

Metals and Non-metals

Class 10 - CBSE Science | Chapter 3 | Worksheet & Test Paper

15 MCQs | 8 board questions | 6 practice problems

Video lesson, notes and an interactive quiz: learn.ultimatetools.io

SECTION A - Multiple Choice Questions (1 mark each)

1. Which of the following is the BEST conductor of electricity?

- (a) Copper
- (b) Silver
- (c) Aluminium
- (d) Iron

2. Which metal is a liquid at room temperature?

- (a) Sodium
- (b) Bromine
- (c) Mercury
- (d) Lead

3. Which non-metal conducts electricity?

- (a) Sulphur
- (b) Graphite
- (c) Iodine
- (d) Phosphorus

4. Which of the following is an AMPHOTERIC oxide?

- (a) Na_2O
- (b) CaO
- (c) Al_2O_3
- (d) CO_2

5. Which metal does NOT react with dilute hydrochloric acid?

- (a) Zinc
- (b) Magnesium
- (c) Iron
- (d) Copper

6. Calcium starts floating when it reacts with water because:

- (a) Calcium is lighter than water
- (b) Bubbles of hydrogen gas stick to its surface
- (c) It dissolves immediately
- (d) The water boils

7. Aqua regia is a mixture of:

- (a) 3 parts conc. HNO_3 + 1 part conc. HCl
- (b) 3 parts conc. HCl + 1 part conc. HNO_3
- (c) Equal parts HCl and H_2SO_4
- (d) Conc. HCl and water

8. Heating a sulphide ore strongly in the presence of excess air is called:

- (a) Calcination
- (b) Roasting
- (c) Smelting
- (d) Refining

9. In the electrolytic refining of copper, the impure metal is used as the:

- (a) Cathode
- (b) Anode
- (c) Electrolyte
- (d) Anode mud

10. The thermite reaction is used to:

- (a) Extract aluminium from bauxite

- (b) Join cracked railway tracks
- (c) Galvanise iron
- (d) Refine copper

11. Ionic compounds conduct electricity:

- (a) In the solid state only
- (b) In molten or aqueous state
- (c) Never
- (d) Only when heated as solids

12. Brass is an alloy of:

- (a) Copper and tin
- (b) Copper and zinc
- (c) Iron and carbon
- (d) Lead and tin

13. Galvanisation protects iron by coating it with a layer of:

- (a) Tin
- (b) Chromium
- (c) Zinc
- (d) Aluminium

14. Sodium is stored under kerosene oil because it:

- (a) Is lighter than kerosene
- (b) Reacts vigorously with oxygen and moisture in air
- (c) Dissolves in kerosene
- (d) Would evaporate otherwise

15. Which metal can be obtained ONLY by electrolysis of its molten ore?

- (a) Copper
- (b) Zinc
- (c) Sodium
- (d) Lead

SECTION B - Board-style Questions

1. Why is sodium kept immersed in kerosene oil? [2 marks]

2. What is the thermite reaction? Write its balanced equation and state one use. [3 marks]

3. Differentiate between roasting and calcination, giving one balanced equation for each. [3 marks]

4. Why do ionic compounds conduct electricity in the molten state but not in the solid state? [2 marks]

5. What is an alloy? How does steel differ from pure iron? Name the alloy used to weld electrical wires and give its composition. [3 marks]

6. Describe the electrolytic refining of copper. Name the anode, the cathode and the electrolyte, and state what anode mud is. [3 marks]

7. Give reasons: (a) Platinum, gold and silver are used to make jewellery. (b) Aluminium does not corrode easily even though it is a reactive metal. [3 marks]

8. Write the reaction of the following metals with water and state what you observe: (a) sodium (b) iron. [3 marks]

SECTION C - Practice Problems

1. An element X burns in air with a dazzling white flame to form a white powder Y. Y dissolves slightly in water to give a solution Z which turns red litmus blue. Identify X, Y and Z, and write the equation for the burning of X.

Hint: Which metal is famous for its dazzling white flame in the laboratory? Then ask what its oxide does in water.

2. A piece of zinc is dropped into copper sulphate solution, and separately a piece of copper is dropped into zinc sulphate solution. State what happens in each case and write any equation that occurs.

Hint: Locate both metals in the reactivity series before deciding which reaction can happen.

3. Balance the equation for the reaction of iron with steam: $\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{H}_2$.

Hint: Start by matching the three iron atoms on the right, then balance oxygen, and finish with hydrogen.

4. Why can sodium not be extracted by reducing its oxide with carbon? Name the method used instead and write the electrode reactions for molten sodium chloride.

Hint: Compare the positions of sodium and carbon in terms of reactivity, then think about what force can pull such a metal out of its compound.

5. A metal M does not react with cold or hot water, but reacts with steam to give an oxide and hydrogen. When M is added to blue copper sulphate solution, copper is displaced and the solution turns PALE GREEN. Identify M and justify both observations using the reactivity series.

Hint: The colour of the new solution is the deciding clue - which metal's sulphate is green?

6. Name the constituents of stainless steel and explain why stainless steel is preferred over pure iron for making cutlery.

Hint: Think about the two problems pure iron has in a kitchen - one about strength, one about what happens when it stays wet.

ANSWER KEY

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Section A - MCQ answers

1. (b) Silver

Silver is the best conductor of electricity, with copper next. (Silver is too costly for wiring, so copper and aluminium are used.)

2. (c) Mercury

Mercury is the only metal that is liquid at room temperature. Bromine is also a liquid, but it is a non-metal.

3. (b) Graphite

Graphite, an allotrope of carbon, conducts electricity because of its free (delocalised) electrons - a standard exception.

4. (c) Al_2O_3

Al_2O_3 (and ZnO) react with both acids and bases to give salt and water, so they are amphoteric.

5. (d) Copper

Copper lies below hydrogen in the reactivity series, so it cannot displace hydrogen from dilute acids.

6. (b) Bubbles of hydrogen gas stick to its surface

Hydrogen bubbles formed in the reaction cling to the calcium, making it float.

7. (b) 3 parts conc. HCl + 1 part conc. HNO_3

Aqua regia is 3 parts concentrated hydrochloric acid to 1 part concentrated nitric acid, and it can dissolve gold and platinum.

8. (b) Roasting

Roasting converts a sulphide ore into its oxide; calcination is used for carbonate ores in limited air.

9. (b) Anode

The impure metal is the anode and a thin strip of pure metal is the cathode; pure metal deposits on the cathode.

10. (b) Join cracked railway tracks

$\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 + \text{heat}$ releases so much heat that the iron formed is molten, ideal for welding tracks on site.

11. (b) In molten or aqueous state

The ions are locked in place in the solid, but become free to move when molten or dissolved, so the compound then conducts.

12. (b) Copper and zinc

Brass = copper + zinc. Bronze = copper + tin, and solder = lead + tin.

13. (c) Zinc

Galvanisation is the coating of iron or steel with a thin layer of zinc to prevent rusting.

14. (b) Reacts vigorously with oxygen and moisture in air

Sodium reacts so vigorously with air and moisture that it can catch fire, so it is kept immersed in kerosene oil.

15. (c) Sodium

Highly reactive metals such as Na, K, Ca, Mg and Al cannot be reduced by carbon and are obtained by electrolytic reduction.

Section B - Model answers

1. Why is sodium kept immersed in kerosene oil?

Sodium is a very reactive metal. It reacts vigorously with the oxygen and moisture present in air, and the reaction is so exothermic that the sodium can catch fire. Keeping it immersed in kerosene oil prevents contact with air and moisture, so it is stored safely.

2. What is the thermite reaction? Write its balanced equation and state one use.

The thermite reaction is the reduction of a metal oxide by aluminium powder, which is highly exothermic: $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow 2\text{Fe} + \text{Al}_2\text{O}_3 + \text{heat}$. So much heat is released that the iron produced is in the molten state. It is used to weld cracked railway tracks and broken machine parts on the spot.

3. Differentiate between roasting and calcination, giving one balanced equation for each.

Roasting: a SULPHIDE ore is heated strongly in the presence of EXCESS air to convert it into the oxide - $2\text{ZnS} + 3\text{O}_2 \xrightarrow{\text{heat}} 2\text{ZnO} + 2\text{SO}_2$. Calcination: a CARBONATE ore is heated in LIMITED air (or absence of air) to convert it into the oxide - $\text{ZnCO}_3 \xrightarrow{\text{heat}} \text{ZnO} + \text{CO}_2$. Both are done before reduction because metal oxides are easier to reduce to the metal.

4. Why do ionic compounds conduct electricity in the molten state but not in the solid state?

Electrical conduction requires charged particles that are free to move. In the solid state, the ions are held tightly in fixed positions by strong electrostatic forces, so they cannot move. On melting (or dissolving in water) these forces are overcome, the ions become free to move towards the electrodes, and the compound conducts electricity.

5. What is an alloy? How does steel differ from pure iron? Name the alloy used to weld electrical wires and give its composition.

An alloy is a homogeneous mixture of a metal with another metal or a non-metal. Pure iron is soft and stretches easily when hot, but adding a small amount of carbon gives steel, which is hard and strong. The alloy used to weld electrical wires is solder, a mixture of lead and tin, which has a low melting point.

6. Describe the electrolytic refining of copper. Name the anode, the cathode and the electrolyte, and state what anode mud is.

A thick block of impure copper is made the ANODE and a thin strip of pure copper is made the CATHODE. The ELECTROLYTE is a solution of a copper salt, usually acidified copper sulphate. On passing current, pure copper from the anode dissolves into the solution and an equal amount of pure copper is deposited on the cathode. The soluble impurities go into the solution, while the insoluble impurities settle below the anode as ANODE MUD.

7. Give reasons: (a) Platinum, gold and silver are used to make jewellery. (b) Aluminium does not corrode easily even though it is a reactive metal.

(a) Platinum, gold and silver are very unreactive - they do not corrode or tarnish easily and retain their lustre for a long time; they are also malleable and ductile, so they can be shaped into ornaments. (b) On exposure to air, aluminium forms a thin, hard and tough layer of aluminium oxide on its surface. This layer sticks firmly and prevents air and moisture from reaching the metal underneath, so further corrosion is stopped.

8. Write the reaction of the following metals with water and state what you observe: (a) sodium (b) iron.

(a) Sodium reacts violently even with cold water: $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 + \text{heat}$. The reaction is so exothermic that the hydrogen evolved catches fire. (b) Iron does not react with cold or hot water; it reacts only with steam: $3\text{Fe} + 4\text{H}_2\text{O}(\text{steam}) \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$. The reaction is slow and no flame is seen.

Section C - Solutions

1. An element X burns in air with a dazzling white flame to form a white powder Y. Y dissolves slightly in water to give a solution Z which turns red litmus blue. Identify X, Y and Z, and write the equation for the burning of X.

X = magnesium (Mg), Y = magnesium oxide (MgO), Z = magnesium hydroxide, $\text{Mg}(\text{OH})_2$ - a base, so it turns red litmus blue. Equation: $2\text{Mg} + \text{O}_2 \xrightarrow{\text{heat}} 2\text{MgO}$ (and $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$).

2. A piece of zinc is dropped into copper sulphate solution, and separately a piece of copper is dropped into zinc sulphate solution. State what happens in each case and write any equation that occurs.

Zinc is ABOVE copper, so zinc displaces copper: $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$ - the blue colour fades and a reddish-brown copper deposit forms. Copper is BELOW zinc, so copper cannot displace zinc: no reaction occurs in the second case.

3. Balance the equation for the reaction of iron with steam: $\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + \text{H}_2$.

$3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$. Check: Fe 3|3, O 4|4, H 8|8.

4. Why can sodium not be extracted by reducing its oxide with carbon? Name the method used instead and write the electrode reactions for molten sodium chloride.

Sodium is far too reactive - it holds oxygen more strongly than carbon does, so carbon cannot reduce sodium oxide. Sodium is obtained by ELECTROLYTIC REDUCTION of molten sodium chloride. At the cathode: $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$. At the anode: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$.

5. A metal M does not react with cold or hot water, but reacts with steam to give an oxide and hydrogen. When M is added to blue copper sulphate solution, copper is displaced and the solution turns PALE GREEN. Identify M and justify both observations using the reactivity series.

M is iron (Fe). Iron lies below magnesium, so it does not react with cold or hot water - only with steam: $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$. It lies above copper, so it displaces copper: $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$. The pale green colour is due to ferrous sulphate (FeSO_4); zinc and aluminium also react only with steam and displace copper, but their sulphate solutions are colourless - so the green colour identifies iron.

6. Name the constituents of stainless steel and explain why stainless steel is preferred over pure iron for making cutlery.

Stainless steel is an alloy of iron with nickel and chromium (and a little carbon). Pure iron is soft and rusts readily in the presence of air and moisture. Alloying makes stainless steel hard and strong and prevents rusting, so cutlery keeps its strength and shine.

