Thermochemistry - Problem Set One

Vocabulary

1. Define the following terms:

a. enthalpy

b. exothermic

c. calorimetry

d. standard enthalpy of formation

e. endothermic

f. heat vs. temperature

Concept

State the first law of thermodynamics.

Problems

2. For the reaction:

$S_{8(s)} + 8O_{2(g)} \rightarrow 8SO_{2(g)}$ $\Delta H = -2368$ kJ

a. How much heat is evolved when 25.0 moles of sulfur is burned in excess oxygen?

b. How much heat is evolved when 275 grams of sulfur is burned in excess oxygen?

c. How much heat is evolved when 150.0 grams of sulfur dioxide are produced?

3. It takes 78.2 J to raise the temperature of 45.6 grams of lead by 13.3 ^{o}C. Calculate the specific heat capacity and molar heat capacity of lead.

4. A 15.0 gram sample of nickel metal is heated to 100.0 ^{o}C and dropped into 55.0 grams of water, initially at 23.0 ^{o}C. Assuming that all the heat lost by the nickel is absorbed by the water, calculate the final temperature of the nickel and water. (The specific heat of nickel is 0.444 J/g ^{o}C)

5. Using the standard enthalpies of formation given to you in a table, calculate the standard enthalpy change for the overall reaction that occurs when ammonia is burned in air to form nitrogen dioxide gas and liquid water. Is this reaction endothermic or exothermic?

6. Two forms of carbon are graphite, the soft, black, slippery material used in "lead" pencils and as a lubricant for locks, and diamond, the brilliant, hard gemstone. Using the standard enthalpy table determine the ΔH for this conversion. Is this an endothermic or an exothermic process?

7. Diborane (B_2H_6) is a highly reactive boron hydride, which was once considered as a possible rocket fuel for the United States space program. Calculate the ΔH for the synthesis of diborane from its elements, according to the equation:

$$2B_{(s)} + 3H_{2(g)} \rightarrow B_2H_{6(g)}$$

using the following data.

Reaction	ΔH (kJ)
$2B(s) + 3/2\ O_2(g) \longrightarrow B_2O_3(s)$	–1273
$B_2H_6(g) + 3\ O_2(g) \longrightarrow B_2O_3(s) + 3\ H_2O(g)$	–2035
$H_2(g) + 1/2\ O_2(g) \longrightarrow H_2O\ (l)$	–286
$H_2O(l) \longrightarrow H_2O(g)$	44

8. Given the following data:

Reaction	ΔH (kJ)
$H_2(g) + 1/2\ O_2(g) \longrightarrow H_2O(l)$	–285.5
$N_2O_5(g) + H_2O(l) \longrightarrow 2\ HNO_3(l)$	–76.6
$1/2\ N_2(g) + 3/2\ O_2\ (g) + 1/2\ H_2(g) \longrightarrow HNO_3(l)$	–174.1

calculate the ΔH for the reaction:

$$2N_{2(g)} + 5O_{2(g)} \rightarrow 2N_2O_{5(g)}$$