LESSON MAKER PRO

Where Heat Goes

Calculate heat transfer and temperature change.

HIGH SCHOOL · PHY.3.7

PHY.3.7 "Enrichment: Use mathematical and computational analysis to analyze problems involving specific heat and heat capacity."

NAME _____ **DATE** _____

HEAT AND TEMPERATURE

Use $Q = m\,c\,(T_{final} - T_{initial})$, where m is mass and c is specific heat. Heat capacity is $C = mc$, so you can also use $Q = C\,(T_{final} - T_{initial})$. A positive Q means heat enters the object, while a negative Q means heat leaves it.

WORKED EXAMPLE

A 35 g sample has a specific heat of 3 J/(g °C). It warms from 14°C to 18°C. How much heat enters the sample?

1. Find the temperature change: 18°C - 14°C = 4°C.
2. Substitute: Q = (35 g)(3 J/(g °C))(4°C).
3. Multiply: Q = 420 J.

Answer: 420 J enters the sample.

PRACTICE 6 problems

1 A 25 g object with a specific heat of 2 J/(g °C) warms from 10°C to 16°C. How much heat enters it?

ANSWER _____

2 An object has a heat capacity of 45 J/°C. How much heat must enter it to raise its temperature by 7°C?

ANSWER _____

3 A 60 g object with a specific heat of 1.5 J/(g °C) starts at 12°C and absorbs 450 J. What is its final temperature?

ANSWER _____

4 A 40 g sample absorbs 360 J as its temperature rises from 11°C to 20°C. What is its specific heat?

ANSWER _____

5 A 75 g object has a specific heat of 0.8 J/(g °C). What is its heat capacity?

ANSWER _____

6 A 90 g object with a specific heat of 2.5 J/(g °C) cools from 28°C to 24°C. Find its signed Q, then state whether heat enters or leaves it.

ANSWER _____

APPLY IT Show your work

1 A gaming laptop's heat sink has a heat capacity of 120 J/°C. It starts at 32°C and absorbs 960 J while a game loads. What is its final temperature?

WORK SPACE

ANSWER _____

2 An aluminum water bottle has a mass of 200 g and a specific heat of 0.9 J/(g °C). It starts at 31°C and loses 1800 J. What is the bottle's final temperature?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A student mixes 100 g of water at 70°C with 200 g of water at 25°C. Use 4 J/(g °C) for the specific heat of water, and assume no heat reaches the cup or surroundings. What is the final temperature? Write an equation that sets heat lost by the hot water equal to heat gained by the cool water.

WORK SPACE AND ANSWER

Where Heat Goes

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A 25 g object with a specific heat of 2 J/(g °C) warms from 10°C to 16°C. How much heat enters it?	**300 J**
2	An object has a heat capacity of 45 J/°C. How much heat must enter it to raise its temperature by 7°C?	**315 J**
3	A 60 g object with a specific heat of 1.5 J/(g °C) starts at 12°C and absorbs 450 J. What is its final temperature?	**17°C**
4	A 40 g sample absorbs 360 J as its temperature rises from 11°C to 20°C. What is its specific heat?	**1 J/(g °C)**
5	A 75 g object has a specific heat of 0.8 J/(g °C). What is its heat capacity?	**60 J/°C**
6	A 90 g object with a specific heat of 2.5 J/(g °C) cools from 28°C to 24°C. Find its signed Q, then state whether heat enters or leaves it.	**Q = -900 J; heat leaves the object.**

PART 2 · APPLY IT

1. **40°C** The temperature rises by 960 J / (120 J/°C) = 8°C. Add 8°C to 32°C.
2. **21°C** Its heat capacity is (200 g)(0.9 J/(g °C)) = 180 J/°C. Losing 1800 J lowers its temperature by 10°C.

CHALLENGE

Let x be the final temperature. (100)(4)(70 - x) = (200)(4)(x - 25), so x = 40°C.

Accept equivalent heat-balance equations for the challenge. In problem 6, the negative sign shows that heat leaves the object.