SCIENCE FOUNDATIONS

Metals, non-metals, and metalloids

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you pick the right material for a job, like copper wire to carry electricity, a plastic handle that stays cool, or a silicon chip to run a phone. A plumber chooses copper pipe because it carries heat and bends without breaking, while a pot handle is plastic so it stays cool to touch. An engineer picks silicon for a chip because it sits halfway between a conductor and an insulator. Knowing metals, non-metals, and metalloids tells you what a material will do before you build with it.



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Rule

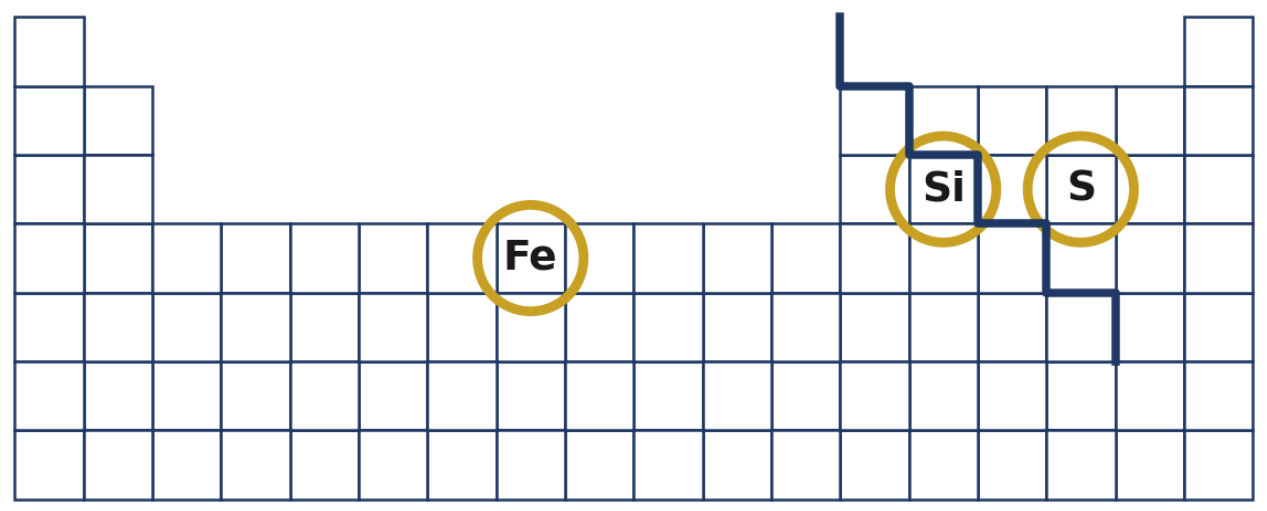
Metals, non-metals, and metalloids: a metal is shiny, conducts heat and electricity, and can be bent or hammered into shape. A non-metal is dull, a poor conductor, and brittle or a gas.

A metalloid sits on the staircase between metals and non-metals, looks metallic, and conducts poorly. Silicon and boron are metalloids.

Worked examples

EXAMPLE 1

Q Classify iron, sulfur, and silicon.



SOLUTION

Iron: shiny, conducts, malleable, so a metal.

Sulfur: dull yellow solid, poor conductor, so a non-metal.

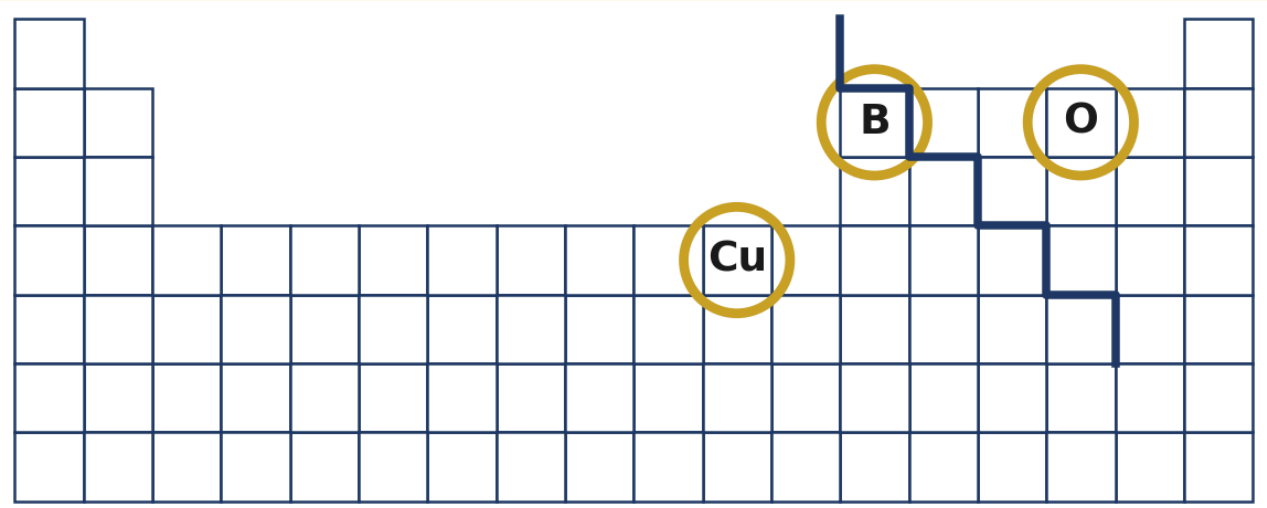
Silicon: looks metallic but is a poor conductor, on the staircase, so a metalloid.

The result is iron metal, sulfur non-metal, silicon metalloid.

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EXAMPLE 2

Q Classify copper, oxygen, and boron.



SOLUTION

Copper: shiny and conducting, so a metal.

Oxygen: a gas, poor conductor, so a non-metal.

Boron: on the staircase with mixed properties, so a metalloid.

The result is copper metal, oxygen non-metal, boron metalloid.

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Practice questions

1 **Classify lead, nitrogen, and tellurium as metal, non-metal, or metalloid, giving one property-based reason for each.**

- **A** Lead: metal, shiny and conducting; nitrogen: non-metal, a gas and poor conductor; tellurium: metalloid, on the staircase with mixed properties
- **B** Lead: non-metal, dull and a poor conductor; nitrogen: metal, shiny and conducting; tellurium: metal, shiny and conducting
- **C** Lead: metal, shiny and conducting; nitrogen: metalloid, on the staircase with mixed properties; tellurium: non-metal, a gas and poor conductor
- **D** Lead: metalloid, on the staircase with mixed properties; nitrogen: non-metal, a gas and poor conductor; tellurium: metal, shiny and conducting

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2

A material is shiny, conducts electricity, and can be hammered into a thin sheet. Is it a metal, a non-metal, or a metalloid? Explain.

A Non-metal, because it conducts electricity.

B Metal, because it is shiny, conducts, and is malleable.

C Metalloid, because it can be hammered into a sheet.

D Cannot tell from these properties.

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3 Why is silicon used to make computer chips instead of copper or sulfur?

- **A** Silicon is a metal, so it conducts better than copper.
- **B** Silicon is a non-metal, so it never conducts.
- **C** Silicon is a metalloid whose conductivity can be controlled, while copper conducts too well and sulfur hardly conducts at all.
- **D** Silicon is the only element found on the staircase.

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4 Why is copper wire used to carry electricity instead of sulfur?

A. Copper is a metalloid on the staircase, while sulfur is a metal.

B. Sulfur is a metal, shiny and conducting, while copper is a non-metal.

C. Both conduct equally well, so either would do.

D. Copper is a metal, shiny and conducting, while sulfur is a non-metal, dull and a poor conductor.

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5 Name one property of metals.

- A Dull and a poor conductor
- B Shiny, conducts heat and electricity, or malleable
- C Found along the staircase line
- D Gains electrons to form negative ions

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6 Name one property of non-metals.

- A Shiny and malleable
- B Conducts heat and electricity well
- C Dull, poor conductor, or often a gas or brittle solid
- D Found along the staircase line

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7 Where are metalloids found on the periodic table?

- A Along the staircase line
- B In the first column
- C In the bottom row
- D Scattered randomly

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8 Do metals tend to lose or gain electrons?

- A Lose electrons
- B Gain electrons

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9

Classify zinc, carbon, and antimony as metal, non-metal, or metalloid.

A Zinc: non-metal; carbon: metal; antimony: metal

B Zinc: metal; carbon: metalloid; antimony: non-metal

C Zinc: metal; carbon: non-metal; antimony: metalloid

D Zinc: metalloid; carbon: non-metal; antimony: metal

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10

Is mercury a metal or a non-metal? Give one reason.

A Non-metal, because it is a liquid

B Metal, because it conducts electricity

C Metalloid, because it is on the staircase

D Metal, because it is shiny and solid

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ANSWER KEY

1. Lead: metal, shiny and conducting; nitrogen: non-metal, a gas and poor conductor; tellurium: metalloid, on the staircase with mixed properties

2. Metal, because it is shiny, conducts, and is malleable.

3. Silicon is a metalloid whose conductivity can be controlled, while copper conducts too well and sulfur hardly conducts at all.

4. Copper is a metal, shiny and conducting, while sulfur is a non-metal, dull and a poor conductor.

5. Shiny, conducts heat and electricity, or malleable

6. Dull, poor conductor, or often a gas or brittle solid

7. Along the staircase line

8. Lose electrons

9. Zinc: metal; carbon: non-metal; antimony: metalloid

10. Metal, because it conducts electricity

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