

**Exam: Ksp**

Chemist: \_\_\_\_\_

AP Chemistry 2015-16

Date: \_\_\_\_\_

**Multiple Choice**

\_\_\_\_\_ 1. The solubility of CuI is  $2 \times 10^{-6}$  molar in a saturated solution of copper (I) iodide. What is the solubility product constant,  $K_{sp}$ , for CuI?

- A)  $2 \times 10^{-6}$                       B)  $4 \times 10^{-12}$                       C)  $2 \times 10^{-12}$                       D)  $8 \times 10^{-18}$

\_\_\_\_\_ 2. How many moles of NaF must be dissolved in 1.00 liter of a saturated solution of  $PbF_2$  at  $25^\circ C$  to reduce the  $[Pb^{2+}]$  to  $1 \times 10^{-6}$  molar? ( $K_{sp}$  of  $PbF_2$  at  $25^\circ C = 4.0 \times 10^{-8}$ )

- A) 0.020 mole                      B) 0.040 mole                      C) 0.10 mole                      D) 0.20 mole

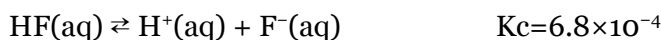
\_\_\_\_\_ 3. A solution is comprised of 0.0012 M  $Pb^{2+}$  and 0.010 M  $Cl^-$ . [ $K_{sp}$  of  $PbCl_2$  is  $1.7 \times 10^{-5}$ ]. What will be true for this system initially?

- A)  $Q > K_{sp}$ , precipitate will form                      B)  $Q > K_{sp}$ , no precipitate will form  
C)  $Q < K_{sp}$ , precipitate will form                      D)  $Q < K_{sp}$ , no precipitate will form

\_\_\_\_\_ 4. Which salt solutions will reduce the molar solubility of  $PbCO_3$ ?

- I. 0.10 M  $Pb(NO_3)_2$   
II. 0.10 M  $NaNO_3$   
III. 0.10 M  $Na_2CO_3$

- A) I only                      B) I and II                      C) III only                      D) I and III



\_\_\_\_\_ 5) The dissolution of calcium fluoride is represented by the equilibrium system above at  $25^\circ C$ . The  $F^-$  ion is produced when the weak acid HF dissociates. If solid calcium fluoride is added to equal volumes of the following solutions at  $25^\circ C$ , in which solution will the most calcium fluoride dissolve?

- A) Pure distilled water                      B) 1M  $HNO_3$  (aq)  
C) 1M NaOH (aq)                      D) A saturated aqueous  $CaF_2$  solution

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### Free Response

1. A 200.0 mL solution of Ni(NO<sub>3</sub>)<sub>2</sub> with a concentration of  $3.700 \times 10^{-8}$  M is mixed with 100.0 mL of 0.0050 M NaOH solution.  $K_{sp}$  of Ni(OH)<sub>2</sub> =  $2.0 \times 10^{-15}$  at 25°C

- Write an equation showing the equilibrium between solid Ni(OH)<sub>2</sub> and its ions in aqueous solution
- Calculate the initial concentrations of each ion in the mixture (before they react).
- Use calculations to show that a precipitate will form in this mixture.
- Calculate the mass of precipitate that forms.
- Determine the molar solubility of Ni(OH)<sub>2</sub> at 25°C.
- The solution process for nickel(II) hydroxide is known to be exothermic. Explain how raising the temperature of the system would affect the value of  $K_{sp}$ .
- Explain what effect, if any, adding hydrochloric acid, HCl, would have on the solubility of Ni(OH)<sub>2</sub>.

2. Iodide salts of silver and lead(II) ions are slightly soluble in water. The  $K_{sp}$  of each is given below:

$$K_{sp} \text{ AgI} = 8.3 \times 10^{-17}, \quad K_{sp} \text{ PbI}_2 = 7.39 \times 10^{-9}$$

- a. Based on these data, which salt is more soluble? Use calculations to justify your answer.
- b. A solution contains  $2.0 \times 10^{-4} \text{ M Ag}^+$  and  $1.5 \times 10^{-3} \text{ M Pb}^{+2}$ . If NaI is slowly added without changing the total volume of the mixture, will AgI or  $\text{PbI}_2$  precipitate first? Justify your answer with calculations.