Unit 11 – Chapter 6: Thermochemistry **Name** _____

Assignment #1: Heat Production, Specific Heat, q = mCΔT **Period** _____

1) Consider the following reaction:

$2\ H_{2(g)} + O_{2(g)} \rightarrow 2\ H_2O_{(l)}$ $\Delta H = -572$ kJ

a. How much heat is evolved for the production of 1.00 mol of $H_2O_{(l)}$?

b. How much heat is evolved when 4.03 g of hydrogen is reacted with excess oxygen?

c. How much heat is evolved when 186 g of oxygen is reacted with excess hydrogen?

d. The total volume of hydrogen gas needed to fill the *Hindenburg* was 2.0×10^8 L at 1.0 atm and 25^0C. How much heat was evolved when the *Hindenburg* exploded, assuming all the hydrogen reacted?

2) Consider the following reaction:

$CH_{3(g)} + 2\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ H_2O_{(l)}$ $\Delta H = -891$ kJ

Calculate the enthalpy change for each of the following cases:

a. 1.00 g methane is burned in excess oxygen.

b. 1.00×10^3 L methane gas at 740.0 torr and 25^0C is burned in excess oxygen.

3) The specific heat capacity of silver is 0.24 J/^{0}C · g,

a. Calculate the energy required to raise the temperature of 150.0 g Ag from 273 K to 296 K.

b. Calculate the energy required to raise the temperature of 1.0 mol Ag by 1.0^0C (called the *molar heat capacity* of silver).

c. It takes 1.25 kJ of energy to heat a sample of pure silver from 12.0^0C to 15.2^0C. Calculate the mass of the sample of silver.

4) It takes 585 J of energy to raise the temperature of 125.6 g mercury from 20.0^{0}C to 53.5^{0}C. Calculate the specific heat capacity and the molar heat capacity of mercury.

5) A biology experiment requires the preparation of a water bath at 37.0^{0}C (body temperature). The temperature of the cold tap water is 22.0^{0}C, and the temperature of the hot tap water s 55.0^{0}C. If a student starts with 90.0 g of cold water, what mass of hot water must be added to reach 37.0^{0}C?

6) Hydrogen gives off 120.0 J/g of energy when burned in oxygen, and methane gives off 50.0 J/g under the same circumstances. If a mixture of 5.0 g of hydrogen and 10.0 g of methane is burned, and the heat released is transferred to 50.0 g of water at 25.0^{0}C, what final temperature will be reached by the water?

7) A 110-g sample of copper (specific heat capacity = 0.20 J/^{0}C · g) is heated to 82.4^{0}C and then placed in a container of water at 22.3^{0}C. The final temperature of the water and copper is 24.9^{0}C. What is the mass of the water in the container, assuming that all the heat lost by the copper is gained by the water?

8) In a coffee cup calorimeter, 1.60 g of NH_4NO_3 is mixed with 75.0 g of water at an initial temperature of 25.00^{0}C. After dissolution of the salt, the final temperature of the calorimeter contents is 23.34^{0}C. Assuming the solution has a heat capacity of 4.18 J/^{0}C · g, and assuming no heat loss to the calorimeter, calculate the enthalpy change for the dissolution of NH_4NO_3 in units of kJ/mol.

9) Consider the reaction:

$$2\ HCl_{(aq)} + Ba(OH)_{2(aq)} \rightarrow BaCl_{2(aq)} + 2\ H_2O_{(l)} \qquad \Delta H = -118\ kJ$$

Calculate the heat when 100.0 mL of 0.500 *M* HCl is mixed with 300.0 mL of 0.100 *M* $Ba(OH)_2$. Assuming that the temperature of both solutions was initially 25.0^{0}C and that the final mixture has a mass of 400.0 g and a specific heat capacity of 4.18 J/^{0}C · g, calculate the final temperature of the mixture.