is because they have very rigid structures. But when these are melted or dissolved in water, the ions become free and therefore, they conduct electricity due to mobility of ions. Thus, the ionic compounds are good conductors of electricity in the molten or dissolved state.

Let us perform an activity to demonstrate the conducting nature of ionic compounds.

Group Activity 7

❑ **To show ionic compounds conduct electricity in aqueous solutions**

Take sodium chloride and dissolve in water in a beaker.

Place two electrodes in the solution as shown in Fig. 8.

Connect these electrodes to a battery, a bulb and a switch with the help of connecting wires.

On pressing the key, if the bulb glows, it means that the current is flowing in the circuit. On the other hand, if the bulb does not glow, it means the current is not flowing in the circuit.

Press the key and **observe if the bulb glows or not!**

When the key is pressed, it is observed that the bulb glows. This means that the current is passing through the circuit as well as through the aqueous solution.

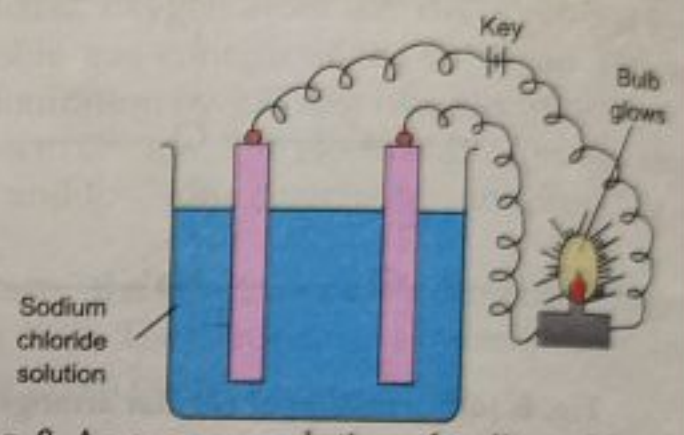


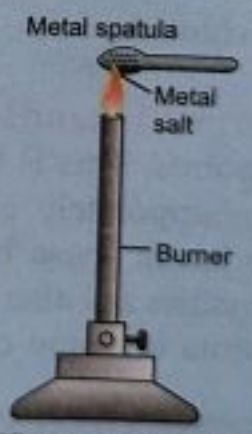
Fig. 8. An aqueous solution of sodium chloride (ionic compound) conducts electricity (blub glows).

➡ Thus, aqueous solution of sodium chloride conducts electricity. Similarly, it can be observed that aqueous solution of other ionic compounds such as magnesium chloride, barium chloride, calcium carbonate, potassium iodide, copper sulphate, etc. conduct electricity.

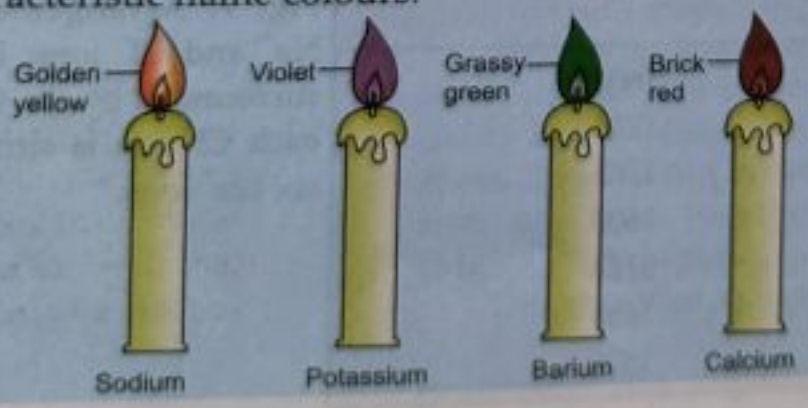
LEARNING PLUS

It is very interesting to note that some metals and their salts impart characteristic colours to the flame. Take a small amount of sodium chloride on a metal spatula and bring it into the bluish flame of Bunsen burner as shown in the figure.

We will see that it imparts golden yellow colour to the flame. Similarly, potassium imparts violet colour, lithium imparts crimson red, barium imparts grassy green, calcium imparts brick red colour and so on. These metals are sometimes identified by their characteristic flame colours.



Heating salt in a metal spatula



Solved Examples

Example 18. Write the electron dot structure for sodium and chlorine atoms. How do these form a chemical bond ? Name the type of bond so formed. Why does a compound so formed has high melting point ?

(C.B.S.E. Sample Paper 2007)

Solution : Electron dot structures of sodium and chlorine atoms are :

Sodium : $\dot{N}a$ (2,8,1) Chlorine : $:\ddot{\underset{\cdot\cdot}{Cl}}:$ (2,8,7)

Sodium atom loses one electron from its outermost shell to form sodium ion.

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

Chlorine atom has seven electrons in its outermost shell and so it gains the electron lost by sodium to form chloride ion

$:\ddot{\underset{\cdot\cdot}{Cl}}\cdot + e^- \longrightarrow [:\ddot{\underset{\cdot\cdot}{Cl}}:]^-$

As a result, both sodium and chlorine atoms complete their octets.

$Na + :\ddot{\underset{\cdot\cdot}{Cl}}: \longrightarrow [Na^+]\ [:\ddot{\underset{\cdot\cdot}{Cl}}:]^-$

The bond formed is **ionic bond** or **electrovalent bond.** It has high melting point because ionic bond holding these Na^+ and Cl^- ions is very strong. Therefore, a large amount of energy is required to break the strong inter ionic forces of attraction and hence melting point is high.

Example 19.

(a) Show on a diagram the transfer of electrons between the atoms in the formation of MgO.

(b) Name the solvent in which ionic compounds are generally soluble.

(c) Why are aqueous solutions of ionic compounds able to conduct electricity?

(2008-2009)

Ans. (a) $Mg + :\ddot{\underset{\cdot\cdot}{O}}: \longrightarrow [Mg]^{2+}\ [:\ddot{\underset{\cdot\cdot}{O}}:]^{2-}$ or MgO

(b) Water.

(c) This is because in aqueous solution, the electrostatic forces of attraction between the oppositely charged ions are very much decreased and the ions become free to move.

OCCURRENCE OF METALS

Earth is a main source of metals. Sea water also contains some soluble salts of metals like sodium chloride, magnesium chloride, etc. All metals are present in the earth's crust either in the *free state* or in the *form of their compounds*. **Aluminium is the most abundant metal in the earth's crust.** The second most abundant metal is iron and third one is **calcium.** The relative abundance (by weight) of some important metals in the earth's crust is given in Table 4.

NATIVE AND COMBINED STATES OF METALS

Metals occur in the crust of earth in two states: ***free state*** and ***combined state***.

1. Native state or free state

A metal is said to occur in a free state when it is found in the crust of the earth in the elementary or uncombined form.

When the metal occurs as free element, it is also said to occur in **native state**.

The metals which are very unreactive (lying at the bottom of activity series) are found in the free state. These have no tendency to react with oxygen and not attacked by moisture, carbon dioxide of air or other non-metals. **Silver, copper, gold** and **platinum** are some examples of such metals.

2. Combined state

A metal is said to occur in a combined state if it is found in nature in the form of its compounds.

The metals which have a tendency to react with moisture, oxygen, sulphur, halogens, etc. occur in the crust of the earth in the form of their

The metals at the top of the activity series (Na, K, Ca, Mg and Al) are so reactive that they are never found in nature as free elements.

compounds such as : oxides, sulphides, halides, silicates, carbonates, nitrates, phosphates, etc. For example, sodium, potassium, calcium, aluminium, magnesium, etc. are very reactive metals (lying at the top of activity series) and therefore, these are never found in the free state. The metals in the middle of the activity series (zinc, iron, lead, etc.) are moderately reactive. They are formed in the earth curst mainly as oxides, sulphides or carbonates. In fact, most of the metals are found in the combined form in the earth's crust. You will find that the ores of many metals are oxides. This is because oxygen is very reactive element and is very abundant on the earth.

Copper and **silver** are metals which occur in the **free** state as well as in the **combined** state.

MINERALS AND ORES

The natural substances in which metals or their compounds occur either in native state or combined state are called **minerals.**

For example, aluminium occurs in the earth's crust in the form of two well known *minerals,* ***bauxite*** ($Al_2O_3.2H_2O$) and ***clay*** ($Al_2O_3.2SiO_2.2H_2O$). The minerals are not pure and contain different types of other impurities. The impurities associated with minerals are collectively known as **gangue** or **matrix.**

The metals are extracted from their minerals. But metals cannot be extracted from all the minerals conveniently and profitably.

The mineral from which the metal can be conveniently and profitably extracted, is called ***an*** **ore.**

For example, aluminium occurs in the earth's crust in the form of two minerals, *bauxite* ($Al_2O_3.2H_2O$) and *clay* ($Al_2O_3.2SiO_2.2H_2O$). Out of these two, aluminium can be conveniently and profitably extracted from bauxite. However, it has not been possible to extract aluminium from clay by some easy and cheap method. Therefore, **the ore of aluminium is bauxite.** Similarly, the minerals of copper are copper glance (Cu_2S), cuprite (Cu_2O) and copper pyrites ($CuFeS_2$). But copper can be conveniently extracted from copper pyrites. Therefore, **ore of copper is copper pyrites.** Thus, it may be concluded that

All ores are minerals but all minerals are not ores.

TYPES OF ORES