



- Metals and non metals represent two major classes of elements. They differ from each other by their physical as well as chemical properties.
- Physical properties include physical state, hardness, lustre, sonority, malleability, ductility, conduction of heat and electricity, tensile strength, density etc.
- Reactivity of metals is linked with their relative positions in the **activity series**.
- Gold and platinum placed at the bottom of the reactivity series are least reactive chemically and are known as **noble metals**.
- The **oxides of metals** are generally **basic** in nature since they combine with water to form bases.
- The **oxides of** the metals like **aluminium, zinc and lead** are **amphoteric** in nature which means that they have both acidic and basic characters.
- The **oxides of non-metals** are generally **acidic** in nature since they combine with water to form acids.
- Some oxides of non-metals** like CO, NO etc. **neutral** in nature.
- Metals differ in their reactivity with water. **Metals below hydrogen** in activity series **do not react** with water.
- Metals like **sodium and potassium** are **kept under kerosene** since they react violently with surrounding air and moisture in it.
- Metals placed above hydrogen can displace the gas on reacting with dilute HCl or dilute  $\text{H}_2\text{SO}_4$ .
- Metals generally do not liberate hydrogen from dilute nitric acid on account of its oxidizing nature. However Mg and Mn liberate hydrogen from very dilute nitric acid (about 1% acid solution).
- Gold and platinum dissolve in **aqua regia** (also called **royal water**) which is a mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3:1 by volume.
- In the displacement reactions, atoms of metal occupying a higher position in the activity series displace the metal placed below from its salt solution.
- Atoms of both metals and non-metals have incomplete valence shell electronic configurations.
- Metal** atoms tend to lose valence electron(s) and are **electropositive** in nature.
- Non-metallic** atoms tend to gain electron(s) in valence shell and are **electronegative** in nature.
- Ionic bond** or **electrovalent bond** is formed by the transfer of one or more electrons from atoms of metals to those of non-metals.
- Ionic solids** are crystalline in nature with high melting and boiling points. These solids are hard and brittle and conduct electricity only in molten or aqueous state due to the movement of ions. **Metals**

**conduct** heat and electricity due to the **movement of electrons**.

- Ionic solids are insulators in solid state due to the absence of free ions.

### ❖ NCERT Intext questions-answers:

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**Q1.** 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.

**Answer:** (i) Metal that exists in liquid state at room temperature → Mercury

(ii) Metal that can be easily cut with a knife → Sodium

(iii) Metal that is the best conductor of heat → Silver

(iv) Metals that are poor conductors of heat → Mercury and lead

**Q2.** Explain the meanings of malleable and ductile.

**Answer:** Malleable: Substances that can be beaten into thin sheets are called malleable. For example, most of the metals like aluminium, magnesium etc. are malleable.

Ductile: Substances that can be drawn into thin wires are called ductile. For example, most of the metals like copper, silver, gold etc. are ductile.

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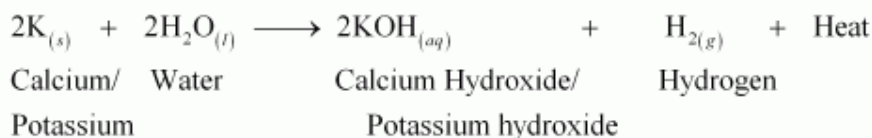
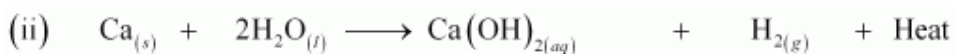
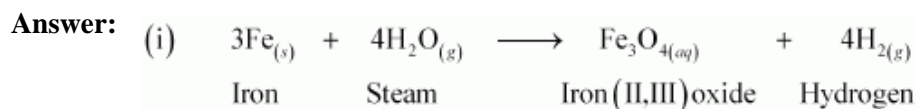
**Q1.** Why is sodium kept immersed in kerosene oil?

**Answer:** Sodium is a very reactive metal and react vigorously with air as well as moisture present in air. Hence, it catches fire if kept in open. Therefore, to prevent accidental fires and accidents, sodium is stored in kerosene oil.

**Q 2.** Write equations for the reactions of

(i) iron with steam

(ii) calcium and potassium with water



**Q3.** 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       |                      | No reaction   |                |
| 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.

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

**Answer:** (i) B is the most reactive metal.

(ii) If B is added to a solution of copper (II) sulphate, then it would displace copper.

$B + CuSO_4 \rightarrow$  Displacement

(iii) The arrangement of the metals in the order of decreasing reactivity is:  $B > A > C > D$

**Q4.** Which gas is produced when dilute hydrochloric acid is added to a reactive metal? Write the chemical reaction when iron reacts with dilute  $H_2SO_4$ .

**Answer:** Hydrogen gas is evolved when dilute hydrochloric acid is added to a reactive metal.

When iron reacts with dilute  $H_2SO_4$ , iron (II) sulphate with the evolution of hydrogen gas is formed.



**Q5.** What would you observe when zinc is added to a solution of iron (II) sulphate? Write the chemical reaction that takes place.

**Answer:** Zinc being more reactive than iron, will displace Fe from  $FeSO_4$  to form  $ZnSO_4$ . Hence the pale green solution turns colourless.



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**Q1.** (i) Write the electron-dot structures for sodium, oxygen and magnesium.

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

(iii) What are the ions present in these compounds?

**Answer:**

- (i) (a) Sodium (2, 8, 1) =  $\text{Na}$   
(b) Oxygen (2, 6) =  $\text{O}$   
(c) Magnesium (2, 8, 2) =  $\text{Mg}$



(iii) The ions present in  $\text{Na}_2\text{O}$  are  $\text{Na}^+$  and  $\text{O}^{2-}$  ions and in  $\text{MgO}$  are  $\text{Mg}^{2+}$  and  $\text{O}^{2-}$  ions.

**Q2.** Why do ionic compounds have high melting points?

**Answer:** Ionic compounds have strong electrostatic forces of attraction between the ions. Therefore, it requires a lot of energy to overcome these forces. That is why ionic compounds have high melting points.

### ❖ NCERT Exercise questions-answers:

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**Q1.** Which of the following pairs will give displacement reactions?

- (a)  $\text{NaCl}$  solution and copper metal  
(b)  $\text{MgCl}_2$  solution and aluminium metal  
(c)  $\text{FeSO}_4$  solution and silver metal  
(d)  $\text{AgNO}_3$  solution and copper metal.

**Answer:** (d)

**Q3.** 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

**Answer:** (a)

**Q5.** You are given a hammer, a battery, a bulb, wires and a switch.

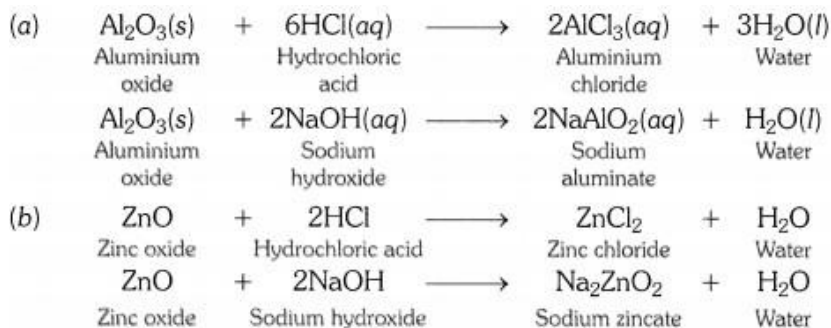
- (a) How could you use them to distinguish between samples of metals and non-metals?  
(b) Assess the usefulness of these tests in distinguishing between metals and non-metals.

**Answer:** (a) Metals can be beaten into thin sheets with a hammer without breaking. Non-metals cannot be beaten with a hammer to form thin sheets. Non-metals break into pieces when hammered. Metals are malleable, while non-metals are non-malleable. When metals are connected into circuit using a battery, bulb, wires and switch, current passes through the circuit and the bulb glows. When non-metals (like sulphur) are connected, the bulb does not light up at all. Metals are good conductors of electricity.

(b) It is because of malleability, metals can be casted into sheets. Metals are good conductors of electricity so these can be used for electrical cables.

**Q6.** What are amphoteric oxides? Give two examples of amphoteric oxides?

**Answer:** Those metal oxides which show basic as well as acidic behaviour are known as amphoteric oxides. In other words, metal oxides that react with both acids and bases to form salt and water are called amphoteric oxides. Aluminium oxide and zinc oxide are amphoteric in nature.



**Q7.** Name two metals which will displace hydrogen from dilute acids and two metals which will not.

**Answer:** (i) Metals above hydrogen in the activity series like sodium and magnesium displace hydrogen from dilute acids.

(ii) Metals below hydrogen in the activity series like copper, silver do not displace hydrogen from dilute acids.

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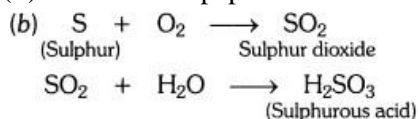
**Q9.** Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it, as shown in the figure.

(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.

**Answer:** (i) Dry litmus paper – no action.

(ii) Moist litmus paper – becomes red.



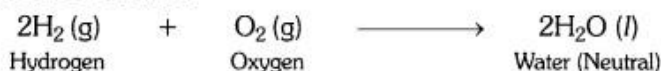
**Q11.** What type of oxides is formed when non-metals combine with oxygen?

**Answer:** Non-metals combine with oxygen to form acidic oxides or neutral oxides.

### Acidic oxide as sulphur dioxide



### Neutral oxide as water



**Q12.** 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.

**Answer:** (a) Platinum, gold and silver are used to make jewellery because these are malleable and ductile. These are highly resistant to corrosion.

(b) Sodium, potassium and lithium are very reactive and catch fire when exposed to air. This is due to their low ignition temperature and high reactivity.

(c) Aluminium forms a non-reactive layer of aluminium oxide on its surface. This layer prevents aluminium to react with other substances. That's why aluminium is used to make cooking utensils.

**Q14.** Differentiate between metal and non-metal on the basis of their chemical properties.

**Answer:** Difference between metals and non-metals:

| Metals  | Non-metals   |
|---|--|
| (i) Metals form basic oxides or amphoteric oxides.                  | (i) Non-metals form acidic or neutral oxides.                      |
| (ii) Metals replace hydrogen from dilute acids and form salts.      | (ii) Non-metals do not replace hydrogen from dilute acids.         |
| (iii) With chlorine, metals form chlorides which are electrovalent. | (iii) With chlorine, non-metals form chlorides which are covalent. |
| (iv) Active metals react with water (cold or hot) or steam.         | (iv) Non metals do not react with water.                           |
| (v) Metals behave as reducing agents                                | (v) Non metals behave as oxidizing agents.                         |

**Q15.** 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 has used?

**Answer:** The goldsmith dipped the gold bangles in aqua-regia (which contains 1 part of concentrated nitric acid and 3 parts of concentrated hydrochloric acid, by volume). Aqua-regia dissolved a considerable amount of gold from gold bangles and hence reduced their weight drastically.

## COMPETENCY BASED QUESTIONS

- 1) A student performs some activities on two substances and records the observations in a table as shown.

| Activity                  | Substance M        | Substance N         |
|---------------------------|--------------------|---------------------|
| cut with a knife          | forms small pieces | forms small pieces  |
| beaten with hammer        | shape changes      | changes into powder |
| stricken with a metal rod | makes a sound      | changes into powder |

Which option classifies the substances into metals and non-metals?

- (a) both the substances are metals
- (b) both the substances are non-metals
- (c) substance M is metal while substance N is non-metal
- (d) substance M is non-metal while substance N is metal

**Correct Answer:** Option (c)

- 2) Which option classifies the substances based on their physical properties?

(a)

| Lustrous            | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|---------------------|-------------------------------|-----------|------------------------------|
| Graphite and silver | Copper                        | Iron      | Rubber                       |

(b)

| Lustrous | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|----------|-------------------------------|-----------|------------------------------|
| Copper   | Rubber                        | Iron      | Graphite and silver          |

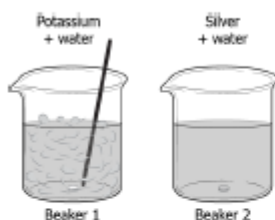
(c)

| Lustrous | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|----------|-------------------------------|-----------|------------------------------|
| Copper   | Graphite and silver           | Iron      | Rubber                       |

(d)

| Lustrous | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|----------|-------------------------------|-----------|------------------------------|
| Copper   | Graphite and silver           | Rubber    | Iron                         |

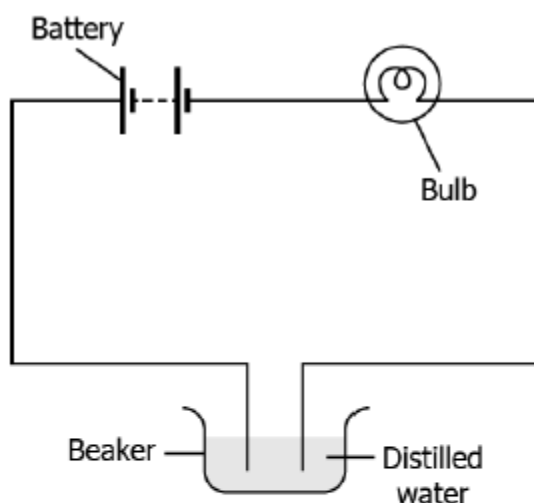
- 3) A student drops pieces of potassium and silver in beakers containing water. The image shows the reaction.



What are the products formed in each beaker?

- (a) Beaker 1:  $K_2O$  and  $H_2O$ ; Beaker 2:  $Ag_2O$  and  $H_2O$
  - (b) Beaker 1:  $KOH$  and  $H_2O$ ; Beaker 2:  $Ag_2O$  and  $H_2O$
  - (c) Beaker 1:  $K_2O$  and  $H_2O$ ; Beaker 2: No reaction takes place
  - (d) 1:  $KOH$  and  $H_2O$ ; Beaker 2: No reaction takes place
- 4) A student adds an equal amount of copper sulphate solution in two beakers. He adds zinc in beaker P and silver in beaker Q. The student observes that the color of the solution in beaker P changes while no change is observed in beaker Q. Which option arranges the metals in increasing order of reactivity?
- (a) silver-zinc-copper
  - (b) zinc-copper- silver
  - (c) silver-copper-zinc
  - (d) copper-silver-zinc
- Correct Answer:** Option (c)

- 5) A student makes an electric circuit using an LED, a battery and connecting wires, as shown.



The student notices that the LED does not glow. He replaces the distilled water with a salt solution and observes that the LED glows. How does the salt solution help the LED to glow?

- (a) Salt solution is covalent in nature and conducts electricity.
- (b) Salt solution has a low melting point which allows the current to flow through it.
- (c) Salt solution has a high boiling point which allows the flow of current in the circuit without getting hot.
- (d) Salt solution contain ions which makes it conductive and allows the electricity to flow through it.

**Correct Answer:** Option (d)