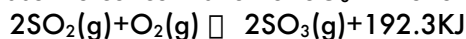Name _____ Date _____Period_____

1. List four ways to increase the concentration of SO_3 in the following equilibrium reaction.
$$2SO_2(g)+O_2(g) \leftrightarrow 2SO_3(g)+192.3KJ$$

   1.

   2.

   3.

   4.

2. $N_2+O_2 \leftrightarrow 2NO$ $\Delta H= 181$ kJ
What will happen to the concentration of NO at equilibrium if

   a. more O_2 is added?

   b. N_2 is removed?

   c. the pressure on the system is increased?

   d. the temperature of the system is increased?

3. How will an increase in temperature or pressure affect each of the following equilibrium?

                                              ↑ temp   ↑pressure

   a. $N_2(g)+3H_2(g) \leftrightarrow 2NH_3(g)$ $\Delta H=-92.2$ kJ

   b. $H_2O(l) \leftrightarrow H_2O(g)$ $\Delta H= 41$ kJ

   c. $N_2(g)+O_2(g) \leftrightarrow 2NO(g)$ $\Delta H= 181$ kJ

   d. $3O_2(g) \leftrightarrow 2O_3(g)$ $\Delta H= 285$ kJ

4. Methanol, CH_3OH, can be manufactured using the following equilibrium reaction.
$$CO(g)+2H_2(g) \leftrightarrow CH_3OH(g) + energy$$
Predict the effect of the following changes on the equilibrium concentration of $CH_3OH(g)$.

   a. a decrease in temperature

   b. an increase in pressure

   c. addition of $H_2(g)$

   d. addition of a catalyst

5. What will be the change in the equilibrium concentration of NO_2 under each of the following conditions for the following equilibrium reaction?

$$2NO(g)+O_2(g) \leftrightarrow 2NO_2(g)+114.6KJ$$
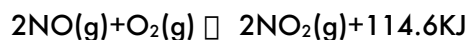
   a. O_2 is added

   b. NO is removed

   c. energy is added

   d. a catalyst is added

6. In the equilibrium reaction: $4HCl(g) + O_2(g) \leftrightarrow 2H_2O(g) + 2Cl_2(g) +114.4KJ$

   Predict the direction of equilibrium shift if the following changes occur

   a. the pressure is increased

   b.   energy is added

   c.   oxygen is added

   d. HCl is removed

   e.   catalyst is added

7. For each of the following reactions between gases at equilibrium determine the effect on the equilibrium

   concentrations of the products when the temperature is decreases and when the external pressure on the

   system is decreased.

   a. $2H_2O(g) \leftrightarrow 2H_2O(g)+O_2$ Δ H= 484 kJ

   b. $N_2(g)+O_2(g) \leftrightarrow 2NO(g)$ Δ H= 181 kJ

   c. $N_2(g)+3H_2(g) \leftrightarrow 2NH_3(g)$ Δ H= -92.2 kJ

   d. $2O_3(g) \leftrightarrow 3O_2(g)$ Δ H= -285 kJ

   e. $H_2(g)+F_2(g) \leftrightarrow 2HF(g)$ Δ H= 541 kJ

8. Nitric Oxide, NO, releases 57.3 kJ/mol when it reacts with oxygen to give nitrogen dioxide.

   a. Write the equation for this reaction.

   b. Predict the effect that increasing the temperature will have on:

        1. the equilibrium concentrations

        2. the speed of formation of NO_2

   c. Predict how increasing the NO concentration will affect 1 and 2 above.

9. For the reaction: $N_2O_4(g)+58.9KJ \leftrightarrow 2NO_2(g)$ How will the equilibrium concentration of NO_2 be affected

   by the following conditions?

   a. increase in pressure

   b.   decrease in temperature

10. Use Le Chatelier's principle to predict how the changes listed will affect the concentration of HI for the

    following equilibrium reaction: $9.4 kJ + 2HI(g) \leftrightarrow H_2(g) + I_2(g)$

    a. a small amount of H_2 is added.

    b. the pressure of the system is increased.

    c. the temperature of the system is increased.

    d. a catalyst is added.