Introduction

In general chemistry 1 students memorized a series of solubility rules (section 3.4.3) to predict if an ionic compound was soluble or not. Using these rules we would predict that insoluble salts formed precipitates and soluble salts dissolved. In this section we will apply chemical equilibria to the concept of solubility and introduce a type of equilibrium constant, the solubility constant, to allow us to calculate how soluble a salt really is.

**Solubility Equilibrium** defines the dynamic equilibria between a precipitate and its dissolved ions when the rate of dissolution equals the rate of crystallization and the resulting solution is a saturated solution, that contains the maximum concentration of dissolved ions that coexist with the undissolved solute (precipitate).

What do we mean by solubility of a salt? If I say one mole of sodium sulfate dissolves in water I am really meaning for every mole of sodium sulfate that dissolves, two moles of sodium are formed and one mole of sulfate. We will use the concept of solubility to describe the moles the salt that dissolves to form a saturated solution, and the actual ion concentration depends on the formula.

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### Solubility Product

This is the equilibrium constant for the process of dissolution. Consider the generic salt

\[M_xA_y(s) \rightleftharpoons xM^{+m}(aq) + yA^{-n}(aq)\]

Noting from charge neutrality that \(x(+m)+y(-n)=0\), then the equilibrium constant expression is:

\[K_{sp}=[M^{+m}]^x[A^{-n}]^y\]

The solid reactant is not part of the equilibrium, and it is called the solubility product because it is the product of the concentration of all the ions a salt breaks into. It is important to realize this is a heterogeneous equilibrium that defines a saturated solution and the solid is part of the process, although it does not influence the equilibrium concentration. That is, if all the solid is dissolved, you may have an unsaturated solution, and the solubility product defines the concentration of a saturated solution. At the end of this chapter is a solubility product table for ionic compounds at 25°C.

Let’s look at the solubility product for Calcium phosphate

\[Ca_3(PO_4)_2(s) \rightleftharpoons 3Ca^{+2} + 2PO_4^{-3}\]

\[K_{sp}(Ca_3(PO_4)_2)=[Ca^{+2}]^3[PO_4^{-3}]^2\]

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### Solubility Calculations

As in most equilibrium calculations, there are two types of problems. Knowing \(K\), what are the equilibrium concentrations, and knowing the equilibrium concentration of one thing, what is \(K\)

**Solubility of a Salt**

The solubility of a salt is "\(x\)" (from the ICE table), but we will not be using ICE tables in solubility product calculations,
and are just using it now to explain what is going on. From the following ICE table you can see that for every \( x \) moles of the calcium phosphate that dissolves per liter (its solubility), the solution gains 3 times that many moles of calcium and twice that many of phosphate, and there is no calcium phosphate floating around, just calcium and phosphate.

<table>
<thead>
<tr>
<th>ICE Table</th>
<th>( \text{(Ca}_3\text{(PO}_4\text{)}_2\text{(s)}) )</th>
<th>( \text{l(eftrightharpoons)} )</th>
<th>( \text{(Ca}^{+2} )</th>
<th>( \text{(PO}_4^{-3}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>[solid]</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Change</td>
<td>still solid</td>
<td>+3x</td>
<td>+2x</td>
<td>0</td>
</tr>
<tr>
<td>Equilibrium</td>
<td>still solid</td>
<td>3x</td>
<td>2x</td>
<td>0</td>
</tr>
</tbody>
</table>

That is, \( x \) the extent of reaction is a ICE diagram is the solubility of a salt. So you do not use a rice diagram, you say that for every \( x \) moles of solid that dissolves, the ions are that times the number of the ions in the formula So for Calcium phosphate

\[
[Ca^{+2}] = 3x \quad \text{and} \quad [PO_4^{-3}] = 2x
\]

\[
K_{sp}(Ca_3(PO_4)_2) = [3x]^3[2x]^2 = 108x^5
\]

Solving for the solubility \( x \) and noting that \( K_{sp}(\text{calcium phosphate}) = 2.07 \times 10^{-33} \)

\[
x = \sqrt[5]{\frac{K_{sp}}{108}} = \left( \frac{2.07 \times 10^{-33}}{108} \right)^{\frac{1}{5}} = 1.14 \times 10^{-7} = 114\text{nM}
\]

So there are three questions that can be answered here

1. The solubility of calcium phosphate is 114nM in water \((x)\)
2. The solubility of calcium is 341 nM in water \((3x)\)
3. The solubility of phosphate is 228 nM in water \((2x)\)

Exercise \(\PageIndex{1}\)

Which is more soluble, silver thiocyanide \((K_{sp} = 1.1 \times 10^{-12})\) or silver sulfite \((K_{sp} = 1.50 \times 10^{-14})\)

**Answer**

Silver sulfite, you can only compare \( K_{sp} \) values if the number of ions are the same, see video below.

For silver thiocyanide,

\[
K_{sp} = [Ag^{+}][SCN^{-}] = x^2 \quad x = \sqrt{K_{sp}} = \sqrt{1.1 \times 10^{-12}} = 1.0 \times 10^{-6}\n\]

For silver sulfite,

\[
K_{sp} = [Ag^{+}][SO_3^{-2}] = 4x^3 \quad x = \sqrt[3]{K_{sp}} = \sqrt[3]{1.50 \times 10^{-14}} = 1.56 \times 10^{-5}\n\]
Video \(\PageIndex{1}\): Solution to exercise \(\PageIndex{1}\).

**Determining \(K_{sp}\)**

If a saturated solution of \(\text{La(IO}_3\text{)}_3\) has an iodate concentration of 0.006M, what is \(K_{sp}\)?

\[\text{La(IO}_3\text{)}_3 \leftrightharpoons \text{La}^{+3} + 3\text{IO}_3^-\]

The lanthanum ion concentration = \(x\) and the iodate ion concentration = \(3x = 0.0060\). So \(x = 0.0020\)

\[K_{sp} = [\text{La}^{+3}][\text{IO}_3^-]^3 = [0.0020][0.0060]^3 = 4.2 \times 10^{-10}\]

**Solubility and Common ion Effect**

In section 17.1.3 solubility was introduced as an example of the common ion effect, and this problem was explained using ICE table and Le Chatelier's Principle.

What is the solubility of Calcium phosphate in a 0.100M sodium phosphate solution?

This is the same problem as above except that there is a common ion as the soluble sodium phosphate introduces phosphate that shifts the calcium phosphate to the left, reducing its solubility.

\[\text{Ca}_3\text{PO}_4(s) \leftrightharpoons 3\text{Ca}^{+2} + 2\text{PO}_4^{-3}\]

\[K_{sp}(\text{Ca}_3\text{PO}_4) = [\text{Ca}^{+2}]^3[\text{PO}_4^{-3}]^2\]

\[K_{sp}(\text{Ca}_3\text{PO}_4) = [0.0020]^3[0.100]^2\]
noting that $[\text{PO}_4^{3-}] = 0.100\text{M} + 3x$ and ignoring the x (see section 17.1.3)

$[\text{K}_\text{(sp)}(\text{Ca}_3\text{PO}_4) = [3x]^3[0.1]^2 = 0.27x^3]$ 

$x = \left( \frac{\text{K}_{sp}}{0.27} \right)^{\frac{1}{3}} = \left( \frac{2.07 \times 10^{-33}}{0.27} \right)^{\frac{1}{3}} = 1.97 \times 10^{-11}$

Exercise $\PageIndex{21}$

What is the lead concentration for a saturated solution of lead(II)bromide, and then mathematically demonstrate Le Chatlier's principle by determining the lead concentration when in the presence of a common ion by making the solution 1M in sodium bromide.

**Answer**

As the following video shows, the lead is 0.0118 in the absence of sodium bromide and is reduced to 6.6x10^{-6} in the presence of 1 M NaBr. This demonstrates Le Chatlier's principle as adding the bromide with the soluble sodium bromide salt pushed the equilibria of the insoluble lead(II)bromide salt to the left (consuming the bromide added), and thus removing the lead.

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Video $\PageIndex{2}$: Solution to exercise $\PageIndex{21}$. 

**Solubility Product Table**

This values relate to 25°C.
<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Compound Formula</th>
<th>$K_{sp}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum phosphate</td>
<td>AlPO$_4$</td>
<td>$9.84 \times 10^{-21}$</td>
</tr>
<tr>
<td>Barium bromate</td>
<td>Ba(BrO$_3$)$_2$</td>
<td>$2.43 \times 10^{-4}$</td>
</tr>
<tr>
<td>Barium carbonate</td>
<td>BaCO$_3$</td>
<td>$2.58 \times 10^{-9}$</td>
</tr>
<tr>
<td>Barium chromate</td>
<td>BaCrO$_4$</td>
<td>$1.17 \times 10^{-10}$</td>
</tr>
<tr>
<td>Barium fluoride</td>
<td>BaF$_2$</td>
<td>$1.84 \times 10^{-7}$</td>
</tr>
<tr>
<td>Barium iodate</td>
<td>Ba(IO$_3$)$_2$</td>
<td>$4.01 \times 10^{-9}$</td>
</tr>
<tr>
<td>Barium nitrate</td>
<td>Ba(NO$_3$)$_2$</td>
<td>$4.64 \times 10^{-3}$</td>
</tr>
<tr>
<td>Barium sulfate</td>
<td>BaSO$_4$</td>
<td>$1.08 \times 10^{-10}$</td>
</tr>
<tr>
<td>Barium sulfite</td>
<td>BaSO$_3$</td>
<td>$5.0 \times 10^{-10}$</td>
</tr>
<tr>
<td>Beryllium hydroxide</td>
<td>Be(OH)$_2$</td>
<td>$6.92 \times 10^{-22}$</td>
</tr>
<tr>
<td>Bismuth arsenate</td>
<td>BiAsO$_4$</td>
<td>$4.43 \times 10^{-10}$</td>
</tr>
<tr>
<td>Bismuth iodide</td>
<td>BiI$_3$</td>
<td>$7.71 \times 10^{-19}$</td>
</tr>
<tr>
<td>Cadmium carbonate</td>
<td>CdCO$_3$</td>
<td>$1.0 \times 10^{-12}$</td>
</tr>
<tr>
<td>Cadmium fluoride</td>
<td>CdF$_2$</td>
<td>$6.44 \times 10^{-3}$</td>
</tr>
<tr>
<td>Cadmium hydroxide</td>
<td>Cd(OH)$_2$</td>
<td>$7.2 \times 10^{-15}$</td>
</tr>
<tr>
<td>Cadmium iodate</td>
<td>Cd(IO$_3$)$_2$</td>
<td>$2.5 \times 10^{-8}$</td>
</tr>
<tr>
<td>Cadmium phosphate</td>
<td>Cd$_3$(PO$_4$)$_2$</td>
<td>$2.53 \times 10^{-33}$</td>
</tr>
<tr>
<td>Cadmium sulfide</td>
<td>CdS</td>
<td>$8.0 \times 10^{-27}$</td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>CaCO$_3$</td>
<td>$3.36 \times 10^{-9}$</td>
</tr>
<tr>
<td>Calcium fluoride</td>
<td>CaF$_2$</td>
<td>$3.45 \times 10^{-11}$</td>
</tr>
<tr>
<td>Calcium hydroxide</td>
<td>Ca(OH)$_2$</td>
<td>$5.02 \times 10^{-6}$</td>
</tr>
<tr>
<td>Calcium iodate</td>
<td>Ca(IO$_3$)$_2$</td>
<td>$6.47 \times 10^{-6}$</td>
</tr>
<tr>
<td>Calcium phosphate</td>
<td>Ca$_3$(PO$_4$)$_2$</td>
<td>$2.07 \times 10^{-33}$</td>
</tr>
<tr>
<td>Compound Name</td>
<td>Compound Formula</td>
<td>$K_{sp}$</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Calcium sulfate</td>
<td>CaSO(_4)</td>
<td>4.93 × 10(^{-5})</td>
</tr>
<tr>
<td>Cesium perchlorate</td>
<td>CsClO(_4)</td>
<td>3.95 × 10(^{-3})</td>
</tr>
<tr>
<td>Cesium periodate</td>
<td>CsI(_4)</td>
<td>5.16 × 10(^{-6})</td>
</tr>
<tr>
<td>Cobalt(II) arsenate</td>
<td>Co(_3)(AsO(_4))(_2)</td>
<td>6.80 × 10(^{-29})</td>
</tr>
<tr>
<td>Cobalt(II) hydroxide</td>
<td>Co(OH)(_2)</td>
<td>5.92 × 10(^{-15})</td>
</tr>
<tr>
<td>Cobalt(II) phosphate</td>
<td>Co(_3)(PO(_4))(_2)</td>
<td>2.05 × 10(^{-35})</td>
</tr>
<tr>
<td>Copper(I) bromide</td>
<td>CuBr</td>
<td>6.27 × 10(^{-9})</td>
</tr>
<tr>
<td>Copper(I) chloride</td>
<td>CuCl</td>
<td>1.72 × 10(^{-7})</td>
</tr>
<tr>
<td>Copper(I) cyanide</td>
<td>CuCN</td>
<td>3.47 × 10(^{-20})</td>
</tr>
<tr>
<td>Copper(I) iodide</td>
<td>CuI</td>
<td>1.27 × 10(^{-12})</td>
</tr>
<tr>
<td>Copper(I) thiocyanate</td>
<td>CuSCN</td>
<td>1.77 × 10(^{-13})</td>
</tr>
<tr>
<td>Copper(II) arsenate</td>
<td>Cu(_3)(AsO(_4))(_2)</td>
<td>7.95 × 10(^{-36})</td>
</tr>
<tr>
<td>Copper(II) oxalate</td>
<td>CuC(_2)O(_4)</td>
<td>4.43 × 10(^{-10})</td>
</tr>
<tr>
<td>Copper(II) phosphate</td>
<td>Cu(_3)(PO(_4))(_2)</td>
<td>1.40 × 10(^{-37})</td>
</tr>
<tr>
<td>Copper(II) sulfide</td>
<td>CuS</td>
<td>6.3 × 10(^{-36})</td>
</tr>
<tr>
<td>Europium(III) hydroxide</td>
<td>Eu(OH)(_3)</td>
<td>9.38 × 10(^{-27})</td>
</tr>
<tr>
<td>Gallium(III) hydroxide</td>
<td>Ga(OH)(_3)</td>
<td>7.28 × 10(^{-36})</td>
</tr>
<tr>
<td>Iron(II) carbonate</td>
<td>FeCO(_3)</td>
<td>3.13 × 10(^{-11})</td>
</tr>
<tr>
<td>Iron(II) fluoride</td>
<td>FeF(_2)</td>
<td>2.36 × 10(^{-6})</td>
</tr>
<tr>
<td>Iron(II) hydroxide</td>
<td>Fe(OH)(_2)</td>
<td>4.87 × 10(^{-17})</td>
</tr>
<tr>
<td>Iron(III) hydroxide</td>
<td>Fe(OH)(_3)</td>
<td>2.79 × 10(^{-39})</td>
</tr>
<tr>
<td>Iron(III) sulfide</td>
<td>FeS</td>
<td>6.3 × 10(^{-18})</td>
</tr>
<tr>
<td>Lanthanum iodate</td>
<td>La(IO(_3))(_3)</td>
<td>7.50 × 10(^{-12})</td>
</tr>
<tr>
<td>Compound Name</td>
<td>Compound Formula</td>
<td>$K_{sp}$</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Lead(II) bromide</td>
<td>PbBr$_2$</td>
<td>$6.60 \times 10^{-6}$</td>
</tr>
<tr>
<td>Lead(II) carbonate</td>
<td>PbCO$_3$</td>
<td>$7.40 \times 10^{-14}$</td>
</tr>
<tr>
<td>Lead(II) chloride</td>
<td>PbCl$_2$</td>
<td>$1.70 \times 10^{-5}$</td>
</tr>
<tr>
<td>Lead(II) fluoride</td>
<td>PbF$_2$</td>
<td>$3.3 \times 10^{-8}$</td>
</tr>
<tr>
<td>Lead(II) hydroxide</td>
<td>Pb(OH)$_2$</td>
<td>$1.43 \times 10^{-20}$</td>
</tr>
<tr>
<td>Lead(II) iodate</td>
<td>Pb(IO$_3$)$_2$</td>
<td>$3.69 \times 10^{-13}$</td>
</tr>
<tr>
<td>Lead(II) iodide</td>
<td>Pbl$_2$</td>
<td>$9.8 \times 10^{-9}$</td>
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<tr>
<td>Lead(II)selenite</td>
<td>PbSeO$_4$</td>
<td>$1.37 \times 10^{-7}$</td>
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<tr>
<td>Lead(II) sulfate</td>
<td>PbSO$_4$</td>
<td>$2.53 \times 10^{-8}$</td>
</tr>
<tr>
<td>Lead(II) sulfide</td>
<td>PbS</td>
<td>$8.0 \times 10^{-28}$</td>
</tr>
<tr>
<td>Lithium carbonate</td>
<td>Li$_2$CO$_3$</td>
<td>$8.15 \times 10^{-4}$</td>
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<tr>
<td>Lithium fluoride</td>
<td>LiF</td>
<td>$1.84 \times 10^{-3}$</td>
</tr>
<tr>
<td>Lithium phosphate</td>
<td>Li$_3$PO$_4$</td>
<td>$2.37 \times 10^{-11}$</td>
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<tr>
<td>Magnesium carbonate</td>
<td>MgCO$_3$</td>
<td>$6.82 \times 10^{-6}$</td>
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<td>Magnesium fluoride</td>
<td>MgF$_2$</td>
<td>$5.16 \times 10^{-11}$</td>
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<td>Magnesium hydroxide</td>
<td>Mg(OH)$_2$</td>
<td>$5.61 \times 10^{-12}$</td>
</tr>
<tr>
<td>Magnesium phosphate</td>
<td>Mg$_3$(PO$_4$)$_2$</td>
<td>$1.04 \times 10^{-24}$</td>
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<tr>
<td>Manganese(II) carbonate</td>
<td>MnCO$_3$</td>
<td>$2.24 \times 10^{-11}$</td>
</tr>
<tr>
<td>Manganese(II) iodate</td>
<td>Mn(IO$_3$)$_2$</td>
<td>$4.37 \times 10^{-7}$</td>
</tr>
<tr>
<td>Mercury(I) bromide</td>
<td>Hg$_2$Br$_2$</td>
<td>$6.40 \times 10^{-23}$</td>
</tr>
<tr>
<td>Mercury(I) carbonate</td>
<td>Hg$_2$CO$_3$</td>
<td>$3.6 \times 10^{-17}$</td>
</tr>
<tr>
<td>Mercury(I) chloride</td>
<td>Hg$_2$Cl$_2$</td>
<td>$1.43 \times 10^{-18}$</td>
</tr>
<tr>
<td>Mercury(I) fluoride</td>
<td>Hg$_2$F$_2$</td>
<td>$3.10 \times 10^{-6}$</td>
</tr>
<tr>
<td>Compound Name</td>
<td>Compound Formula</td>
<td>$K_{sp}$</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Mercury(I) iodide</td>
<td>$\text{Hg}_2\text{I}_2$</td>
<td>$5.2 \times 10^{-29}$</td>
</tr>
<tr>
<td>Mercury(I) oxalate</td>
<td>$\text{Hg}_2\text{C}_2\text{O}_4$</td>
<td>$1.75 \times 10^{-13}$</td>
</tr>
<tr>
<td>Mercury(I) sulfate</td>
<td>$\text{Hg}_2\text{SO}_4$</td>
<td>$6.5 \times 10^{-7}$</td>
</tr>
<tr>
<td>Mercury(I) thiocyanate</td>
<td>$\text{Hg}_2(\text{SCN})_2$</td>
<td>$3.2 \times 10^{-20}$</td>
</tr>
<tr>
<td>Mercury(II) bromide</td>
<td>$\text{HgBr}_2$</td>
<td>$6.2 \times 10^{-20}$</td>
</tr>
<tr>
<td>Mercury (II) iodide</td>
<td>$\text{Hgl}_2$</td>
<td>$2.9 \times 10^{-29}$</td>
</tr>
<tr>
<td>Mercury(II) sulfide (red)</td>
<td>$\text{HgS}$</td>
<td>$4 \times 10^{-53}$</td>
</tr>
<tr>
<td>Mercury(II) sulfide (black)</td>
<td>$\text{HgS}$</td>
<td>$1.6 \times 10^{-52}$</td>
</tr>
<tr>
<td>Neodymium carbonate</td>
<td>$\text{Nd}_2(\text{CO}_3)_3$</td>
<td>$1.08 \times 10^{-33}$</td>
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<tr>
<td>Nickel(II) carbonate</td>
<td>$\text{NiCO}_3$</td>
<td>$1.42 \times 10^{-7}$</td>
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<tr>
<td>Nickel(II) hydroxide</td>
<td>$\text{Ni(OH)}_2$</td>
<td>$5.48 \times 10^{-16}$</td>
</tr>
<tr>
<td>Nickel(II) iodate</td>
<td>$\text{Ni(IO}_3)_2$</td>
<td>$4.71 \times 10^{-5}$</td>
</tr>
<tr>
<td>Nickel(II) phosphate</td>
<td>$\text{Ni}_3(\text{PO}_4)_2$</td>
<td>$4.74 \times 10^{-32}$</td>
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<tr>
<td>Palladium(II) thiocyanate</td>
<td>$\text{Pd(SCN)}_2$</td>
<td>$4.39 \times 10^{-23}$</td>
</tr>
<tr>
<td>Potassium hexachloroplatinate</td>
<td>$\text{K}_2\text{PtCl}_6$</td>
<td>$7.48 \times 10^{-6}$</td>
</tr>
<tr>
<td>Potassium perchlorate</td>
<td>$\text{KClO}_4$</td>
<td>$1.05 \times 10^{-2}$</td>
</tr>
<tr>
<td>Potassium periodate</td>
<td>$\text{KIO}_4$</td>
<td>$3.71 \times 10^{-4}$</td>
</tr>
<tr>
<td>Praseodymium hydroxide</td>
<td>$\text{Pr(OH)}_3$</td>
<td>$3.39 \times 10^{-24}$</td>
</tr>
<tr>
<td>Rubidium perchlorate</td>
<td>$\text{RbClO}_4$</td>
<td>$3.00 \times 10^{-3}$</td>
</tr>
<tr>
<td>Scandium fluoride</td>
<td>$\text{ScF}_3$</td>
<td>$5.81 \times 10^{-24}$</td>
</tr>
<tr>
<td>Scandium hydroxide</td>
<td>$\text{Sc(OH)}_3$</td>
<td>$2.22 \times 10^{-31}$</td>
</tr>
<tr>
<td>Silver(I) acetate</td>
<td>$\text{AgCH}_3\text{CO}_2$</td>
<td>$1.94 \times 10^{-3}$</td>
</tr>
<tr>
<td>Silver(I) arsenate</td>
<td>$\text{Ag}_3\text{AsO}_4$</td>
<td>$1.03 \times 10^{-22}$</td>
</tr>
<tr>
<td>Compound Name</td>
<td>Compound Formula</td>
<td>$K_{sp}$</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Silver(I) bromate</td>
<td>AgBrO₃</td>
<td>$5.38 \times 10^{-5}$</td>
</tr>
<tr>
<td>Silver(I) bromide</td>
<td>AgBr</td>
<td>$5.35 \times 10^{-13}$</td>
</tr>
<tr>
<td>Silver(I) carbonate</td>
<td>Ag₂CO₃</td>
<td>$8.46 \times 10^{-12}$</td>
</tr>
<tr>
<td>Silver(I) chloride</td>
<td>AgCl</td>
<td>$1.77 \times 10^{-10}$</td>
</tr>
<tr>
<td>Silver(I) chromate</td>
<td>Ag₂CrO₄</td>
<td>$1.12 \times 10^{-12}$</td>
</tr>
<tr>
<td>Silver(I) cyanide</td>
<td>AgCN</td>
<td>$5.97 \times 10^{-17}$</td>
</tr>
<tr>
<td>Silver(I) iodate</td>
<td>AgIO₃</td>
<td>$3.17 \times 10^{-8}$</td>
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<tr>
<td>Silver(I) iodide</td>
<td>AgI</td>
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<tr>
<td>Silver(I) oxalate</td>
<td>Ag₂C₂O₄</td>
<td>$5.40 \times 10^{-12}$</td>
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<tr>
<td>Silver(I) phosphate</td>
<td>Ag₃PO₄</td>
<td>$8.89 \times 10^{-17}$</td>
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<tr>
<td>Silver(I) sulfate</td>
<td>Ag₂SO₄</td>
<td>$1.20 \times 10^{-5}$</td>
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<tr>
<td>Silver(I) sulfide</td>
<td>Ag₂S</td>
<td>$6.3 \times 10^{-50}$</td>
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<td>Silver(I) sulfite</td>
<td>Ag₂SO₃</td>
<td>$1.50 \times 10^{-14}$</td>
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<tr>
<td>Silver(I) thiocyanate</td>
<td>AgSCN</td>
<td>$1.03 \times 10^{-12}$</td>
</tr>
<tr>
<td>Strontium arsenate</td>
<td>Sr₃(AsO₄)₂</td>
<td>$4.29 \times 10^{-19}$</td>
</tr>
<tr>
<td>Strontium carbonate</td>
<td>SrCO₃</td>
<td>$5.60 \times 10^{-10}$</td>
</tr>
<tr>
<td>Strontium fluoride</td>
<td>SrF₂</td>
<td>$4.33 \times 10^{-9}$</td>
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<tr>
<td>Strontium iodate</td>
<td>Sr(IO₃)₂</td>
<td>$1.14 \times 10^{-7}$</td>
</tr>
<tr>
<td>Strontium sulfate</td>
<td>SrSO₄</td>
<td>$3.44 \times 10^{-7}$</td>
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<tr>
<td>Thallium(I) bromate</td>
<td>TlBrO₃</td>
<td>$1.10 \times 10^{-4}$</td>
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<tr>
<td>Thallium(I) bromide</td>
<td>TlBr</td>
<td>$3.71 \times 10^{-6}$</td>
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<tr>
<td>Thallium(I) chloride</td>
<td>TlCl</td>
<td>$1.86 \times 10^{-4}$</td>
</tr>
<tr>
<td>Thallium(I) chromate</td>
<td>Tl₂CrO₄</td>
<td>$8.67 \times 10^{-13}$</td>
</tr>
<tr>
<td>Compound Name</td>
<td>Compound Formula</td>
<td>$K_{sp}$</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Thallium(I) iodate</td>
<td>TlIO$_3$</td>
<td>$3.12 \times 10^{-6}$</td>
</tr>
<tr>
<td>Thallium(I) iodide</td>
<td>TlI</td>
<td>$5.54 \times 10^{-8}$</td>
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<tr>
<td>Thallium(I) thiocyanate</td>
<td>TlSCN</td>
<td>$1.57 \times 10^{-4}$</td>
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<td>Thallium(III) hydroxide</td>
<td>Ti(OH)$_3$</td>
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<tr>
<td>Tin(II) hydroxide</td>
<td>Sn(OH)$_2$</td>
<td>$5.45 \times 10^{-27}$</td>
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<td>Tin(II) sulfide</td>
<td>SnS</td>
<td>$1.0 \times 10^{-25}$</td>
</tr>
<tr>
<td>Yttrium carbonate</td>
<td>Y$_2$(CO$_3$)$_3$</td>
<td>$1.03 \times 10^{-31}$</td>
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<tr>
<td>Yttrium fluoride</td>
<td>YF$_3$</td>
<td>$8.62 \times 10^{-21}$</td>
</tr>
<tr>
<td>Yttrium hydroxide</td>
<td>Y(OH)$_3$</td>
<td>$1.00 \times 10^{-22}$</td>
</tr>
<tr>
<td>Yttrium iodate</td>
<td>Y(IO$_3$)$_3$</td>
<td>$1.12 \times 10^{-10}$</td>
</tr>
<tr>
<td>Zinc arsenate</td>
<td>Zn$_3$(AsO$_4$)$_2$</td>
<td>$2.8 \times 10^{-28}$</td>
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<tr>
<td>Zinc carbonate</td>
<td>ZnCO$_3$</td>
<td>$1.46 \times 10^{-10}$</td>
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<td>Zinc fluoride</td>
<td>ZnF$_2$</td>
<td>$3.04 \times 10^{-2}$</td>
</tr>
<tr>
<td>Zinc hydroxide</td>
<td>Zn(OH)$_2$</td>
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<tr>
<td>Zinc selenide</td>
<td>ZnSe</td>
<td>$3.6 \times 10^{-26}$</td>
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<td>Zinc sulfide (wurtzite)</td>
<td>ZnS</td>
<td>$1.6 \times 10^{-24}$</td>
</tr>
<tr>
<td>Zinc sulfide (sphalerite)</td>
<td>ZnS</td>
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</table>


Test Yourself

Homework: Section 17.4

Contributors and Attributions
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