CH 05 blank

Section 5.1:

1. Identify the kind of energy change usually associated with each of the following:

(a) Toaster
(b) Radio
(c) Automobile engine
(d) Automobile battery
(e) Automobile generator
(f) Model airplane engine
(g) Friction
(h) Ski jump
(i) Fluorescent lamp
(j) Photoelectric cell
(k) furnace

2. distinguish between a change of state and a phase change. Give an example of each.

Section 5.2: & 5.3

3. **(6 points)** For the following processes determine whether the process is endothermic or exothermic:

   a. A piston is heated by adding 51 kJ of heat. It expands, doing 15 kJ of work on the atmosphere.

   b. A system releases 125 kJ of heat while 104kJ of work is done on it.

   c. A chemical reaction releases 5.75 kJ of heat and does no work on the surroundings.

	ΔE	Endo thermic	Exo thermic
A			
B			
C			

4. **(6 points)** For the following processes determine whether the process is endothermic or exothermic:

   d. A balloon is heated by adding 240J of heat. It expands, doing 135J of work on the atmosphere.

   e. A 50-g sample of iron metal is cooled from 100 °C to 90°C, thereby losing approximately 225 J of heat.

   f. A chemical reaction releases 5.75 kJ of heat and does no work on the surroundings.

Section 5.4:

5. Deterioration of buildings, bridges, and other structures through the rusting of iron costs millions of dollars ad day. The actual process requires water, but a simplified equation is $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}\ \Delta H = —1.65X10^3 kJ$

    a) How much heat is released when 0.250 kg of iron rusts?

    b) How much rust forms when 4.85 x 103 kJ of heat is released?

6. **(4 points)** Benzene is an organic liquid that easily combusts in the presence of oxygen. The value of ΔH for the following reaction is -6535kJ. How many kJ of heat will be evolved during the combustion of 16.0 g of $C_6H_{6(l)}$?

$$2C_6H_{6(l)} + 15O_{2(g)} \rightarrow 12CO_{2(g)} + 6\ H_2O_{(l)}$$

Section 5.5:

7. **(combines with 11.4) (5 points)** What is the quantity of heat (in joules) needed to raise the temperature of 454 g of tin from room temperature (25.0°C) to its melting point, 231.9°C, and then melt the tin to form liquid tin? The Cp tin= 0.277J/g-K and the ΔHfus tin = 59.2J/g.

8. **(6 points)** A 20.0 g piece of metal at 100.0 °C is placed in a calorimeter containing 50.7 g of water at 22.0 °C the final temperature of the mixture is 25.7 °C. What is the specific heat capacity of the metal?

9. **(8 points)** The Quinone, $C_6H_4O_2$, is burned completely in oxygen in a bomb calorimeter. Burning a 0.1964-g sample caused the temperature of the calorimeter to rise 3.200°C. The heat capacity of the calorimeter and its contents (the bomb and the water) is 1.56kJ/C. Calculate the ΔH (kJ/g of Quinone) for the combustion reaction of Quinone

$$C_6H_4O_{2s)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 2H_2O_{(l)}$$

10. **(6 points)** A 20.0 g piece of metal at 100.0 °C is placed in a calorimeter containing 50.7 g of water at 22.0 °C, the final temperature of the mixture is 25.7 °C. What is the specific heat capacity of the metal?

11. **(6 points)** The sugar arabinose, $C_5H_{10}O_5$, is burned completely in oxygen in a bomb calorimeter. Burning a 0.548-g sample caused the temperature of the calorimeter to rise from 20.00°C to 20.54°C. The heat capacity of the calorimeter and its contents (the bomb and the water) is 15.8kJ/C. Calculate the ΔH (kJ/mole arabinose) for the combustion reaction per mole of arabinose.

$$C_5H_{10}O_{5(s)} + 5O_{2(g)} \rightarrow 5CO_{2(g)} + 5H_2O_{(l)}$$

Section 5.6:

12. **(5 points)** From the following enthalpies of reaction (2 equations) listed below, calculate the ΔHrxn for the reaction of sulfur with oxygen gas:

$$S_{(s)} + O_{2(g)} \rightarrow SO_{2\,(g)}$$

$$2\,SO_{2\,(g)} + O_{2(g)} \rightarrow 2\,SO_{3(g)} \qquad \Delta H = -196\ kJ$$
$$2\,S_{(s)} + 3\,O_{2(g)} \rightarrow 2\,SO_{3(g)} \qquad \Delta H = -790\ kJ$$

13. **(6 points)** What is the ΔH_{RXN} at constant pressure for the reaction of interest?

Reaction of interest: $ClF_{(g)} + F_{2(g)} \rightarrow ClF_{3(g)}$
Pathway reactions:
Equation 1: $2ClF_{3(g)} + 2\,O_{2(g)} \rightarrow Cl_2O_{(g)} + 3F_2O_{(g)}$ ΔHrxn = 341.4 kJ/mol
Equation 2: $F_{2(g)} + 1/2\,O_{2(g)} \rightarrow F_2O_{(g)}$ ΔHrxn =-21.8 kJ/mol
Equation 3: $2\,ClF_{(g)} + O_{2(g)} \rightarrow Cl_2O(g + F_2O_{(g)}$ ΔHrxn = + 167.4 kJ/mol

Section 5.7:

14. **(5 points)** Calculate the $\Delta H°_{rxn}$ for the reaction of

$$3NO_{2(g)} + H_2O_{(l)} \rightarrow 2HNO_{3(aq)} + NO_{(g)}.$$

Heats of formation for the compounds are: $\Delta H°f_{NO2(g)}$ =33.84 kJ/mol, $\Delta H°f_{H2O(l)}$=-285.83 kJ/mol, $\Delta H°f_{HNO3(aq)}$= -206.6 kJ/mol, $\Delta H°f_{NO(g)}$=90.37kJ/mol

15. Styrene is an organic liquid that easily combusts in the presence of oxygen. The $\Delta H°_{rxn}$ for the following reaction is —4395.0kJ. Using the standard heats of formation listed on the formula page, calculate the heat of formation ($\Delta H°_f$) for styrene,$C_8H_{8(l)}$?

$C_8H_{8(l)} + 10O_{2(g)} \rightarrow 8CO_{2(g)} + 4\,H_2O_{(l)}$

16. **(6 points)** Aspartame is a white crystalline solid that was discovered in 1963 by accident in the lab. A careless chemist licked his dirty fingers and tasted sweetness. Aspartame has a molecular formula of $C_{14}H_{18}N_2O_{5(s)}$. Write the equation for the standard enthalpy of formation for 1 mole of aspartame. Include all phases, correct formulas, and coefficients.