

Use complete sentences to answer questions that require an explanation.

1. Determine the final temperature of 6.50 L of water at 15.0 °C if it absorbs 800 kJ of heat. [2]

$$Q = 800 \text{ kJ} = 800,000 \text{ J}$$

$$m = 6.50 \text{ kg} = 6,500 \text{ g}$$

$$T_i = 15.0^\circ \text{C}$$

$$T_f = ?$$

$$c = 4.19 \frac{\text{J}}{\text{g}^\circ \text{C}}$$

$$Q = mc\Delta t$$

$$\Delta t = \frac{Q}{mc}$$

$$\Delta t = \frac{800,000 \text{ J}}{(6,500 \text{ g} \cdot 4.19 \frac{\text{J}}{\text{g}^\circ \text{C}})} = 29.4^\circ$$

$$\Delta t = t_f - t_i$$

$$t_f = \Delta t + t_i$$

$$t_f = 44.4^\circ \text{C}$$

2. An 80.4 g piece of metal alloy is heated from 20.0 °C to 42.0 °C while it absorbs 834 J of heat. Determine the specific heat capacity of the alloy. [2]

$$Q = 834 \text{ J}$$

$$m = 80.4 \text{ g}$$

$$T_i = 20.0^\circ \text{C}$$

$$T_f = 42.0^\circ \text{C}$$

$$c = ?$$

$$Q = mc\Delta t$$

$$c = \frac{Q}{m\Delta t}$$

$$c = \frac{834 \text{ J}}{(80.4 \text{ g} (42.0^\circ \text{C} - 20.0^\circ \text{C}))}$$

$$c = 0.472 \frac{\text{J}}{\text{g}^\circ \text{C}}$$

3. Explain what is meant by the term *enthalpy*. Explain how enthalpy changes are measured and why they cannot be measured directly. [3]

• Enthalpy is the total energy of a chemical system which includes both kinetic and potential energies.

• Enthalpy changes are measured using a calorimeter where the energy of a chemical system is either absorbed from or released into water of known mass and temperature.

• Enthalpy can't be measured directly because it occurs in a non-isolated system.

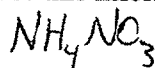
4. When 8.60 g of ammonium nitrate is dissolved in 150 mL of water which had an initial temperature of 22.3 °C, the water cools down to 17.7 °C. Use this information to determine the experimental molar enthalpy of solution of ammonium nitrate. [3]

$$\Delta_R H = Q$$

$$\Delta_R H = mc\Delta t$$

$$= 150 \text{ g} \cdot 4.19 \frac{\text{J}}{\text{g}^\circ \text{C}} \cdot (17.7^\circ \text{C} - 22.3^\circ \text{C})$$

$$\Delta_R H = +2891.1 \text{ J}$$



$$M: \text{N}: 2 \cdot 14.01 \text{ g/mol}$$

$$+ \text{H}: 4 \cdot 1.01 \text{ g/mol}$$

$$+ \text{O}: 3 \cdot 16.00 \text{ g/mol}$$

$$80.06 \text{ g/mol}$$

$$n = \frac{m}{M} = \frac{8.60 \text{ g}}{80.06 \text{ g/mol}}$$

$$n = 0.107 \text{ mol}$$

$$\Delta_R H_m = n \cdot \Delta_R H$$

$$\Delta_R H_m = \frac{\Delta_R H}{n}$$

$$\Delta_R H_m = \frac{+2891.1 \text{ J}}{0.107 \text{ mol}}$$

$$\Delta_R H_m = +26.9 \frac{\text{kJ}}{\text{mol}}$$