

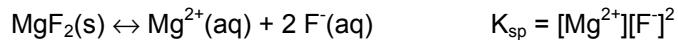
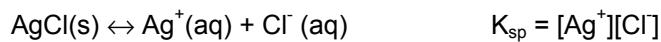
Name:

Honors Chemistry

Section:

Solubility Product Constants

The **solubility product** is just the equilibrium constant for the dissolving of a slightly soluble solid. Here are some examples:



Since the reactant is always a solid, there is no denominator on solubility equilibrium expressions. Assume that the denominator is always "1".

There are two basic types of K_{sp} problems:

1. Give the solubility (also known as the concentration of a saturated solution), find the K_{sp} .
2. Given the K_{sp} , find the molarity or the concentration of a saturated solution (also known as the solubility) of the solid in question.

Watch out—these problems all use different ways of saying the same thing!

1. The solubility of AgCl is 1.34×10^{-5} M. Find the K_{sp} of AgI.
Model Calculation:

General Problem-Solving Strategy

List what you know.

Write out the balanced ionization expression.

List known values. Identify the unknown(s).

Set up the problem.

Write the K_{sp} expression.

Estimate and calculate.

Substitute and evaluate. Use sig figs.

2. The concentration of a saturated solution of barium carbonate, BaCO_3 , is 7.00×10^{-5} M. Calculate the K_{sp} of barium carbonate. (4.90×10^{-9})
3. What is the K_{sp} of $\text{Pb}(\text{IO}_3)_2$ if a saturated solution has a concentration of 2.30 mg/100 cm³? (2.82×10^{-13})
4. Find the K_{sp} of copper (II) sulfide if a saturated solution is 2.51×10^{-18} M. (6.31×10^{-36})

5. The K_{sp} of strontium oxalate, SrC_2O_4 , is 1.58×10^{-7} . Find the concentration of a saturated solution of strontium oxalate.

Model Calculation:

6. If the K_{sp} of barium chromate is 2.00×10^{-10} , what is the solubility of BaCrO_4 ?
 $(1.41 \times 10^{-5} \text{ M})$

7. What will be the concentration of copper ions in a saturated solution of copper (II) carbonate, CuCO_3 ?
(The K_{sp} of copper carbonate is 8.7×10^{-9}).
 $(9.3 \times 10^{-5} \text{ M})$

8. What is the molarity of a saturated solution of lead (II) iodide, PbI_2 ? The K_{sp} of lead (II) iodide is 7.08×10^{-9} . (Note: Be careful! Write the balanced equation first, then express the unknown concentrations of the ions in terms of each other.)
 $(1.21 \times 10^{-3} \text{ M})$

Name:

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Section:

Ksp Problems Level 2

A useful application of K_{sp} data is to determine if precipitation will occur when a salt and a solution or when two solutions are mixed. Precipitation takes place only when the ion product exceeds the K_{sp} .

Ion product < K_{sp}	no precipitate will form
Ion product = K_{sp}	no precipitate will form
Ion product > K_{sp}	precipitate will form

Remember that if the final solution is formed by mixing two solutions, it is necessary to consider dilution. Each solute is diluted when the other solution is added.

Example:

Will precipitation occur when 50.0 mL of a 3.00×10^{-2} M $\text{Pb}(\text{NO}_3)_2$ solution is added to 50.0 mL of 2.00×10^{-3} M KCl? The K_{sp} of PbCl_2 is 1.62×10^{-5} .

- Assume volumes are additive (total volume = 100.0 mL)
- Calculate new concentrations of ions in mixture
- Substitute into K_{sp} expression

1. 25.0 mL of 6.00×10^{-6} M $\text{Sr}(\text{NO}_3)_2$ is mixed with 25.0 mL of 4.00×10^{-7} H_3PO_4 . Will precipitation occur? The K_{sp} of $\text{Sr}_3(\text{PO}_4)_2$ is 4.07×10^{-28} . (No precipitation)
2. Determine if a precipitate of silver chromate, Ag_2CrO_4 , will form when 100.0 mL of .100 M AgNO_3 are added to 100.0 mL of .350 M K_2CrO_4 . The K_{sp} of Ag_2CrO_4 is 9.00×10^{-12} . (ppt will form)

3. Predict whether calcium carbonate will precipitate when 0.5 L of 0.001 M $\text{Ca}(\text{NO}_3)_2$ is mixed with 0.5 L of 0.0008 M Na_2CO_3 to form 1.0 L of solution. The K_{sp} of CaCO_3 is 4.5×10^{-9} M. (ppt will form)
4. The solubility product constant for lead (II) chloride is 1.7×10^{-5} . How many moles of lead nitrate can dissolve in 1.00 L of a 0.1 M solution of sodium chloride? (Hint: One of the ions found in PbCl_2 , the chloride ion, is already present in the solution. That can be taken to be its equilibrium concentration.) (0.0017 mol can be dissolved)