Heat Capacity and Specific Heat Problems: II

1. A student used a BIC butane lighter to heat a test tube containing 40.0 mL of water, initially at 5.0˚C. The lighter was allowed to burn until the water reached 39.0˚C. Before the heating process the lighter had a mass of 42.70 g. Afterwards it had a mass of 42.49 g.

   a) Calculate the heat absorbed by the water. The specific heat capacity of water is 4.18 J/g ˚C.

   b) Assuming all the heat from the burning butane (C_4H_{10}) was captured by the water, calculate the heat of combustion of the butane in kJ/mol.

2. When 0.6484 g of cetyl palmitate $C_{32}H_{64}O_2$ (a fruit wax), was burned in a bomb calorimeter with a heat capacity of 11.99 kJ/˚C, the temperature of the calorimeter rose from 24.518˚C to 26.746˚C. Calculate the molar heat of combustion of cetyl palmitate in kJ/mol.

3. 1.20 g of hydrogen gas is completely burned in the presence of oxygen gas in a bomb calorimeter producing water. The heat capacity of the calorimeter is 9.43 kJ/˚C and the temperature of the calorimeter rose from 25.55 ˚C to 41.97˚C. Calculate the enthalpy change in J and in kJ/mol or water produced.

4. The combustion of 2.4 g of butane (C_4H_{10}) in a calorimeter causes a rise in temperature of 12˚C. The calorimeter contains 4000 g of water and the calorimeter has a mass of 450 g.
   c_{water} = 4.18 J/g¡C $C_{calorimeter}$ = 1.39 J/g¡C
   Determine:
   a) the heat absorbed by the calorimeter
   b) the heat absorbed by the water
   c) ΔH in J/mol of butane

5. 5.61 g of potassium hydroxide (KOH) were dissolved in 200.0 mL of water. The temperature of the water rose from 20.0 °C to 27.0°C after dissolving. Calculate the molar heat of dissolving for KOH. (Specific heat of water = 4.18 J/g ˚C)

6. Calculate the enthalpy change that occurs when 68.0 g of liquid gold at a temperature of 1063˚C are cooled to 23. The melting point of gold is 1063˚C. The heat of fusion and specific heat capacity of gold are 64.0 J/g and 0.130 J/g ˚C respectively.

7. A 2.64 g sample of sucrose ($C_{12}H_{22}O_{11}$) is burned in a bomb calorimeter. The heat capacity of the calorimeter is 9.43 kJ/˚C. The temperature changes from 21.00˚C to 25.62 ˚C. Calculate the heat of combustion of sucrose in kJ/mol.

8. 100 cm^3 of water was placed in a styrofoam cup and its temperature was found to be 18.0 ^{O}C. 0.1 mol of $NH_4Cl_{(s)}$ was added and the temperature fell to 14.0 ^{O}C. Calculate $\Delta H_{(solution)}$ for the dissolving of 1.0 mol of $NH_4Cl_{(s)}$. Draw a potential energy level diagram.