WORKSHEET
“Calorimetry II”

1. Sulfur (2.56 g) was burned in a bomb calorimeter with excess O$_2$(g). The temperature increased from 21.25°C to 26.72°C. The bomb had a heat capacity of 923 J/K, and the calorimeter contained 815 g of water. Calculate the heat evolved per mole of SO$_2$ (in kJ/mol) formed in the course of the following reaction:

   \[ S(s) + O_2(g) \rightarrow SO_2(g) \]

2. You can find the amount of heat evolved in the combustion of carbon by carrying out the reaction in a combustion calorimeter. Suppose you burn 0.300 g of C(graphite) in an excess of O$_2$(g) to give CO$_2$(g):

   \[ C_{graphite} + O_2(g) \rightarrow CO_2(g) \]

   The temperature of the calorimeter, which contains 775 g of water, increases from 25.00°C to 27.38°C. The heat capacity of the bomb is 893 J/K. What quantity of heat is evolved per mole of C (in kJ/mol)?
3. You mix the strong base CsOH with the strong acid HCl.

\[ \text{CsOH}_{(aq)} + \text{HCl}_{(aq)} \rightarrow \text{CsCl}_{(aq)} + \text{H}_2\text{O}_{(l)} \]

Assume you mix 100. mL of 0.200 M CsOH with 50. mL of 0.400 M HCl. The temperature of the original solutions was 22.50°C, and it rises to 24.28°C after the acid-base reaction occurs. What is the enthalpy of the neutralization reaction per mole of CsOH (in kJ/mol)? (Assume the densities of the solutions are all 1.00 g/mL, and the specific heat capacities of the solutions are 4.20 J/g K.)

4. If the strong base CsOH is mixed with a weak acid, HF, the heat evolved by the reaction differs from the heat of reaction with the strong acid HCl.

\[ \text{CsOH}_{(aq)} + \text{HF}_{(aq)} \rightarrow \text{CsF}_{(aq)} + \text{H}_2\text{O}_{(l)} \]

Assume you mix exactly 125 mL of 0.250 M CsOH with 50.0 mL of 0.625 M HF. The temperature of the original solutions was 21.50°C, and it rises to 24.40°C after the acid-base reaction occurs. What is the enthalpy of the neutralization reaction per mole of CsOH (in kJ/mol)? (Assume the densities of the solutions are all 1.00 g/mL and the specific heat capacities of the solutions are 4.20 J/g K.)

Complete and balance the following reactions. In addition, give the type of reaction in the blank.

a. Magnesium is added to a solution of aluminum sulfate.

b. Solutions of zinc nitrate and sodium hydroxide are mixed.