SCIENCE FOUNDATIONS

Ohm's law

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how an electrician picks the right fuse or resistor, and how you work out whether a new bulb will be too dim or dangerously bright on a circuit. A fuse blows when the current gets too high, protecting the wires behind it from overheating. A mechanic testing a headlight circuit checks whether the voltage and resistance are letting the right current through. Knowing Ohm's law tells you how voltage, current, and resistance trade off against each other in any circuit.



Rule

Ohm's law: the voltage across a resistor equals the current through it times its resistance, $V = I \times R$.

At fixed voltage, doubling the resistance halves the current.

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Worked examples

EXAMPLE 1

Q A 12 V battery drives 2 A through a resistor. Resistance?

SOLUTION

Write the rule:

$V = I \times R$

Rearrange:

$R = V \div I$

Substitute:

$R = 12 \div 2 = 6$ ohms

The result is resistance 6 ohms.

EXAMPLE 2

Q A 6 ohm resistor has 12 V across it. Current?

SOLUTION

Write the rule:

$V = I \times R$

Rearrange:

$I = V \div R$

Substitute:

$I = 12 \div 6 = 2$ A

The result is current 2 A.

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Practice questions

1 A 15 V battery drives 3 A through a resistor. What is the resistance?

- **A** 3 ohms
- **B** 5 ohms
- **C** 15 ohms
- **D** 45 ohms

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2 At fixed resistance, the voltage across a resistor doubles. What happens to the current?

- **A** It doubles
- **B** It halves
- **C** It stays the same
- **D** It becomes zero

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3 A 8 ohm resistor has 24 V across it. What is the current?

- **A** 2 A
- **B** 3 A
- **C** 8 A
- **D** 24 A

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4 At fixed voltage, the resistance is halved. What happens to the current?

- **A** It halves
- **B** It doubles
- **C** It stays the same
- **D** It becomes zero

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5 A current of 3 A flows through a 4 ohm resistor. What is the voltage across it?

- **A** 3 V
- **B** 7 V
- **C** 12 V
- **D** 0.75 V

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6 Which has the greater voltage across it: 2 A through 10 ohms, or 3 A through 4 ohms?

- **A** 2 A through 10 ohms
- **B** 3 A through 4 ohms
- **C** They are equal
- **D** Cannot tell

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7 At fixed voltage, the resistance doubles. What happens to the current?

- **A** It halves
- **B** It doubles
- **C** It stays the same
- **D** It becomes zero

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8 Which is Ohm's law?

- **A** $V = I \times R$
- **B** $V = I \div R$
- **C** $R = V \times I$
- **D** $I = V \times R$

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What are the units of voltage, current, and resistance?

A Volts, amperes, ohms

B Amperes, volts, watts

C Ohms, volts, joules

D Volts, ohms, newtons

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10

Which resistor lets more current through at the same voltage: a 3 ohm resistor or a 6 ohm resistor?

A The 3 ohm resistor

B The 6 ohm resistor

C They let the same current through

D Neither lets current through

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ANSWER KEY

1. 5 ohms

2. It doubles

3. 3 A

4. It doubles

5. 12 V

6. 2 A through 10 ohms

7. It halves

8. $V = I \times R$

9. Volts, amperes, ohms

10. The 3 ohm resistor

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