Electrical power, energy and fuse-choice reasoning

Student activity • observation and reasoning

YEAR 10 / LESSON 50 / PHYSICS + SCIENCE (DOUBLE AWARD)

The question

How do power and operating time determine electrical energy transfer?

Use explicitly stated practice appliance ratings to calculate current and energy, then explain the limits of classroom fuse selection.

Equipment

- Booklet, calculator and original rating cards

Calculation activity only. Do not operate high-power appliances, remove plugs, replace fuses or create heating faults. Use the stated numbers on paper.

Course coverage: Shared Physics / Double Award: 2.1, 2.3–2.5, 6.1. P = IV and E = IVt.

Plan, model or apparatus sketch

Draw a labelled setup or force diagram; include the measured quantities.

Method and reasoning

Read the whole sequence before starting

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1. For an invented resistive appliance rated 1 150 W at 230 V, calculate its normal operating current using I = P/V. These are problem values, not a claim about the local mains voltage.

2. Calculate energy transferred when it operates for 120 s using E = Pt, then confirm with E = IVt.

3. Convert the same energy to kilowatt-hours using power in kilowatts and time in hours. Keep energy and power units distinct.

4. For a simplified question offering 3 A, 7 A and 13 A fuses and assuming all other ratings are suitable, identify the smallest option above the normal 5 A current.

5. Explain why a real replacement fuse must follow the manufacturer’s specified type and rating, including startup behaviour and cable protection. A calculation alone is not permission to fit a different fuse.

6. Explain heating in a resistor through electrical energy transfer to the material. Compare useful heating in a kettle with unwanted heating in a lead.

Cleanup

- Return calculators and retain corrected calculations.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Invented practice values: 1 150 W, 230 V and 120 s. Normal current is 5 A; energy is 138 000 J = 0.0383 kWh approximately. The hypothetical fuse options are for reasoning only, not a recommendation for a real appliance.

Quantity	Equation / conversion	Answer with unit
Current		
Energy / J		
Energy / kWh		
Hypothetical fuse reasoning		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Find the normal practice current.

2. Find energy in 120 s.

3. Express this energy in kWh.

4. Choose among the stated hypothetical fuse options.

5. Why not fit a fuse from this calculation alone?

6. Is power the same as energy?