CHAPTER 15 PRACTICE QUIZ

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

⊖ ←Linked, begin at 0:00

$$N_2O_5(g) \rightleftarrows 2 NO_2(g) + \frac{1}{2} O_2(g)$$
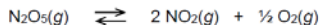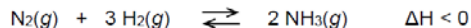
1. The equilibrium constant for the gas phase reaction above is 95 at 25°C. What is the value of the equilibrium constant for the following reaction at 25°C?

$$O_2(g) + 4 NO_2(g) \rightleftarrows 2 N_2O_5(g)$$

(A) $(95)^2$

(B) $(95)^{\frac{1}{2}}$
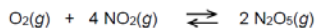
(C) $\dfrac{1}{95}$

(D) $\dfrac{1}{95^2}$

Questions 6 – 7 refer to the following.

$$N_2(g) + 3 H_2(g) \rightleftarrows 2 NH_3(g) \qquad \Delta H < 0$$

6. $NH_3(g)$ was synthesized at 200°C in the presence of a powdered Os(s) catalyst, leading to the equilibrium system represented above. Which of the following changes would result in more $NH_3(g)$ in the mixture after equilibrium is re-established?

(A) Replacing the powdered Os(s) with a solid cube of Os(s) of the same total mass

(B) Increasing the temperature of the system to 250°C at constant pressure

(C) Removing some $H_2(g)$

(D) Adding some $N_2(g)$

7. In a separate experiment, the system is allowed to reach equilibrium at 200°C. Then additional $H_2(g)$ is added to reaction vessel. Which of the following will most likely occur as the system approaches equilibrium at constant temperature?

(A) $[N_2]$ will increase, and K_c will decrease.

(B) $[N_2]$ will decrease, and K_c will increase.

(C) $[N_2]$ will decrease, but K_c will remain constant.

(D) $[N_2]$ will increase, but K_c will remain constant.

$$A_2(g) + B_2(g) \rightleftarrows 2 AB(g)$$
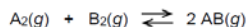
8. In a certain experiment, 4.00 mol each of $A_2(g)$ and $B_2(g)$ are placed in a 1.00 L vessel and allowed to react at constant temperature according to the equation above. Once equilibrium is reached for the reaction mixture, it is determined that the concentration of AB(g) is equal to 2.0 M. What is the value of the equilibrium constant, K_c ?

(A) $\dfrac{2}{9}$

(B) $\dfrac{4}{9}$

(C) 0.50

(D) 1.0

$$H_2(g) + I_2(g) \rightleftarrows 2 HI(g) \qquad K_c = 50. \text{ @ } 450°C$$

9. At 450°C, 2.0 moles each of $H_2(g)$, $I_2(g)$, and $HI(g)$ are combined in a 1.0 L rigid container. Which of the following will occur as the system moves toward equilibrium?

(A) More $H_2(g)$ and $I_2(g)$ will form.

(B) More $HI(g)$ will form.

(C) The total pressure will decrease.

(D) No net reaction will occur because the number of molecules is the same on both sides of the equation.
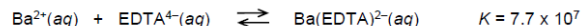
$$CO(g) + H_2O(g) \rightleftarrows CO_2(g) + H_2(g) \qquad K_c = 1.5 \times 10^3$$
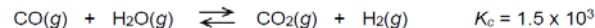
10. A 2.0 mol sample of CO(g) and a 2.0 mol sample of $H_2O(g)$ are introduced into a previously evacuated 100. L rigid container, and the temperature is held constant as the reaction represented above reaches equilibrium. Which of the following is true at equilibrium?
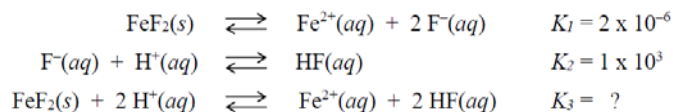
(A) $[H_2O] > [CO]$ and $[CO_2] > [H_2]$

(B) $[H_2O] > [H_2]$

(C) $[CO_2] > [CO]$

(D) $[CO] = [H_2O] = [CO_2] = [H_2]$

12. Which of the systems in equilibrium represented below will exhibit a shift to the left (toward reactants) when the pressure on the system is increased by reducing the volume of the system? (Assume that temperature is constant.)

(A) $SF_4(g) + F_2(g) \rightleftarrows SF_6(g)$

(B) $H_2(g) + Br_2(g) \rightleftarrows 2 HBr(g)$

(C) $CaF_2(s) \rightleftarrows Ca^{2+}(aq) + 2 F^-(aq)$

(D) $SO_2Cl_2(g) \rightleftarrows SO_2(g) + Cl_2(g)$

$$Ba^{2+}(aq) + EDTA^{4-}(aq) \rightleftharpoons Ba(EDTA)^{2-}(aq) \qquad K = 7.7 \times 10^7$$

3. The polyatomic ion $C_{10}H_{12}N_2O_8^{4-}$ is commonly abbreviated as $EDTA^{4-}$. The ion can form complexes with metal ions in aqueous solutions. A complex of $EDTA^{4-}$ with the Ba^{2+} ion forms according to the equation above. A 50.0 mL volume of a solution that has an $EDTA^{4-}(aq)$ concentration of 0.30 M is mixed with 50.0 mL of 0.20 M $Ba(NO_3)_2$ to produce 100.0 mL of solution.

(a) Considering the value of K for the reaction, determine the concentration of $Ba(EDTA)^{2-}(aq)$ in the 100.0 mL of solution. Justify your answer.

(b) The solution is diluted with distilled water to a total volume of 1.00 L. After equilibrium has been re-established, is the number of moles of $Ba^{2+}(aq)$ present in the solution *greater than*, *less than*, or *equal to* the number of moles of $Ba^{2+}(aq)$ present in the original solution before it was diluted? Justify your answer. You should compare Q vs. K in your answer.

$$FeF_2(s) \rightleftharpoons Fe^{2+}(aq) + 2F^-(aq) \qquad K_1 = 2 \times 10^{-6}$$
$$F^-(aq) + H^+(aq) \rightleftharpoons HF(aq) \qquad K_2 = 1 \times 10^3$$
$$FeF_2(s) + 2H^+(aq) \rightleftharpoons Fe^{2+}(aq) + 2HF(aq) \qquad K_3 = \ ?$$

15. On the basis of the information above, the dissolution of $FeF_2(s)$ in acidic solution is

(A) favorable, because $K_2 > 1$

(B) favorable, because $K_3 > 1$

(C) not favorable, because $K_1 < 1$

(D) not favorable, because $K_3 < 1$

$$Mg(OH)_2(s) \rightleftharpoons Mg^{2+}(aq) + 2OH^-(aq) \qquad \Delta H < 0$$
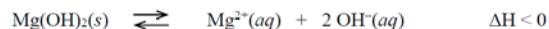
16. The exothermic dissolution of $Mg(OH)_2(s)$ in water is represented by the equation above. The K_{sp} of $Mg(OH)_2$ is 1.8×10^{-11}. Which of the following changes will increase the solubility of $Mg(OH)_2$ in an aqueous solution?

(A) Increasing the temperature of the solution

(B) Decreasing the pH of the solution

(C) Adding NaOH to the solution

(D) Adding $Mg(NO_3)_2$ to the solution

Compound	K_{sp}
$PbCl_2$	1.2×10^{-5}
CuCl	1.6×10^{-7}
AgCl	1.8×10^{-10}
Hg_2Cl_2	1.4×10^{-18}

17. Based on the K_{sp} values in the table above, a saturated solution of which of the following compounds has the highest $[Cl^-]$?

(A) $PbCl_2$ (B) CuCl   (C) AgCl   (D) Hg_2Cl_2

Compound	K_{sp}
Ag_2SO_4	1×10^{-5}
$PbSO_4$	1×10^{-8}

18. A 1.0 L solution of $AgNO_3$ and $Pb(NO_3)_2(aq)$ has a Ag^+ concentration of 0.020 M and a Pb^{2+} concentration of 0.0010 M. A 0.0010 mol sample of $K_2SO_4(s)$ is added to the solution. Based on the information in the table above, which of the following will occur? (Assume that the volume change of the solution is negligible.)

(A) No precipitate will form.

(B) Only $Ag_2SO_4(s)$ will precipitate.

(C) Only $PbSO_4(s)$ will precipitate.

(D) Both $Ag_2SO_4(s)$ and $PbSO_4(s)$ will precipitate.

19. A beaker contains 1.0 L of a saturated solution of $CaF_2(aq)$ that is in equilibrium with undissolved $CaF_2(s)$. A chemist adds 1.0 mL of 10.0 M $KF(aq)$ to this beaker. The solution is stirred and the equilibrium is re-established. Which of the following most accurately represents the changes, if any, that have occurred in the system as a result of the addition of 1.0 mL of 10.0 M $KF(aq)$?

	The concentration of $Ca^{2+}(aq)$	The mass of $CaF_2(s)$ in the beaker
(A)	has decreased	remains the same
(B)	has decreased	has increased
(C)	has increased	has decreased
(D)	remains the same	remains the same

3. Answer the following questions concerning magnesium hydroxide, $Mg(OH)_2$.

(a) A saturated solution of $Mg(OH)_2(s)$ is prepared that is in equilibrium with $Mg(OH)_2(s)$. Write the solubility-product expression, K_{sp}, for $Mg(OH)_2$.

(b) The pH of a saturated solution of magnesium hydroxide is equal to 10.52.

(i) Calculate the value of $[OH^-]$ in this saturated solution: _____

(ii) Calculate the value of $[Mg^{2+}]$ in this solution: _____

(c) Use your answers to part (b) to calculate the value of K_{sp} for $Mg(OH)_2$. Show the set-up for your calculations in order to receive full credit.

(d) In a different experiment, 50.0 mL of 4.0×10^{-4} M $Mg(NO_3)_2$ was added to 50.0 mL of 3.0×10^{-4} M NaOH. Assume that the final volume of this solution is 100.0 mL. Will a precipitate be formed in this experiment? Justify your answer by comparing the value of Q to the value of K_{sp} obtained in part (c).