Thermochemistry Problem Set

1. Which of the following statements is true about temperature?

   a. The temperature of a body when compared to some neighboring body or region determines whether or not heat will flow into or out of the body into the neighboring body or region.
   b. The temperature of a substance has a direct relationship to the internal energy of the substance.
   c. An increase in the vigor of molecular motion does not necessarily correspond to an increase in temperature in the substance.
   d. all of the above.

2. The amount of heat required to increase the temperature of 1 g of water by 1 K equals:

   a. 1 kcal
   b. 4.18 cal
   c. 4.18 J
   d. none of the above

3. A laboratory scientist working to identify an unknown, large atomic weight element has measured its specific heat, obtaining the value .20 J K^{-1} g^{-1}. From other tests, he believes the element to be among the following. Which is it?

   a. selenium (AW 78.96)
   b. tungsten (AW 183.85)
   c. tellurium (AW 127.60)
   d. bismuth (AW 208.98)

4. A positive value of ΔH for a reaction means that:

   a. Heat is given off to the environment during the reaction.
   b. Heat is absorbed from the environment during the reaction.
   c. The reaction is exothermic.
   d. The internal energy of the substance has increased.

5. The equations for the two ways that carbon may be combusted (to carbon dioxide or carbon monoxide) are as follows:

   $$C\ (graphite) + O_2\ (g) \longrightarrow CO_2\ (g) \qquad \Delta H = -393.5\ KJ\ mol^{-1}$$
   $$C\ (graphite) + 1/2\ O_2\ (g) \longrightarrow CO\ (g) \qquad \Delta H = -110.5\ KJ\ mol^{-1}$$

   What is the value of the enthalpy of combustion of carbon monoxide to carbon dioxide?

   a. -504.0 KJ mol^{-1}
   b. -172.5 KJ mol^{-1}
   c. -283.0 KJ mol^{-1}
   d. cannot be determined from given information

6. Which of the following statements is true about the following exothermic reaction, when carried out at constant temperature?

$$2H_2\,(g) + O_2\,(g) \longrightarrow 2H_2O\,(g)$$

a. The magnitude of the change in internal energy over the reaction is greater than the magnitude of the enthalpy change.
b. The magnitude of the change in internal energy over the reaction is less than the magnitude of the enthalpy change.
c. The magnitude of the change in internal energy over reaction is equal to the magnitude of the enthalpy change.
d. Impossible to determine any of the above from given information.

7. Which of the following standard molar enthalpies of formation is not zero?

a. $O_2\,(g)$
b. Hg (l)
c. C (graphite)
d. CH_4

8. Which of the following statements does not directly follow from or lead to Hess' Law?

I. The enthalpy change for a reaction is the same whether a one step or a five step process is utilized.
II. The enthalpy change of a reaction in which all coefficients are one is equal to the sum of the standard molar enthalpies of formation of the products minus the sum of the standard enthalpies of formation of the reactants.
III. The enthalpy is a state function.

a. I
b. I and III
c. II and III
d. I, II, and III

9. Given these bond energies:

H—H (435 kJ/mol)
Br—Br (192 kJ/mol)
H—Br (368 kJ/mol)

What would you estimate to be the enthalpy of the rollowing reaction?

$$H_2\,(g) + Br_2\,(g) \longrightarrow 2HBr\,(g)$$

a. -26 kcal
b. -109 kcal
c. 259 kcal
d. 109 kcal