6

Dip the substances made of metal like iron nail, steel spoon etc in a bucket fill of water. What you observe? You observe that all the substances sink in water as their density is higher than water. Some metal have low density and therefore floats on water. Example sodium (Na) and Potassium (K) etc.

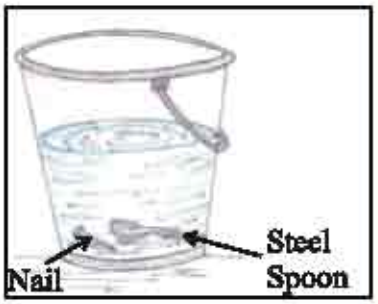

Fig. 2.4 Density of metals

7. Melting point :

That point of temperature on which any substance start melting from solid state to liquid state is called melting point of that substance. Metals have high melting points, because of their hardness. Examples are Iron (Fe) melting point – 1593° C. But Gallium (Ga) is exception to this which melts even when kept on palm because its melting point is very low.

8. Conduction of heat :

Are metals conductors of heat? Let us know.

Activity 7

Take a glass beaker and fill it half with water. Dip a steel spoon and a wooden stick in it. Now heat the beaker. After sometime touch and feel the spoon and wooden stick. What have you have you observe? You will observe that steel spoon feels hot while wooden stick do not. Therefore we can say that metals are good conductors of heat. That is why the utensils used in kitchen for cooking are

made up of iron, brass, copper or aluminium. Silver (Ag) is the best conductor of heat whereas lead (Pb) is the worst conductor of heat.

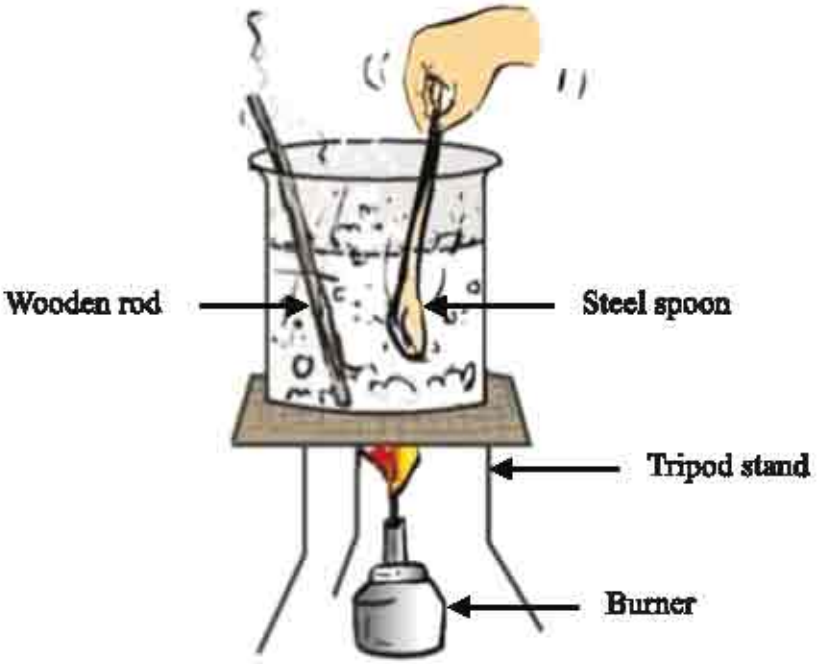

Fig. 2.5 Thermal conductivity of metals

9. Malleability:

Malleable means to be drawn into sheets and wires. Metals are malleable and drawn into sheets.

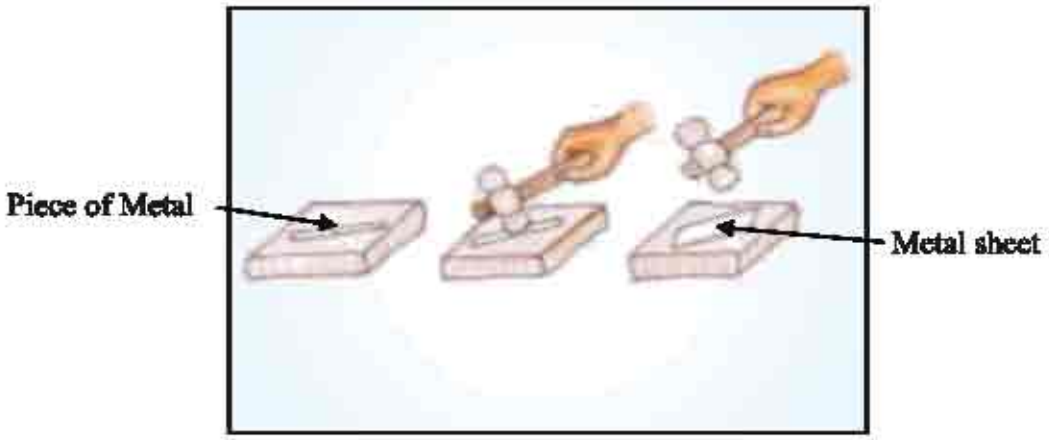

Fig. 2.6 Malleability of metals

10. Electrical conductance:

The flow of electric current from metal made them conductors of electricity. Silver has highest conductance.

Activity 8

Take a cell and connect a bulb through wires as shown in figure. When you connect the circuit the bulb starts glowing. Therefore we can say that metals are conductors of electricity.

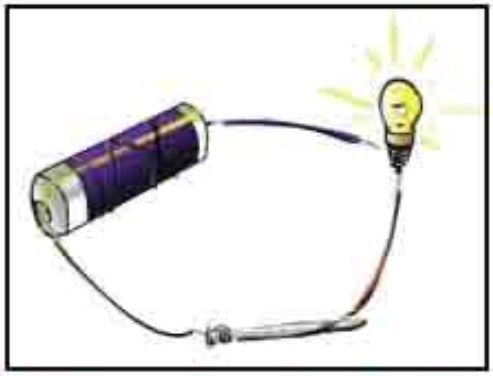

Fig. 2.7 Electrical conductivity of metals

11. Ductility:

The property of metals to be drawn into thin wires is called ductility. All metals are ductile. Those substances which are hard, have lustre, malleable, ductile, sonorous conductors of heat and electricity are called metals.

Physical properties of Non-metals:

1. Physical state:

At room temperature non-metal can be solid, liquid or gas. Example

Solid – carbon (c), Sulphur(s) ,iodine (I),

Liquid – Bromine (Br)

Gas – oxygen (O2) Nitrogen (N2) Hydrogen (H2)

2. Colour:

Non metals have different colour like sulphur yellow, chlorine gas- green yellow, phosphorous – Pink etc.

3. Lustre :

Activity 9

Take piece of coal and observe it in shade first and then in sufficient light. You will observe that it does not have any shine. Therefore, non metals are do not have shine and do not reflect light but diamond and iodine are its exceptions. They have shine.

4. Hardness :

Non metals are soft and loose in texture. Diamond is exception. It is a form of carbon.

5. Sonorous:

Non metals do not produce sound when strike with other objects.

6. Density :

They have very low density.

Activity 10 :

Take a glass beaker fill with small amount of water. Now dip a cap of pen, pencil piece, wooden block one by one in it. What you will observe? You will observe that they all float on water they have density lower than water.

7. Melting point:

Non metals have very low melting point. But graphite & dimond are form of carbon are exception of this. The alltropes of carbon exception. They have very high melting point.

8. Heat and electricity conductance:

Normally non metals are insulators and are bad conductor of heat and electricity except graphite.

9. Brittle:

Non-metals are brittle and cannot be drawn into sheets or wire.

Activity 11

Take a large piece of coal and strike with hammer. The coal gets converted into its powder. This nature of

Fig. 2.8 Brittleness of non-metals

non metals is called Brittleness.

2.3 Chemical properties of metals:

It has been seen that the utensils made of copper and aluminium loose shine after being used continuously. Even the jewellery made of silver gets blackened. Why this happens? Because metals react with water, air, acid and form other chemical compounds.

Let us we study these chemical properties in detail.

(A) Reaction of metals with air.

Metals form their oxides on reacting with air.

Metal + oxygen ⟶ Metal oxide.

Activity 12

Take a thin ribbon of Magnesium and burn in flame of candle. It burns with light and flames of white colour. Now take its ash and mix with water in a test tube. Now test with litmus paper. The litmus paper turns blue. Therefore the

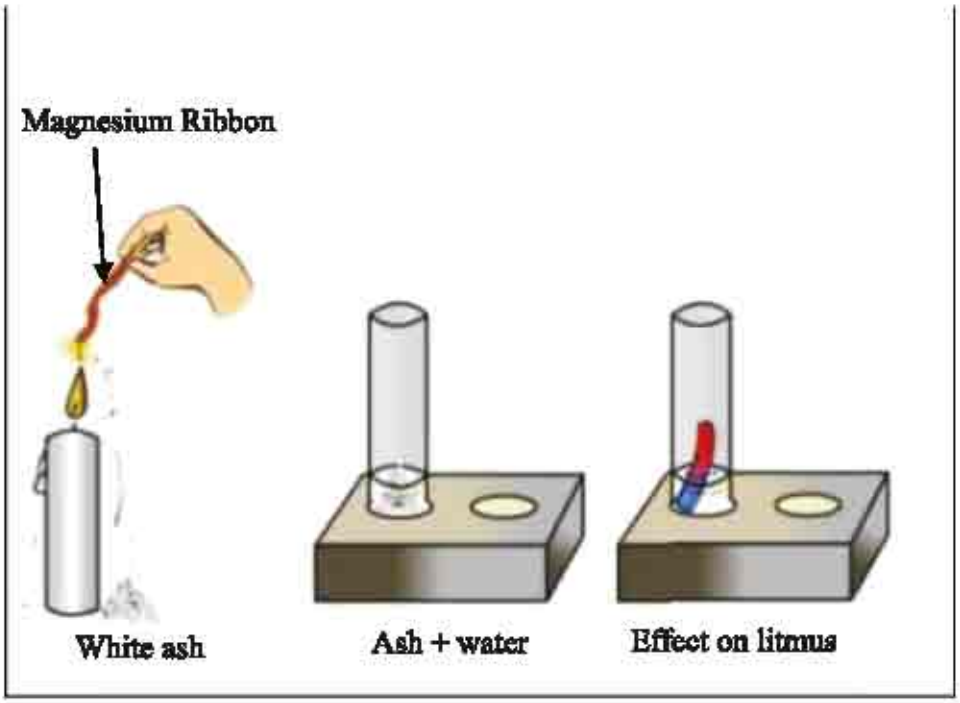

Fig. 2.9 Reaction of metal with air

oxide formed from reaction is acidic in nature.

(Do this activity with the help of your teachers).

Magnesium (Mg) + Oxygen (O_2) Magnesium oxide (MgO)

Likewise copper and aluminium also react with air and form their oxides. That's why after regular use they lose their shine.

(B) Reaction with water :

Different metals react differently with water. They form either their hydroxide or Hydrogen gas on reaction with water.

Sodium (Na) + Water (H_2O) Sodium hydroxide ($NaOH + H_2$).

Activity 13 :

This activity will be done by teachers only. Take a piece of sodium (app. Size of millet) dry on filter paper. Now dip on a beaker filled with water. It reacts with water vigorously and form NaOH and H_2 gas. Why sodium is is kept in kerosene? Sodium metal is highly reactive. It form sodium hydroxide and hydrogen gas when react with air and water. It catches fire easily. To avoid

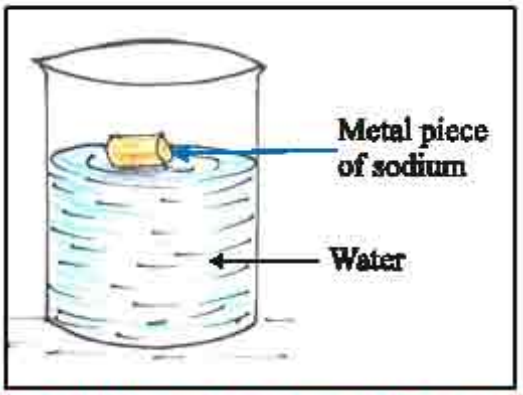

Fig. 2.10 Reaction of metal with water

Also know this

Why sodium metal is stored in kerosene oil ?

Sodium metal is highly reactive. It reacts vigorously with oxygen and water and produce sodium hydroxide and hydrogen gas. Hydrogen gas catches fire. To protect sodium from air, it is stored under kerosene.

reaction with air, sodium is kept in Kerosene.

(C) Reaction with acid:

Metal reacts with acid and gives hydrogen gas.

2.4 Chemical PROPERTIES OF non metals:

(A) Reaction with air :

Non-metals react with air and form oxides. These oxides are acidic in nature.

Activity 14

Take small quantity of powder sulphur in inflammable spoon and heat. If spoon is not available then use any metallic of bottle. When sulphur starts burning take it to a gas jar and cover it with a lid so that the gas does not come out. Now pour little water and cover it again. Now test with litmus paper. The solution is acidic. Now reaction of sulphur with air it form sulphur dioxide gas with is acid oxide of non-metal.

Sulphur (S) + Oxygen (O_2) Sulphurdioixide SO_2

(B) Reaction with water:

Non-metals do not react with water and steam. Therefore Phosphorus is kept in water for storage.

(C) Reaction with Acid :

All non-metals do not react with dilute acids. But sulphur reacts with concentrated Nitric acid (HNO_3) and form Suphur di Oxide (SO_2) and Nitric acid (NO_2) and water.

2.5 Uses of metals and non-metals in daily life

Uses of Metals

1. Metals are used in utensils used for cooking.
2. Aluminium and iron sheets are used at home roofs, to prevent from sun and rain.
3. Copper wire is used in electronic instruments, radio electric wires, Refrigerators etc.

4. Gold and silver are used in jewellery.
5. Mercury is used in thermometers.

Uses of non metals:

1. Sulphur is used in acid, Medicine and gun powder.
2. Red phosphorous is used in matchsticks, crackle and pesticides.
3. Graphite is used in electrodes.
4. Graphite is used in pencils.

2.6 Inert Metal:

Those metals which do not react with water, air, acid etc are called inert metal. Gold, silver never lose their shine due to this reason. Purity of gold is measure in Karat, 24k Gold is purest. 23 and 24 K gold has mixing of other metals.

2.7 Alloy :

Some metals do not rust like utensils made of stainless steel. Why this happens? Because these metals are mixed with other metals in small quantities.

The Jewellery weared by our mother and sisters. the utensils used air our kitchen do not have rust why? Because in these jewellery and utensils smell amount of other metals & non metals are mixed with main metals.

Stainless steel has a mixing of Chromium and Nickel and Zinc in copper and brass in fixed quantities so that they do not get rusted.

Alloy are homogeneous solid mixtures of metals or of metals and non metals. Ailloging is alone to make the parent metal stranger and to get desired properties in parent metal e.g. brass, bronze, stainless steel etc.

What have you learnt

- Metals are hard, shiny, have high density, conductors, malleable and ductile.
- Non metals can be solid, liquid, gases.
- Non metals are soft with diamond as an exception.
- Non metals are insulators of heat and energy. Graphite is an exception.
- Metal react with oxygen to form acidic oxides and form acidic hydroxides with water.
- Metals form hydrogen gas on reaction with an acid.
- Non-metals don't react with acids.
- Inert metal: Some metals are less reactive with air, water, acid and base like gold, silver and are known as inert metals.
- We can get desirable properties of any substance by mixing it with a non metal or metal or both. These mixture is called mixed metal like brass, bronze, stainless steel etc.

□□□

Exercise

Choose the correct options for the following

1. The metal which is found in liquid state at room temperatures—
   (a) Sodium (b) Magnesium
   (c) Mercury (d) Aluminium ( )
2. The non metal which is conductor of electricity
   (a) Coal (b) Graphite
   (c) Sulphur (d) Nitrogen ( )
3. Which is most reactive from the following metals
   (a) Gold (b) Sodium
   (c) Magnesium (d) Silver ( )

4. Metal form ——— on reacting with oxygen

(a) Acidic oxides (b) Basic oxides

(c) Neutral oxides (d) None ( )

Fill in the blanks:-

1. Pure gold is ——carat.
2. The reaction of metals with acid gives out ——— gas.
3. Metals are ——— of heat and electricity.
4. The oxides of non metals are generally ——— in properties.

Match column A and column B

Column A	Column B
1. Gold	a. Medicinal use
2. Sulphur	b. Jewellery
3. Mercury	c. Pencil
4. Graphite	d. Thermometer

Short answer questions:-

1. What is malleability?
2. What are mixed metals?
3. What is melting point of substance?
4. Why is graphite conductor of electricity?
5. Why lemon juice is not kept in iron containers?

Long answer questions:-

1. Why sodium metal is kept in kerosene?
2. Differentiate metals and non metals on the basis of their physical properties.
3. Write any four uses of metals.
4. Why copper wire is use for wiring at our houses? Explain.
5. Write differences in metals and non metals on the basis of their chemical properties.

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