Enthalpy Changes and Calorimetry, Extra Exercises

1. Calculate the enthalpy change for the melting of a 30 g ice cube.

2. A reference gives a value of +39.23 kJ/mol for the molar enthalpy of vaporization for methanol. What enthalpy change occurs in the evaporation of 10.0 g of methanol?

3. An experiment produces evidence that the evaporation of 4.00 g of liquid butane, $C_4H_{10(l)}$, requires a gain in enthalpy of 1.67 kJ. Find the molar enthalpy of vaporization for butane from this evidence.

4. A calorimeter has a heat capacity of 40.00 kJ/°C. Complete combustion of 1.00 g of hydrogen in this calorimeter causes a temperature increase of 3.54°C. Calculate the molar enthalpy of combustion for hydrogen from this evidence.

5. Combustion of 3.50 g of ethanol, $C_2H_5OH_{(l)}$, in a calorimeter with a heat capacity of 15.2 kJ/°C causes a temperature increase from 19.88°C to 26.18°C. Find the molar enthalpy of combustion for ethanol from this evidence.

Enthalpy Changes and Calorimetry, Extra Exercises, Solution

1. Calculate the enthalpy change for the melting of a 30 g ice cube.

$$\Delta H = n\Delta H_{fus}$$

$$= 30\text{ g} \times \frac{1\text{ mol}}{18.02\text{ g}} \times \frac{6.03\text{ kJ}}{\text{mol}}$$

$$= 10\text{ kJ}$$

2. A reference gives a value of +39.23 kJ/mol for the molar enthalpy of vaporization for methanol. What enthalpy change occurs in the evaporation of 10.0 g of methanol?

$$\Delta H = n\Delta H_{vap}$$

$$= 10\text{ g} \times \frac{1\text{ mol}}{32.05\text{ g}} \times \frac{39.23\text{ kJ}}{\text{mol}}$$

$$= 12.2\text{ kJ}$$

3. An experiment produces evidence that the evaporation of 4.00 g of liquid butane, $C_4H_{10(l)}$, requires a gain in enthalpy of 1.67 kJ. Find the molar enthalpy of vaporization for butane from this evidence.

$$\Delta H = n\Delta H_{vap}$$

$$1.67\text{ kJ} = 4.00\text{ g} \times \frac{1\text{ mol}}{58.14\text{ g}} \times H_{vap}$$

$$\Delta H_{vap} = 24.3\text{ kJ/mol}$$

4. A calorimeter has a heat capacity of 40.00 kJ/°C. Complete combustion of 1.00 g of hydrogen in this calorimeter causes a temperature increase of 3.54°C. Calculate the molar enthalpy of combustion for hydrogen from this evidence.

$$\Delta H_{H_2} = q_{(calorimeter)}$$

$$n\Delta H_c = C\Delta t$$

$$1.00\text{ g} \times \frac{1\text{ mol}}{2.02\text{ g}} \times \Delta H_c = 40.00\frac{\text{kJ}}{\text{°C}} \times 3.54\text{°C}$$

$$\Delta H_c = 286\text{ kJ/mol}$$

5. Combustion of 3.50 g of ethanol, $C_2H_5OH_{(l)}$, in a calorimeter with a heat capacity of 15.2 kJ/°C causes a temperature increase from 19.88°C to 26.18°C. Find the molar enthalpy of combustion for ethanol from this evidence.

$$\Delta H_{C_2H_5OH} = q_{(calorimeter)}$$

$$n\Delta H_c = C\Delta t$$

$$3.50\text{ g} \times \frac{1\text{ mol}}{46.08\text{ g}} \times \Delta H_c = 15.2\frac{\text{kJ}}{\text{°C}} \times (26.18 - 19.88)\text{°C}$$

$$\Delta H_c = 1.26\text{ MJ/mol}$$