SCIENCE FOUNDATIONS

Electrical power

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you work out what a space heater or an air conditioner costs to run, and why leaving lights and chargers on adds up on your power bill. A homeowner comparing two heaters can tell which one will cost more per hour before buying it. A camper choosing a portable fridge needs to know whether the battery can run it all night. Knowing electrical power tells you what an appliance really costs you, and why a small device left on all day is not free.



Rule

Electrical power: $P = V \times I$, and $P = I^2 \times R$.

Energy: $E = P \times t$. Power is measured in watts, energy in joules, or in kilowatt-hours on a power bill.

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Worked examples

EXAMPLE 1

Q A 12 V device draws 2 A. Power?

SOLUTION

Write the rule:

$P = V \times I$

Substitute:

$P = 12 \times 2 = 24$ W

Write the answer in watts.

The result is power 24 W.

EXAMPLE 2

Q A 100 W bulb runs for 10 hours. Energy in kilowatt-hours?

SOLUTION

Convert power: $100 \div 1000 = 0.1$ kW

Energy = power × time

energy $= 0.1 \times 10 = 1$ kWh

Write the answer in kWh.

The result is energy 1 kWh.

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Practice questions

1 Electrical power formula?

- A Current divided by voltage
- B Voltage times current
- C Voltage plus current
- D Resistance times current

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2 9 V, 3 A: power?

- A 12 W
- B 27 W
- C 3 W
- D 6 W

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3 60 W for 5 hours: energy in kWh?

- A 3 kWh
- B 12 kWh
- C 0.3 kWh
- D 300 kWh

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4 Energy formula?

- A Voltage times current
- B Power divided by time
- C Power times time
- D Current times resistance

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5 Units of power?

A Amps

B Joules

C Volts

D Watts

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6 Units of energy for bills?

A Kilowatt-hours

B Watts

C Amps

D Volts

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7 How many joules are in 1 kWh?

- A 3,600,000 J
- B 3,600 J
- C 60,000 J
- D 1,000 J

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8 Current 3 A, resistance 4 ohms: power?

- A 12 W
- B 36 W
- C 7 W
- D 144 W

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9 A device uses 480 J of energy in 2 s. What is its power?

- **A** 240 W
- **B** 960 W
- **C** 482 W
- **D** 120 W

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10 Power 50 W for 2 hours: energy in joules?

- **A** 360000 J
- **B** 36000 J
- **C** 100 J
- **D** 3600 J

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ANSWER KEY

1. Voltage times current

2. 27 W

3. 0.3 kWh

4. Power times time

5. Watts

6. Kilowatt-hours

7. 3,600,000 J

8. 36 W

9. 240 W

10. 360000 J

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