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Chapter – 3 Metals and Non-Metals

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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 beat conductor of heat
iv) Is a poor conductor of heat

Answer:

i) Mercury
ii) Sodium
iii) Silver
iv) Lead

Q2. Explain the meanings of malleable and ductile?

Answer:

a) A material is turned into thin sheets on hammering so it is malleable.
b) A material is turned into thin wires, so it is ductile.

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Q1. Why is sodium kept immersed in kerosene oil?

Answer:

Sodium is a very reactive metal which reacts vigorously with the oxygen and catches fire if kept in the open. Sodium is immersed in kerosene oil to protect it from the action of air and to prevent accidental fires.

Q2. Write equations for the reactions of:

i) Iron with steam
ii) Calcium with water
iii) Potassium with water

Answer:

i) Equation for the reaction of iron with steam is given below:

$$3Fe\,(s) \;+\; 4H_2O\,(g) \;\longrightarrow\; Fe_3O_4\,(s) \;+\; 4H_2\,(s)$$

ii) Equation for the reaction of calcium with water is as follows:

$$Ca\,(s) \quad + \quad 2H_2O \quad \longrightarrow \quad Ca(OH)_2\,(aq) \quad + \quad H_2\,(g)$$

iii) Equation for the reaction of potassium with water can be written as:

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

Q3. Samples of four metals A, B, C and D were taken and added to the solution given in the following table, one by one. The results obtained are 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 above table to answer the following questions about metals A, B, C and D:

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

Answer:

i) B is the most reactive metal because it gives displacement reaction with iron (II) sulphate.
ii) When metal B reacts with copper (II) sulphate solution, a displacement reaction occur due to which the blue colour of copper (II) sulphate fade and a red-brown deposit of copper is on metal B.
iii) Metal B is the most reactive since it displaces iron from its salt solution, metal A is less reactive since it displaces copper from its salt solution; metal C is still less reactive since it can displace any metal from its salt solution. Hence, the decreasing order of reactivity of the metals 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 sulphuric acid.

Answer:

a) When dilute hydrochloric acid is added to a reactive metal, then hydrogen gas is produced.
b) When iron reacts with dilute sulphuric acid, then iron (II) sulphate and hydrogen gas are produced. This chemical reaction can be represented by an equation:

$$Fe\,(s) + H_2SO_4\,(aq) \longrightarrow FeSO_4\,(aq) + H_2\,(g)$$

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

Answer:

When zinc reacts with solution of iron (II) sulphate, greenish colour of iron (II) sulphate solution fades due to the formation of colourless zinc sulphate solution, and iron metal deposit on zinc:

$$FeSO_4\,(aq) + Zn\,(s) \longrightarrow ZnSO_4\,(aq) + Fe\,(s)$$

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Q1. i) Write the electron-dot structure for sodium, oxygen and magnesium.

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

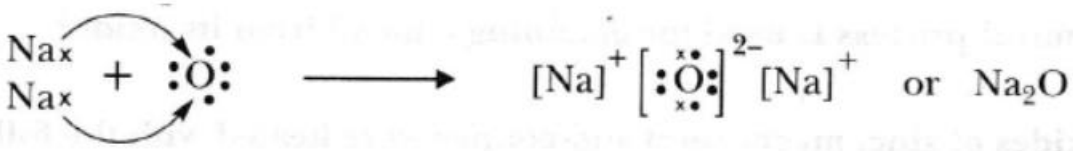
iii) What are the ions present in these compounds?

Answer:

i) The sodium atom (Na) has 1 outermost electron (or 1 valence electron), so its electron-dot structure is Na; the oxygen atoms (O) has 6 outermost electrons (or 6 valence electrons), so its electron-dot structure is Mg.

ii) **Formation of Na_2O**

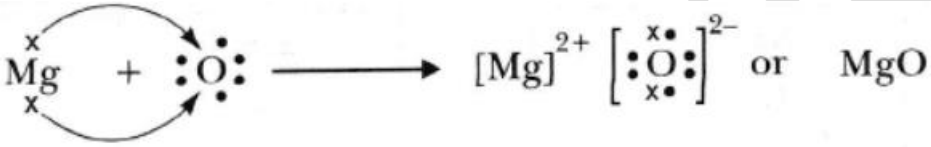
Na_2O is sodium oxide. In the formation of sodium oxide, two sodium atoms transfer their 2 outermost electrons to an oxygen atom. By losing 2 electrons, the two sodium atoms from two sodium ions $(2Na^+)$, and by gaining 2 electrons, the oxygen atoms form an oxide ion (O^{2-}):



The oppositely charges sodium ions and oxide ions are bonded by strong electrostatic forces of attraction to form ionic sodium oxide Na_2O.

Formation of MgO

MgO is magnesium oxide. In the formation of magnesium oxide, a magnesium atom transfers its 2 outermost electrons to an oxygen atom. By losing 2 electrons, a magnesium atom forms magnesium ion (Mg^{2+}) and by gaining 2 electrons, the oxygen atom forms an oxide ion (O^{2-}):



The oppositely charged magnesium ions and oxide are held together by strong electrostatic forces of attraction to form the ionic magnesium oxide compound MgO.

iii) The ions present in sodium oxide (Na_2O) compound are sodium ions Na^+ and oxide ions (O^{2-}).
The ions present in magnesium oxide (MgO) are magnesium ion (Mg^{2+}) and oxide ions (O^{2-}).

Q2. Why do ionic compounds have high melting points?

Answer:

Ionic compounds have positive and negative ions and a strong force of electrostatic attraction between the oppositely charged ions of an ionic compound, so a lot of heat energy is required to melt the ionic compound, so they have high melting points.

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Q1. Define the terms: (i) mineral (ii) ore, and (iii) gangue.

Answer:

i) The natural metals or their compounds found in the earth are called minerals. Different minerals contain varying percentage of metal. Minerals contain impurities which hinder the extraction of metals.

ii) Minerals from which the metals is extracted profitably are called ores which contains a good percentage of metal with no impurities in it.

iii) The ores mined from the earth are usually contaminated with large number of impurities. The unwanted impurities like sand, rocky, material, earthy particles, limestone, mica etc., present in an ore are called gangue.

Q2. Name two metals which are formed in nature in the free state.

Answer:

The two metals which are found in nature in the free state are Gold and Platinum.

Q3. What chemical process is used for obtaining a metal from its oxide?

Answer:

Reduction is used for obtaining a metal from its oxide.

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Q1. Zinc oxide, magnesium oxide and copper oxide were heated, turn by turn with zinc magnesium and copper metals as shown in the following table:

Metal	Zinc	Magnesium	copper
Zinc oxide			
Magnesium oxide			
Copper oxide			

In which case will you find displacement reactions taking place?

Answer:

A more reactive metal displace a less reactive metal from its oxide that is zinc, magnesium and copper metals, magnesium is the most reactive, zinc is less reactive whereas copper is the least reactive metal, so the displacement reactions is:

Metal	Zinc	Magnesium	copper
Zinc oxide	No reaction	Displacement	No reaction
Magnesium oxide	No reaction	No reaction	No reaction
Copper oxide	Displacement	Displacement	No reaction

Q2. Which metals do not corrode easily?

Answer:

Those metals which are at the bottom of the 'reactivity series' are highly unreactive and do not corrode easily because they are not affected by air, moisture or ordinary chemicals. The two examples of metals which do not corrode easily are gold and platinum.

Q3. What are alloys?

Answer:

Alloys are a homogeneous mixture of two or more metals, or a metal and non-metals. For example, brass is an alloy of copper and zinc, whereas steel is an alloy of a metal and a small amount of a non-metal: iron and carbon.

An alloy mix the metals in molten state in definite proportions and then cooled at room temperature. The alloy of a metal and a non-metal is prepared by mixing metal with the non-metal in it, followed by cooling to the room temperature.

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

a) $NaCl$ **solution and copper metal**
b) $MgCl_2$ **solution and aluminium metal**
c) $FeSO_4$ **solution and silver metal**
d) $AgNO_3$ **solution and copper metal**

Answer: Option d)

Copper metal is more reactive than silver metal (Ag), so a displacement reaction will take place between $AgNO_3$ solution and copper metal.

Q2. Which of the following methods is suitable for preventing an iron frying pan from rusting?

a) **Applying grease**
b) **Applying paint**
c) **Applying a coat of zinc**
d) **All of the above**

Answer: Option c)

The method for preventing an iron frying pan from rusting is by coating zinc called galvanisation. We do not apply grease because it will spoil the food to be cooked in frying pan. We do not apply paint because it will gradually come out when frying pan is heated on a gas stove during the cooking of food.

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: Option a)

Calcium reacts with oxygen to form ionic compound, calcium oxide with high melting point and is soluble in water. Carbon reacts with oxygen to form carbon dioxide. Silicon reacts with oxygen to form silicon dioxide with high melting point but insoluble in water, iron reacts with oxygen to form iron (III) oxide compound with high melting point but insoluble in water.

Q4. 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**

Answer: Option c)

Zinc is more reactive than tin, being more reactive, zinc may react with acidic foods to form toxic products.

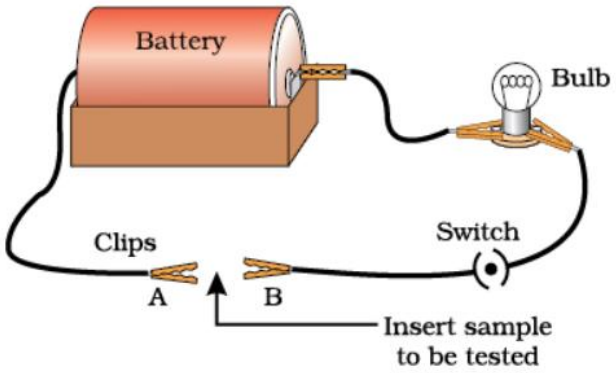
Q5. You are given a hammer, a battery, a bulb, wires and a switch.

a) **How could you use them to distinguish between samples of metals and non-metals?**
b) **Assess the usefulness of metals based on properties shown by these tests.**

Answer:

a) We take given samples of metal and non-metal, place them on a block of iron and beat them with a hammer four or five times. The sample which changes into a thin sheet on hammering is metal. The sample which breaks into pieces on hammering is non-metal, so metals are malleable whereas non-metals are brittle.
Take a battery, a tourch bulb fitted in a holder, some wires with crocodile clips and a switch and connect them to make an electric circuit. Insert the given samples of the metal and non-metal between the free ends of the crocodile

clips in the circuit. The sample which allows the current to pass through it making the bulb to light up, is a metal.
The sample which does not allow the current to pass and does not make the bulb to light up, is a non-metal, so metals are good conductors of electricity whereas non-metals do not conduct electricity.



b) Since metals are malleable, they can be turned into sheets and these metals sheets can then be used for various purposes. Example, iron sheets are used for making boxes, buckets and roofing material, because metals are good conductors of electricity, therefore, metal wires are used as electric wires for various purposes. Example, copper wires are used in domestic electric wiring for carrying electricity.

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

Answer:

Those metal oxides which has basic as well as acidic nature are known as amphoteric oxides. Amphoteric oxides react with both acids and bases to form salts and water. The two examples of amphoteric oxides are: aluminium oxide (Al_2O_3) and Zinc oxide (ZnO).

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

Answer:

a) The two metals which will displace hydrogen from acids are: Zinc and Iron.
b) The two metals which will not displace hydrogen from dilute acids are: Copper and Silver.

Q8. In the electrolytic refining of a metal M, what would you take as the anode, the cathode and the electrolyte?

Answer:

In the electrolytic refining of metal M:

a) the impure metal M is made anode and is connected to the positive terminal of the battery.
b) A thin strip of the pure metal M is made cathode which is connected to the negative terminal of the battery.
c) A water-soluble salt of metal M is taken as electrolyte.

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 here.

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:

a) When sulphur burn in air, sulphur dioxide is formed.
   i) Sulphur dioxide has no action on dry litmus paper.
   ii) Sulphur dioxide gas turns moist blue litmus paper to red.
b) $S\,(s) \;+\; O_2\,(g) \;\longrightarrow\; SO_2\,(g)$

Q10. State two ways to prevent the rusting of iron.

Answer:

i) Rusting of iron is prevented by painting thus a coat of paint is applied on the surface of iron object to keep the air and moisture away.
ii) Rusting of iron can be prevented by galvanisation. In this process, a thin layer of zinc metal is deposited over the surface of iron object to prevent the air and moisture from coming in contract with it.

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

Answer:

Non-metals combine with oxygen to form acidic or neutral oxides. Example: carbon is a non-metal and burns in air, and with the oxygen of air to form an acidic oxide called carbon dioxide. Hydrogen is a non-metal. When hydrogen burns in air, it

combines with the oxygen of air to form a neutral oxide called hydrogen oxide or 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**
d) **Carbonate and sulphide ores are usually converted into oxides during the process of extraction.**

Answer:

a) Platinum, gold and silver are used to make jewellery because:

   i) They have bright and shiny surface
   ii) They are highly resistant to corrosion
   iii) They are highly malleable and ductile

b) Sodium, potassium and lithium are reactive metals and react with the oxygen of air and catch fire if kept in the open. Sodium, potassium and lithium are stored under oil to protect them from the action of air and to prevent accidental fires.
c) When highly reactive aluminium metal is exposed to air, the oxygen of air reacts with aluminium to form a thin but tough protective layer of aluminium metal resistant to the action of air and water. Due to its high resistance to corrosion and high heat conductivity, aluminium metal is used for making cooking utensils.
d) The direct reduction of carbonate and sulphide ores to obtain metals is usually not possible. The carbonate and sulphide ores are converted into metal oxides as it is easier to reduce metal oxides to metals.

Q13. 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.

Answer:

The sour substances such as lemon or tamarind juice contain acids. These acids dissolve the coating of copper oxide or basic copper carbonate present on the surface of tarnished copper vessels and makes them shining red-brown again.

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

Answer:

S/No.	Metals	Non-metals
1.	Metals form basic oxides.	Non-metals form acidic oxides or neutral oxides.
2.	Metals displace hydrogen from water (or steam).	Non-metals do not react with water (or steam) and hence do not displace hydrogen from water or steam.
3.	Metals displace hydrogen from dilute acids.	Non-metals do not react with dilute acids and hence do not do not displace hydrogen from dilute acids.
4.	Metals form ionic chlorides with chlorine. These ionic chlorides are electrolytes but non-volatile.	Non-metals form covalent chlorides with chlorine, which are non-electrolytes but volatile.
5.	Metals usually do not combine with hydrogen.	Non-metals react with hydrogen to form stable, covalent hydrides.

Q15. A man went from 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?

Answer:

The dishonest goldsmith dip gold bangles in aqua-regia solution, with 1 part of concentrated nitric acid and 3 parts of concentrated hydrochloric acid, by volume. Aqua-regia dissolved gold from gold bangles and reduce their weight. The dishonest goldsmith can recover the dissolved gold from aqua-regia by a suitable treatment.

Q16. Give reasons why copper is used to make hot water tanks and not steel (an alloy of iron).

Answer:

i) Copper is fairly resistant to corrosion but steel rusts quite easily.
ii) Copper is very good conductor of heat but steel is not such a good conductor of heat.