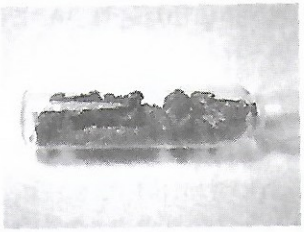
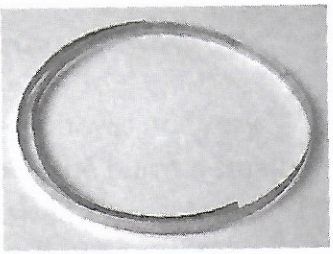
CHAPTER 4

Metals and Non-Metals

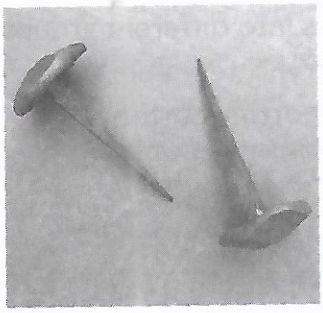
Last year, you learnt that elements can be broadly classified into **metals** and **non-metals**. There are many more metals than non-metals. Look at the pictures below. They show you some elements. Which ones are metals? Which ones are non-metals? List them in your notebook.



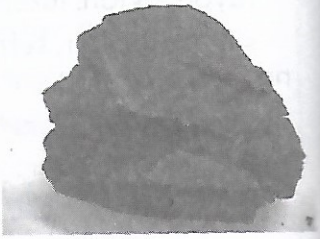
▲ calcium



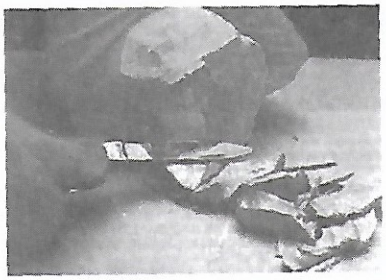
▲ magnesium ribbon



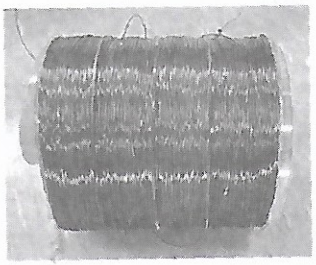
▲ nails



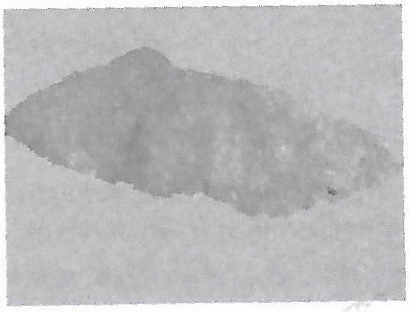
▲ coal



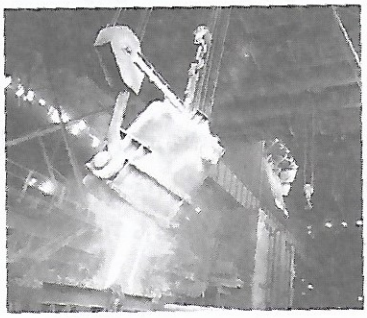
▲ sodium being cut with a knife



▲ copper wire

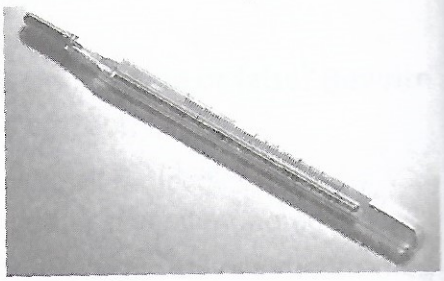


▲ sulphur



▲ molten iron

▲ oxygen masks used by mountain climbers



▲ clinical thermometer containing mercury

Physical Properties of Metals and Non-Metals

Knowing the properties of metals and non-metals and how they react chemically, tells us how they can be used. For example, gold is lustrous or shiny and is malleable and ductile. Hence, it is used to make jewellery. The next table shows the properties of most metals and non-metals. However, there may be some exceptions.

Metals	Non-Metals
1. They are **malleable**. They can be beaten into thin sheets without breaking. Gold and silver are highly malleable metals.	**1.** They are **not malleable**. They break into pieces when hammered.
2. They are **ductile**. They can be melted and drawn into thin wires. Gold, silver, copper and aluminium are very ductile.	**2.** They are **not ductile**.
3. They are **good conductors of heat and electricity**. Silver is the best conductor of electricity. Copper and aluminium are also good conductors of electricity.	**3.** They are **bad conductors of heat and electricity**. Graphite, a form of carbon, is an exception. It conducts electricity.
4. They are **lustrous**. Gold, silver, copper and platinum can be polished, so that they shine.	**4.** They are **not lustrous**. Usually dull, they cannot be polished. Only graphite and iodine show some lustre.
5. They are very **strong**. They can hold heavy loads without breaking.	**5.** They are **not strong**. They break very easily. One exception is diamond, a form of carbon. It is the hardest mineral known.
6. They are **solids at room temperature**, except for mercury, which is a liquid at room temperature. Solid metals are hard, except sodium and potassium which are soft metals. Soft metals can be cut with a knife.	**6.** They may be **solids, liquids or gases at room temperature**. Some like carbon and sulphur are solids. Bromine, a non-metal, is liquid at room temperature. Most others like oxygen, hydrogen and chlorine are gases.
7. They have **high melting and boiling points**. Iron has to be heated to a very high temperature in a furnace before it melts into a liquid.	**7.** They have **low melting and boiling points**.
8. They are **sonorous**. Metals make a ringing sound when hit with an object.	**8.** They are **not sonorous**.

Exercise 1

Answer the following questions.

i. Name two metals that are known for their lustre. _____

ii. Name a liquid metal. _____

iii. Name two gaseous non-metals. _____

iv. Name a non-metal that is a solid. _____

v. Name a non-metal that is a good conductor of electricity. _____

vi. Name a metal that is used to make electrical wires. _____

vii. Name a metal that is used to build bridges. _____

viii. Name the metal used as the negative terminal of a dry cell. _____

ix. Name the non-metal used as the positive terminal in a dry cell. _____

x. Why are cooking vessels made of metals and not non-metals?

_____

_____

xi. What is meant by malleability and ductility?

_____

_____

Though most metals have all the properties listed in the table, they are different from each other. For example, iron has all the properties mentioned. Yet, unlike most other metals, it is **magnetic** and **rusts**. **No two metals have exactly the same properties.**

There are similarities in the way metals react chemically. These reactions follow a similar pattern.

Chemical Properties of Metals and Non-Metals

Metallic and Non-metallic Oxides

Sodium and potassium react most vigorously with the oxygen in air to form their oxides. For this reason they have to be stored under oil. Magnesium is less reactive than sodium. It does not react with oxygen at room temperature. However magnesium wire, on heating, burns in air, to form a white powder, magnesium oxide.

▲ sodium stored in oil

Activity 1 Teacher Demonstration

You will need: a small piece of magnesium ribbon, a pair of tongs, a spirit lamp

Hold a piece of magnesium ribbon with a pair of tongs in the flame for some time. Observe what happens.

Magnesium burns in air with a sparkle, forming a white powder, magnesium oxide.

Exercise 2

Write a balanced chemical equation for the above reaction.

When zinc, lead and copper are left exposed to air, a coating of their oxides is formed on the surface of the metals. This coating prevents them from reacting further with the oxygen in air.

Iron, one of the most widely used metals, forms a layer of crumbly, brown **rust** on its surface when it is exposed to air over a long period of time. **Rusting is a process in which iron combines with oxygen in the presence of moisture and gets converted into a reddish-brown powder, iron oxide, Fe_2O_3.** The rusting of iron causes corrosion, so it is very important to try and prevent it. Find out how iron bridges and railings do not get rusty.

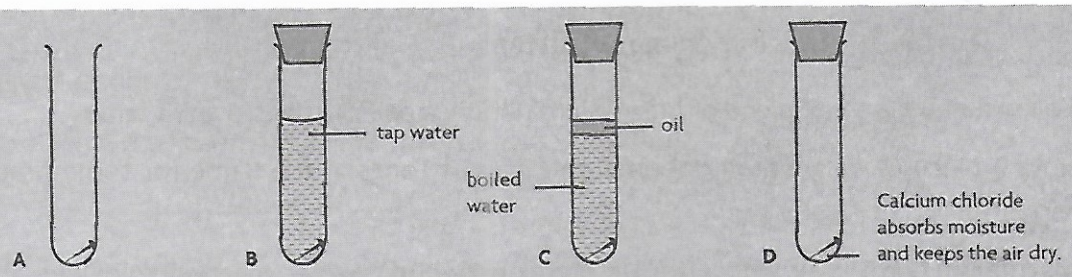
Activity 2

You will need: some clean new nails, four test tubes with rubber stoppers

Place one clean nail in each of the four test tubes. Label the test tubes A, B, C, D. Leave test tube A without a rubber stopper. Fill half of test tube B with tap water. Pour boiled water in test tube C and pour in a thin layer of oil. Oil will float on top of the water and prevent any air from entering it. Close test tube C with a rubber stopper for extra protection from air. Put some calcium chloride in test tube D and close it with a stopper. Calcium chloride absorbs any moisture in the air.

Observe the nails daily and notice the changes, if any. Draw a table like the one below and record your observations.

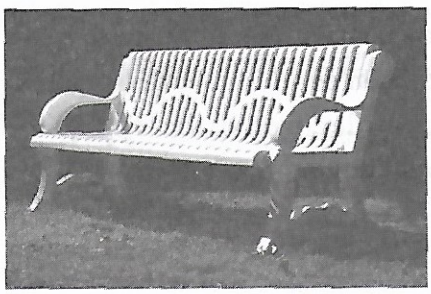
Test Tube	Appearance of Nail After Two Days	Appearance of Nails After a Week	Appearance of Nails After Two Weeks
A			
B			
C			
D			



i. In which test tubes did the nail rust?

ii. What difference did you notice between test tubes B and C?

iii. Under what conditions do iron and steel rust most?



▲ plastic coated furniture

▲ The Statue of Liberty in New York, USA, is made from copper. It is green because the copper has combined with carbon dioxide and water in air to form a covering of green copper sulphate. This layer prevents any further corrosion.

Many common objects in our world, such as cars, bridges, fences and furniture are made from iron and steel. These need to be protected from corrosion by rust. Simple methods of protection from rusting include regular oiling and cleaning. Oiling bicycle chains at regular intervals prevents them from rusting. Large objects such as bridges and ships are protected by painting them at regular intervals.

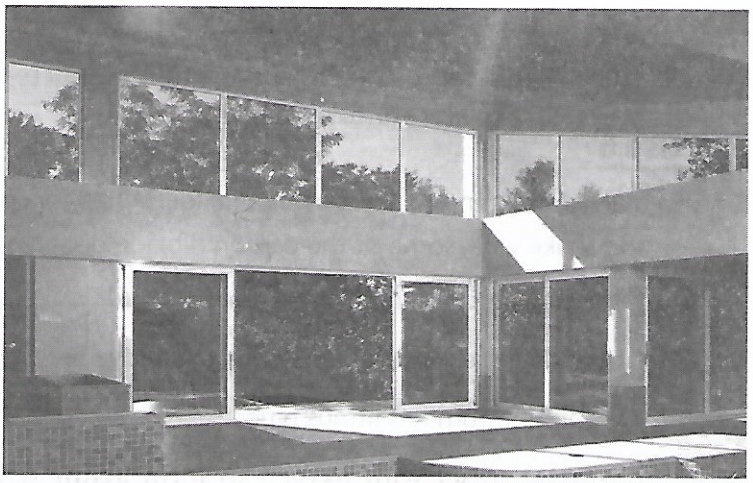
Exercise 3

How does it help to have a plastic covering on this piece of iron furniture?

Electroplating is the process of coating one metal over another, using electricity. Iron and steel can be coated with a covering of tin or chromium by electroplating. Tin is a non-reactive metal. Car bumpers, bicycle handlebars, taps and kettles are electroplated with chromium. The iron sheets used in roofs and iron dustbins are coated with a layer of zinc. This is done by immersing them in molten zinc. This process of coating iron with zinc is known as **galvanisation**. Both these processes prevent corrosion of the iron object by rust.

Metals like gold and platinum are called **noble metals**. They do not get corroded as they do not react with air. Silver does not combine with oxygen in air. However, it readily combines with sulphur compounds, such as hydrogen sulphide, present in the air to form a black coating of silver sulphide. In terms of reactivity with oxygen, sodium is the most reactive metal and gold is the least reactive.

Non-metals react with oxygen to form non-metallic oxides. For example, hydrogen combines with oxygen in the air to form water. Hydrogen gas burns in air with a blue flame.



▲ Aluminium that is used to make windows like this, reacts slowly with oxygen in the air to form a thin coating of aluminium oxide. This layer protects the metal from further corrosion.

Exercise 4

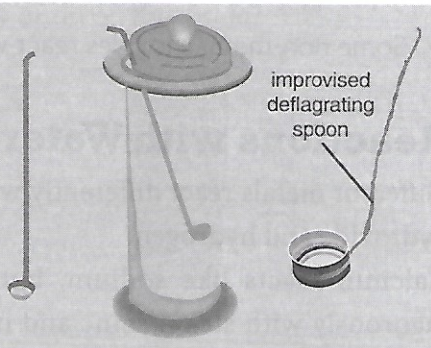
A teacher prepared some hydrogen in a test tube and held a lighted splinter to the test tube. The gas burnt with a 'pop' sound. Afterwards when the students observed the test tube carefully, they found droplets of water near the mouth of the test tube. Can you say where the water droplets came from? Write a balanced chemical equation for the reaction that takes place.

You have learnt last year that some non-metallic oxides are acidic in nature. They dissolve in water to form acids. Let us perform an activity to understand this.

Activity 3 Reaction of Sulphur with Oxygen (Teacher Demonstration)

You will need: a teaspoon of sulphur powder, a metal bottle cap, a jam jar with lid, water, blue and red litmus paper

Attach wire to a small bottle cap as shown. Fill half the cup with sulphur powder.



burning of sulphur powder

Now set fire to the sulphur powder. Lower the burning powder into the jar. The jar fills with the fumes of a gas. **Do not inhale the fumes.** After a few moments, close the lid to extinguish the burning sulphur. Add a small quantity of water into the jar. Shake well. Test the solution in the jar with red and blue litmus paper.

Sulphur burns with oxygen to form sulphur dioxide. Sulphur dioxide dissolves in water to form sulphurous acid. The sulphurous acid turns blue litmus red.

testing of solution with litmus papers

Exercise 5

Write balanced chemical equations for the two chemical reactions that take place in Activity 3?

Exercise 6

Carbon burns in oxygen to form carbon dioxide. When you pour water into a jar containing carbon dioxide and shake well, some of the carbon dioxide dissolves in water.

i. What is the product formed in this reaction? _____

ii. Write balanced chemical equations for the above reactions.

iii. Will the solution turn red litmus blue?

Some non-metals react with oxygen to form **acidic oxides**. Phosphorus bursts into flame in air without being heated. A white solid called phosphorus pentoxide is formed. That is why phosphorous is stored under water.

Exercise 7

You have already learnt the differences between the oxides of metals and non-metals. How much do you remember?

i. metal + _____ → metal oxide

ii. Two examples of metal oxides are _____ and _____.

iii. Some metal oxides are soluble in water and form _____.

iv. Some non-metallic oxides react with water to form _____.

Reactions with Water

Different metals react differently with water. Sodium reacts violently with cold water to form sodium hydroxide and hydrogen.

Calcium reacts like sodium, but more slowly. Magnesium reacts mildly with cold water, but vigorously with steam. Zinc and iron react very mildly with steam. Most metals, if they react with water produce hydroxides and hydrogen. Copper, silver and gold do not react at all. Non-metals do not react with water.

Exercise 8

Complete the following reactions as balanced chemical equations.

i. $Na + H_2O \rightarrow$ _____

ii. $K + H_2O \rightarrow$ _____

iii. $Ca + H_2O \rightarrow$ _____

Reactions with Acids

Sodium and potassium react vigorously with dilute acids to form the salt of the acid and hydrogen. You have already learnt that calcium, magnesium and zinc react with dilute acids to release hydrogen from the acid. Copper, silver and gold do not react with acids.

Exercise 9

Complete and balance the following equations in your notebook.

i. $Mg + HCl \rightarrow$ _____ $+ H_2$

ii. $Ca +$ _____ $\rightarrow CaSO_4 +$ _____

iii. _____ $+ HCl \rightarrow ZnCl_2 + H_2$

iv. _____ $+$ _____ $\rightarrow MgSO_4 + H_2$

v. Metal + acid $\rightarrow$ _____ $+$ _____

Exercise 10

What are these reactions called?

Exercise 11

Can you say why citrus fruits are sold in steel cans coated with a layer of tin on the inside?

Exercise 12

Name the following.

i. the gas produced when metals react with acids

ii. the compound formed when sulphur reacts with oxygen

iii. the non-metal that catches fire when exposed to air

iv. the gas produced when metal reacts with sulphuric acid

v. the gas that burns with a 'pop' sound

vi. the gas produced when a metal reacts with water

vii. a metal that is non-malleable at room temperature

viii. the compound formed when sulphur dioxide reacts with water

Exercise 13

Which of the following is a balanced chemical equation showing a correct chemical reaction?

i. $4Na + 2H_2O \rightarrow 4NaOH$

ii. $Mg + 2HCl \rightarrow MgCl_2 + H_2O$

iii. $2K + 2H_2O \rightarrow 2KOH + H_2$

iv. $Ca + H_2SO_3 \rightarrow CaSO_4 + H_2$

Exercise 14

Which of the following is a balanced chemical equation?

i. $Mg + H_2O \rightarrow MgO + H_2$

ii. $Mg + H_2O \rightarrow 2MgO + H_2$

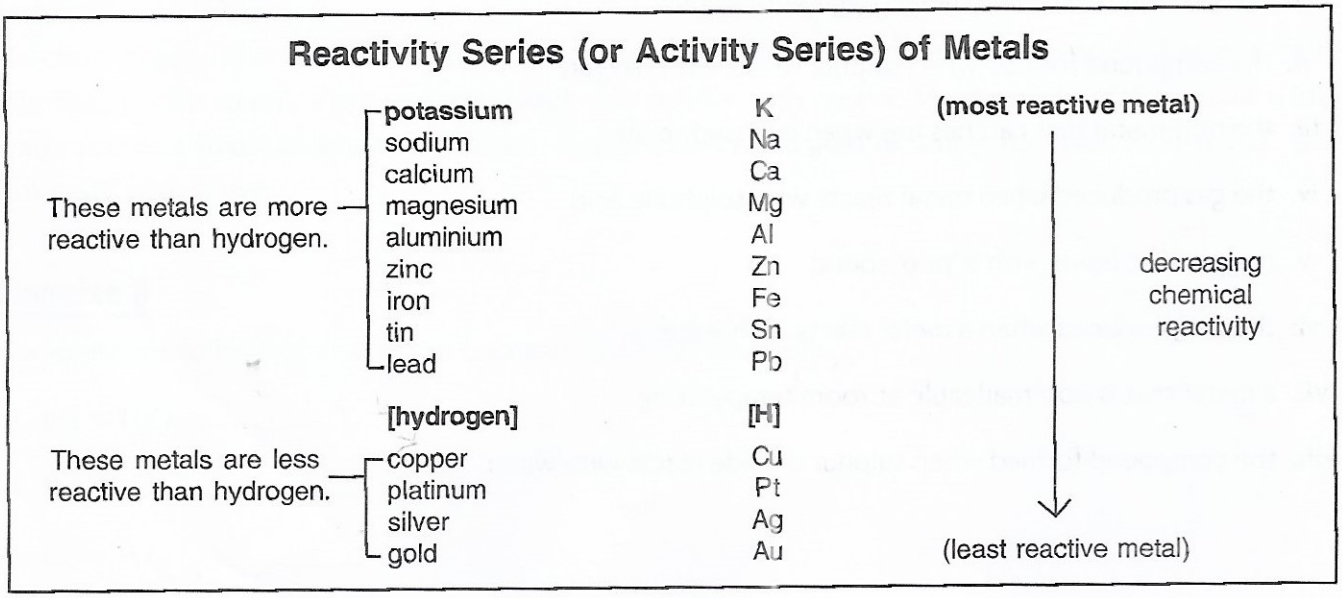
iii. $Mg + 2H_2O \rightarrow MgO + 2H_2$

iv. $Mg + 2H_2O \rightarrow 2MgO + H_2$

Reactivity Series

By comparing their reactions with oxygen and acids, metals can be arranged in order of their reactivity. The list is called the **reactivity series.**

Although hydrogen is a non-metal, it has been included in the table as a special case. **Metals above hydrogen in the reactivity series can displace it from dilute acids. Metals which are less reactive are placed below hydrogen. These cannot displace hydrogen from acids.**



More About Displacement Reactions

Activity 4

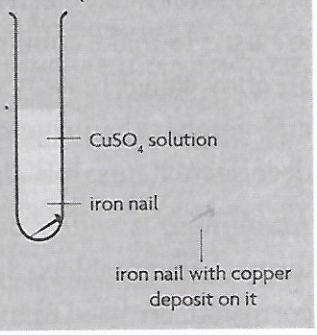
Ask your teacher to show you this reaction. Place a clean iron nail in a solution of copper sulphate. Remove the nail after a few minutes and observe it carefully. What do you observe?

You will find that the nail has a layer of copper on it, while the blue copper sulphate has turned greenish. The green colour is due to the formation of iron sulphate.

If you study the reactivity series, you will notice that iron is more reactive than copper. Hence it is able to displace copper from a solution of copper sulphate. The displaced copper is deposited on the iron nail.

The reaction can be written as:

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$



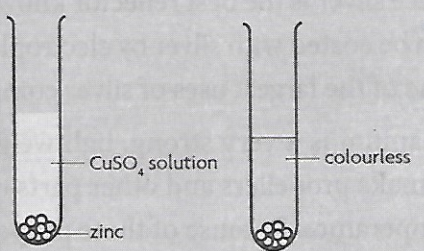
Activity 5

Now ask your teacher to show you two more reactions.

i. Take some copper sulphate solution in a test tube. Place some zinc granules in it. Wait for a few minutes. You will notice that the blue colour of copper sulphate disappears.

ii. In another test tube, place a clean copper wire in a solution of iron sulphate. Remove the strip after some time. You will observe that nothing happens.

Explain both observations.



Exercise 15

Look at the reactivity series and say which of the following reactions will take place.

i. $Fe + MgCl_2 \rightarrow FeCl_2 + Mg$

ii. $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$

iii. $Mg + ZnSO_4 \rightarrow MgSO_4 + Zn$

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

v. $Zn + 2AgNO_3 \rightarrow Zn(NO_3)_2 + 2Ag$

vi. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

Uses of Metals

Metals are present in minute quantities in all living things. Iron is an important component of haemoglobin in the blood. Sodium, potassium, zinc, magnesium and calcium are needed by the human body to function properly. Chlorophyll in plants contains magnesium.

Metals are widely used in our lives, either in the pure form or as compounds. Copper and aluminium are used for make electrical wires. Copper, stainless steel (an alloy of iron and carbon) and aluminium are used to make cooking utensils and machinery for factories. Copper combines with zinc to form an alloy called brass. Copper and tin form an alloy called bronze. These alloys are much stronger and tougher than copper. Brass has an attractive golden colour and is used to make ornaments and decorative items. It is also used to make statues. These can withstand corrosion for a long time.

Aluminium is widely used to make cans, foil and utensils. Aluminium foil is used for cooking and for packaging tablets. Special aluminium alloys, which are lightweight, very strong and resistant to corrosion, are used to make aircraft bodies.

Iron is used extensively to make magnets. It is used for making ornamental gates, railings, nails, bolts, wire netting and agricultural implements. Stainless steel, an alloy of iron, is resistant to rusting. It has replaced iron in making nettings and utensils.

In India, silver foil has been used for centuries to garnish and decorate sweets and even betel leaves. Since silver is the best reflector known, it is used in mirrors and for coating glass or other metals. Metals can be coated with silver by electroplating. Steel or brass electroplated with silver is used to make cutlery. One of the largest uses of silver compounds is in the making of photographic paper and film.

Titanium is a very strong, lightweight metal. It has excellent resistance to seawater. Hence, it is used to make propellers and other parts of the ship that are exposed to seawater. It can withstand very high temperature. Because of these properties it is used to make the bodies of space shuttles. Titanium pins are used in skeletal surgery and for joint replacements.

Gold has an extraordinary ability to reflect high intensity light. Hence space shuttles and satellites are coated with an extremely thin layer of gold to protect them from solar radiation. Gold is non-toxic and does not react with acids. It is very malleable and ductile which makes it ideal for use in dental procedures. Dentists use an alloy of gold to fill cavities, as pure gold would be too soft. It is extensively used in medicine, in special thermometers, for certain types of surgery and even for administering medicine inside the human body.

Many compounds of sodium find use in our daily lives. Sodium chloride (common salt) and sodium bicarbonate (baking soda) are used in cooking. The latter is also an antacid and is used to prevent or reduce indigestion. Sodium carbonate or washing soda is used in detergents.

Scientists are constantly experimenting to create new alloys with special properties for various uses in industry.

Uses of Non-Metals

Nitrogen is used to make explosives like nitroglycerine, nitrocellulose, trinitrotoluene (TNT). It is used in the production of fertilisers like ammonium nitrate. Ammonia gas, NH_3, which is used to prepare a number of industrial compounds, is made from nitrogen.

Sulphur is used as a medicine and in the manufacture of sulphuric acid. Sulphuric acid is used in car batteries. Sulphur is also used in the **vulcanisation** of rubber. In this process, rubber is treated with sulphur at high temperature to increase its elasticity and strength. This process can make the rubber either hard or soft and flexible.

One form of phosphorus is used in 'safety matches'. Phosphorus is used in fertilisers. Phosphorus compounds can be found in toothpaste and in shampoos.

Graphite, a form of carbon, is used to make pencil leads. Being a good conductor of electricity, it is used in electrodes. Graphite has a high melting point; hence it is used to make crucibles to melt metals in laboratories. Diamond, another form of carbon, is the hardest mineral known. It is used to cut glass.

Silicon is used to make computer chips. Silicones are important products of silicon. These are used as lubricants, polishes and electrical insulators. They are used as implants by plastic surgeons. Silica gel keeps the surrounding air dry by absorbing moisture. You must have seen small packets of silica gel inside packaging material used for medicines, computer parts, tape recorders, cameras.

Chlorine gas is used to treat the water supply and kill germs.

Recycling Metals

Metals are extracted from their naturally occurring mineral **ores**. When the ore is dug up from the earth's crust, no new ore is formed to replace it. Metals are therefore a **non-renewable** resource. If they are extracted from the earth in enormous quantities, the supply will eventually run out. There are two ways to tackle this problem. The first is to **reduce the use** of these precious resources. The second is to **recycle** them.

The most commonly used metals or alloys which should be recycled are aluminium and steel. Metals like gold, silver, brass and

Did you know?

Exposure to mercury can cause serious problems. About 40 years ago, mercury was discharged into the Minamata Bay in Japan by a local factory. It was noticed that the local fisherman became very tired and suffered from headaches. This soon spread to the rest of the community, including the population of cats. The fish in the bay had become poisoned by the mercury. This was passed on to the people who ate the fish. Many people died or suffered severe nervous disabilities due to mercury poisoning.

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Graphite, a form of carbon, is used to make pencil leads. Being a good conductor of electricity, it is used in electrodes. Graphite has a high melting point; hence it is used to make crucibles to melt metals in laboratories. Diamond, another form of carbon, is the hardest mineral known. It is used to cut glass.

Silicon is used to make computer chips. Silicones are important products of silicon. These are used as lubricants, polishes and electrical insulators. They are used as implants by plastic surgeons. Silica gel keeps the surrounding air dry by absorbing moisture. You must have seen small packets of silica gel inside packaging material used for medicines, computer parts, tape recorders, cameras.

Chlorine gas is used to treat the water supply and kill germs.

Recycling Metals

Metals are extracted from their naturally occurring mineral **ores**. When the ore is dug up from the earth's crust, no new ore is formed to replace it. Metals are therefore a **non-renewable** resource. If they are extracted from the earth in enormous quantities, the supply will eventually run out. There are two ways to tackle this problem. The first is to **reduce the use** of these precious resources. The second is to **recycle** them.

The most commonly used metals or alloys which should be recycled are aluminium and steel. Metals like gold, silver, brass and

Did you know?

Exposure to mercury can cause serious problems. About 40 years ago, mercury was discharged into the Minamata Bay in Japan by a local factory. It was noticed that the local fisherman became very tired and suffered from headaches. This soon spread to the rest of the community, including the population of cats. The fish in the bay had become poisoned by the mercury. This was passed on to the people who ate the fish. Many people died or suffered severe nervous disabilities due to mercury poisoning.

copper are so valuable that they are rarely thrown away. They do not create a waste disposal problem, while aluminium and steel do. Think of the number of times you have thrown away a metal can after drinking juices or soft drinks. These cans are non-biodegradable too!

Recycling does not cause any change in the strength or quality of the metal. It can be a never-ending process that helps to save energy and resources. It involves collecting used metal objects, and melting them to form new objects rather than throwing them away. We need to treat metals as a precious, limited resource and plan steps to conserve and recycle them.

CHECK IT OUT

1. i. gold, silver, copper; ii. mercury; iii. hydrogen, oxygen, nitrogen, chlorine; iv. carbon, iodine; v. graphite (a form of carbon); vi. copper, aluminium; vii. iron; viii. zinc; ix. carbon; x. Metals are good conductors of heat whereas non-metals are not. xi. Malleability means a substabce can be beaten into sheets. Ductility means a substance can be drawn into wires. **2.** $2Mg + O_2 \rightarrow 2MgO$ ***Activity 2:*** *i. The nails in test tubes A and B will rust. ii. The nail in C will not usually rust, so long as oxygen/air does not get mixed in the water. If the oil is poured in quickly and the test-tube is tightly corked, this will not happen. If the test tube is left open for a long time, some rusting may occur. iii. Both* ***moisture*** *and* ***oxygen*** *are necessary for rusting to take place.* **3.** *The plastic covering prevents moisture and oxygen from coming into contact with the iron furniture. So it will not rust.* **4.** *Hydrogen reacts with oxygen to form water. The water formed condenses as drops on the cold test tube.* $2H_2 + O_2 \rightarrow 2H_2O$ **5.** $S + O_2 \rightarrow SO_2$; $SO_2 + H_2O \rightarrow H_2SO_3$ **6.** *i. Carbonic acid,* H_2CO_3; *ii.* $C + O_2 \rightarrow CO_2$; $CO_2 + H_2O \rightarrow H_2CO_3$; *iii. No. It is an acid which turns litmus red.* **7.** *i. metal +* ***oxygen*** *→ metal oxide ii. sodium oxide, potassium oxide, calcium oxide, magnesium oxide, zinc oxide iii. Some metal oxides are soluble in water and form* ***alkalies****. iv. Some non-metallic oxides react with water to form* ***acids****.* **8.** *i.* $2Na + 2H_2O \rightarrow 2NaOH + H_2$; *ii.* $2K + 2H_2O \rightarrow 2KOH + H_2$; *iii.* $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ **9.** *i.* $Mg + 2HCl \rightarrow MgCl_2 + H_2$; *ii.* $Ca + H_2SO_4 \rightarrow CaSO_4 + H_2$; *iii.* $Zn + 2HCl \rightarrow ZnCl_2 + H_2$; *iv.* $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$; *v. Metal + acid → salt + hydrogen* **10.** *These reactions are called* ***displacement reactions****. The metal displaces hydrogen from the acid.* **11.** *Citrus fruits are sold in steel cans coated with a layer of tin on the inside because tin is non-toxic and does not react with the citric acid in these fruits.* **12.** *i. hydrogen; ii. sulphur dioxide; iii. phosphorus; iv. hydrogen; v. hydrogen; vi. hydrogen; vii. mercury; viii. sulphurous acid* **13.** *iii* **14.** *i.* ***Activity 5:*** *i. The more reactive zinc displaces copper from copper sulphate and forms zinc sulphate which is colourless in solution. ii. Copper is less reactive than iron. So it cannot displace iron from iron sulphate and the reaction cannot take place.* **15.** *Reactions ii; iii; v; vi can take place. Notice the positions of the metals in the reactivity series.*

BECOME A YOUNG SCIENTIST

1. Metals are used widely all around us. Find out about as many different uses of metals as you can and arrange a bulletin-board display of the same.
2. Find out the prices of some of the metals in the market, like aluminium, copper, gold and silver. What do you think is the reason for the difference in prices?
3. Our society is rapidly consuming metals that are non-renewable. Discuss in class whether we should rely on scientists to develop new materials to replace old ones that are no longer available. Or should we use and discard currently available materials more wisely?

   Discuss what types of materials are important to recycle. Should recycling be made a law all over the country? Is it important to spend money on campaigning for the importance of recycling?

   Make posters to be displayed in school to make other students aware of the need to reduce the use of metals and to recycle them. Think of all the different objects that we use that are made from metals.

Can You Answer These?

Tick the correct answer in Q1 to Q10.

1. Elements are usually divided into
   a. acids and alkalis.
   b. metals and non-metals.
   c. compounds and mixtures.
   d. alloys and ores.

2. Which one of the following is a non-metallic element?
   a. mercury
   b. sulphur
   c. water
   d. carbon dioxide

3. Which of the following compounds can be produced by the combination of a metal with an acid?
   a. iron chloride
   b. magnesium oxide
   c. copper sulphide
   d. carbon dioxide

4. The formation of calcium oxide from its elements is a reaction between
   a. two metals.
   b. two non-metals.
   c. a metal and a non-metal.
   d. an alkali and an acid.

5. Radhika carried out tests on four elements W, X, Y and Z. The results are shown in the table below.

Element	Solid at room temperature	Conducts electricity	Can be hammered into sheets
W	No	No	No
X	Yes	No	No
Y	Yes	Yes	No
Z	Yes	Yes	Yes

From these results, which of the four elements could she say is a metal?

a. W b. X c. Y d. Z

6. Which sequence indicates correctly the increasing reactivity of metals?

a. iron, zinc, magnesium, sodium, potassium
b. sodium, potassium, magnesium, zinc, iron
c. magnesium, potassium, sodium, iron, zinc
d. iron, zinc, sodium, magnesium, potassium

7. Which metal from this list will displace all the other from solutions of their salts?

a. copper b. iron
c. magnesium d. zinc

8. Dr Kumar is trying to identify an unknown metal Z. When he places it in copper sulphate solution, there is a reaction and red brown pieces of copper fall to the bottom the test tube. When he placed it in magnesium suphate solution, nothing happens. Which one of the elements given below do you think it is?

a. sodium b. iron
c. calcium d. barium

9. Which of the following reactions will take place?

A. $Mg + ZnSO_4 \rightarrow MgSO_4 + Zn$
B. $Zn + CuCl_2 \rightarrow ZnCl_2 + Cu$
C. $Cu + FeSO_4 \rightarrow CuSO_4 + Fe$
D. $Fe + MgCl_2 \rightarrow FeCl_2 + Mg$

a. C and D b. A and B
c. A, B and C d. all the above

10. Which of the following will be a displacement reaction?

a. zinc + hydrochloric acid
b. iron + copper sulphate
c. magnesium + sulphuric acid
d. all the above

11. Define the following terms: electroplating, rusting, galvanisation

12. Name the following:

a. a non-metal present in steel
b. a metal which reacts vigorously with cold water
c. a non-metal used to vulcanise rubber
d. a metal stored in oil
e. a metal that becomes black in the presence of hydrogen sulphide
f. the gas released when metals react with water
g. a metal that replaces silver from silver nitrate
h. a metal used for galvanising iron
i. a metal that will displace copper from copper sulphate solution
j. a noble metal

13. An archaeologist found a gold coin, a silver bracelet and an iron sword while digging at a site. On washing them carefully, he found that while the gold coin shone brightly, the iron sword had a reddish brown colour and was chipped from the sides and the silver bracelet had turned black. Explain these observations.

14. Give two uses each of the following metals:
iron, copper, aluminium

15. Alloys have some advantages over a pure metal. Explain this statement with two examples.

16. Give the differences between the properties of metals and non-metals with suitable examples.

17. Give reasons for the following:
    a. Steel is used to make cooking vessels.
    b. Gold is found in nature as an element in the free state.
    c. Titanium is used to make the body of a spacecraft.
    d. An alloy of gold is used in dentistry.
    e. Silver is used for making mirrors.
    f. Iron sheets are galvanised before use.
    g. Aluminium does not corrode easily.

18. Arrange the following in the order of decreasing reactivity of metals:
magnesium, potassium, iron, gold

19. Give three methods by which rusting can be prevented.

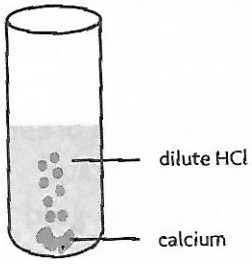
20. The cans used for soft drinks are made of aluminium.
    a. Give two reasons why aluminium is a good material for this purpose.
    b. Explain why it is important to recycle these cans.

21. Explain what difference you would see when zinc is put into hydrochloric acid and when sulphur is put into hydrochloric acid.

22. Shyama performed some displacement reactions between metals and some metallic salts. Copy and complete the table to show her findings. Put a cross wherever you think a reaction is not possible. In case it is possible, write the name of the salt formed.

Metal	Solution to Which Metal is Added				
	Magnesium Chloride	Iron Sulphate	Lead Nitrate	Copper Sulphate	Silver Nitrate
magnesium					
iron					
lead					
copper					
silver					

23. Look at the diagram of an experiment shown here and answer the questions.



a. What are the reactants?

b. Name the gas that is evolved in this reaction.

c. Write a balanced chemical equation for this reaction.

24. Compare the following pairs of reactions, giving equations in each case.

a. the reaction of sodium and calcium with water

b. the reaction of aluminum and silver with atmospheric oxygen

c. the reaction of zinc and copper with dilute sulphuric acid

25. Write balanced chemical equations for the following reactions.

a. the action of water on calcium oxide

b. the action of dilute nitric acid on zinc

c. the reaction between sulpur dioxide and water

d. the reaction between sodium and water

e. the reaction between calcium and sulphuric acid

f. the reaction between iron and copper sulphate solution

g. the reaction between potassium and water

26. Study the table below and answer the questions that follow.

Metal	Reactivity with		
	Water	Air	Dilute Acids
A	does not react	does not react	dilute acids
B	mild reaction with steam	develops coating of oxide if exposed to air	will react to form salt of acid and hydrogen
C	vigorous	vigorous	vigorous
D	can react	can react	will react to form salt of acid and hydrogen

a. Which of these elements will react with cold water to form hydrogen gas?

b. Which of these will rust?

c. Which is an unreactive metal?

d. Arrange the metals shown above in the order of decreasing reactivity.

27. Copy the chart shown here in your notebook and fill in at least two examples in the blank spaces provided at each step of the chart.