R&R #15

I. Concept Questions

Disturbance	Action needed to return to equilibrium	Effect of equilibrium	Effect on K
Reactions Involving Solids, Liquids, or Gases			
Addition of reactant			
Addition of product			
Rise in temperature			
Drop in temperature			
Reactions Involving Gases			
Decrease in volume (_____ in pressure)			
Increase in volume (_____ in pressure)			

II. Practice Problems

1. Explain the effect of each of the following stresses on the position of the following equilibrium:

$3\ NO\ (g) \rightarrow N_2O\ (g) + NO_2\ (g)$

The reaction as written is exothermic.

(a) The equilibrium mixture is cooled.

(b) The volume of the equilibrium mixture is reduced at constant temperature.

(c) Gaseous argon (which does not react) is added to the equilibrium mixture while both the total gas pressure and the temperature are kept constant.

2. Write down K_3 using K_1 and K_2.

   $2P\ (g) + 3Cl_2\ (g) \rightarrow 2\ PCl_3\ (g)$ K_1

   $PCl3\ (g) + Cl_2\ (g) \rightarrow PCl_5\ (g)$ K_2

   $2P\ (g) + 5\ Cl_2\ (g) \rightarrow 2PCl_5\ (g)$ K_3

   K_3 =

3. Hemoglobin (Hb) can form a complex with both O2 and CO. For the reaction $HbO_2(aq) + CO(g) \rightarrow HbCO\ (aq) + O_2(g)$ at body temperature, K is about 200. If the ratio $[HbCO]/[HbO_2]$ comes close to 1, death is probable. What partial pressure of CO in the air is likely to be fatal? Assume the partial pressure of O_2 is 0.20 atm.

4. The reaction of hydrogen and iodine to give hydrogen iodide has an equilibrium constant, Kc, of 56 at 435 °C.

   (a) What is the value of Kp?

   (b) Suppose you mix 0.045 mol of H_2 and 0.045 mol of I_2 in a 10.0-L flask at 425 °C. What is the total pressure of the mixture before and after equilibrium is achieved?

   (c) What is the partial pressure of each gas at equilibrium?

III. MCAT Questions (source: M Prep - Tags (mcatquestion.com))

1. For a particular reaction, the ratio of the forward rate over the reverse rate is measured (forward rate / reverse rate). Which of the following will most increase this quotient?

   A Include a catalyst.
   B Add thermal energy to the system.
   C Remove thermal energy from the system.
   D None of the above.

2. Sodium hypochlorite, NaClO, is highly soluble in water and decomposes to liberate $O_2(g)$. What would happen to the freezing point of a 0.05 M solution of sodium hypochlorite after it has completely decomposed?

   $2ClO^- \rightarrow 2Cl^- + O_2$

   A The freezing point would increase because the molarity of the solution would decrease.

   B The freezing point would remain the same because the molarity of the solution would be unchanged.

   C The freezing point would decrease because the molarity of the solution would increase.

   D The answer cannot be determined from the given information.

3. A reaction, $A + 2B \rightarrow C + D$ takes place in a chamber. 5 moles of A and 12 moles of B are mixed together to produce 3 moles of C at equilibrium. Assuming all of the reactants and products are in aqueous solution and volume remains constant, what is the equilibrium constant for the reaction? (Assume V=1 L)

   A 14/27
   B 9
   C 9/12
   D 1/8

4. Which of the following is true of a reversible reaction where Q > K?

   A The reaction is at equilibrium.
   B The reaction will increase the concentration of products over time.
   C The reaction will increase the concentration of reactants over time.
   D The reaction will be at equilibrium once the activation energy is reached.

5. Increasing the temperature in an exothermic reaction will:

   A shift the equilibrium right.
   B shift the equilibrium left.
   C have no effect on the reaction.
   D shift the equilibrium to the left or the right depending on the catalyst used.