Name ____________________ Date ______________ Class ______________

17 THERMOCHEMISTRY

Practice Problems

In your notebook, solve the following problems.

SECTION 17.1 THE FLOW OF ENERGY—HEAT AND WORK

Use the three-step problem-solving approach you learned in Chapter 1.

1. How many kilojoules of energy are in a donut that contains 200.0 Calories?
2. What is the specific heat of a substance that has a mass of 25.0 g and requires 525.0 calories to raise its temperature by 15.0°C?
3. Suppose 100.0 g of $H_2O(s)$ absorbs 1255.0 J of heat. What is the corresponding temperature change? The specific heat capacity of $H_2O(s)$ is 2.1 J/g•°C.
4. How many joules of heat energy are required to raise the temperature of 100.0 g of aluminum by 120.0°C? The specific heat capacity of aluminum is 0.90 J/g•°C.

SECTION 17.2 MEASURING AND EXPRESSING ENTHALPY CHANGES

1. A student mixed 75.0 mL of water containing 0.75 mol HCl at 25°C with 75.0 mL of water containing 0.75 mol of NaOH at 25°C in a foam cup calorimeter. The temperature of the resulting solution increased to 35°C. How much heat in kilojoules was released by this reaction?

$$C_{\text{water}} = 4.18 \text{ J/g•°C}$$

2. Calculate the amount of heat evolved when 15.0 g of $Ca(OH)_2$ forms from the reaction of $CaO(s) + H_2O(l)$.

$$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(s) \qquad \Delta H = -65.2 \text{ kJ}$$

3. Calculate the amount of heat produced when 52.4 g of methane, CH_4, burns in an excess of air, according to the following equation.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) \qquad \Delta H = -890.2 \text{ kJ}$$

4. Balance the following equation, then calculate the enthalpy change for the reaction given that the standard heat of combustion of $NH_3(g)$ is −226 kJ/mol.

$$NH_3(g) + O_2(g) \rightarrow NO(g) + H_2O(g)$$

SECTION 17.3 HEAT IN CHANGES OF STATE

1. Calculate the amount of heat needed to melt 35.0 g of ice at 0°C. Express your answer in kilojoules.
2. Calculate the amount of heat needed to convert 190.0 g of liquid water at 18°C to steam at 100.0°C.
3. How much heat (kJ) is released when 2.543 mol NaOH(*s*) is dissolved in water?

$$NaOH(s) \xrightarrow{H_2O(l)} Na^+(aq) + OH^-(aq) \qquad \Delta H_{\text{soln}} = -445.1 \text{ kJ/mol}$$

4. Calculate the amount of heat needed to convert 96 g of ice at −24°C to water at 28°C. The specific heat capacity of $H_2O(s)$ is 2.1 J/g•°C.

SECTION 17.4 CALCULATING HEATS OF REACTION

1. What is the standard heat of reaction for the combustion of hydrogen sulfide? Refer to Table 17.4 in your textbook.

$$2H_2S(g) + 3O_2(g) \rightarrow 2H_2O(g) + 2SO_2(g)$$

2. Calculate the enthalpy change (in kJ) for the following reaction. State whether the reaction is exothermic or endothermic. Refer to Table 17.4 in your textbook.

$$CaO(s) + CO_2(g) \rightarrow CaCO_3(s)$$

3. What is the enthalpy change for the formation of hydrazine, $N_2H_4(l)$, from its elements?

$$N_2(g) + 2H_2(g) \rightarrow N_2H_4(l)$$

Use the following reactions and enthalpy changes:

$$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(l) \quad \Delta H = -622.2 \text{ kJ}$$
$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(l) \quad \Delta H = -285.8 \text{ kJ}$$