

UNIQUE STUDY POINT

By Sumeet Sahu

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Class: X	Subject: Science	Session: 2025-26
Chapter: 03 - Metals and Non-metals	Time: 1½ Hours	Max. Marks: 40

General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

SECTION A - Multiple Choice Questions (1 mark each)

1. Which non-metal is lustrous?
 - (a) Sulphur
 - (b) Iodine
 - (c) Carbon
 - (d) Phosphorus
2. Aqua regia is a mixture of concentrated HCl and concentrated HNO₃ in the ratio:
 - (a) 1:3
 - (b) 3:1
 - (c) 2:1
 - (d) 1:2
3. Which metal is the most ductile?
 - (a) Silver
 - (b) Gold
 - (c) Copper
 - (d) Aluminium
4. Which of the following metals does not react with cold water?
 - (a) Sodium
 - (b) Calcium
 - (c) Magnesium
 - (d) Potassium
5. The thermit reaction is used for:
 - (a) Extraction of aluminium
 - (b) Welding railway tracks
 - (c) Galvanisation
 - (d) Making alloys

6. Which of the following pairs will not show displacement reaction?
- (a) Zinc and copper sulphate
 - (b) Iron and copper sulphate
 - (c) Copper and silver nitrate
 - (d) Copper and zinc sulphate
7. Ionic compounds have:
- (a) Low melting points
 - (b) High melting points
 - (c) Variable melting points
 - (d) No definite melting point
8. Which gas does NOT evolve when metals react with nitric acid?
- (a) Nitrogen dioxide
 - (b) Nitrogen monoxide
 - (c) Hydrogen
 - (d) Nitrous oxide
9. An alloy of copper and zinc is:
- (a) Bronze
 - (b) Brass
 - (c) Solder
 - (d) Amalgam
10. Which metal is found in free state in nature?
- (a) Sodium
 - (b) Magnesium
 - (c) Gold
 - (d) Zinc

SECTION B - Short Answer Questions (2 marks each)

11. What is an alloy? Give two examples with their composition.
12. Write the equations for the reactions of sodium and calcium with water.
13. Define the following terms: (i) Mineral (ii) Ore
14. Why do ionic compounds conduct electricity in molten state but not in solid state?

SECTION C - Short Answer Questions (3 marks each)

15. Explain the formation of sodium chloride (NaCl) with electron-dot structure. Show the transfer of electrons.
16. What are the conditions necessary for rusting of iron? Describe an experiment to demonstrate these conditions.
17. Distinguish between roasting and calcination with suitable examples and chemical equations.

SECTION D - Long Answer Question (5 marks)

18. Describe the reactivity of metals with water. Explain how different metals react with cold water, hot water, and steam with appropriate chemical equations.

SECTION E - Case Study Based Questions (4 marks each)

19. Case Study 1:

During a laboratory experiment, a student added small pieces of metals A, B, C, and D to solutions of iron(II) sulphate, copper(II) sulphate, zinc sulphate, and silver nitrate. The results obtained showed that: - Metal A displaced iron from iron(II) sulphate - Metal B displaced copper but not iron - Metal C did not displace any metal - Metal D displaced silver from silver nitrate but not zinc

Based on this information, answer the following:

- Identify which metal is the most reactive among A, B, C, and D. (1 mark)
- Arrange metals A, B, C, and D in order of decreasing reactivity. (1 mark)
- Write the chemical equation for the reaction of metal A with iron(II) sulphate. (2 marks)

20. Case Study 2:

A chemistry teacher demonstrated an experiment where she took three test tubes labeled P, Q, and R containing iron nails. In tube P, she added water and corked it. In tube Q, she added boiled distilled water, poured some oil on top, and corked it. In tube R, she added anhydrous calcium chloride and corked it. After a week, the students observed that nails rusted only in test tube P.

Answer the following questions:

- Why did the nails rust only in test tube P? (1 mark)
- What was the purpose of adding oil in test tube Q? (1 mark)
- What role did anhydrous calcium chloride play in test tube R? Explain why nails did not rust in this tube. (2 marks)

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SECTION A - Answers to MCQs

1. (b) Iodine

Iodine is a non-metal that shows metallic lustre. It has a shiny, grayish-black appearance.

2. (b) 3:1

Aqua regia is a freshly prepared mixture of concentrated HCl and concentrated HNO₃ in the ratio 3:1. It can dissolve gold and platinum.

3. (b) Gold

Gold is the most ductile metal. A wire of about 2 km length can be drawn from one gram of gold.

4. (c) Magnesium

Magnesium does not react with cold water. It reacts only with hot water to form magnesium hydroxide and hydrogen gas.

5. (b) Welding railway tracks

The thermit reaction between iron(III) oxide and aluminium produces molten iron which is used to join railway tracks or cracked machine parts.

6. (d) Copper and zinc sulphate

Copper cannot displace zinc from zinc sulphate because copper is less reactive than zinc according to the activity series.

7. (b) High melting points

Ionic compounds have high melting and boiling points due to strong electrostatic forces of attraction between oppositely charged ions.

8. (c) Hydrogen

Hydrogen gas does not evolve when metals react with nitric acid because HNO₃ is a strong oxidizing agent that oxidizes H₂ to water.

9. (b) Brass

Brass is an alloy of copper and zinc. Bronze is an alloy of copper and tin.

10. (c) Gold

Gold is found in free state in nature as it is very unreactive and does not combine easily with other elements.

SECTION B - Answers to Short Answer Questions

11.

Alloy: An alloy is a homogeneous mixture of two or more metals, or a metal and a non-metal. Alloys are prepared by melting the primary metal and dissolving other elements in definite proportions, then cooling to room temperature.

Examples:

1. **Brass:** Copper (Cu) + Zinc (Zn)
2. **Bronze:** Copper (Cu) + Tin (Sn)
3. **Solder:** Lead (Pb) + Tin (Sn) - used for welding electrical wires

12.

Reaction of Sodium with water:



The reaction is very violent and exothermic. The hydrogen evolved catches fire.

Reaction of Calcium with water:



The reaction is less violent. Calcium starts floating because hydrogen bubbles stick to its surface.

13.

(i) Mineral: Elements or compounds that occur naturally in the earth's crust are known as minerals. All minerals are not useful sources of metals.

(ii) Ore: Minerals that contain a very high percentage of a particular metal and from which the metal can be profitably extracted are called ores. All ores are minerals, but all minerals are not ores.

14.

Ionic compounds conduct electricity in molten state but not in solid state because:

In solid state: The ions are held in fixed positions by strong electrostatic forces and cannot move. Therefore, they cannot conduct electricity.

In molten state: When heated, the electrostatic forces are overcome due to heat energy. The ions become free to move and can conduct electricity by moving to opposite electrodes.

SECTION C - Answers to Short Answer Questions

15.

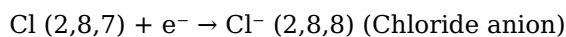
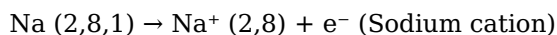
Formation of Sodium Chloride (NaCl):

Sodium (Na) has atomic number 11 with electronic configuration 2,8,1

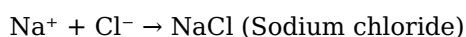
Chlorine (Cl) has atomic number 17 with electronic configuration 2,8,7

Electron transfer:

- Sodium has 1 electron in its outermost shell. It loses this electron to achieve stable configuration of 2,8
- Chlorine has 7 electrons in its outermost shell. It gains 1 electron to achieve stable configuration of 2,8,8



The oppositely charged ions Na^+ and Cl^- attract each other through strong electrostatic forces to form ionic compound NaCl.



16.

Conditions necessary for rusting of iron:

1. Presence of moisture (water)
2. Presence of oxygen (air)

Both conditions must be present simultaneously for iron to rust.

Experiment to demonstrate:

Take three test tubes A, B, and C with clean iron nails in each.

Test tube A: Add water and cork it (both air and water present)

Test tube B: Add boiled distilled water + oil layer on top and cork (only water, no dissolved air)

Test tube C: Add anhydrous calcium chloride and cork (only dry air, no moisture)

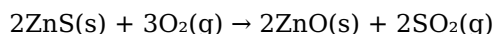
Observation: After a few days, rusting occurs only in test tube A where both air and water are present. Test tubes B and C show no rusting, proving that both air and moisture are essential for rusting.

17.

Roasting:

- Process of converting sulphide ores into oxides by heating strongly in the presence of excess air
- Used for sulphide ores

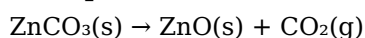
Example: Zinc sulphide to zinc oxide



Calcination:

- Process of converting carbonate ores into oxides by heating strongly in limited or no air
- Used for carbonate ores

Example: Zinc carbonate to zinc oxide



Key Difference: Roasting requires excess air/oxygen while calcination is done in limited air. Roasting is for sulphides, calcination is for carbonates.

SECTION D - Answer to Long Answer Question

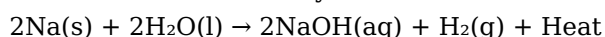
18.

Reactivity of Metals with Water:

Metals show different reactivity with water depending on their position in the activity series. The reaction produces metal hydroxide (or oxide) and hydrogen gas.

1. Reaction with Cold Water (Very reactive metals):

Sodium: Reacts violently with cold water

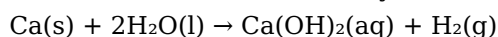


The reaction is so exothermic that hydrogen catches fire.

Potassium: Reacts even more vigorously than sodium



Calcium: Reacts less violently with cold water



Calcium starts floating due to hydrogen bubbles sticking to its surface.

2. Reaction with Hot Water (Moderately reactive metals):

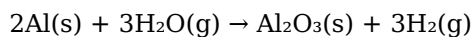
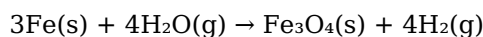
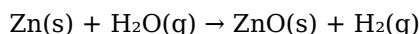
Magnesium: Does not react with cold water but reacts with hot water



It also starts floating due to hydrogen bubbles.

3. Reaction with Steam (Less reactive metals):

Metals like aluminium, iron, and zinc do not react with cold or hot water but react with steam to form metal oxide and hydrogen.

Aluminium:**Iron:****Zinc:****4. No Reaction with Water:**

Metals like lead, copper, silver, and gold do not react with water at all, even as steam, because they are very less reactive or unreactive.

SECTION E - Answers to Case Study Based Questions**19.**

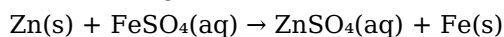
(a) Metal A is the most reactive among A, B, C, and D because it can displace iron from iron(II) sulphate. According to the activity series, metals that can displace iron must be more reactive than iron (like magnesium, aluminium, or zinc).

(b) Order of decreasing reactivity: **A > B > D > C**

Explanation:

- Metal A can displace iron (most reactive)
- Metal B can displace copper but not iron (more reactive than copper, less than iron)
- Metal D can displace silver but not zinc (more reactive than silver, less than zinc)
- Metal C cannot displace any metal (least reactive)

(c) Assuming metal A is zinc (or it could be magnesium/aluminium):



(Zinc displaces iron from iron(II) sulphate to form zinc sulphate and iron metal)

This is a displacement reaction where a more reactive metal (zinc) displaces a less reactive metal (iron) from its salt solution.

20.

(a) The nails rusted only in test tube P because both air and water were present in this tube. Rusting of iron requires the simultaneous presence of both oxygen (from air) and moisture (water). Test tube P provided both these essential conditions for rust formation.

(b) The purpose of adding oil in test tube Q was to prevent air from dissolving in the water. The oil layer floats on top of the boiled distilled water and acts as a barrier, preventing atmospheric oxygen from dissolving in the water. Boiling the water beforehand also removed any dissolved air. Without dissolved oxygen, rusting cannot occur even though water is present.

(c) Anhydrous calcium chloride is a desiccant (drying agent) that absorbs moisture from the air. In test tube R:

- It absorbed all the moisture/water vapor present in the air inside the test tube
- This created a completely dry environment around the iron nails
- Although air (oxygen) was present, the absence of moisture prevented rusting

This proves that moisture is an essential condition for rusting. Without water, even in the presence of oxygen, iron does not rust. The experiment demonstrates that BOTH air and moisture must be present simultaneously for iron to rust.

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