Science

(Chapter – 3) (Metals and Non – Metals)
(Class X)

Exercises

Question 1:

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 1:

(d) $AgNO_3$ solution and copper metal

Question 2:

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

(a) Applying grease

(b) Applying paint

(c) Applying a coating of zinc

(d) All of the above.

Answer 2:

(c) Applying a coating of zinc

(We can also apply grease and paint to prevent iron from rusting. However, in case of iron frying pan, grease and paint cannot be applied because when the pan will be heated and washed again and again, the coating of grease and paint would get destroyed.)

Question 3:

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 3:

(a) The element is likely to be calcium.

Question 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.

Answer 4:

(c) Food cans are coated with tin and not with zinc because zinc is more reactive than tin.

Question 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.

Answer 5:

(a) With the hammer, we can beat the sample and if it can be beaten into thin sheets (that is, it is malleable), then it is a metal otherwise a non-metal. Similarly, we can use the battery, bulb, wires, and a switch to set up a circuit with the sample. If the sample conducts electricity, then it is a metal otherwise a non-metal.

(b) The above tests are useful in distinguishing between metals and non-metals as these are based on the physical properties. No chemical reactions are involved in these tests.

Question 6:

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

Answer 6:

Those oxides that behave as both acidic and basic oxides are called amphoteric oxides.

Examples: aluminium oxide (Al_2O_3)

$$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O \quad [\text{ Basic }]$$

$$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O \quad [\text{ Acidic }]$$

Zinc oxide (ZnO) is also an amphoteric oxide.

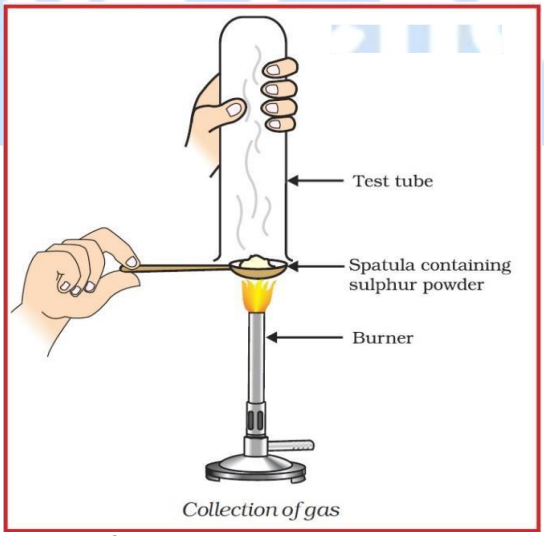
Question 7:
Name two metals which will displace hydrogen from dilute acids, and two metals which will not.

Answer 7:
Metals that are more reactive than hydrogen displace it from dilute acids.
For example: sodium and potassium.
Metals that are less reactive than hydrogen do not displace it.
For example: copper and silver.

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

Answer 8:
In the electrolytic refining of a metal M:
Anode → Impure metal M
Cathode → Thin strip of pure metal M
Electrolyte → Solution of salt of the metal M

Question 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.

Answer 9:

(a) (i) There will be no action on dry litmus paper.

(ii) Since the gas is sulphur dioxide (SO_2), it turns moist blue litmus paper to red because sulphur dioxide reacts with moisture to form sulphurous acid.

(b)

$$S_{(s)} + O_{2\,(g)} \rightarrow \underbrace{SO_{2\,(g)}}_{Sulphur\ dioxide}$$

$$SO_{2\,(g)} + H_2O_{\,(l)} \rightarrow \underbrace{H_2SO_{3\,(aq)}}_{Sulphurous\ Acid}$$

Question 10:

State two ways to prevent the rusting of iron.

Answer 10:

Two ways to prevent the rusting of iron are:

- **Oiling, greasing, or painting:** By applying oil, grease, or paint, the surface becomes water proof and the moisture and oxygen present in the air cannot come into direct contact with iron. Hence, rusting is prevented.
- **Galvanisation:** An iron article is coated with a layer of zinc metal, which prevents the iron to come in contact with oxygen and moisture. Hence, rusting is prevented.

Question 11:

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

Answer 11:

Non-metals combine with oxygen to form acidic oxides.

For example:

$$S_{(s)} + O_{2(g)} \rightarrow \underbrace{SO_{2\,(g)}}_{Acidic\ in\ nature}$$

Question 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.

Answer 12:

(a) Platinum, gold, and silver are used to make jewellery because they are very lustrous. Also, they are very less reactive and do not corrode easily.

(b) Sodium, potassium, and lithium are very reactive metals and react very vigorously with air as well as water. Therefore, they are kept immersed in kerosene oil in order to prevent their contact with air and moisture.

(c) Though aluminium is a highly reactive metal, it is resistant to corrosion. This is because aluminium reacts with oxygen present in air to form a thin layer of aluminium oxide. This oxide layer is very stable and prevents further reaction of aluminium with oxygen. Also, it is light in weight and a good conductor of heat. Hence, it is used to make cooking utensils.

(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction because metals can be easily extracted from their oxides rather than from their carbonates and sulphides.

Question 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.

Answer 13:

Copper reacts with moist carbon dioxide in air to form copper carbonate and as a result, copper vessel loses its shiny brown surface forming a green layer of copper carbonate. The citric acid present in the lemon or tamarind neutralises the basis copper carbonate and dissolves the layer. That is why, tarnished copper vessels are cleaned with lemon or tamarind juice to give the surface of the copper vessel its characteristic lustre.

Question 14:

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

Answer 14:

Metal	Non-metal
Metals are electropositive.	Non-metals are electronegative.
They react with oxygen to form basic oxides. $4Na + O_2 \rightarrow 2Na_2O$ These have ionic bonds.	They react with oxygen to form acidic or neutral oxides. $C + O_2 \rightarrow CO_2$ These have covalent bonds.
They react with water to form oxides and hydroxides. Some metals react with cold water, some with hot water, and some with steam. $2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$	They do not react with water.
They react with dilute acids to form a salt and evolve hydrogen gas. However, Cu, Ag, Au, Pt, Hg do not react. $2Na + 2HCl \rightarrow 2NaCl + H_2\uparrow$	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. $2CuSO_4 + Zn \rightarrow ZnSO_4 + Cu$	These react with the salt solution of non-metals.
They act as reducing agents (as they can easily lose electrons). $Na \rightarrow Na^+ + e^-$	These act as oxidising agents (as they can gain electrons). $Cl_2 + 2e^- \rightarrow Cl^-$

Question 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?

Answer 15:

He must have dipped the gold metal in the solution of aqua regia − a 3:1 mixture of conc. HCl and conc. HNO_3. Aqua regia is a fuming, highly corrosive liquid. It dissolves gold in it. After dipping the gold ornaments in aqua regia, the outer layer of gold gets dissolved and the inner shiny layer appears. That is why the weight of gold ornament reduced.

Question 16:

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

Answer 16:

Copper does not react with cold water, hot water, or steam. However, iron reacts with steam. If the hot water tanks are made of steel (an alloy of iron), then iron would react vigorously with the steam formed from hot water.

$$\underbrace{3Fe}_{Iron} + \underbrace{4H_2O}_{Steam} \rightarrow \quad \underbrace{Fe_3O_4}_{Iron\ Oxide} + \underbrace{4H_2}_{Hydrogen}$$

That is why copper is used to make hot water tanks, and not steel.

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Question 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.

Answer 1:

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

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

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

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

Question 2:

Explain the meanings of malleable and ductile.

Answer 2:

Malleable:

Substances that can be converted into thin sheets by beating are called malleable. Most of the metals are malleable. Gold and Silver are most malleable metals.

Ductile:

Substances that can be drawn into thin wires are called ductile. Most of the metals are ductile. Gold is the most ductile metal.

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Question 1:

Why is sodium kept immersed in kerosene oil?

Answer 1:

Metals such as potassium and sodium react so vigorously that they catch fire if kept in the open. Hence, to protect them and to prevent accidental fires, they are kept immersed in kerosene oil.

Question 2:

Write equations for the reactions of

(i) iron with steam

(ii) calcium and potassium with water

Answer 2:

(i) Iron react with steam to form the metal oxide and hydrogen.

$$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$$

(ii) The reaction of calcium with water is exothermic but the heat evolved is not sufficient for the hydrogen to catch fire.

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$$

Calcium starts floating because the bubbles of hydrogen gas formed stick to the surface of the metal.

Potassium react violently with cold water and its reaction is so violent and exothermic that the evolved hydrogen immediately catches fire.

$$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g) + \textit{heat energy}$$

Question 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		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.

(i) Which is the most reactive metal?

(ii) What would you observe if 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 3:

(i) As per reactivity series, Iron is most reactive metal among Iron, Silver and Copper. Since B can displace Iron from its sulphate, so B is the most reactive metal.

(ii) As B is more reactive than Iron (As discussed in answer (i)), so it will displace Copper from its Copper Sulphate solution.

(iii) B is most reactive as discussed in part (i) and D is the least reactive metal as unable to displace any of the solutions. Copper is more reactive than Silver and metal A can displace Copper, so A is more reactive than C.

Hence, the order of decreasing reactivity is B > A > C > D.

Question 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.

Answer 4:

When reactive metals react with dilute hydrochloric acids, gives a salt and hydrogen gas

$$Metal + Dilute\ acid \rightarrow Salt + Hydrogen$$

Reaction between Iron and H_2SO_4:

$$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$$

Question 5:

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

Answer 5:

Zinc is more reactive than Iron. When Zn is added to Iron (II) Sulphate, Zinc displaces Iron from its solutions and Zinc sulphate is formed.

$$Zn(s) + FeSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

Question 1:

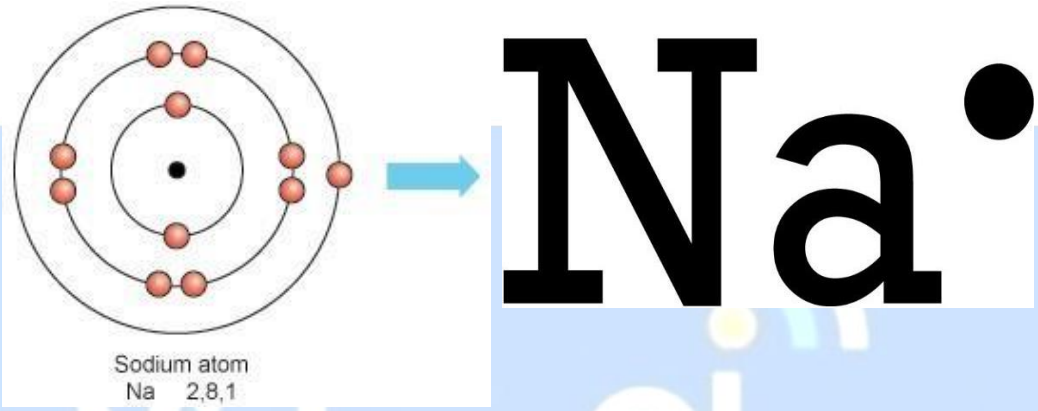
(i) Write the electron-dot structures for sodium, oxygen and magnesium.

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

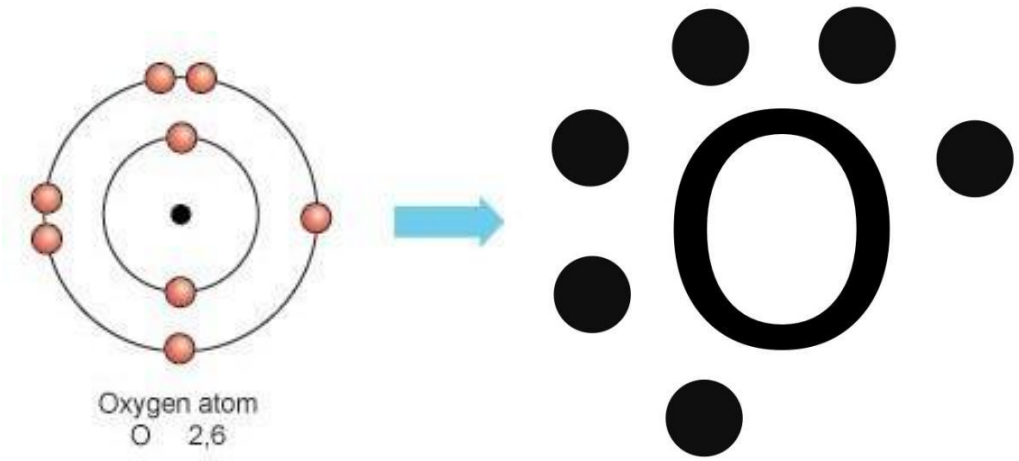
(iii) What are the ions present in these compounds?

Answer 1:

(i) Electron – dot structure for Sodium:

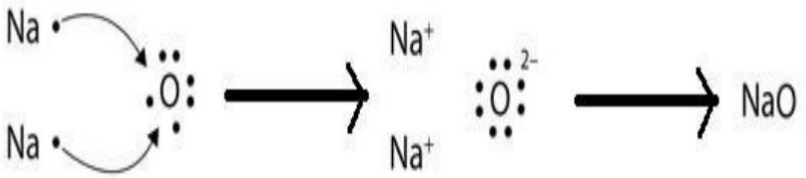


Electron – dot structure for Oxygen:

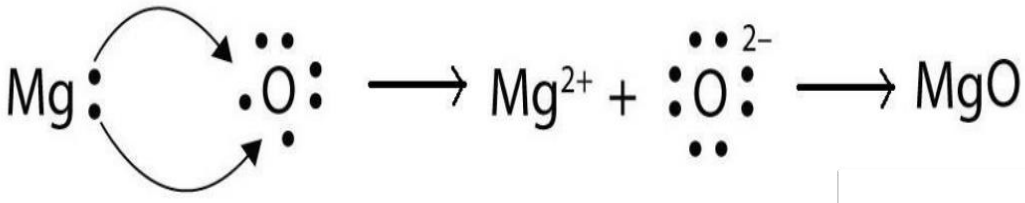


Electron – dot structure for Magnesium:

(ii). Formation of Na_2O by transfer of electron:



Formation of Na_2O by transfer of electron:



(iii). Ions present in these compounds are Mg^{2+}, O^{2-} and Na^{+}.

Question 2:

Why do ionic compounds have high melting points?

Answer 2:

Ionic compounds have high melting and boiling points. Because ionic compounds are formed by the attraction force of two opposite ions and a considerable amount of energy is required to break this strong inter-ionic attraction.

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Question 1:
Define the following terms.
(i) Mineral
(ii) Ore
(iii) Gangue.

Answer 1:
(i) Mineral:
The elements or compounds, which occur naturally in the earth's crust, are known as minerals.

(ii). Ore:
If minerals contain a very high percentage of a particular metal and the metal can be profitably extracted from it. These minerals are called ores.

(iii). Gangue:
Ores mined from the earth are usually contaminated with large amounts of impurities such as soil, sand, etc., called gangue.

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

Answer 2:
The metals which are the least reactive, they are often found in a free state.

For example:
Gold, silver, platinum and copper are found in the free state.

Question 3:

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

Answer 3:

- Metals low in the activity series are very unreactive. The oxides of these metals can be reduced to metals by heating alone.

$$2HgO(s) \xrightarrow{Heat} 2Hg(l) + O(g)$$

- The metals in the middle of the activity series such as iron, zinc, lead, copper, etc., are moderately reactive. These metal oxides are reduced to the corresponding metals by using suitable reducing agents

$$ZnO(s) + C(s) \rightarrow Zn(s) + CO(g)$$

- The metals high up in the reactivity series are very reactive. They are separated from their oxides by electrolysis process.

Question 1:

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

Metal	Zinc	Magnesium	Copper
Zinc oxide			
Magnesium oxide			
Copper oxide			

Answer 1:

Magnesium is the most reactive among these three metals and Zinc is more reactive than Copper. So, Magnesium will displace Zinc oxide and Copper oxide whereas Zinc will displace Copper oxide only.

Metal	Zinc	Magnesium	Copper
Zinc oxide	No Reaction	Displacement Reaction	No Reaction
Magnesium oxide	No Reaction	No Reaction	No Reaction
Copper oxide	Displacement Reaction	Displacement Reaction	No Reaction

Question 2:

Which metals do not corrode easily?

Answer 2:

The metals which are the least reactive, do not corrode easily.

For example:

Gold, silver, platinum and copper.

Question 3:

What are alloys?

Answer 3:

An alloy is a homogeneous mixture of two or more metals, or a metal and a non-metal.

For example:

- *Stainless steel* is an alloy of Nickel and Chromium.
- *Amalgam* is an alloy of Mercury.
- *Brass* is an alloy of Copper and Zinc.
- *Bronze* is an alloy of Copper and Tin.
- *Solder* is an alloy of Lead and Tin.