

Heat Problems II

Key

Standards:

- 3.1.10 B Describe the concepts of models as a way to predict and understand science and technology.
- 3.4.10 B Analyze energy sources and transfers of heat.

Specific Heat Capacities of some Common Substances

Substance	Cp (J/g°C)	Substance	Cp (J/g°C)
Water (l)	4.184	Iron (s)	0.45
Water (s)	2.03	Mercury (l)	0.14
Water (g)	2.0	Carbon (s)	0.71
Aluminum (s)	0.89	Silver (s)	0.24
Chloroform	0.230	Gold (s)	0.13

Problems:

- A 250. g bar of aluminum absorbed 465 J of heat energy. If the bar was originally at 22.0 °C, what is its final temperature?

$$\Delta T = \frac{Q}{m C_p} = \frac{465 \text{ J}}{250 \text{ g} \cdot 0.89 \text{ J/g}^\circ\text{C}} = 2.1^\circ\text{C}$$

22.0 + 2.1°C = 24.1°C

- A 650. g piece of iron pipe absorbs 832 J of heat energy. By how much does the temperature of the pipe increase?

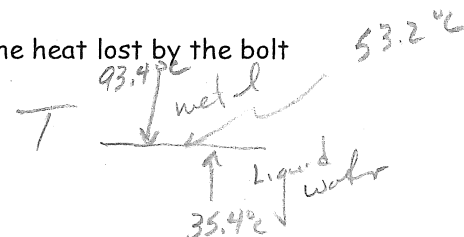
$$\Delta T = \frac{Q}{m C_p} = \frac{832 \text{ J}}{650 \text{ g} \cdot 0.45 \text{ J/g}^\circ\text{C}} = 2.8^\circ\text{C}$$

STOP working problems and wait for a short demonstration!

- Where did the heat from the hot metal go? water
- What device is used to measure heat changes? thermometer
- If the demo were more properly conducted, where would all the heat lost by the hot bolt go? into the water
- In fact, it would be accurate to say that in the above scenario, all the heat lost by the bolt was gained by the water.

Or $Q(\text{metal}) = Q(\text{water})$

Or $m C_p \Delta T(\text{metal}) = m C_p \Delta T(\text{water})$



- A piece of an unknown metal with a mass of 50.86 kg is heated to 93.4 °C and dropped into 3,572 cm³ of water at 35.4 °C. The final temperature of the system was 53.2°C. What is the specific heat of the metal in J/g°C?

$$C_p = \frac{Q_{\text{metal}}}{m \Delta T} = \frac{266,000 \text{ J}}{50.86 \text{ kg} \cdot 40.2^\circ\text{C}} = 0.130 \text{ J/g}^\circ\text{C} \quad \boxed{\text{Au}}$$

- Identify the metal.

$$Q_{\text{water}} = m C_p \Delta T$$

$$\frac{3572 \text{ g} \cdot 4.184 \text{ J/g}^\circ\text{C} \cdot 17.8^\circ\text{C}}{1 \text{ g}^\circ\text{C}} = 266,000 \text{ J}$$

$$\frac{266,000 \text{ J}}{50.86 \text{ kg} \cdot 40.2^\circ\text{C}} = 0.130 \text{ J/g}^\circ\text{C}$$