Chem 1104 - 2018 Summer Problem Set #5

1. The specific heat of silver is 0.235 J/g·°C. How many joules of heat are required to heat a 75 g silver spoon from 20°C to 35°C?

2. At body temperature it requires 2404 joules to evaporate 1 g of water. After vigorous exercise a person feels chilly because their body is giving up heat to evaporate the perspiration. A typical person perspires 25 g of water after 20 minutes of exercise. How much body heat is this person using to evaporate this water?

3. If 325 g of water at 4.2°C absorbs 12.28 kJ, then what is the final temperature of the water?

4. The combustion of butane produces heat according to the equation:

$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$ $\Delta H°_{rxn} = -5314$ kJ

How many grams of butane must be burned to release 6375 kJ of heat?

5. Glycine $C_2H_5O_2N$ is important for biological energy. The combustion of glycine is given by the equation,

$4C_2H_5O_2N(s) + 9O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l) + 2N_2(g)$ $\Delta H°_{rxn} = -3857$ kJ

Given that $\Delta H°_f[CO_2(g)] = -393.5$ kJ/mol, $\Delta H°_f[H_2O(l)] = -285.8$ kJ/mol.
$\Delta H°_f[O_2(g)] = \Delta H°_f[N_2(g)] = 0$ kJ/mole

Calculate the enthalpy of formation $\Delta H°_f$ per mole of glycine.

6. Using Hess's Law calculate the enthalpy change for the reaction:

$C(graph) + 2H_2(g) + 1/2O_2(g) \rightarrow CH_3OH(l)$ $\Delta H°_{rxn} = ?$

Given the following information:

$C(graph) + O_2(g) \rightarrow CO_2(g)$ $\Delta H° = -393.5$ kJ.

$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$ $\Delta H° = -285.8$ kJ.

$CH_3OH(l) + 3/2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ $\Delta H° = -726.4$ kJ

7. A 0.1326 g sample of magnesium was burned in an oxygen bomb calorimeter. The total heat capacity of the calorimeter plus water was 5760 J/°C. If the temperature rise of the calorimeter with water was 0.570°C, calculate the change in internal energy and the enthalpy of combustion of magnesium. Note: Assume the temperature is about 25°C.

$Mg(s) + 1/2O_2(g) \rightarrow MgO(s)$

8. a) The combustion of 1.00 mol of glucose liberates 2820 kJ of heat. When 1.25 g of glucose was combusted in a calorimeter containing 950 g of water a temperature rise of 3.15°C was observed. What is the heat capacity of the bomb calorimeter?

b) When 2.02 g of an unknown substance is combusted in the same calorimeter, under the same conditions, a temperature change of 6.86°C is observed. Calculate the heat of combustion of this unknown substance in kJ/g.

Answer Set for Chem 1104-2018 Summer Problem Set #5

1. 260 J

2. 60,100 J

3. 13.2°C

4. 139 g

5. -537.2 kJ/mol

6. -238.7 kJ

7. $q = \Delta E = -3.28$ kJ = -602 kJ/mole; $\Delta H = -4.52$ kJ = -828 kJ/mole

8.a) $C_{cal} = 6.22$ kJ/°C; b) 21.1 kJ/g