Using the Calorimetry Equation

\[ q = \Delta T \times m \times C \]

Identify each variable and determine which is the unknown variable.

- The quantity of heat in joules that is consumed or produced \( q \)
- The change in temperature in °C \( \Delta T \)
- The mass of the object being heated or cooled in grams \( m \)
- The specific heat of the material in units of \( \frac{J}{°C \cdot g} (C) \)

**Example 1:**
How much heat is consumed when \( 5.52 \) g of water is heated from \( 20.0 \) °C to \( 64.5 \) °C?

\( q \) is unknown variable
\( m = 5.52 \) g
\( c_{\text{water}} = 4.184 \frac{J}{°C \cdot g} \)
\( \Delta T = 44.5 \) °C

\[ q = \Delta T \times m \times C \]

\[ q = 44.5 °C \times 5.52 \text{ g} \times 4.184 \frac{J}{°C \cdot g} = 1.03 \times 10^3 \text{ J} = 1.03 \text{ kJ} \]

**Example 2:**

The temperature of a \( 57 \) g lead fishing sinker drops from \( 100 \) °C to \( 24 \) °C when placed in water. The water is found to have gained \( 480 \) J of heat energy. What is the specific heat of lead?

\( q = 480 \) J
\( c \) is unknown variable

If \( q \) is not the unknown variable, solve for the unknown variable first.

\[ C = \frac{q}{\Delta T \times m} = \frac{480 \text{ J}}{76 °C \times 57 \text{ g}} = 0.11 \frac{J}{°C \cdot g} \]

**Problems**

1. How much heat is required to raise the temperature of 1 mole (18 g) of water from 0 °C to 100 °C?

2. An 18.7 g bar of platinum metal increases in temperature by 2.3 °C when 5.7 J of heat are added. What is the specific heat of platinum?

3. 1,450 J of heat is added to a volume of water and the temperature is found to increase by 12.5 °C. What is the mass of the water?

4. 504 J of heat energy is added to a 15 g ice cube \( (c = 2.1 \frac{J}{°C \cdot g}) \) initially at \(-22 °C\). What will be the new temperature of the ice?
5. The specific heat of aluminum is 0.90 \( \frac{J}{^\circ C \times g} \). How much heat is needed to change the temperature of 10 g of aluminum from 20 °C to 50 °C?

6. A 30 g lump of an unknown metal at 100 °C is placed in cold water at 20 °C. From the small increase in temperature of the water, it is found that 1.1 kJ of heat was transferred from the hot metal to the cold water. From the following specific heats in \( \frac{J}{^\circ C \times g} \), which of the following might be the metal?
   a. Aluminum, 0.90
   b. Iron, 0.46
   c. Zinc, 0.39
   d. Silver, 0.24

7. Calculate the heat required to raise the temperature of 100g of aluminum 100ºC.

8. If you applied the same amount of heat to 50g of aluminum what would the change in temperature be?