CONCEPT: SOLUBILITY PRODUCT CONSTANT (Ksp)

● Recall, solubility is a chemical property that deals with the ability of a _____ to become dissolved in a _____.

□ **Solubility Product Constant (Ksp):** The equilibrium constant that deals with the solubility of _____ solids.

- Solubility can also be referred to as _____ or _____.

□ ___ Ksp = _____ soluble solid.

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EXAMPLE: Which substance is the most soluble?

a) AgCl Ksp = 1.6×10^{-10}

b) $MgCO_3$ Ksp = 3.5×10^{-8}

c) $CaSO_4$ Ksp = 7.1×10^{-5}

d) CuS Ksp = 8.5×10^{-45}

Equilibrium Expressions

● Placing an ionic solid within a solvent involves 2 competing processes: the _____ reaction and its reverse.

$$A_2B_3\ (s) \rightleftharpoons \_\_\_\_\_ + \_\_\_\_\_$$

□ From this equilibrium equation, its *equilibrium expression* can be determined.

□ **Equilibrium expression:** The ratio of the concentrations of _____ over _____.

- Recall, the equilibrium expression ignores _____ and _____ for its ratio.

EXAMPLE: Provide the equilibrium expression for calcium nitrate, $Ca(NO_3)_2$.

STEP 1: Write the equilibrium equation by breaking up the ionic solid into its _____ ions.

$$Ca(NO_3)_2\ (s) \rightleftharpoons \_\_\_\_\_ + \_\_\_\_\_$$

STEP 2: Using Ksp, write the equilibrium expression based on the equilibrium equation.

□ Since the reactant is a solid, set it equal to ____ within the equilibrium expression.

$$Ksp = \frac{\qquad\qquad}{\qquad\qquad} = \frac{\qquad\qquad}{\qquad\qquad}$$

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Calculating Ksp from Solubility

● If the solubility or _____ concentrations of ions within an ionic solid are known, the Ksp can be calculated.

EXAMPLE: Calculate the Ksp value for silver phosphate, Ag_3PO_4, which has a solubility of 1.8×10^{-18} at 25ºC.

STEP 1: Write the equilibrium equation by breaking up the ionic solid into its _____ ions.

STEP 2: Write the equilibrium expression based on the equilibrium equation.

STEP 3: Make concentrations of the ions are equal to their _____ multiplied by the ____ variable.

STEP 4: Substitute the given solubility value for the ____ variable and solve for Ksp.

Calculating Solubility from Ksp

● Conversely, the solubility of an ionic solid can be determined when its Ksp value is already known.

EXAMPLE: The Ksp value for strontium fluoride, SrF_2, is 7.9×10^{-10} at 25ºC. Calculate its solubility in M.

STEP 1: Write the equilibrium equation by breaking up the ionic solid into its _____ ions.

STEP 2: Write the equilibrium expression based on the equilibrium equation.

STEP 3: Solve for the solubility variable ____ based on the given Ksp value.

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PRACTICE: Determine the equilibrium expression of the barium nitride solid.

PRACTICE: Manganese (V) hydroxide has a measured solubility of 3.4×10^{-5} M at 25ºC. Calculate its Ksp value.

PRACTICE: The Ksp value for strontium fluoride, SrF_2, is 7.9×10^{-10} at 25ºC. Calculate its solubility in g/L.