LESSON MAKER PRO

Heat in Motion

Calculate heat flow during temperature and phase changes.

HIGH SCHOOL · CHE.10.4

CHE.10.4 "Enrichment: Use mathematical and computational thinking to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change"

NAME _____ DATE _____

TWO HEAT RULES

For warming or cooling, use Q = mcΔT, where m is mass, c is specific heat, and ΔT is the size of the temperature change. For a phase change at constant temperature, use Q = mL, where L is latent heat. State whether the heat is absorbed or released.

WORKED EXAMPLE

A 15 g sample warms from 18°C to 24°C. Its specific heat is 0.50 J/(g°C). How much heat does it absorb?

1. Find the temperature change: ΔT = 24°C - 18°C = 6°C.
2. Substitute: Q = (15 g)(0.50 J/(g°C))(6°C).
3. Multiply: Q = 45 J.

Answer: The sample absorbs 45 J.

PRACTICE 6 problems

1 A 25 g sample of water warms from 22°C to 26°C. Use a specific heat of 4.0 J/(g°C). How much heat does it absorb?

ANSWER _____

2 A 50 g piece of aluminum warms from 28°C to 38°C. Use a specific heat of 0.9 J/(g°C). How much heat does it absorb?

ANSWER _____

3 A 40 g material absorbs 320 J of heat. Its specific heat is 2.0 J/(g°C). How many degrees does its temperature rise?

ANSWER _____

4 An 80 g sample cools from 37°C to 29°C and releases 640 J. What is its specific heat?

ANSWER _____

5 A 9 g piece of ice melts at 0°C. Use a latent heat of fusion of 334 J/g. How much heat does it absorb?

ANSWER _____

6 A 7 g sample of water vapor condenses at 100°C. Use a latent heat of vaporization of 2260 J/g. How much heat does it release?

ANSWER _____

APPLY IT Show your work

1 At a concert, a 5 g ice cube at 0°C melts completely in a drink. Use a latent heat of fusion of 334 J/g. How much heat does the ice absorb while melting?

WORK SPACE

ANSWER _____

2 A laptop's 60 g aluminum heat sink cools from 70°C to 40°C after the laptop shuts down. Use a specific heat of 0.9 J/(g°C). How much heat does the heat sink release?

WORK SPACE

ANSWER _____

CHALLENGE One step up

An 8 g piece of ice at 0°C melts completely. The resulting water then warms to 5°C. Use a latent heat of fusion of 334 J/g and a specific heat of water of 4.0 J/(g°C). How much heat is absorbed in total? Show the heat needed for each stage.

WORK SPACE AND ANSWER

ANSWER KEY

Heat in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A 25 g sample of water warms from 22°C to 26°C. Use a specific heat of 4.0 J/(g°C). How much heat does it absorb?	**400 J absorbed**
2	A 50 g piece of aluminum warms from 28°C to 38°C. Use a specific heat of 0.9 J/(g°C). How much heat does it absorb?	**450 J absorbed**
3	A 40 g material absorbs 320 J of heat. Its specific heat is 2.0 J/(g°C). How many degrees does its temperature rise?	**4°C**
4	An 80 g sample cools from 37°C to 29°C and releases 640 J. What is its specific heat?	**1.0 J/(g°C)**
5	A 9 g piece of ice melts at 0°C. Use a latent heat of fusion of 334 J/g. How much heat does it absorb?	**3006 J absorbed**
6	A 7 g sample of water vapor condenses at 100°C. Use a latent heat of vaporization of 2260 J/g. How much heat does it release?	**15,820 J released**

PART 2 · APPLY IT

1. **1670 J absorbed** The ice changes phase without changing temperature, so $Q = mL = (5\ g)(334\ J/g) = 1670\ J$.
2. **1620 J released** The temperature drops by 30°C, so the amount of heat released is $Q = mc\Delta T = (60\ g)(0.9\ J/(g°C))(30°C) = 1620\ J$.

CHALLENGE

Melting: (8 g)(334 J/g) = 2672 J. Warming: (8 g)(4.0 J/(g°C))(5°C) = 160 J. Total: 2832 J absorbed.

Accept answers without commas in four-digit numbers. For cooling and condensation, accept a negative signed heat value if the student clearly uses it to represent heat leaving the material.