EXP 4

**POSTLABORATORY ASSIGNMENT** NAME KEY

1. Calculate the number of kilocalories necessary to raise 250 g of water from 19.6 to 68.8°C.

$$\Delta T = 68.8 - 19.6 = 49.2 \times 250 \times 1 = 12300 \text{ cal} \times \frac{1 \text{ kcal}}{1000 \text{ cal}} = 12.3 \text{ kcal}$$

2. Calculate the mass of a piece of copper that released 125 calories when cooled from 100.0°C to 25.3°C. The specific heat of copper is 0.00924 cal/g × °C.

$$125 = (100.0 - 25.3)\left(0.00924 \frac{\text{cal}}{\text{g} \cdot ^\circ\text{C}}\right) g$$

$$g = \frac{125}{74.7 \times 0.00924}$$

$$g_{Cu} = 181$$

3. Find the specific heat of an unknown metal if a 35.5 g sample at 99.6°C produced a resulting temperature of 26.1°C when placed in a calorimeter containing 100.5 g of water at 20.2°C.

$$\Delta T_m = 99.6 - 26.1 = 73.5\ ^\circ\text{C}$$

$$\Delta T_w = 26.1 - 20.2 = 5.9$$

$$q_w = 5.9^\circ \left(\frac{1 \text{ cal}}{^\circ\text{g}}\right)(100.5 \text{ g}) = 590 \text{ cal}$$

$$\text{sp. heat} = \frac{590 \text{ cal}}{73.5^\circ \times 35.5 \text{ g}} = 0.23 \frac{\text{cal}}{^\circ\text{C} \cdot \text{g}}$$

4. A 65.0 g sample of zinc (specific heat = 0.0922 cal/g × °C) was cooled from 100.0°C to 29.4°C in a calorimeter cup containing water initially at 21.5°C. Find the mass of water in the cup.

$\Delta T_{Zn} = 100 - 29.4 = 70.6\,^\circ C$

$\Delta T_W = 29.4\,^\circ C - 21.5\,^\circ C = 7.9\,^\circ C$

$Q_{ZINC} = Q_{WATER} = 0.0922 \frac{cal}{g\,^\circ C}(65.0\,g)(70.6\,^\circ C) = 423.1\ cal$

$\frac{1.0\ cal}{g\,^\circ C} = \frac{423.1\ cal}{7.9\,^\circ C \cdot g}$

$g = \frac{423.1\ cal}{7.9\,^\circ C} = 53.56\ g$

$= 54\ g$

5. (optional) Ignoring any heat loss to the surrounding environment, calculate the theoretical maximum temperature produced in a calorimeter containing 95.5 g of water at 20.8°C after a 25.0 g sample of aluminum (specific heat = 0.215 cal/g × °C) at 98.6°C has been introduced.

$\Delta T_W = T_{max} - 20.8\,^\circ C$

$\Delta T_{Al} = 98.6\,^\circ C - T_{max}$

$Q_{water} = Q_{Al} = \frac{0.215\ cal}{g\,^\circ C}(25.0\,g)(98.6 - T_{max}) = \frac{1.0\ cal}{^\circ C \cdot g}(95.5\,g)(T_{max} - 20.8)$

$0.215(25.0)(98.6) - .215(25.0)T_{max} = 95.5\,T_{max} - 95.5(20.8)$

$0.215(25)(98.6) + 95.5(20.8) = 95.5\,T_{max} + .215(25.0)T_{max}$

$0.215(25)(98.6) + 95.5(20.8) = T_{max}[95.5 + .215(25.0)]$

$\frac{0.215(25)(98.6) + 95.5(20.8)}{95.5 + 215(25.0)} = T_{max}$

$\frac{530. + 1990}{100.9} = \frac{2520}{100.9} = 25.0\,^\circ C = T_{max}$