



*Answer the following questions then check your answers*

1. *Which of the following metals can be extracted by smelting (using carbon to reduce the metal ore)?*

- a) *Sodium*      b) *Calcium*      c) *Iron*      d) *Potassium*

2. *Which metal is commonly extracted by electrolysis?*

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

3. *Which process is used to extract copper from low-grade ores?*

- a) *Smelting*      b) *Electrolysis*      c) *Phytomining*      d) *Distillation*

*Answer: c) Phytomining*

4. *In bioleaching, which organisms are used to extract metals?*

- a) *Plants*      b) *Bacteria*      c) *Fungi*      d) *Animals*

5. Match the metal to its extraction method:

Metal	Extraction Method
Zinc	Electrolysis
Iron	Phytomining
Aluminium	Carbon reduction (smelting)
Copper	Bioleaching

6. Fill in the gaps to complete the sentences below:

- Iron is extracted from its ore using \_\_\_\_\_ in a blast furnace.
- The process of extracting metals using plants is called \_\_\_\_\_.
- Electrolysis is used to extract metals that are \_\_\_\_\_ in the reactivity series.
- The metal extracted from bauxite ore is \_\_\_\_\_.

7. Describe how phytomining works.

8. What is bioleaching and how is it used to extract metals?

9. Why is electrolysis used for extracting aluminium?

10. Why can carbon be used to extract some metals but not others?

11. What are the environmental benefits of phytomining and bioleaching?

- a. What is the role of carbon in the extraction of metals like iron?
12. Compare the efficiency of carbon reduction and electrolysis in metal extraction.
13. Discuss the process of extracting copper using bioleaching and compare it with traditional smelting.

## Answers

1. Which of the following metals can be extracted by smelting (using carbon to reduce the metal ore)?

- a) Sodium      b) Calcium      c) Iron      d) Potassium

Answer: c) Iron

2. Which metal is commonly extracted by electrolysis?

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

Answer: c) Aluminium

3. Which process is used to extract copper from low-grade ores?

- a) Smelting      b) Electrolysis      c) Phytomining      d) Distillation

Answer: c) Phytomining

4. In bioleaching, which organisms are used to extract metals?

- a) Plants      b) Bacteria      c) Fungi      d) Animals

Answer: b) Bacteria

5. Match the metal to its extraction method:

Metal	Extraction Method
Zinc	Electrolysis
Iron	Phytomining
Aluminium	Carbon reduction (smelting)
Copper	Bioleaching

6. Fill in the gaps to complete the sentences below:

a. Iron is extracted from its ore using \_\_\_\_\_ in a blast furnace.

Answer: carbon

b. The process of extracting metals using plants is called \_\_\_\_\_.

Answer: phytomining

c. Electrolysis is used to extract metals that are \_\_\_\_\_ in the reactivity series.

Answer: high

d. The metal extracted from bauxite ore is \_\_\_\_\_.

Answer: aluminium

7. Describe how phytomining works.

Answer: Phytomining involves growing plants that can absorb metal ions from the soil. These plants are harvested and burned to produce ash that contains the metal compounds. The metals are then extracted from the ash through various

chemical processes including electrolysis and displacement reactions using cheap readily available metals.

8. What is bioleaching and how is it used to extract metals?

Answer: Bioleaching is the process of using bacteria to extract metals from ores. Bacteria feed on the minerals in the ore, producing a solution of metal ions. These metal ions are then processed by electrolysis or a displacement reaction to recover the metal.

9. Why is electrolysis used for extracting aluminium?

Answer: Electrolysis is used for extracting aluminium because it is a highly reactive metal, and traditional reduction methods such as using carbon are not effective. Aluminium oxide is dissolved in molten cryolite and subjected to electrolysis, which separates the aluminium from the oxygen.

10. Why can carbon be used to extract some metals but not others?

Answer: Carbon can be used to extract metals that are less reactive than carbon itself. For metals higher up in the reactivity series, such as aluminium, carbon is not reactive enough to reduce the metal oxides, so alternative methods like electrolysis are used.

11. What are the environmental benefits of phytomining and bioleaching?

Answer: Phytomining and bioleaching are more environmentally friendly compared to traditional mining methods. They reduce the need for large-scale mining operations, minimize landscape disruption, and lower the energy consumption and pollution associated with metal extraction processes.

a. What is the role of carbon in the extraction of metals like iron?

Answer: Carbon is used as a reducing agent in the extraction of metals like iron. Using carbon as a reducing agent to extract a metal is called smelting, it involves heating the metal ore to a high temperature in a furnace and using carbon to reduce the metal ore.

12. Compare the efficiency of carbon reduction and electrolysis in metal extraction.

Answer: Carbon reduction is efficient for extracting metals that are less reactive than carbon, such as iron and zinc. It is cost-effective and energy-efficient for these metals. Electrolysis, on the other hand, is more suitable for extracting highly reactive metals like aluminium and sodium but is more energy-intensive and expensive due to the high electricity consumption.

13. Discuss the process of extracting copper using bioleaching and compare it with traditional smelting.

#### Bioleaching Process:

Bacteria such as *Thiobacillus ferrooxidans* are used in bioleaching. These bacteria feed on sulfide minerals present in low-grade copper ores.

The bacteria produce a solution containing copper ions through their metabolic processes.

This solution is called a leachate and contains dissolved copper ions.

The copper ions are then extracted from the leachate using methods such as electrolysis or displacement reactions.

#### Comparison with Traditional Smelting:

Traditional smelting involves heating copper ore in a furnace to extract the metal, which requires high temperatures and significant energy consumption.

*Smelting can release many toxic gases such as sulfur dioxide, which contributes to air pollution and acid rain.*

*Bioleaching is more environmentally friendly, as it operates at ambient temperatures and reduces the need for fossil fuels.*

*However, bioleaching is a slower process compared to smelting, taking months or even years to produce significant amounts of copper.*