Specific heat capacity: energy calculations

Student activity • observation and reasoning

YEAR 11 / LESSON 70 / PHYSICS ONLY

The question

Why can equal energy inputs produce different temperature rises?

Compare labelled ideal examples using mass, specific heat capacity and temperature change.

Equipment

- Booklet, calculator and original energy cards

Calculation and model work only. No heaters, hot blocks or boiling water are used.

Course coverage: Physics only: 5.2P, 5.12P, 5.13P. ΔQ = mcΔT and specific heat capacity.

Plan, model or apparatus sketch

Draw the relevant wavefront, particle or energy-transfer model and label its assumptions.

Method and reasoning

Read the whole sequence before starting

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1. Define specific heat capacity as energy needed per kilogram per degree of temperature rise, within a specified state and range. Write its unit J kg^{-1} $°C^{-1}$.

2. Use $\Delta Q = mc\Delta T$ to calculate energy for 0.50 kg of a practice metal with c = 900 J kg^{-1} $°C^{-1}$ warming by 20 °C. State the assumption that no phase change occurs.

3. Apply the same 9000 J to 0.50 kg of practice water with c = 4200 J kg^{-1} $°C^{-1}$. Calculate the ideal temperature rise and compare it with the metal example.

4. Rearrange the equation to find c when 2400 J raises 0.20 kg of a practice material by 15 °C. Convert any mass in grams to kilograms before substitution.

5. Distinguish temperature change from final temperature. Explain why a 20 °C rise is also a 20 K rise, although absolute Celsius and kelvin readings differ.

6. Explain why electrical energy supplied to a real heater may also warm the container and escape to the room. State why inserting all electrical input as sample energy can bias a measured c.

Cleanup

- Return cards and calculators and retain worked solutions.

Record your evidence

Blank spaces are for your own work

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Reference and task data

All values are practice examples. Answers: metal energy 9000 J; ideal water rise about 4.29 °C; unknown c = 800 J kg^{-1} $°C^{-1}$. The equation describes temperature change within a state; phase changes need separate energy accounting.

Example	Substitution with units	Result
Metal energy		
Water temperature rise		
Unknown c		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Define specific heat capacity.

2. Find the metal energy.

3. Find the water temperature rise.

4. Find c for the unknown sample.

5. Why use ΔT rather than final temperature?

6. How can heat loss affect a simple electrical estimate of c?