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Pre-Lab 1

Preliminary Questions.

1. The specific heat of copper is 0.385 J/g°C. Calculate the final temperature when 25.0 g of copper metal at 100°C is added to 50 mL of water at 20°C.

$$q_{\text{copper}} = m_{\text{copper}} c_{\text{copper}} \Delta T = m_{\text{copper}} c_{\text{copper}} (T_{\text{initial-copper}} - T_{\text{final}})$$
$$q_{\text{water}} = m_{\text{water}} c_{\text{water}} \Delta T = m_{\text{water}} c_{\text{water}} (T_{\text{final}} - T_{\text{initial-water}})$$
$$q_{\text{copper}} = q_{\text{water}} \Rightarrow \frac{m_{\text{copper}} c_{\text{copper}}}{m_{\text{water}} c_{\text{water}}} = \frac{T_{\text{final}} - T_{\text{initial-water}}}{T_{\text{initial-copper}} - T_{\text{final}}} \Rightarrow \text{Let } k = \frac{m_{\text{copper}} c_{\text{copper}}}{m_{\text{water}} c_{\text{water}}}$$
$$kT_{\text{initial-copper}} - kT_{\text{final}} = T_{\text{final}} - T_{\text{initial-water}} \Rightarrow T_{\text{final}} = \frac{kT_{\text{initial-copper}} + T_{\text{initial-water}}}{k+1}$$
$$k = \frac{(25.0g)(0.385J/g^\circ C)}{(50.0g)(4.184J/g^\circ C)} = 0.0460 \Rightarrow T_{\text{final}} = \frac{(0.0460)(100.0^\circ C) + (20.0^\circ C)}{(0.0460)+1} = 23.52^\circ C$$

2. If 75.0 grams of water is headed from 32.6°C to 78.9°C, how many kilojoules of heat does the water absorb?

$$q_{\text{water}} = mc\Delta T = (75.0g)(4.184J/g^\circ C)(78.9^\circ C - 32.6^\circ C) = 14500J = 14.5kJ$$

3. A 25.0 sample of zinc metal at 85.0°C is added to 75.0 g of water initially at 18°C. The final temperature is 20.0°C.
    1. How much is gained by the water?

$$q_{\text{water}} = mc\Delta T = (75.0g)(4.184J/g^\circ C)(20.0^\circ C - 18.0^\circ C) = 628J$$

    2. How much heat is lost by the zinc metal?

$$q_{\text{zinc}} = q_{\text{water}} = 628J$$

    3. From the data in this problem, calculate the specific heat of the zinc metal.

$$c_{\text{zinc}} = \frac{q_{\text{zinc}}}{m_{\text{zinc}} \Delta T} = \frac{(628J)}{(25.0g)(85.0^\circ C - 20.0^\circ C)} = 0.386J/g^\circ C$$