CHEM 1
Problem Set Ch. 6

1. How many kilocalories are in 5225 J?

2. How much heat in kilocalories has to be removed from 225 g of water to lower its temperature from 25.0 ^{o}C to 10.0 ^{o}C? (This would be like cooling a glass of lemonade.) Specific heat of water is 4.184 J/g•^{o}C.

3. What is the molar heat of combustion of methanol (CH_3OH) if combustion of 1.00 grams methanol causes a temperature rise of 3.68 ^{o}C in a bomb calorimeter that has a heat capacity of 6.43 kJ/^{o}C. (CH_3OH M_m = 32g/mol)

4. A quantity of 1.00×10^2 mL of 0.500 *M* HCl is mixed with 1.00×10^2 mL of 0.500 *M* NaOH in a constant-pressure calorimeter having a heat capacity of 335 J/^{o}C. The initial temperature of the HCl and NaOH solutions is the same, 22.50 ^{o}C, and the final temperature of the mixed solution is 24.90 ^{o}C. Calculate the heat change for the neutralization reaction

$$NaOH\ (aq) + HCl\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$$

Assume that the densities and specific heats of the solutions are the same as for water (1.00 g/mL and 4.184 J/g•^{o}C, respectively).

5. Consider the following balanced thermochemical equation sometimes used for H_2S production:

$$1/8\ S_8\ (s) + H_2\ (g) \rightarrow H_2S\ (g) \qquad \Delta H = -20.2\ kJ$$

a) Is this an exothermic or endothermic reaction?

b) What is ΔH for the reverse reaction?

c) What is ΔH when 1.0 mol S_8 reacts?

6. Liquid hydrogen peroxide is an oxidizing agent in many rocket fuel mixtures because it releases oxygen gas on decomposition:

$$2\ H_2O_2\ (l) \rightarrow 2\ H_2O\ (l) + O_2\ (g) \quad \Delta H = -196.1\ kJ$$

How much heat is released when 732 kg H_2O_2 decomposes?

7. Barium oxide, BaO, can be used to neutralize pure sulfuric acid, H_2SO_4. The equation is

$$BaO\ (s) + H_2SO_4\ (l) \rightarrow BaSO_4\ (s) + H_2O\ (l)$$

What is the standard enthalpy change of this reaction? The following thermochemical equations can be used.

$$SO_3\ (g) + H_2O\ (l) \rightarrow H_2SO_4\ (l) \quad \Delta H^o = -78.2\ kJ$$
$$2\ BaO\ (s) + 2\ SO_3\ (g) \rightarrow 2\ BaSO_4\ (s) \quad \Delta H^o = -426\ kJ$$

8. Calculate ΔH^o for the following reaction, which describes the preparation of an unstable acid, HNO_2, nitrous acid.

$$HCl\ (g) + NaNO_2\ (s) \rightarrow HNO_2\ (l) + NaCl\ (s)$$

Use the following thermochemical equations. Calculate the answer in kilojoules.

$$2\ NaCl\ (s) + H_2O\ (l) \rightarrow 2\ HCl\ (g) + Na_2O\ (s) \quad \Delta H^o = 507.31\ kJ$$
$$NO\ (g) + NO_2\ (g) + Na_2O\ (s) \rightarrow 2\ NaNO_2\ (s) \quad \Delta H^o = -427.14\ kJ$$
$$NO\ (g) + NO_2\ (g) \rightarrow N_2O\ (g) + O_2\ (g) \quad \Delta H^o = -42.68\ kJ$$
$$2\ HNO_2\ (l) \rightarrow N_2O\ (g) + O_2\ (g) + H_2O\ (l) \quad \Delta H^o = 34.35\ kJ$$

9. Using the standard enthalpies of formation in Table 6.2 in your book, calculate the standard enthalpy change for the following reaction:

$$2\ H_2S\ (g) + 3\ O_2\ (g) \rightarrow 2\ SO_2\ (g) + 2\ H_2O\ (g)$$

10. Acetylene burns in air according to the following equation:

$$C_2H_2\ (g) + 5/2\ O_2\ (g) \rightarrow 2\ CO_2\ (g) + H_2O\ (g) \quad \Delta H^o = -1255.8\ kJ$$

Given that ΔH_f^o of $CO_2\ (g) = -393.5$ kJ/mol and ΔH_f^o of $H_2O\ (g) = -241.8$ kJ/mol, what is ΔH_f^o of $C_2H_2\ (g)$?