AP Exam Review- Equilibrium Name: _____ Period: ____

(1) An aqueous solution is prepared that is initially 0.100 M in CdI_4^{2-}. After equilibrium is established, the solution is found to be 0.013 M in Cd^{2+}.

a. Derive the expression for the dissociation constant, K_d, and determine the value of the constant.
b. What will be the cadmium ion concentration arising when 0.400 mol of KI is added to 1.00 L of the solution in part **a**?
c. A solution is prepared by mixing 0.500 L of the solution from part **b** and 0.500 L of 2.0×10^{-5} M NaOH. Will cadmium hydroxide, $Cd(OH)_2$, precipitate? The K_{sp} for cadmium hydroxide is 2.2×10^{-14}.
d. When the initial solution is heated, the cadmium ion concentration increases. Is the equilibrium an exothermic or an endothermic process? Explain how you arrived at your conclusion.

(2) $MgF_2(s) <===> Mg^{2+}(aq) + 2\ F^-(aq)$

In a saturated solution of MgF_2 at 18° C, the concentration of Mg^{2+} is 1.21×10^{-3} molar. The equilibrium is represented by the equation above.

(a) Write the expression for the solubility-product constant, K_{sp}, and calculate its value at 18° C.

(b) Calculate the equilibrium concentration of Mg^{2+} in 1.000 liter of saturated MgF_2 solution at 18°C to which 0.100 mole of solid KF has been added. The KF dissolves completely. Assume the volume change is negligible.

(c) Predict whether a precipitate of MgF_2 will form when 100.0 milliliters of a 3.00×10^{-3} molar $Mg(NO_3)_2$ solution is mixed with 200.0 milliliters of a 2.00×10^{-3} molar NaF solution at 18°C. Calculations to support your prediction must be shown.

(d) At 27°C the concentration of Mg^{2+} in a saturated solution of MgF_2 is 1.17×10^{-3} molar. Is the dissolving of MgF_2 in water an endothermic or an exothermic process? Give an explanation to support your conclusion.

(3)

$$2\ H_2S(g) \rightleftarrows 2\ H_2(g) + S_2(g)$$

1. When heated, hydrogen sulfide gas decomposes according to the equation above. A 3.40 g sample of $H_2S(g)$ is introduced into an evacuated rigid 1.25 L container. The sealed container is heated to 483 K, and 3.72×10^{-2} mol of $S_2(g)$ is present at equilibrium.

   (a) Write the expression for the equilibrium constant, K_c, for the decomposition reaction represented above.

   (b) Calculate the equilibrium concentration, in mol L^{-1}, of the following gases in the container at 483 K.
   (i) $H_2(g)$
   (ii) $H_2S(g)$

   (c) Calculate the value of the equilibrium constant, K_c, for the decomposition reaction at 483 K.

   (d) Calculate the partial pressure of $S_2(g)$ in the container at equilibrium at 483 K.

   (e) For the reaction $H_2(g) + \frac{1}{2} S_2(g) \rightleftarrows H_2S(g)$ at 483 K, calculate the value of the equilibrium constant, K_c.