Chem 1105-2016 Summer Problem Set #1

1. What is the change in internal energy(in J) of a system that releases 675 J of thermal energy to its surroundings and has 530 cal of work done on it?

2. Classify the following processes as exothermic or endothermic: a) freezing of water; b) boiling of water; c) digestion of food; d) a person running; e) a person growing; f) wood being chopped; g) heating with a furnace

3. Write a balanced equation and draw an approximate enthalpy diagram for:
a) combustion of 1 mole of ethane; b) freezing of liquid water

4.a) Find q when 22.0 g of water is heated from 25.0°C to 100.°C.
b) A 295 g aluminium engine part at an initial temperature of 13.00°C absorbs 75.0 kJ of heat. What is the final temperature of the part?(specific heat of Al = 0.900 J/g·K)

5. When 155 mL of water at 26°C is mixed with 75 mL of water at 85°C, what is the final temperature? Assume that no heat is lost to the surrounding; density of water = 1.00 g/mL.

6.a) A chemical engineer placed 1.520 g of a hydrocarbon in a bomb calorimeter. The bomb was immersed in water and the sample burned. The temperature rose from 20.00°C to 23.55°C. If the calorimeter has a heat capacity of 11.07 kJ/°C, what was the heat released per gram of the hydrocarbon?
b) A bomb calorimeter is standardized by combusting 1.221 g of benzoic acid(C_6H_5COOH; heat of combustion: -3227 kJ/mol) causing a temperature rise from 21.000°C to 23.500°C. Determine the heat capacity of the calorimeter with the proper units.

7. Using Hess's law and the data below calculate ΔH for the following reaction:

$$2Ca(s) + O_2(g) + 2CO_2(g) \rightarrow 2CaCO_3(s) \qquad \Delta H = ?$$

1) $Ca(s) + 1/2O_2(g) \rightarrow CaO(s)$ $\Delta H = -635.1$ kJ
2) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ $\Delta H = 178.3$ kJ

8. Using enthalpies of formation($\Delta H_f°$) determine ΔH° for the following:
a) $2H_2S(g) + 3O_2(g) \rightarrow 2SO_2(g) + 2H_2O(g)$
b) $CH_4(g) + Cl_2(g) \rightarrow CCl_4(l) + HCl(g)$ [unbalanced]

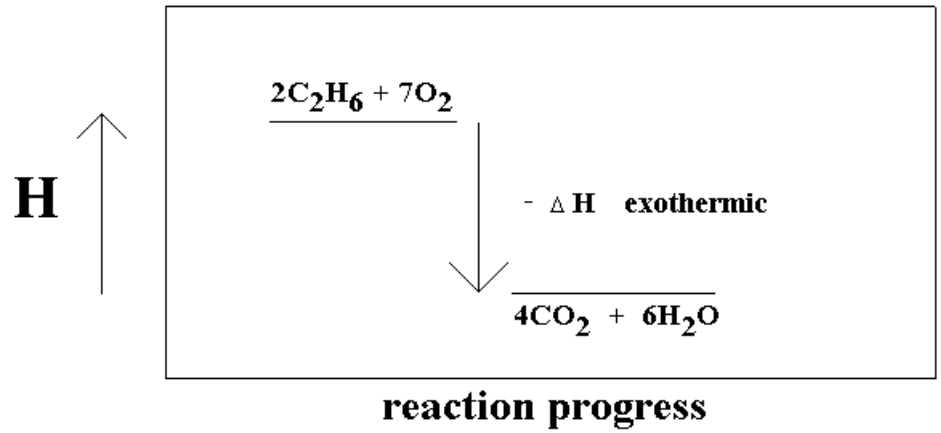
9. Stearic acid($C_{18}H_{36}O_2$) is a fatty acid molecule. It is used to make cosmetics, ointments, soaps, candles, and found in the animal tissue of meat.
a) Write a balanced equation for the combustion of stearic acid to gaseous products.
b) Calculate ΔH° for the combustion reaction. $\Delta H_f°(C_{18}H_{36}O_2)$ = -948 kJ/mol
c) Calculate the heat(q) released in kJ and kcal when 1.00 g of stearic acid is burned completely.
d) A candy bar contains 11.0 g of fat and 100. Cal from fat; is this consistent with your answer from part c)?

Answer Set for Chem 1105-2016 Summer Problem Set #1

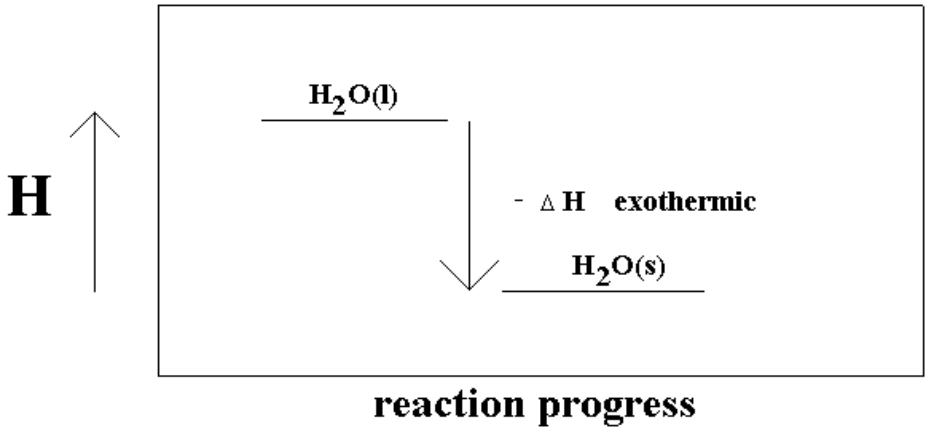
1. 1.54×10^3 J

2. endothermic: b), e), f); exothermic: a), c), d), g)

3. a) $2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g) + \text{heat}$



b) $H_2O(l) \rightarrow H_2O(s) + \text{heat}$



4.a) 6.9×10^3J; b) 295°C

5. 45°C

6.a) 25.9 kJ/g; b) 12.90 kJ/K

7. -1627 kJ

8.a) -1036.9 kJ; b) -433 kJ

9.a) $C_{18}H_{36}O_2(s) + 26O_2(g) \rightarrow 18CO_2(g) + 18H_2O(g)$; b) -10488 kJ
c) -36.9 kJ, -8.81 kcal; d) 8.81 kcal/g×11.0 g = 96.9 kcal