SCIENCE FOUNDATIONS

Heat and calorimetry

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you work out how much heat a pot of water needs to boil, or how a food label's calories are measured by burning a sample in a lab. A camper planning a trip knows how much fuel it takes to heat water for a meal at altitude. An engineer sizing a heater for a room works out how much heat the cold air needs before the room feels warm. Knowing heat and calorimetry tells you how much energy it takes to warm something up, and where that energy ends up.



Rule

$Q = m \times c \times \Delta T$

Q is the heat in joules (J), m is the mass in grams (g), c is the specific heat, and ΔT is the temperature change in degrees Celsius (°C). For water, c = 4.19 $\frac{J}{g \cdot °C}$.

Doubling the mass or doubling the temperature change doubles the heat.

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Worked examples

EXAMPLE 1

Q How much heat warms 100 g of water by 10 °C?

SOLUTION

$m = 100\ g$, $c = 4.19\ \frac{J}{g \cdot °C}$, $\Delta T = 10\ °C$. Find Q.

$Q = m \times c \times \Delta T$

$Q = 100 \times 4.19 \times 10$

$Q = 4190\ J$

The result is 4190 J.

EXAMPLE 2

Q How much heat warms 50 g of water by 20 °C?

SOLUTION

$m = 50\ g$, $c = 4.19\ \frac{J}{g \cdot °C}$, $\Delta T = 20\ °C$. Find Q.

$Q = m \times c \times \Delta T$

$Q = 50 \times 4.19 \times 20$

$Q = 4190\ J$

The result is 4190 J.

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Practice questions

1 Heat equation?

A. Q = m divided by c times temperature change

B. Q = mass plus specific heat plus temperature change

C. Q = temperature change divided by mass

D. Q = m times c times temperature change

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2 Heat to warm 150 g water by 10 degrees C?

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4190 J warms some water by 10 degrees C. What mass of water is warmed?

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Specific heat of water?

A 1.0 J/g degrees C

B 0.42 J/g degrees C

C 4.19 J/g degrees C

D 4.19 J/g

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Units of heat?

A Watts

B Joules

C Newtons

D Degrees Celsius

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What temperature change does 8380 J cause in 100 g of water?

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If mass doubles, heat does what?

A Halves

B Stays the same

C Doubles

D Quadruples

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8

If both the mass and the temperature change double, what happens to the heat?

A Quadruples

B Doubles

C Stays the same

D Halves

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9 What is a calorimeter?

- A A device that heats water
- B A device that measures heat change
- C A device that measures mass
- D A device that cools a reaction

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10 Heat lost equals what?

- A Heat gained
- B Heat lost
- C Temperature gained
- D Mass lost

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ANSWER KEY

1. Q = m times c times temperature change

2. 6285 J

3. 100 g

4. 4.19 J/g degrees C

5. Joules

6. 20 degrees C

7. Doubles

8. Quadruples

9. A device that measures heat change

10. Heat gained

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