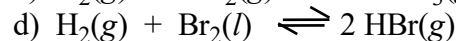
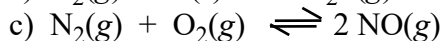
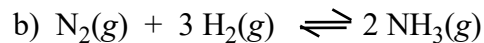
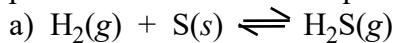


Chapter 17 Study Questions

1. Draw an energy diagram for a reaction where $\Delta H = -40$ kJ, the activation energy of the uncatalyzed reaction is +120 kJ, and the activation energy for a catalyzed reaction is +80 kJ. Indicate the position of the activated complex for both the catalyzed and uncatalyzed reactions.
2. List three factors that affect reaction rate and briefly explain the basis for their effects.
3. The breakdown of nitrous oxide gas (N_2O) to nitrogen gas and oxygen gas is believed to occur in two steps. In the first step, nitrous oxide breaks down to form nitrogen gas and a free oxygen atom.
 - a) Write a balanced equation for the overall reaction (do not use fractional coefficients).
 - b) Write balanced equations for each of the two steps.
 - c) Which substance could be considered a "reaction intermediate"?
4. For a system at equilibrium, which of the following are true?
 - a) The rate of the reaction is zero.
 - b) The concentrations of reactants and products are no longer changing.
 - c) The value for the equilibrium constant, K , will change when temperature is changed.
 - d) The rate of the forward reaction is equal to the rate of the reverse reaction.
5. The following equilibrium is established: $2 \text{NO}(g) + 2 \text{H}_2(g) \rightleftharpoons \text{N}_2(g) + 2 \text{H}_2\text{O}(g)$
At equilibrium, $[\text{NO}] = 0.070$ M, $[\text{H}_2] = 0.020$ M, $[\text{N}_2] = 0.015$ M, and $[\text{H}_2\text{O}] = 0.130$ M.
 - a) Write an expression for K , the equilibrium constant, for this reaction and calculate K .
 - b) At equilibrium, how will the concentrations of products compare to the concentrations of reactants?
6. Consider the reaction, $2 \text{NO}_2(g) \rightleftharpoons \text{N}_2\text{O}_4(g)$ for which $K = 5.0$ at 100°C .
 - a) Write an expression for K , the equilibrium constant, for this reaction.
 - b) Find the concentration of N_2O_4 in a system at equilibrium at 100°C if the equilibrium concentration of NO_2 is 0.30 mol/L.
7. Consider the following system at equilibrium:
$$2 \text{N}_2\text{O}(g) + 163 \text{ kJ} \rightleftharpoons 2 \text{N}_2(g) + \text{O}_2(g)$$
For each situation below, indicate whether more product or more reactant is produced in order to re-establish equilibrium.
 - a) N_2 is added
 - b) O_2 is removed
 - c) the volume is increased
 - d) the pressure is increased by compressing the mixture
 - e) the temperature is increasedWhich of the situations above will increase yield?
What effect will an increase in temperature have on the value for K ?

8. For each reaction below, write an expression for K and indicate what effect an increase in pressure would have on equilibrium.



Summary of Chapter 17: Equilibrium

collision model

reaction rate

factors affecting rate (and why)

concentrations of reactants, temperature, surface area, catalysts, inhibitors

activation energy

relation to temperature

relation to rate

energy diagrams

activated complex (transition state)

catalysis

reaction mechanism

definition of equilibrium

factors affecting equilibrium: temperature

equilibrium constant, K

expression for K from equation

only gases and aqueous

relate to extent of reaction

calculation of K from concentrations at equilibrium and vice versa

LeChatelier's Principle

statement of principle

effect of adding or removing product or reactant

effect of changing volume or pressure

effect of changing temperature

relationship between temperature and K for endothermic and exothermic reactions