Notes

212en27

27

METALS AND NON-METALS

At home, in school, in the street or in office, we are surrounded by metals and non- metals. In the kitchen, we use both metals and non-metals. Cooking utensils are made of metals like iron, aluminium, zinc and copper. Our storage containers could be made of non-metals such as plastics and glass. **Thus metals and non-metals are an integral part of our lives.**

You have already read about metal and non-metals in the chapter of **periodic classification of elements**. You also know the criteria for classifying metals and non-metals which are basically based on electronic configuration of the elements.

Apart from day-to-day life situations, metal and non-metal are industrially very important. They play an important role in our national economy. You might have heard about various iron and steel plants, zinc and copper plants and aluminium plants (factories) established in our country. Have you seen any one of these so fars?. There are basically metal based industries. Apart from these, you also must have heard acid plants and fertilizer factories. These are basically non-metal based industries. All these metals and non-metals are obtained from **minerals**. You are lucky that our mineral resources are very rich. You will study about all these in your higher classes. In this Chapter we will discuss certain relevant properties of metal and non-metals which will be quite meaningful for you.

OBJECTIVES

After completing this lesson, you will be able to :

- *differentiate between metals and non-metals on the basis of their physical properties;*
- *describe the reactions of metals with oxygen, water and some common acids and bases;*
- *distinguish between mineral and ores;*

- *recognize various metallurgical processes in the extraction of common metals;*
- *explain the phenomenon of corrosion and list various methods to prevent it;*
- *describe the reactions of non-metals with oxygen;*
- *arrange the metals in order of their reactivity and construct reactivity series;*
- *list some of the important uses of metals and non-metals.*

27.1 PHYSICAL PROPERTIES OF METALS AND NON-METALS

Elements can be broadly divided into two categories: metals and non-metals. They differ both in physical and chemical properties.The characteristic physical properties of metals and non-metals are listed in Table 27.1

Table 27.1

Physical Properties	Metals	Non-Metals
Malleability and Ductilily	Metals are malleable. They can be beaten into thin sheets. They are also ductile and can be drawn into wire (except a few metals like Na, K etc.)	Non-metals are neither malleable nor ductile. For e.g. coal, (carbon) and sulphur
Metallic Lusture	All the metals show metallic lusture.	They do not show any metallic lusture.
Hardness	Metals are generally hard	Non-metals are soft in comparison to metals
Physical state	They exist in solid and liquid states	Non-metals exist in solid, liquid and gaseous states.
Sonorous	Metals are sonorous and produce characteristic metallic sound when struck (e.g school bell)	They are non sonorous
Density	High density	Low density
Electrical conductivity	Good conductor of electricity	Bad conductor of electricity

Do you know

- Mercury is the only metal and bromine is the only non-metal which exist in liquid state at room temperature.
- Graphite and iodine possess metallic lusture though they are non-metals
- Sodium metal is soft like wax and it can be cut with a knife.
- Gallium metal would melt if kept on our palm
- Gold and silver are the most malleable and ductile metals .
- Diamond is a better conductor of heat than copper but poor conductor of electricity.
- Graphite is the only non-metal which is a good conductor of electricity but poor conductor of heat.
- Gold, silver, platinum and copper are found in the free state. This is because of their poor reactivity as compared to other metals.

INTEXT QUESTIONS 27.1

1. Which properties of gold allows it to make ornaments?
2. Name a few metals which are found in free state?
3. Metals are generally very hard. Name the metal which is soft like wax?
4. Name a non-metal which is a good conductor of electricity.
5. Name two metals which show malleability and ductility.

ACTIVITY 27.1

- Collect samples of iron, copper and aluminium and note down the colour of each sample.
- Clean the surface of all the samples of the metals with sand paper and compare the appearance before and after cleaning the surfaces.

27.2 CHEMICAL PROPERTIES OF METALS AND NON-METALS

Metals are electropositive in nature. They generally have 1, 2 or 3 electrons in their valence shells and readily lose these electrons to form positively charged ions

(cations). These cations are stable as they acquire noble gas configuration after losing the valence shell electrons. You must have learnt in the lesson on chemical bonding.

$$Na(g) \longrightarrow Na^{+}(gas) + e^{-}$$

2,8,1 2,8

During electrolysis of their aqueous soluitons they are discharged at the cathode. On the other hand non-metals are electronegative in nature. They generally have 5,6 or 7 electrons in their valence shells.They have tendency to form anion by gaining electrons.

$$Cl(g) + e^{-} \longrightarrow Cl^{-}(g)$$

2,8,7 2,8,8

27.2.1 Chemical Properties of Metals

Let us now understand some common chemical reactions of metals.

1. Reaction of metals with Oxygen: - Most of the metals react with oxygen and form oxides. The reaction may take place without heating as in sodium, calcium or potassium, while some metals react with oxygen on heating to form oxides.

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

$$Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$

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

Oxides of metals are **basic** in nature as they react with water and form bases .e.g. Na_2O, CaO, MgO, K_2O etc.

$$Na_2O(s) + H_2O(l) \longrightarrow 2NaOH(aq)$$

$$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)$$

Oxides of aluminium (Al_2O_3), zinc (ZnO), tin (SnO) and iron (Fe_2O_3) are amphoteric in nature as they react with acids as well as with bases.

$$Al_2O_3(s) + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2O(l)$$

$$Al_2O_3(s) + 2NaOH(aq) \longrightarrow 2NaAlO_2(aq) + H_2O(l)$$

2. Reaction of metals with acids: - Metals react with common acids like dilute HCl and dilute H_2SO_4 with evolution of H_2. The reaction of Mg ribbon with dil. HCl is represented in Fig. 27.1 below.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

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

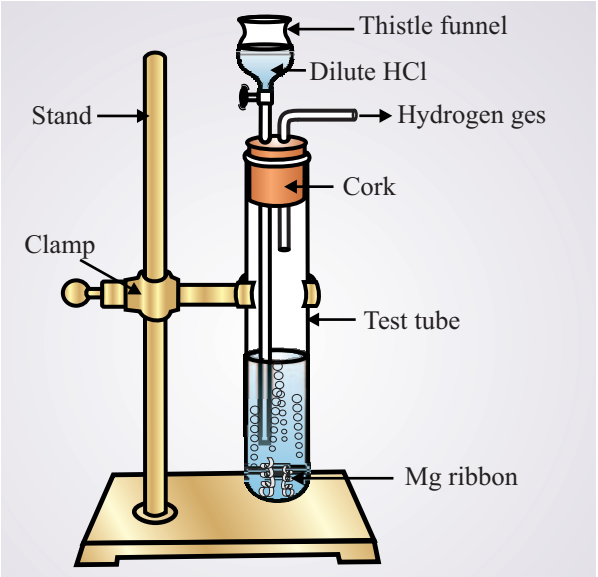


Fig. 27.1 *Reaction between Mg and dil HCl*

3. Reaction of Metals with Water: Many metals react with water to form hydroxides. Hydroxides are basic in nature. Sodium and potassium react with cold water.

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$$

$$2K(s) + 2H_2O(l) \longrightarrow 2KOH(aq) + H_2(g)$$

Magnesium reacts with hot water

$$Mg(s) + H_2O(l) \longrightarrow Mg(OH)_2(aq) + H_2(g)$$

- Metals like Al or Fe react on heating with water or with steam**.** In these conditions metals form metal oxides.

$$2Al(s) + 3H_2O(g) \longrightarrow Al_2O_3(s) + 3H_2(g)$$
(steam)

$$Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$$
(steam)

4. Reaction of metals with Common bases: Some metals like aluminum and zinc react with common bases.

$$Sn(s) + 2NaOH(aq) + H_2O(l) \longrightarrow Na_2SnO_3$$
sodium stannate

$$Zn(s) + 2NaOH(aq) \longrightarrow Na_2ZnO_2$$
Sodium zincate

27.2.2 Corrosion

As you know that metals react with air and form their oxides. This oxide formation tendency of metals affects their physical and chemical properties .Can you guess one example in your day to day observation? You have already studied corrossion in Chapter No. 4. You might have observed the rusted nails at your home, rusted iron grills or gate in your garden due to oxidation of iron. You just bring a rusted nail and fresh nail if you have and compare their physical properties. You might have observed a green layer over old copper coin. This green layer is due to oxidation leading to formation of copper oxide which is finally converted to basic copper carbonate on its surface due to its oxidation. All these processes of oxidation of metals are known as **Corrosion.** Let us one again learn more about corrosion and various methods to prevent it.

Corrosion leads to the destruction of metal surface by the action of air and moisture.

Generally the corrosion word is used for oxidation of different metals but in case of corrosion of iron we use specifically term rusting. Let us see how rusting takes place in term of chemical reaction. When iron reacts with oxygen it produce brown powder called **rust** which is chemically hydrated ferric oxide.

Fig. 27.2 *Rusted nut-bolt*

$$4Fe(s) + xH_2O + 3O_2 \longrightarrow \underset{\text{Brown Rust}}{2Fe_2O_3.xH_2O}$$

You might have observed that in rainy season maximum rusting takes place due to increased moisture in the air.

For **rusting** of iron, two important conditions are required:

(i) Presence of moisture

(ii) Presence of oxygen

Let us do **activity 27.2** to see if this conditions of rusting is true

ACTIVITY 27.2

You can do this activity in the lab of your study centre to find out if the above specified conditions for rusting hold true.

- Take three test tubes or small glass bottles (Clean & dry) and three clean iron nails.

- Label these test tubes or small glass bottles as **A**,**B** &**C** and put one iron nail into each test tube.
- In test tube **A** take distilled water so that half of the nail is immersed in water and cover the mouth of the test tube with a cork.
- In test tube **B** take distilled water in excess so that nail is completely immersed in the water. Cover the mouth of the test tube with cork so that no air comes in contact with the nails.
- Test tube **C** should be dry and must contains anhydrous calcium chloride with iron nail.

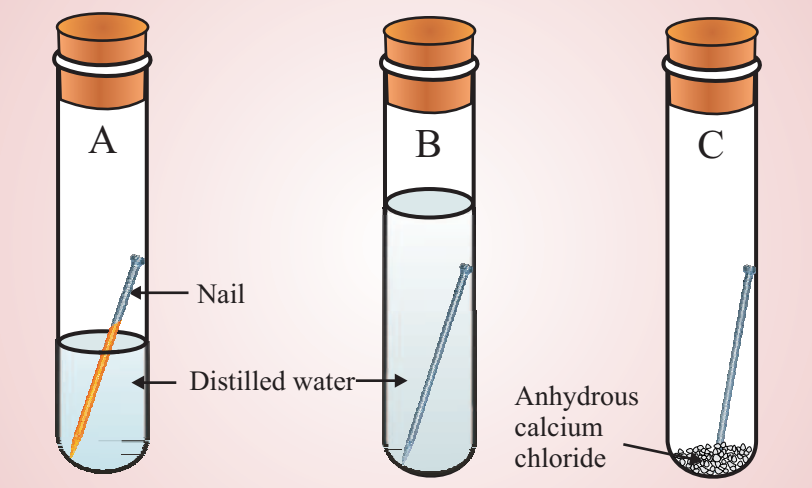


Fig. 27.3 *Activity to study the condition for rusting*

What do you observe?

You will find that maximum rusting has happened on the nail put inside the test tube **A**, but they do not rust in test tube **B** and **C**. Have a look on the nails in the test tube **A** and touch the surface of rusted nail .You will find a flaky reddish brown powder on its surface and it is known as rust.

Why does this happen?

In test tube **A** both oxygen as well as moisture(water) are present. Hence maximum rusting has happened. But in case of test tube **B** only moisture is present but not air and in test tube **C** only air is present not moisture. Hence rusting did not happen.

From the above activity it is clear that for rusting both oxygen and moisture are required. Now, can you tell me what you generally do to prevent your bicycle wheels or iron gate in your garden from rusting? Yes, we generally paint or put grease over the iron objects to prevent it from rusting. Let us know other various methods of prevention of rusting/corrosion.

Methods of Prevention of Corrosion

There are various methods of preventing corrosion and rusting of iron. Our main concern is to know the various methods to prevent the rusting of iron because iron is a strategic metal as it plays a very important role in the development of a nation.

Some of the important methods of prevention of corrosion are as follows:

1. Painting

This is a common method of preventing iron from rusting. You might have observed that your parents paint iron gate in the garden and iron grills in your house. This painting prevents rusting by providing a coating over iron objects.

2. Oiling and greasing

To put a layer of oil and grease on the iron objects also prevents them from rusting. Iron parts of various machines and vehicles are oiled and greased to prevent rusting and to minimize friction.

3. Galvanization

In this method we put a layer of zinc metal on the iron objects and this process is known as **galvanization.** This method is used on large scale for making galvanized iron sheets for making boxes and for roof covering. You might have seen large boxes and containers sold in the market. Do you know that theses iron sheets do not rust even if small zinc coating is removed from the sheet. Can you find the reason why such sheets do not rust? Galvanised iron sheets are used to make drum, trunks and other iron containers. Galvanised iron sheets are also used for building roofs and manhole covers. In brief, galvanization prevents rusting in a big way.

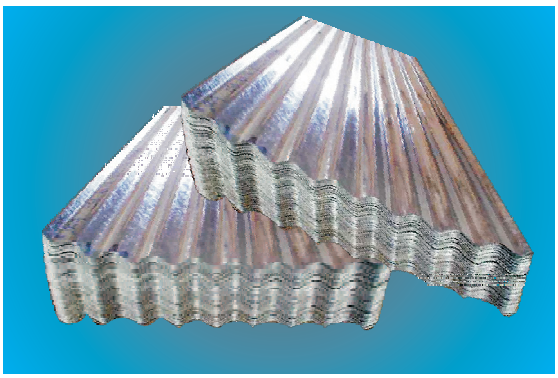


Fig. 20.4 *Galvanized sheets*

4. Alloying

This is a very good method for improving the quality of different metals. In this method a particular metal with other metal or non-metal is mixed in a fixed proportion

to improve its quality like resistance towards corrosion, strength , hardness, shining and high tensile strength. For example iron metal can not be used for making utensils because it will rust but when it is mixed with nickel and chromium metal it becomes **stainless steel**. Now it becomes very useful and we are using this steel on a large scale for making kitchenwares and so many other things for our day to day uses. You just ask your father or mother about the carats of gold used for making the jewelery. You also can see the purity in terms of carat printed on the back of any gold jewelery. You will see that 22c is printed. It means it is of 22 carats. Pure Gold is actually 24 carats. Just think that why jewelers do not use 24 carat gold which is for making jewelery? This is because 24 carat gold is very soft and it can not be easily converted into fine wire or sheets.

INTEXT QUESTIONS 27.2

1. Under what conditions there are more chances for iron to be rusted?
2. Why metals are electropositive but non-metals are electronegative in nature?
3. Name a metal oxide which reacts with an acid as well as with a bases?
4. When zinc reacts with sodium hydroxide what is the product? Write the equation.
5. Write the formula of rust.

27.3 REACTIVITY OF METALS AND THE ACTIVITY SERIES OF METALS

You have already seen that when Fe is placed in a solution of $CuSO_4$ it replaces Cu from the solution according to the following reaction (Chapter 4).

$$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$$

On the other hand when we place a silver wire in a solution of $CuSO_4$, no reaction occurs because silver is less reactive than copper.

$$Ag(s) + CuSO_4(aq) \longrightarrow \text{No reaction}$$

However when a copper wire is dipped in $AgNO_3$ solution, silver is replaced and deposited on copper wire. Reaciton is as following

$$Cu(s) + 2AgNO_3(aq) \longrightarrow 2Ag(s) + Cu(NO_3)_2(aq)$$

This indicates that copper is more reactive than silver.

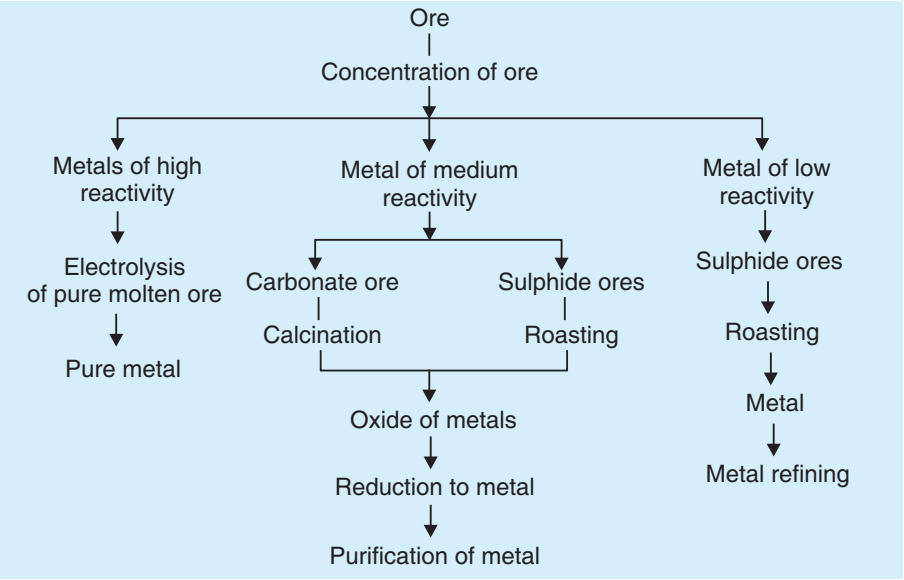
In general , a more reactive metal displaces a less reactive metal from its salt solution.

By observing these reactions we will say that Fe is more reactive than Cu and copper is more reactive than silver. If we take solution of different metals and place other metals in these solutions, we can compare the reactivity of metals with respect to each other. The arrangement of metals in the decreasing order of their activity is known as **activity** or **reactivity series**. It is also known as **electrochemical series**. A portion of this series is given below. In this series only few metals are shown.

K	Most reactive metal	
Na	↓	
Ca		
Mg		
Al		
Zn		Decreasing Reactivity
Fe		
Pb		
H		
Cu		
Hg		
Ag	↓	
Au	Least reactive metal	

27.4 WHAT IS THE SOURCE OF METALS AND HOW DO WE OBTAIN THEM

After learning some interesting properties of metals and being aware of their day-to-day importance you will be definitely motivated to know the source of metals. You will be delighted to learn that earth crust is the major source of metals. Some metal salts are also present in sea. These salts are also source of certain metals like sodium, magnesium etc. The constituents of earth crust which contain these metals or their compounds are known as **minerals**. At some places minerals contain a high percentage of a particular metals and the metal can be profitably extracted from it, such minerals are called **ores**. An ore taken out from the earth contains a lot of impurities in form of sand and other undesirable materials. In fact, metal is present in these ores in form of a compound. Now getting pure compound of a metal from its ore and finally getting the metal from it pure compound is called **metallurgy**. Several steps involved in the extraction of metals from their ore are provided in the following chart.



After understanding the activity series you can broadly consider metals in three categories

(i) lower part of activity series (i.e. metal of low reactivity)

(ii) the middle part of activity series (metals of medium reactivity)

(iii) top part of activity series (metal of high reactivity)

Metals in the lower part of the activity series are very unreactive. For example mercury which is obtained as HgS (cinnabar) can be extracted easily

$$2HgS + 3O_2(g) \xrightarrow{\text{heat}} 2HgO(s) + 2SO_2(g)$$

On further heating HgO is decomposed in mercury and oxygen

$$2HgO(s) \xrightarrow{\text{heat}} 2Hg(l) + O_2(g)$$

Metals in the bottom of activity series like Ag, Au etc are least reactive and are found in native state. No doubt some of them are also found in combined state.

The metals in the middle of the activityy series such as iron, zinc lead etc are moderately reactive. They are present usually as sulphide or carbonate in nature. Prior to reduction these ores are converted into oxides as it is easy to reduce metal oxides.

For example, in case of zinc we get following reaction,

(i) Roasting $2ZnS(s) + 3O_2(g) \xrightarrow{\text{heat}} 2ZnO(g) + 2SO_2(g)$

(ii) Calcination $ZnCO_3(s) \xrightarrow{\text{heat}} ZnO(s) + CO_2(g)$

Metal oxides are reduced to corresponding metal using carbon.

$$ZnO(s) + C(s) \longrightarrow Zn(s) + CO(g)$$

Here ZnO is reduced to Zn, you are already familiar with process of oxidation-reduction (chapter 4). Obtaining metal from their compounds in always a reduction process.

We also use displacement reaction for reduction of metal oxide. For example

$$Fe_2O_3(s) + 2Al(s) \longrightarrow 2Fe(l) + Al_2O_3(s)$$

This type of reaction is also known as **thermite process** and is very useful in welding of rail tracks or other heavy machineries.

Metal at the top of activity series are highly reactive. These metals have high affinity for oxygen and therefore can not be obtained by reduction with carbon. These metals (such as Na, K, Mg) are obtained by the process of electrolysis of their molten salt. Even Al is also obtained by electrolysis of its oxide (Al_2O_3). Sodium is obtained by electrolysis of its **molten salt**, NaCl.

At the cathodd $Na^+(l) + e^- \longrightarrow Na(s)$

At the anode $2Cl^-(l) \longrightarrow Cl_2(g) + 2e^-$

27.5 CHEMICAL REACTION OF NON-METALS

1. Reaction of non-metals with Oxygen, Water and some common acids and bases: Non-metals react with oxygen on heating or burning to form their oxides

$$S(s) + O_2(g) \longrightarrow SO_2(g)$$

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

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$$

Many non metals form more than one oxide.

- Carbon with limited supply of oxygen on burning forms CO which is a neutral oxide. However in ample supply of air carbon forms CO_2 which is an acidic oxide

$$2C(g) + O_2(g) \longrightarrow 2CO$$

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

- Nitrogen forms a series of oxides with oxygen
  - (i) Nitrous oxide or laughing gas N_2O (neutral)
  - (ii) Nitric oxide, NO (neutral)
  - (iii) Dinitrogen trioxide, N_2O_3 (acidic)

(iv) Nitrogen dioxide NO_2 (acidic)

(v) Dinitrogen tetroxide, N_2O_4 (acidic)

(vi) Dinitrogen pentoxide, N_2O_5 (acidic)

Nature of oxides of non- metals

In general oxides of non-metals are acidic in nature or after dissolving in water they form acids

Carbon dioxide forms carbonic acid with water

$$CO_2(g) + H_2O(l) \longrightarrow H_2CO_3(aq)$$
(carbonic acid)

Sulphur trioxide forms sulphuric acid with water

$$SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(l)$$
Sulphuric acid

Dinitrogen pentoxide forms nitric acid with water

$$N_2O_5(g) + H_2O(l) \longrightarrow 2HNO_3(l)$$
(nitric acid)

H_2SO_4 and HNO_3 are very important acids and play very important role in industries.

Due to their acidic nature, many non-metal oxides directly react with bases to form salts.

$$SO_2(g) + 2NaOH(aq) \longrightarrow Na_2SO_3(aq) + H_2O(l)$$
$$SO_3(g) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + H_2O(l)$$
$$CO_2(g) + 2NaOH(aq) \longrightarrow Na_2CO_3(aq) + H_2O(l)$$

Halogens (F, Cl, Br, I) are also non-metals and they react with metals to form halides. For example, NaCl, NaBr, KCl, KBr, KI. Important source of these halides is sea. Oxides of halogens are not very important as compared to their salts. NaCl which is obtained from sea, is used as a raw materials for the manufacture of many important chemicals.

INTEXT QUESTIONS 27.3

1. What will happen if you keep a solution of copper (II) sulphate in an iron vessel? Explain the observation and give suitable explanation.
2. What will happen if you keep a solution of silver nitrate in a copper vessel? Explain the observation

3. An element reacts with oxygen to form an oxide which dissolves in water to form a solution that turns red litmus blue. The oxide dissolves in dil. HCI. Identify the element as metal or non-metal.
4. Give an example of a metal which
   (a) is a liquid at room temperature.
   (b) can be easily cut with a knife.
   (c) is the best conductor of electricity.
   (d) poorest conductor of electricity.
5. Write the formula of the oxide of magnesium formed on burning of magnesium ribbon in oxygen?
6. Name the hydroxide of magnesium formed when magnesium oxide reacts with hot water?
7. What happens when sodium metal reacts with water in cold? Write the reaction for the same?
8. Define activity series of metals? Write a reaction when zinc granules are added to copper sulphate solution?
9. What is the difference between 'mineral' and 'ore'?

27.6 SOME IMPORTANT USE OF METALS AND NON-METALS

Metals and non-metals are put to many uses which are based upon their properties.

Uses of metals

(i) Many metals like iron ,copper and aluminium are used to make containers.

(ii) Metals like copper, aluminium , iron and stainless steel are used to make utensils and fry pans.

(iii) Ductile metals like copper and aluminium are used for making electrical wires. Steel ropes are used in cranes to lift heavy objects in making bridges.

(iv) Iron and steel are used to make machines

(v) Zinc, lead, mercury, lithium are used to make cells and batteries.

(vi) Malleable metals like iron and aluminium are used to make sheets which are used for various construction purposes.

(vii) Gold, silver and platinum metals are used to make jewellaries due to their luster, high malleability and inert nature.

(viii) Alloys of different metals and non-metals are used for various purposes e.g. Stainless steel for making utensils

Uses of non-metals

(i) Hydrogen is used in manufacturing of ammonia gas which is further used in the manufacturing of urea (fertilizer).

(ii) Hydrogen is a constituent of many industrial fuels like water gas (CO +H_2) and coal gas (H_2 + CH_4).

(iii) Silicon is used in making transistors, chips for computers and photovoltaic cells.

(iv) Silicon is used in steel industry to deoxidize steel and it produces high quality corrosion resistant steel.

(v) Most of the phosphorous is used for making phosphoric acid H_3PO_4 which is used in the manufacturing of phosphate fertilizers.

(vi) White phosphorous as (P_4S_3) is used in the match industry.

(vii) Phosphates are added to the detergents as they help in the removal of dirt from soiled cloths.

(viii) Sulphur is used in agriculture to control fungus and pests.

(ix) Sulphur is used in the manufacturing of gun powder which is an intimate mixture of sulphur, charcoal and potassium nitrate.

(x) Most of sulphur is converted into sulphuric acid which is called the **king of chemicals** and is used to make variety of other chemicals.

WHAT YOU HAVE LEARNT

- Metals and non-metals are inseparable part of human life. Elements are broadly classified as metals non-metals.
- Metals can be distinguished from non-metal on the basis of their physical properties like malleability ductility, lusture etc.
- Metals have tendency to lose electrons whereas non-metal have tendency to gain electrons. Thus metals show electron positive character whereas non-metals show electronegative character.
- Metals are arranged in an activity or reactivity series based on their reactivity. More reactive metal replace less reactive metal from their solutions (e.g. Zn(s) + $CuSO_4$(aq) $\longrightarrow$ Cu(s) + $ZnSO_4$(aq). Most of the metals are found in nature in combined form as minerals. There are also less or least reactive metals like gold, platinum and silver which are found in nature or in free states. Metal are obtained from their ores by the process of **reduction.**
- An ore is a mineral from which a metal can be profitably extracted from it.
- Metallurgy is the branch of science which deals with extraction of metals from its ores.

- Some of the non-metals also are found in free sate in nature for example sulphur and carbon (as coal, graphite, diamond).
- Metals mix with metal and non-metals and form **alloys** of desired properties like hardness, tensile strength colour etc. Bronze, stainless steel brass and duralamine are some common examples of alloys.
- Chemical properties of metals and non-metal are different. Metal and non-metal both react with oxygen (air), water and acids.
- Metals on combination with oxygen normally form basic oxides like Na_2O, MgO and CaO whereas non-metals normally form acidic oxides like CO_2, SO_2, NO_2 etc. Some non-metal oxides are neutral like CO, N_2O and H_2O.
- Certain oxides of metals show both the properties acidic as well as basic e.g. ZnO and Al_2O_3.
- Reactive metals replace hydrogen from dilute solution of acids like (H_2SO_4, HCl etc.)

TERMINAL EXERCISES

1. Name two precious metals used in making ornaments and write names of two important properties of these metals.
2. Name two non-metals which are commonly available and name their two important properties.
3. Write four physical properties of metals.
4. Write four physical properties of non-metals.
5. How would you differentiate between a metals and a non-metal.
6. Write reaction of metals with the following:
   (a) water (b) air or oxygen (c) acids
7. What are three types of oxides of metals?
8. Name four uses of metals.
9. Write four uses of non-metals.
10. Define the following:
    (a) Brittleness (b) Sonorous nature.
11. Name two metals which are most malleable and ductile. Also define:
    (a) Malleability (b) Ductility
    (c) brittleness (d) Tensile nature

12. Write uses of the following metals:

    (a) Pt (b) Au (c) Na

    (d) Ag (e) Ni

13. What is corrosion? How will you prevent it?

14. You are provided atomic number of metal X, Y and Z (not real names) in the following table. Based on electronic configuration predict whether they fall in the category of metal or non-metal.

Atomic number	Metal	Metal or non-metal
9	X	.....
12	Y	.....
16	Z	.....

15. Complete and balance the following reactions:

    (i) $Mg(s) + H_2SO_4(aq) \longrightarrow$ ..... + ...

    (ii) $Fe(s) + H_2O(steam) \longrightarrow$ ..... + ...

    (iii) $Na(s) + H_2O(l) \longrightarrow$ ..... + ...

16. Write names and formulas of different oxides of nitrogen.

17. Which one of the following oxides is not acidic?

    (a) CO (b) CO_2 (c) SO_2 (d) SO_3

18. Write at least one important use of the following chemicals

    (a) H_3PO_4 (b) H_2SO_4 (c) NH_3 (d) Water gas

19. Identify the non-metal from the following which is used for fungus control in agriculture:

    (a) Phosphorus (b) Sulphur (c) Iodine

20. Whch of the following metals is not used in making cell/battery?

    (a) Zn (b) Pb (c) Hg (d) Na

21. Which of the following non-metals is a liquid at room temperature

    (a) Bromine (b) Phosphorous (c) Sulphur (d) Iodine

22. Complete the following reactions

    (i) $Al_2O_3(s) +$ ..... $\longrightarrow 2NaAlO_2 + H_2O(l)$
    (Sodium aluminate)

    (ii) $CaO(s) +$ ..... $\longrightarrow Ca(OH)_2$

    (iii) $Sn(s) +$ .....$+ H_2O(l) \longrightarrow Na_2SnO_3$
    (Sodium stannate)

23. Define Roasting and Calcination.

ANSWER TO INTEXT QUESTIONS

27.1

1. Malleability and ductility
2. Gold, silver and platinum
3. Sodium
4. Graphite (an allotropic form of carbon)
5. Gold and aluminium

27.2

1. Iron will be rusted if there is oxygen (air) and water.
2. Metals have tendency to lose electrons and get converted into a positive ion and therefore are electropositive. Non-metals have tendency to take electron and get converted into a negatively charged ion and therefore are electronegative.
3. Al_2O_3 and ZnO are amphoteric in nature and react with acid and base.
4. Sodium zincate is formed

   $Zn(s) + 2NaOH(aq) \longrightarrow Na_2ZnO_2(aq)$
5. $Fe_2O_3.xH_2O$

27.3

1. Iron will react with copper (II) sulphate and after sometimes a hole will be formed in the bottom of iron vessel. Reaction will be as following

   $$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$$
2. When silver nitrate is kept in copper vessel, copper will replace silver as copper is above silver in the activity series and a hole is expected in the bottom of copper vessel. Reaction will be as following:

   $$Cu(s) + 2AgNO_3(aq) \longrightarrow 2Ag(s) + Cu(NO_3)_2(aq)$$
3. Since oxide of the element turn read litmus blue therefore that must ba a basic oxide. This is further supported by dissolution of oxide in HCl. Basic oxide will be formed by a metal. Therefore element must be a metal
4. (a) Hg (mercury) is metal which is liquid at room temperature
   (b) Sodium metal can be cut easily with knife
   (c) Silver is best conductor of electricity
   (d) Iron is poorest conductor of electricity

5. When magnesium burns it forms magnesium oxide

   $2Mg(s) + O_2\ (g) \longrightarrow 2MgO(s)$

6. $MgO(s) + H_2O(l)\ (hot) \longrightarrow 2Mg(OH)_2(aq)$

7. $2Na(s) + H_2O(l) \longrightarrow 2NaOH(aq)$

8. When the metals are arranged in the decreasing order of their reactivity, a series is obtained, this series is called activity series. Metals in the upper position of the series can replace the metal in lower position from their aqueous solution.

   When zinc granules are added to copper sulphate solution, reaction will be as following.

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

   Zn is above copper in activity series therefore it (Zn) will replace copper from the solution.

9. Naturally occuring homogeneous inorganic substances are called minerals. But those minerals from which metals can be extracted profitability are called ores. every ore is a mineral but every mineral cannot be an ore.