

Metals and Non-Metals

1. Give an example of a metal which

(i) Is a liquid at room temperature?

(ii) Can be easily cut with a knife?

(iii) Is the best conductor of heat?

(iv) Is a poor conductor of heat?

Solution:

(i) Mercury is the metal which is liquid at room temperature

(ii) Sodium and potassium are the metals which can be cut with a knife

(iii) Silver is the best conductor of heat

(iv) Mercury and lead are poor conductor of heat.

2. Explain the meanings of malleable and ductile.

Solution:

1. Metals which can be beaten to sheets are said to be malleable
2. Metals which can be drawn into thin wires are said to be ductile

In-text questions set 2 Page number 46

1. Why is sodium kept immersed in kerosene oil?

Solution: Sodium is a reactive metals, if kept open it will react with oxygen to explore and catch fire. Sodium metal is kept immersed in kerosene to prevent their reaction with oxygen, moisture and carbon dioxide of air.

2. Write equations for the reactions of

(i) iron with steam

(ii) calcium and potassium with water

Solution: (i) Iron reacts with steam to form a magnetic oxide of Fe with the liberation of H₂.



(ii) Calcium reacts with water to form calcium hydroxide and hydrogen.



Potassium reacts with cold water violently immediately with evolution of H_2 which catches fire.



3. Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows

Metal	Iron(II) sulphate	Copper(II) sulphate	Zinc sulphate	Silver Nitrate
A	No reaction	Displacement	–	–
B	Displacement	–	–	–
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

Use the Table above to answer the following questions about metals A, B, C and D.

1. Which is the most reactive metal?
2. What would you observe if B is added to a solution of Copper (II) sulphate?
3. Arrange the metals A, B, C and D in the order of decreasing reactivity.

Solution:

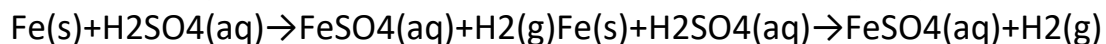
(i) Metal B is the most reactive as it gives displacement reaction with iron (II) sulphate.

(ii) When metal B is added to copper (II) sulphate solution, a displacement reaction will take place because of which the blue colour of copper (II) sulphate solution will fade and a red-brown deposit of copper will be formed on metal B.

(iii) Metal B is the most reactive because it displaces iron from its salt solution. Metal A is less reactive because it displaces copper from its salt solution. Metal C is still less reactive because it can displace only silver from its salt solution and metal D is the least reactive because it cannot displace any metal from its salt solution. Hence, the decreasing order of reactivity of the metals is $B > A > C > D$.

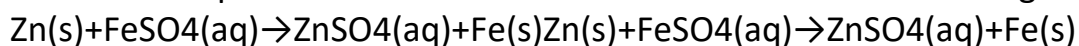
4. Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute H_2SO_4 .

Ans: Iron is more reactive than hydrogen according to the reactivity series. So, when iron comes in contact with dilute H_2SO_4 it replaces hydrogen to form iron sulphate and in the reaction it releases hydrogen gas.



5. What would you observe when zinc is added to a solution of iron (II) sulphate? Write the chemical reaction that takes place.

Ans: According to the reactivity series we know zinc is more reactive than iron. So, when zinc comes in contact with iron sulphate solution it replaces iron and forms zinc sulphate. And the colour of solutions turns brown from green.



Intext Exercise:

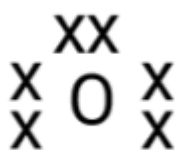
1. Answer the following:

i. Write the electron-dot structures for sodium, oxygen and magnesium.

Ans: Sodium, oxygen and magnesium atomic numbers are 11, 8 and 12. The electron dot structures are below:

Sodium (2,8,1) = NaXNaX

Oxygen (2,6) =



Magnesium

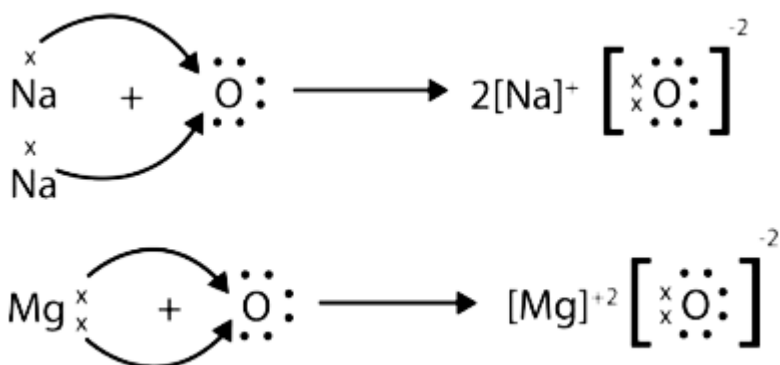
(2,8,2)

=

MgXXMgXX

ii. Show the formation of Na_2O and MgO by the transfer of electrons.

Ans: Both of the compounds will form an ionic bond.



iii. What are the ions present in these compounds?

Ans: In the Na₂O, the ions 2Na⁺ and O²⁻ and in MgO are Mg²⁺ and O²⁻. Na₂O, the ions 2Na⁺ and O²⁻ and in MgO are Mg²⁺ and O²⁻.

2. Why do ionic compounds have high melting points?

Ans: Ionic compounds have high electrostatic force between the molecules due to which they are very closely packed and rigid. This tight packing results in ionic compounds having high melting points.

Refer to page 53.

1. Define the following terms.

i. Minerals:

Ans: The minerals which are present as a mixture of metallic compounds and extractable impurities are known as ores and the compound of a metal found in nature is called mineral.

ii. Ore:

Ans: The minerals from which the metals can be conveniently and economically extracted are known as ores.

iii. Gangue:

Ans: The ore contains some impurities like sand, clay and rocky material. These impurities are called gangue or matrix. Gangue is removed before the metallurgical process starts.

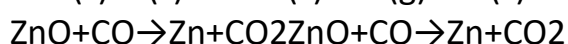
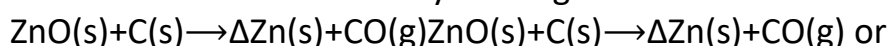
2. Name two metals which are found in nature in the free state.

Ans: Silver and Gold are found in free state as their reactivity potential is very low.

For example: Silver(Ag), Gold (Au), and Platinum(Pt).

3. What chemical process is used for obtaining a metal from its oxide?

Ans: More reactive metals are reduced by the electrolysis process. moderate reactive metals can be reduced by either carbon or carbon monoxide. Metal oxides are reduced by using suitable reducing agents such as carbon or by highly reactive metals to displace the metals from their oxides. For example, zinc oxide is reduced to metallic zinc by heating with carbon.



Thermite process: Chromium oxides are reduced to chromium by treating it with aluminium powder. In this case, aluminium displaces manganese from its oxide.



Refer to page 55.

1. Metallic oxides of zinc, magnesium and copper were heated with the following metals.

Metals	Zinc	Magnesium	Copper
Zinc Oxide	-	-	-
Magnesium Oxide	-	-	-
Copper Oxide	-	-	-

In which cases will you find displacement reactions taking place?

Ans:

Metals	Zinc	Magnesium	Copper
Zinc Oxide	No reaction	Displacement	No reaction
Magnesium Oxide	No reaction	No reaction	No reaction
Copper Oxide	Displacement	Displacement	No reaction

14. Which metals do not corrode easily?

Solution : Metals which are placed at the bottom of activity series like silver, gold, platinum do not corrode easily.

15. What are alloys?

Solution : An alloy is homogenous mixture of two or more metals or metal and non-metal. It is obtained by first melting primary metal and then dissolving the other element in it in definite proportion.

16. Which of the following pairs will give displacement reactions?

- (a) NaCl solution and copper metal
- (b) MgCl_2 solution and aluminum
- (c) FeSO_4 solution and silver metal
- (d) AgNO_3 solution and copper

Solution : (d) AgNO_3 solution and copper

17. Which of the following method is suitable for preventing an iron fry pan from rusting?

- (a) Applying grease
- (b) applying paint
- (c) Applying coating of zinc
- (d) All of the above

Solution : (c) Applying coating of zinc

18. An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be

- (a) Calcium
- (b) Carbon
- (c) Silicon
- (d) Iron

Solution : (a) Calcium

4. Food cans are coated with tin and not with zinc because

- (a) Zinc is costlier than tin.
- (b) Zinc has a higher melting point than tin.
- (c) Zinc is more reactive than tin.
- (d) Zinc is less reactive than tin.

Solution: Answer is c. Food cans are coated with tin and not with zinc because Zinc is more reactive than tin.

5. You are given a hammer, a battery, a bulb, wires and a switch.

- (a) How could you use them to distinguish between samples of metals and non-metals?
- (b) Assess the usefulness of these tests in distinguishing between metals and non-metals.

Solution:

1. Metals are malleable and can be easily drawn into sheets by hitting with hammer. On the other hand if we beat non-metals they break down and they cannot be drawn into sheets as they are non-malleable. Metals are good conductors of electricity hence they make bulb when you connect metals with a battery, wire and bulb. Similarly If non-metals are bad conductors of electricity chance they fail to lit up the bulb on connecting with wire and battery.
2. These experiments can be helpful to demonstrate the malleability and electric conductivity of the metals and non-metals

6. What are amphoteric oxides? Give two examples of amphoteric oxides

Solution: Oxides that react with both acids and bases to form salt and water are known as amphoteric oxides. Examples: PbO and Al₂O₃.

Amphoteric oxides are the one which reacts with both acids and bases to form salt and water. Examples: Lead oxide – PbO and Aluminium oxide – Al₂O₃.

7. Name two metals which will displace hydrogen from dilute acids, and two metals which will not.

Solution: Zinc (Zn) and Magnesium (Mg) are the two metals which will displace Hydrogen from dilute acids as they are very reactive metals. Gold (Au) and Silver (Ag) are the metals which will not replace Hydrogen from dilute acids as these metals are less reactive.

8. In the electrolytic refining of a metal M, what would you take as the anode, the cathode and the electrolyte?

Solution: In the process of electrolytic refining of metal called 'M', An impure and thick block of metal M. is considered as anode, Thin strip or wire of pure metal M is taken as cathode. A suitable salt solution of metal M is considered as the electrolyte.

9. Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it, as shown in figure below.

(a) What will be the action of gas on

(i) dry litmus paper?

(ii) moist litmus paper?

(b) Write a balanced chemical equation for the reaction taking place.

Solution: a) When sulphur powder is burnt in the air sulphur-di-oxide is formed.

(i) Sulphur-di-oxide does not have any effect on dry litmus paper.

(ii) Sulphur-di-oxide turn the moist litmus paper from blue to red as contact of SO₂ with water turns to sulfurous acid.

(b) $S(s) + O_2(g) \rightarrow SO_2(g)$

$SO_2(g) + H_2O \rightarrow H_2SO_3$

10. State two ways to prevent the rusting of iron.

Solution:

1. Iron can be prevented from rusting by coating the surface of the iron with rust proof paints
2. By applying Oil/grease on the surface of iron objects as it will prevent the iron surface to get in contact with air consisting of moisture.

11. What type of oxides are formed when non-metals combine with oxygen?

Solution: When non-metals combine with oxygen it forms either acidic or neutral oxides. Ex: N_2O_5 or N_2O_3 is an acidic oxide; CO is a neutral oxide.

12. Give reasons

(a) Platinum, gold and silver are used to make jewellery.

(b) Sodium, potassium and lithium are stored under oil.

(c) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.

(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction

Solution:

(a) Platinum, gold and silver are used to make jewellery for these metals are very less reactive hence they are not affected by air, water or most chemicals. These metals have a lot of luster and they are malleable and ductile in nature and also high corrosion resistance in nature.

(b) Sodium, potassium and lithium readily react with water to produce a lot of heat. As a result, Hydrogen evolved in the reaction results in a fire. On exposure to water they react with moisture (water droplets) present in the atmosphere, In order to prevent contact with water hence these metals are stored under oil.

(c) Aluminium forms on its surface a nonreactive surface of aluminium oxide. Such coating prevents other compounds from reacting to aluminium. So aluminium is being used to produce utensils for cooking.

(d) Reducing metal oxide into free metal is easy. Additionally, because it is easier to obtain metals directly from their oxides than from their carbonates or sulphides, the carbonate and sulphide ores are first transformed to oxides to obtain the metals.

13. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.

Solution: Tarnished copper vessels being cleaned with lemon or tamarind because this sour substance contains acids which dissolve the coating of copper oxide or basic copper carbonate present on the surface or tarnished copper vessels. This makes them shining red-brown again. Hence they are very effective in cleaning tarnished copper vessels.

14. Differentiate between metals and non-metals.

Ans: Differences between metals and non-metals are as follows:

METALS	NON-METALS
Metals are electropositive.	Non-metals are electronegative.
They react with water to form oxides and hydroxides. Some metals react with cold water, some with hot water, and some with steam. $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 \uparrow$ $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 \uparrow$	They do not react with water.
They react with oxygen to form basic oxides $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$ $4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$ These have ionic bonds.	They react with oxygen to form acidic or neutral oxides. $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ These have covalent bonds
They react with dilute acids to form a salt and evolve hydrogen gas. However, Cu, Ag, Au, Pt, Hg do not react. $2\text{Na} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2 \uparrow$ $2\text{Na} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2 \uparrow$.	They do not react with dilute acids. These are not capable of replacing hydrogen.
They react with the salt solution of metals. Depending on their reactivity, displacement reaction can occur $\text{CuSO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{Cu}$ $\text{CuSO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{Cu}$.	These react with the salt solution of non-metals
They act as reducing agents. $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$ $\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$	These act as oxidizing agents. $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$ $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$

15. A man went door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of

gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used?

Ans: The man is using Aqua Regia which is 3 parts of HCLHCL and 1 part of HNO₃HNO₃ solution. Gold is the least reactive metal but when we put it in aqua regia the upper most layer gets dissolved in the solution and the inner layer comes out due to which it weighs less than before but is glitterier.

16. Give reasons why copper is used to make hot water tanks and not steel (an alloy of iron).

Ans: In the reactivity reaction copper comes below hydrogen and hence, it will not react with the water present/stored. On the other hand, steel which is an alloy of iron will react with the steam and can get corroded easily.

Important Points Covered in This Chapter

- Metals and non-metals are two types of elements. Metals are shiny, malleable, ductile, and excellent heat and electricity conductors. Except for mercury, which is a liquid at normal temperature, all are solids.
- By losing electrons to nonmetals, metals can generate positive ions.
- Basic oxides are formed when metals react with oxygen. Aluminum oxide and zinc oxide exhibit both basic and acidic oxide characteristics. Amphoteric oxides are the name for these oxides.
- With water and dilute acids, various metals have varied reactivities.
- An activity series is a list of common metals grouped in decreasing order of reactivity.
- Metals in the Activity class above hydrogen can displace hydrogen from dilute acids.
- When non-metals receive electrons from metals, they produce negatively charged ions, which are then converted into acidic or neutral oxides.
- Dilute acids do not have hydrogen displaced by non-metals. They create hydrides when they react with hydrogen.