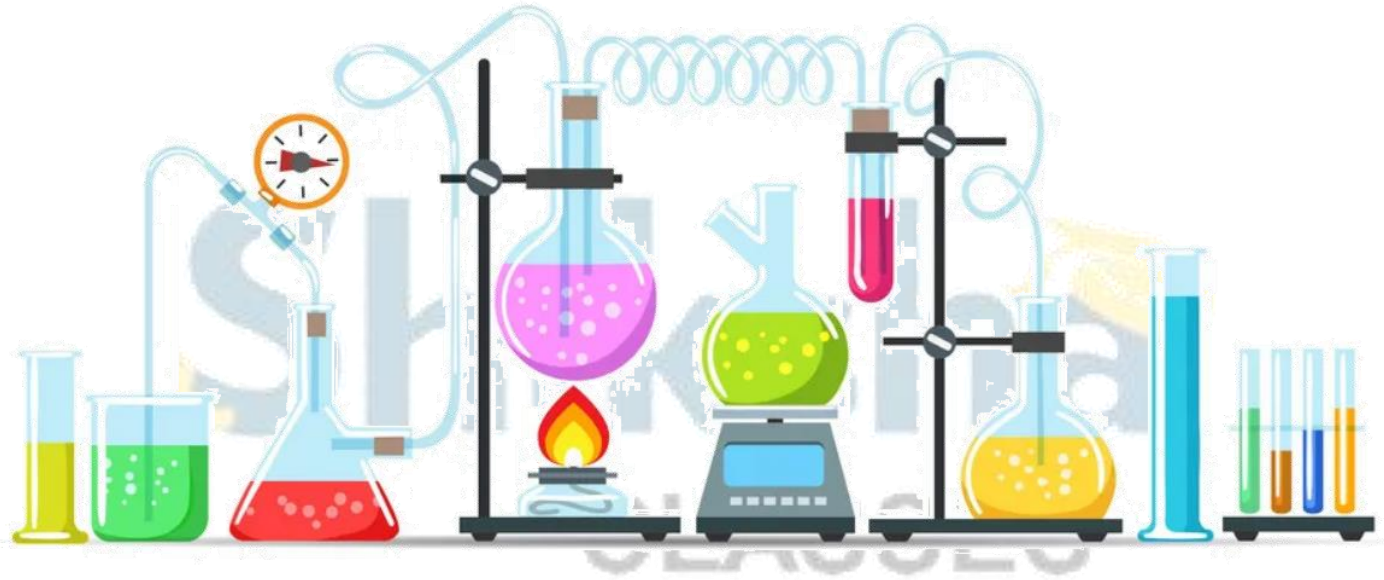
Shiksha CLASSES

SCIENCE

(Chemistry)

Chapter 3: Metals & Non-Metals



Metals & Non-Metals

Physical Properties of Metals

- **Physical State:** With the exception of mercury and gallium, which are liquids at room temperature, metals are solids at room temperature.
- **Lustre:** The property of metals which makes the light reflect from their surfaces is called lustre. This property of the metals can be due to the polished metal surfaces. Eg., gold and silver.
- **Malleability:** Metals may be formed into thin sheets known as foils and can withstand hammering. With the exception of Zinc, which is fragile.
- **Ductility:** Wires can be made out of metals. With the exception of Zinc, which is fragile.
- **Hardness:** Except for sodium and potassium, which are soft and can be cut with a knife, all metals are hard.
- **Conduction:** Because metals have free electrons, they are good conductors. Silver and copper are the best heat and electricity conductors. Lead is the least efficient heat conductor. Iron, bismuth, and mercury are likewise poor conductors.
- **Density:** Metals have a high density and weigh a lot. The densities of iridium and osmium are the greatest, whereas lithium has the lowest density.
- **Melting and Boiling Point:** Metals are known for their high melting and boiling points. The melting point of tungsten is the highest, while the boiling point of silver is the lowest. The melting values of sodium and potassium are both low.
- **Alloy Formation:** Metals combine to create an alloy, which is a homogeneous combination of metals. Brass is a copper and zinc alloy.
- **Sonorous:** Metals, when hit by a solid object, produce sound. This property of a metal is known as sonorous.

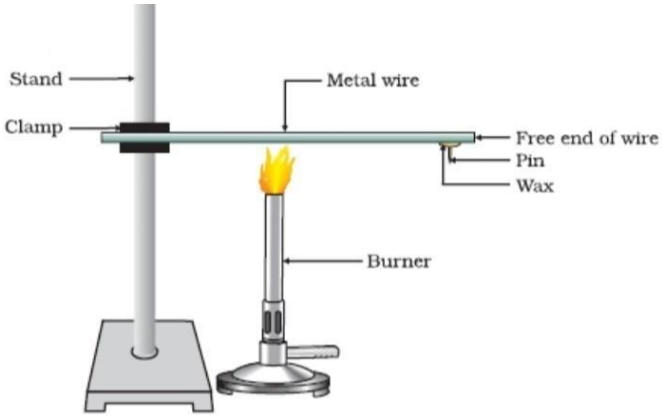
Physical Properties of Non-Metals

Non-metals

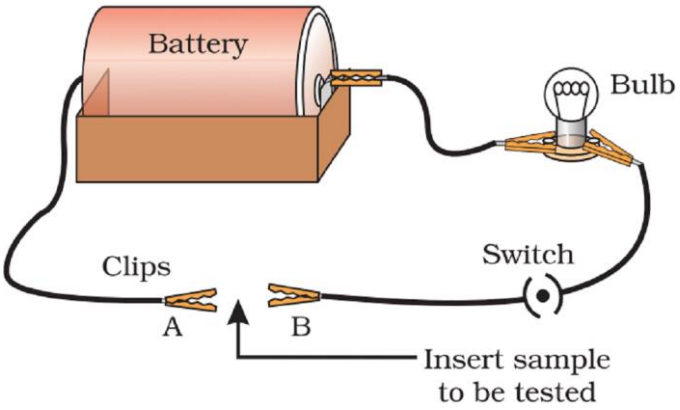
- **Physical State:** At ambient temperature, the majority of non-metals exist in two of the three states of matter: gases (oxygen) and solids (iodine, carbon, sulphur). There is no metallic sheen to them (save iodine) and they do not reflect light. (With the exception of carbon in the form of diamond.)
- **Nature:** Non-metals are extremely fragile, and they can't be coiled into wires or hammered into sheets. Except for diamond, which is the world's hardest substance.
- **Conduction:** Non-metals are poor heat and electrical conductors. (Except graphite conducts heat, both graphite and gas carbon conduct electricity.)
- **Electronegative Character:** Non-metals have a proclivity for gaining or sharing electrons with neighbouring atoms. Hence, non-metals are known for their electronegative nature.
- **Reactivity:** When they come into contact with oxygen, they produce acidic or neutral oxides. Hence, non-metals are reactive.
- **Melting and Boiling Points:** Non-metals are known for its low melting and boiling points.

Difference in Physical Properties of Metals and Non-Metals:

Metals	Non-metals
1. Metals are good conductors of heat and electricity.	1. Non-metals are bad conductors of heat and electricity.
2. Metals are malleable that is they can be beaten into sheets.	2. Non-metals are not malleable.
3. Metals are ductile that is they can be drawn into wires.	3. Non-metals are not ductile.
4. Metals are sonorous.	4. Non-metals are not sonorous.
5. Metals have high tensile strength due to high attraction between molecules.	5. Non-metals have low tensile strength due to low attraction between molecules.
6. Metals have high density.	6. Non-metals have low density.



Metals are good conductors of heat.



Metals are good conductors of electricity

Chemical Properties of Metals

Reaction of Metals are burnt in Air (with Oxygen)

Almost all metals react with oxygen to form metal oxides.

Metal + Oxygen → Metal oxide (basic)

- Sodium and potassium are the most reactive and react with oxygen present in the air at room temperature to form the oxides. It is kept immersed in kerosene oil as they react vigorously with air and catch fire.

  $4K_{(s)}+O_{2(g)} \rightarrow 2K_2O_{(s)}$ (vigorous reaction)

- Magnesium does not react with oxygen at room temperature, but on heating, it burns in the air with intense light and heat to form magnesium oxide.

  $2Mg_{(s)}+O_{2(g)} \rightarrow 2MgO_{(s)}$ (Mg burns with white dazzling light)

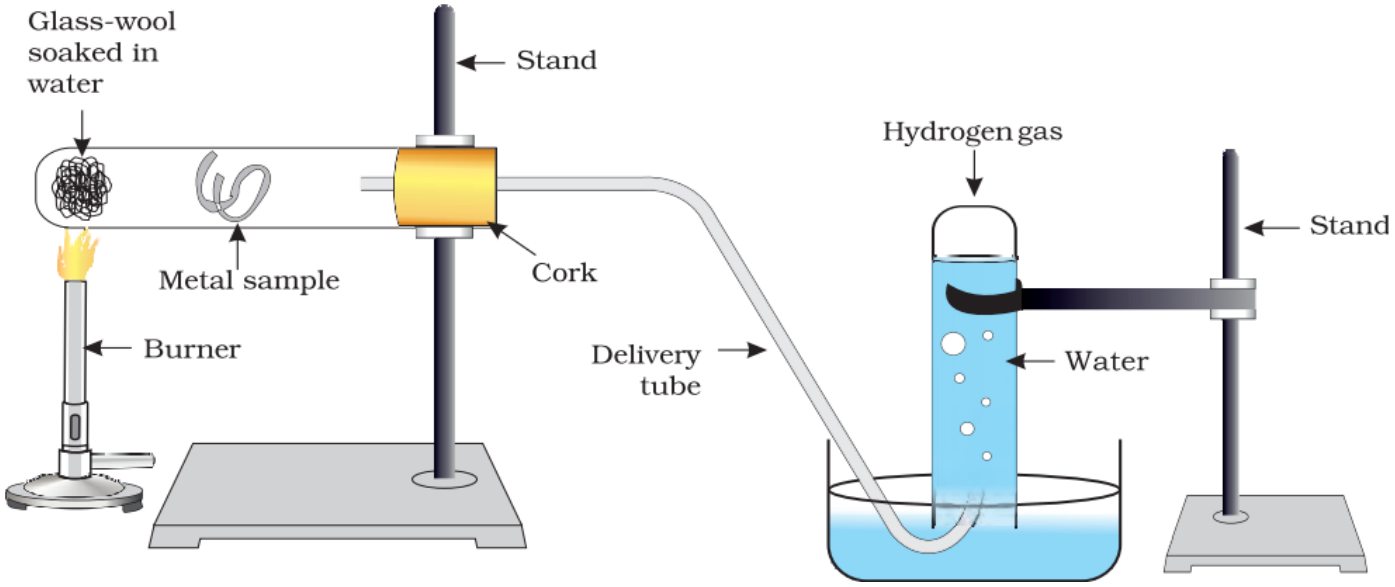
- Silver, platinum and gold don't burn or react with air.

Reaction of Metals with Water

Metals react with water and produce a metal oxide and hydrogen gas. Metal oxides that are soluble in water dissolve in it to further form metal hydroxide. But all metals do not react with water.

Metal + Water → Metal oxide + Hydrogen

Metal oxide + Water → Metal hydroxide



Action of steam on a metal

- Metals such as sodium and potassium react vigorously with cold water to lead to evolution of hydrogen, which immediately catches fire producing a large quantity of heat.

  $2K_{(s)} + 2H_2O_{(l)} \rightarrow 2KOH_{(aq)} + H_{2(g)}$ + heat energy

  $2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$ + heat energy

- Metals such as aluminium, zinc and iron do not react with cold or hot water, but they react with steam to form metal oxides and hydrogen.

  $2Al_{(s)} + 3H_2O_{(g)} \rightarrow Al_2O_{3(s)} + 3H_{2(g)}$

  $3Fe_{(s)} + 4H_2O_{(g)} \rightarrow Fe_3O_{4(s)} + 4H_{2(g)}$

- Metals such as lead, copper, silver and gold do not react with water at all

Reactions of Metals with Acids

Metals react with acids to form salt and hydrogen gas.

Metal + Dilute acid → Salt + Hydrogen

1. Metals react with dilute hydrochloric acid to give metal chloride and hydrogen gas.

   $Mg + 2HCl \rightarrow MgCl_2 + H_2$

2. Metals react with sulphuric acid to form metal sulphate and hydrogen gas.

   $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

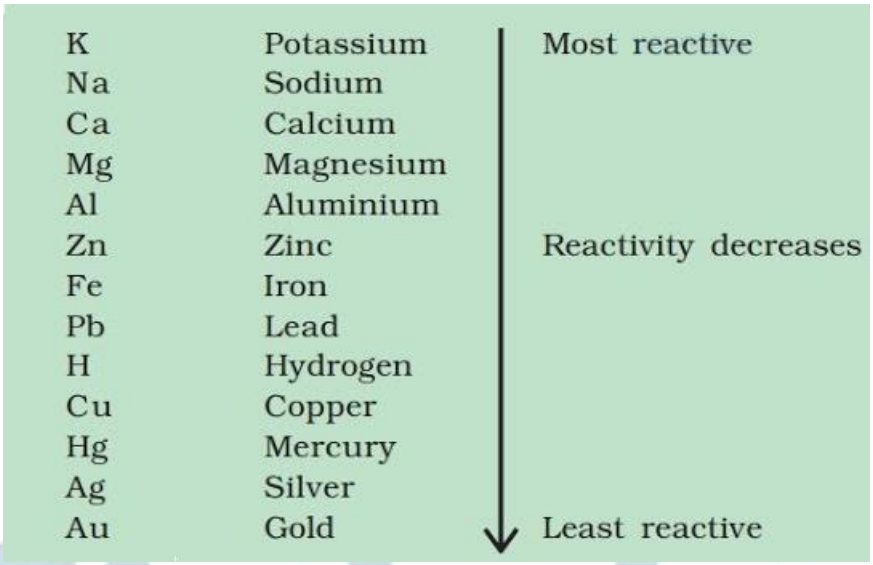
3. Metals react with nitric acid, but hydrogen gas is not evolved since nitric acid is a strong oxidising agent. So, it oxidises the hydrogen to water and itself gets reduced to a nitrogen oxide.
   But magnesium and manganese react with dilute nitric acid to evolve hydrogen gas.

$Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

$Mn + 6HNO_3 \rightarrow Mn(NO_3)_2 + H_2$

Reactivity Series

The arrangement of metals in the order of decreasing reactivities is called the reactivity series of metals.



Activity series: Relative reactivities of metals

Reactions of Metals with Solutions of Other Metal

A more reactive metal displaces a less reactive metal from its salt solution.

For example:

When an iron nail is placed in a copper sulphate solution, the blue colour of $CuSO_4$ fades away slowly and a reddish brown copper metal is formed.

$CuSO_{4(aq)} + Fe_{(s)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$

Reaction of Metals with Chlorine

Metals react with chlorine to form metal chlorides. **For example:**

- Sodium readily reacts with chlorine to form ionic chloride called sodium chloride.

  $2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$

- Calcium reacts vigorously with chlorine to form calcium chloride.

  $Ca_{(s)} + Cl_{2(g)} \rightarrow 2CaCl_{2(s)}$

Properties of Ionic Compounds

- Ionic compounds are hard solids, due to the strong force of attraction between the positive and negative ions.
- They are generally brittle and break into pieces when pressure is applied.

- Ionic compounds have high melting and boiling points, since a large amount of energy is required to break the strong intermolecular attractions.
- They are soluble in water, but insoluble in solvents such as kerosene, petrol, etc.
- They do not conduct electricity in a solid state, because electrostatic forces of attraction between ions in the solid state are very strong but conduct electricity in the fused (or in the aqueous state) because these forces weaken in the fused (or in solution) state so that their ions become mobile.

Metallurgy

- **Minerals**: The naturally occurring compounds of metals, along with other impurities are known as minerals.
- **Ores**: The minerals from which metals are extracted profitably and conveniently are called ores.
- **Gangue**: Earthly impurities including silica, mud, etc. associated with the ore are called gangue.
- **Metallurgy:** The process used for the extraction of metals in their pure form from their ores is referred to as metallurgy.

Extraction of Metals

- The reactivity of elements differs for different metals.
- Three major steps involved in the extraction of metals from their ores are:

Conversion of Concentrated Ore into Metal

- The extraction of a metal from its concentrated ore is essentially a process of reduction of the metal compound present in the ore.
- The method of reduction to be used depends on the reactivity of the metal to be extracted.
- **Extraction of Less Reactive Metals**

Metals at the bottom of the reactivity series are not very reactive and the oxides of these metals can be reduced by heating the ore itself.

Extraction of Mercury

Cinnabar, an ore of mercury is first heated in the air and is converted into mercuric oxide.

$2HgS_{(s)} + 3O_{2(g)} \xrightarrow{Heat} 2HgO_{(s)} + 2SO_{2(g)}$

$2HgO_{(s)} \xrightarrow{Heat} 2Hg_{(s)} + O_{2(g)}$

- **Extraction of Moderately Reactive Metals**
  - The moderately reactive metals in the middle of the reactivity series are extracted by the reduction of their oxides with carbon, aluminium, sodium or calcium.
  - It is easier to obtain metals from their oxides (by reduction) than from carbonates or sulphides. So, before reduction can be done, the ore is converted into a metal oxide.
  - The concentrated ores can be converted into metal oxides by the process of calcination or roasting.

Calcination is the process in which a carbonate ore is heated strongly in the absence of air to convert it into a metal oxide. The ore is heated to a high temperature in the absence of air, or when air is not present throughout the reaction. Carbonate ores, as well as ores containing water, are usually calcined to remove carbonate and moisture impurities.

For example:

$ZnCO_{3(s)} \xrightarrow{Calcination} ZnO_{(s)} + CO_{2(g)}$

Roasting is the process in which a sulphide ore is strongly heated in the presence of air to convert it into a metal oxide.

$2ZnS_{(s)} + 3O_{2(g)} \xrightarrow{Roasting} 2ZnO_{(s)} + 2SO_{2(g)}$

The metal oxides are converted to free metal by using reducing agents such as carbon, aluminium, sodium or calcium.

For example:

- The metal zinc is extracted by the reduction of zinc oxide with carbon. Thus, when zinc oxide is heated with carbon, zinc is produced.
- Aluminium reduces iron oxide to produce the metal iron with the evolution of heat. Due to this heat, the iron is produced in the molten state.

  $Fe_2O_{3(s)} + 2Al(s) \rightarrow 2Fe_{(l)} + Al_2O_{3(s)} + Heat$

  The reaction of iron (III) oxide with aluminium is used to join railway tracks or cracked machine parts. This reaction is known as the thermite reaction.

- **Extraction of Highly Reactive Metals**

Metals high up in the reactivity series are very reactive.

These metals have a strong affinity for oxygen. So, oxides of sodium, magnesium, calcium and aluminium cannot be reduced by carbon.

These metals are obtained by electrolytic reduction.

Sodium, magnesium and calcium are obtained by the electrolysis of their molten chlorides.

For example:

Sodium metal is extracted by the electrolytic reduction of molten sodium chloride.

$2NaCl_{(l)} \xrightarrow{Electrolytic} 2Na_{(s)} + Cl_{2(g)}$

At Cathode: $Na^+ + e^- \rightarrow Na$

At Anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

Refining of Metals

- The most widely used method for refining impure metals is electrolytic refining.
- Electrolytic refining means refining by electrolysis. Metals such as copper, zinc, tin, lead, chromium, nickel, silver and gold are refined electrolytically.

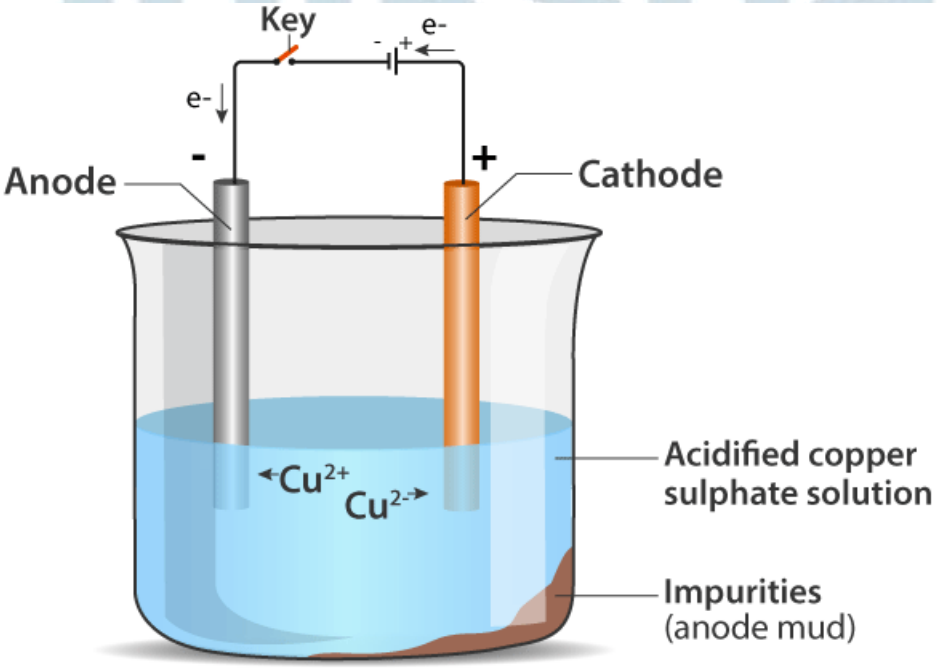
Electrorefining

Electrolysis can be used to recover metals that cannot be separated via a chemical reduction technique, as well as to purify metals acquired through other means. The anode in the electrorefining process is a block of impure metal, while the cathode is a thin sheet of pure metal. An aqueous solution of the metal salt is included in the electrolytic cell. When an electric current of a sufficient voltage is passed via the anode, impure metal is dissolved and pure metal is deposited at the cathode. The following is how metal ions from the anode enter the electrolyte:

$M \rightarrow M^{+n} + ne^-$

These ions get deposited on the cathode in the following manner

$M^{+n} + ne^- \rightarrow M$



Electrolytic refining of copper. The electrolyte is a solution of acidified copper sulphate. The anode is impure copper, whereas, the cathode is a strip of pure copper. On passing electric current, pure copper is deposited on the cathode.

This technique is used to refine volatile metals with lower boiling points than their impurities, such as copper, silver, tin, and nickel. For example: Mercury and Zinc.

- An electrolyte is a substance (salt, acid, or base) that transmits an electric current in solution or in a molten form while also being decomposed by it. The current is carried by

ionised electrolytes, which are electrically charged ions.

- Charged ions migrate towards oppositely charged electrodes in order to lose their electric charge and form atoms, which are then either released or deposited at the electrodes.

Corrosion

Most of the metals keep on reacting with the atmospheric air. This leads to the formation of a layer over the metal. In the long run, the underlying layer of metal keeps on getting lost due to conversion into oxides or sulphides or carbonate, etc. As a result, the metal gets eaten up. The process is called Corrosion.

Rusting of Iron: Rusting of iron is the most common form of corrosion. When iron articles like the gate, grill, fencing, etc. come in contact with moisture present in the air, the upper layer of iron turns into iron oxide. Iron oxide is brown-red in colour and is known as Rust. The phenomenon is called Rusting of Iron.

If rusting is not prevented in time, the whole iron article would turn into iron oxide. This is also known as Corrosion of Iron. Rusting of iron gives a huge loss every year.

Conditions necessary for rusting of iron

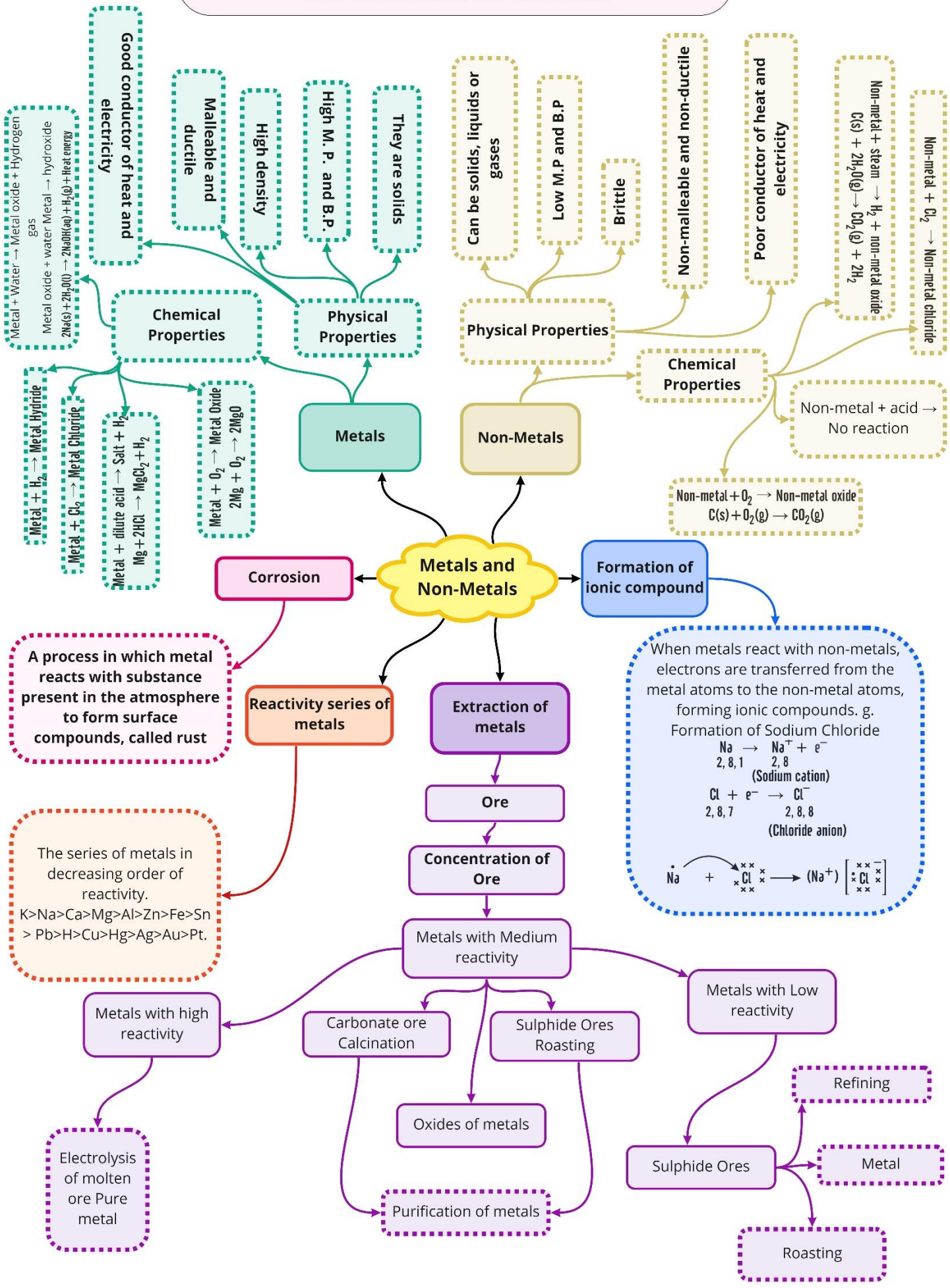
i. Presence of air (or oxygen)
ii. Presence of water (or moisture)

Prevention of Corrosion

- **Galvanising**: It is the process of giving coating a thin layer of zinc on iron or steel to protect them from corrosion. Example: shiny nails, pins. etc.
- **Tinning:** It is a process of coating tin over other metals.
- **Electroplating:** In this method, a metal is coated with another metal using electrolysis. Example: silver plated spoons, gold plated jewellery etc.
- **Alloying:** An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal in a definite proportion. The resultant metals, called alloys do not corrode easily.

  For example: Brass (copper and zinc), Bronze (copper and tin) and Stainless steel (iron, nickel, chromium and carbon)

Class : 10th Chemistry
CHAPTER : 3 metals and non-metals



Important Questions

➢ Multiple Choice Questions:

1. Aluminium is used for making cooking utensils. Which of the following properties of aluminium are responsible for the same?

(i) Good thermal conductivity
(ii) Good electrical conductivity
(iii) Ductility
(iv) High melting point

(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (i) and (iv)

2. The most abundant metal in the earth's crust is

(a) Iron
(b) Aluminium
(c) Calcium
(d) Sodium

3. The poorest conductor of heat among metals is

(a) Lead
(b) Mercury
(c) Calcium
(d) Sodium

4. Which property of metals is used for making bells and strings of musical instruments like Sitar and Violin?

(a) Sonorousness
(b) Malleability
(c) Ductility
(d) Conductivity

5. $Al_2O_3 + 2NaOH \rightarrow + H_2O$

(a) $Al(OH)_3$
(b) Na_2O
(c) $NaAlO_2$
(d) $AlNaO_2$

6. Which of the following is the correct arrangement of the given metals in ascending order of their reactivity?

Zinc, Iron, Magnesium, Sodium

(a) Zinc > Iron > Magnesium > Sodium
(b) Sodium > Magnesium > Iron > Zinc

(c) Sodium > Zinc > Magnesium > Iron
(d) Sodium > Magnesium > Zinc > Iron

7. Which of the following pairs will give dis-placement reactions?

(a) $FeSO_4$ solution and Copper metal
(b) $AgNO_3$ solution and Copper metal
(c) $CuSO_4$ solution and Silver metal
(d) NaCl solution and Copper metal

8. Non-metals form covalent chlorides because

(a) they can give electrons to chlorine
(b) they can share electrons with chlorine
(c) they can give electrons to chlorine atoms to form chloride ions
(d) they cannot share electrons with chlorine atoms

9. Which of the following oxide(s) of iron would be obtained on prolonged reaction of iron with steam?

(a) FeO
(b) Fe_2O_3
(c) Fe_3O_4
(d) Fe_2O_3 and Fe_2O_4

10. Which of tire following are not ionic compounds?

(i) KCl
(ii) HCl
(iii) CCl_4
(iv) NaCl

(a) (i) and (ii)
(b) (ii) and (iii)
(c) (iii) and (iv)
(d) (i) and (iii)

➢ Very Short Question:

1. Name the metal which is most abundant in earth's crust.

2. What is the difference between calcination and roasting ?

3. What is the chemical formula of rust?

4. Name the process used for the enrichment of sulphide ore.

5. Out of zinc and iron, which evolves hydrogen more readily on reacting with dilute HCl?

6. How do alloys brass and bronze differ in composition?

7. Does german silver contain silver in it?

8. Write the chemical formulae of the main ores of iron and aluminium.

9. Name the non-metal which can conduct electricity.

10. Write the names of two neutral oxides.

➢ Short Questions:

Which important properties of aluminium are responsible for its great demand in industry?

2. Name an alloy of

- Aluminium used in construction of air crafts.
- Lead in joining metals for electric welding.
- Copper used in household vessels.

3. All ores are minerals but all minerals are not ores. Justify.

4. (a) An iron knife kept in blue copper sulphate solution turns the blue solution into light green. Explain.

(b) An athlete won a bronze medal in a race competition. After some days, he found that the medal had lost its lustre due to the formation of a greenish layer on it. Name the metals present in the medal. What is the reason for the appearance of a greenish layer on its surface?

5. Why is titanium called a strategic metal? Mention two of its properties which make it so special.

6. A copper plate was dipped into a solution of $AgNO_3$. After Sometime, a black layer was deposited on the copper plate. State the reason for it. Write the chemical equation for the reaction involved.

On placing a piece of zinc metal in a solution of mercuric chloride, it acquires a silvery surface but when it is placed in a solution of magnesium sulphate, no change is observed. State the reason for the behaviour of zinc metal.

8. Which method of concentration of ore is preferred in the following cases and why?

- The ore has higher density particles mixed with a large bulk of low density impurities.
- The ore consists of copper sulphide intermixed with clay particles. Give an example of amalgam.

➢ Long Questions:

When the powder of a common metal is heated in an open china dish, its colour turns black. However, when hydrogen gas is passed over the hot black substance formed, it regains its original colour. Based on this information, answer the following questions:

- What type of chemical reaction takes place in each of the two given steps ?

- Name the metal initially taken in the powder form. Write balanced chemical equations for both these reactions.

2. (a) Which of the following metals would give hydrogen when added to dilute hydrochloric acid?

- iron
- copper
- magnesium

(b) Explain why do surfaces of some metals acquire a dull appearance when exposed to air for a long lime.

3. How will your demonstrate that the ionic compounds do not conduct electricity in the solid state and can do so in solution.

➢ Assertion Reason Questions:

1. For two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   a. Both A and R are true, and R is correct explanation of the assertion.
   b. Both A and R are true, but R is not the correct explanation of the assertion.
   c. A is true, but R is false.
   d. A is false, but R is true.

Assertion: Aluminium oxide and zinc oxide are acidic in nature.

Reason: Amphoteric nature means that substances have both acidic and basic character.

2. For two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   a. Both A and R are true, and R is correct explanation of the assertion.
   b. Both A and R are true, but R is not the correct explanation of the assertion.
   c. A is true, but R is false.
   d. A is false, but R is true.

Assertion: C and N do not react with dil. HCl and dil. H_2SO_4.

Reason: Metals do not react with dil. HCl and dil. H_2SO_4.

➢ Case Study Questions:

1. Read the following and answer any four questions from (i) to (v).

An element is a pure substance made up of same kind of atoms. At present, nearly 118 elements are known but all of them do not occur free in nature, some of them have been synthesized by artificial methods. Based on their properties, they are mainly classified as metals and non-metals. Metals are those elements which lose electrons and form positive ions i.e., they are electropositive in nature. They are

generally hard, good conductors of heat and electricity, malleable, ductile and have striking luster. They have a significant role to play in our daily life.

i. Metals which are of vital importance to the national Défense, energy and industry sector are called strategic metals. Which of the following is a strategic metal?

   a. Titanium.
   b. Zirconium.
   c. Manganese.
   d. All of these.

ii. Which metal is the best conductor of electricity?

   a. Silver.
   b. Platinum.
   c. Nickel.
   d. Iron.

iii. Which of the following metals is not a coinage metal?

   a. Copper.
   b. Silver.
   c. Iron.
   d. Gold.

iv. Which of the following are the most malleable metals?

   I. Sodium.
   II. Gold.
   III. Potassium.
   IV. Silver.

      a. (I) and (IV)
      b. (II) and (III)
      c. (III) and (IV)
      d. (II) and (IV)

v. Identify the correct statement(s).

   I. The wires that carry current in our homes have a coating of PVC or a rubber like material.
   II. School bells are made of metals.
   III. Metals do not conduct electricity.
   IV. Metals which produce a sound on striking a hard surface are said to be non-sonorous.

      a. (I) and (III)
      b. (I) and (II)
      c. (III) and (IV)
      d. Only (II)

2. Read the following and answer any four questions from (i) to (v).

Ionic compound is a chemical compound in which ions are held together by ionic bonds. An ionic bond is the type of chemical bond in which two oppositely charged ions are held through electrostatic forces. We know that metal atoms have loosely bound valence electrons in their valence shell and non-metal atoms need electrons in their valence shell to attain noble gas configuration. The metal atom loses the valence electrons while non-metal atom accepts these electrons. By losing electrons, metal atoms change to cations and by accepting electrons, non-metals form anions. Ionic compounds are generally solid and exist in the form of crystal. They have high melting and boiling points.

i. Which of the following can change to a cation?

a. Fluorine.
b. Oxygen.
c. Potassium.
d. Neon.

ii. Which of the following can change to an anion?

a. Iodine.
b. Magnesium.
c. Calcium.
d. Xenon.

iii. Ionic compounds are soluble in _____.

a. Kerosene.
b. Petrol.
c. Water.
d. None of these.

iv. Which of the following statements is correct about ionic compounds?

I. They conduct electricity in solid state.
II. They conduct electricity in solutions.
III. They conduct electricity in molten state.

a. I only.
b. II only.
c. III only.
d. II and III only.

v. Select the incorrect statement.

a. Ionic compounds are generally brittle.
b. Ions are the fundamental units of ionic compounds.
c. Formation of ionic bonds involve sharing of electrons.
d. NaCl is an ionic compound.

Answer Key-

➢ Multiple Choice Answers:

1. (d) (i) and (iv)
2. (b) Aluminium
3. (a) Lead
4. (a) Sonorousness
5. (b) $NaAlO_2$
6. (c) Sodium > Magnesium > Zinc > Iron
7. (b) $AgNO_3$ solution and Copper metal
8. (c) they can share electrons with chlorine
9. (d) Fe_3O_4
10. (b) (ii) and (iii)

➢ Very Short Answers:

1. Answer: Aluminium (Al) is the most abundant metal in the earth's crust and is present to the extent of 8-1 per cent by mass.
2. Answer: Calcination is carried in the absence of air while roasting is done in excess of air.
3. Answer: Rust is hydrated ferric oxide and its chemical formula is $Fe_2O_3.xH_2O$.
4. Answer: The process is called Froth Floatation process.
5. Answer: Zinc evolves hydrogen more readily than iron on reacting with dilute HCl because it is placed above iron in the reactivity series.
6. Answer: Constituents of brass are copper and zinc while those of bronze are copper and tin.
7. Answer: German silver is an alloy of copper, zinc and nickel. It does not contain any silver in it.
8. Answer: The main ore of iron is haematite (Fe_2CO_3) while that of aluminium is bauxite ($Al_2O_3.2H_2O$).
9. Answer: Graphite, an allotropy form of carbon conducts electricity.
10. Answer: Two neutral oxides are: carbon monoxide (CO) and nitrous oxide (N_2O).

➢ Short Answer:

1. Answer:

   The properties of aluminum metal responsible for its great demand in industry are:

   - The metal is a good conductor of electricity.
   - The metal is not attacked by water.

- The metal is a powerful reducing agent.

2. Answer:
   - The alloy is duralumin: A1 (93%), Cu (4%), Mg (0.5%), Mn (0.5%).
   - The alloy is solder: Pb (50%), Sn (50%)
   - The alloy is brass: Cu (80%), Zn (20%)
3. Answer: In the earth's crust, metals are present in the form of minerals and there are more than one mineral for a particular metal. However, metal may not be extracted from all of them. The mineral from which a metal can be profitably and conveniently extracted is known as ore. This clearly means that all ores are minerals but all minerals are not ores. For example, the different minerals of iron are:

   Haematite: FeO_3;

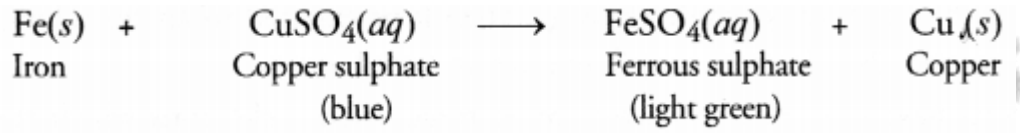
   Limonite: $Fe_2O_3.3H_2O$;

   Siderite: $FeCO_3$;

   Iron pyrites: FeS_2

   Iron is extracted from haematite (Fe_2CO_3). Haematite mineral is the ore of iron while other minerals are not the ores.
4. Answer:

   (a) Iron lies above copper in the activity series. This means that iron or iron knife will displace copper from copper sulphate solution. As a result of the reaction, ferrous sulphate will be formed and the solution will be light green in colour.



   (b) The bronze medal is an alloy and the constituting metals are copper and tin. The loss of lustre by the medal is due to the formation of a coating of green layer. This layer is at basic copper carbonate.
5. Answer: Titanium is called strategic metal because it is used for making certain war equipments. The properties which make the metal so special are:

   It is light in weight but at the same time stronger than the other metals.

   It is not affected by corrosion even if kept in the open for a very long time.
6. Answer: Copper lies above silver in the activity series. This means that copper is more reactive than silver. Therefore, copper had replaced silver from $AgNO_3$ solution. Silver got deposited on the copper plate and changed to black after sometime because silver and also some salts of silver are sensitive to light. They readily become blackish on standing or on exposure to air.

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

7. Answer: Zinc lies above mercury in the activity series and can easily replace it from mercuric chloride solution. Mercury formed in the reaction gets deposited on the surface of zinc to give it a silvery look.

$$Zn(s) + HgCl_2(aq) \longrightarrow ZnCl_2(aq) + Hg(s)$$

But zinc is placed below magnesium in the activity series. Therefore, no chemical reaction occurs between zinc and magnesium sulphate solution.

8. Answer:
   - The concentration of ore can be done by gravity separation method.
   - The concentration of ore is done by Froth Floatation process.
   - An amalgam of mercury with silver or gold called dental alloy is used to fill cavities in the teeth.

➢ Long Answer:

1. Answer:

The available information suggests the metal is copper. In open air, its is oxidised to form copper (II) oxide which is black in colour. The reaction is known as oxidation reaction. On passing hydrogen gas over the hot substance, the original colour of the metal is regained. It is an example of reduction reaction.

The balanced chemical equations for the reactions are:

$$2Cu(s) + O_2(g) \xrightarrow{\text{heat}} 2CuO(s)$$
(Metal) Copper (II) oxide (Black)

$$CuO(s) + H_2(g) \xrightarrow{\text{heat}} Cu(s) + H_2O(g)$$

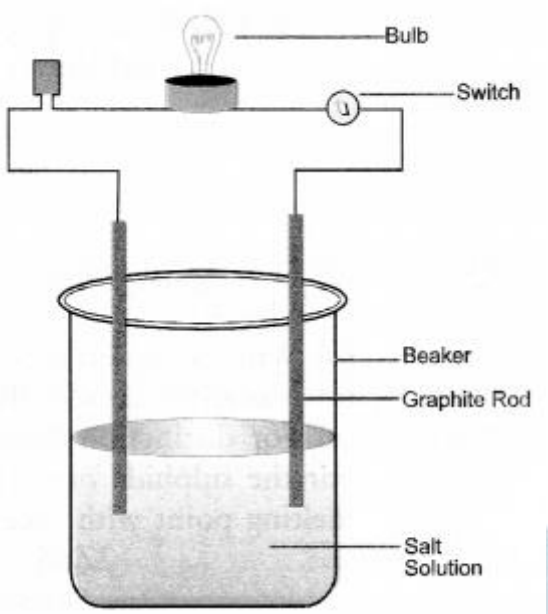
2. Answer:

(a) Both iron (Fe) and magnesium (Mg) will evolve hydrogen on reacting with dilute hydrochloric acid. These are active metals and are placed above hydrogen in the activity series. As copper is placed below hydrogen in the series, it will not evolve hydrogen.

(b) Surfaces of some metals acquire a dull appearance when exposed to air for a long time and they lose their lustre. This is due to the formation of layer of oxides, hydroxides, carbonates etc. on the surface For example, surface of aluminium metal becomes dull white due to the formation of coating oi aluminium oxide ($Al2O_3$). Similarly, the surface of copper acquires a greenish colour since a layer oi basic copper carbonate with the formula $Cu(OH)_2CuCO_3$ is deposited on the surface.

3. Answer:

- In a glass beaker, take small amount of solid sodium chloride.
- Dip two graphite rods (electrodes) in the solution.
- Connect these rods to a battery through a bulb and a switch.
- Switch on the battery. The bulb will not glow. This show that no current has passed through the solid sodium chloride.
- Now, add some water to the salt so that it may dissolve.
- Repeat the operation. The bulb will immediately glow showing that current has passed through the salt solution.



Explanation: Sodium chloride (NaCl) is a crystalline solid and the current is carried by the mobility (movement) of ions. Since the ions do not move in the solid state, the salt is not conducting. In aqueous solution, both Na^+ and Cl^- ions can move and the salt will be conducting in the solution. That is why the bulb glows.

➢ Assertion Reason Answer:

1. (d) A is false, but R is true.

Explanation:

Aluminium and zinc oxides are amphoteric in nature.

2. (c) A is true, but R is false.

Explanation:

Metals react with dilute HCl and dil. H_2SO_4. Non-metals do not react with dilute acids.

➢ Case Study Answer:

1. i (d) All of these.

Explanation:

Titanium, zirconium, and manganese are used in Défense equipment's as they are light and durable and therefore, are called strategic metals.

ii. (a) Silver.

iii. (c) Iron.

Explanation:

Copper, silver and gold are called coinage metals because they are used in making coins, jewellery etc.

iv. (d) (II) and (IV)

v. (b) (I) and (II)

Explanation:

Metals conduct electricity. Metals which produce a sound on striking a hard surface are said to be sonorous.

2. i (c) Potassium.

Explanation:

Potassium, being a metal, can change to cation by losing its valence electron.

ii. (a) Iodine.

Explanation:

Iodine, being a non-metal, can change to anion by gaining electron.

iii. (c) Water.

Explanation:

Ionic compounds are generally soluble in water and insoluble in kerosene and petrol.

iv. (d) II and III only.

Explanation:

Ionic compounds do not conduct electricity in solid state, as ions are very closely packed and are free to move.

v. (c) Formation of ionic bonds involve sharing of electrons.

Explanation:

Formation of ionic bonds involve complete transfer of electrons from metal atom to non-metal atom.