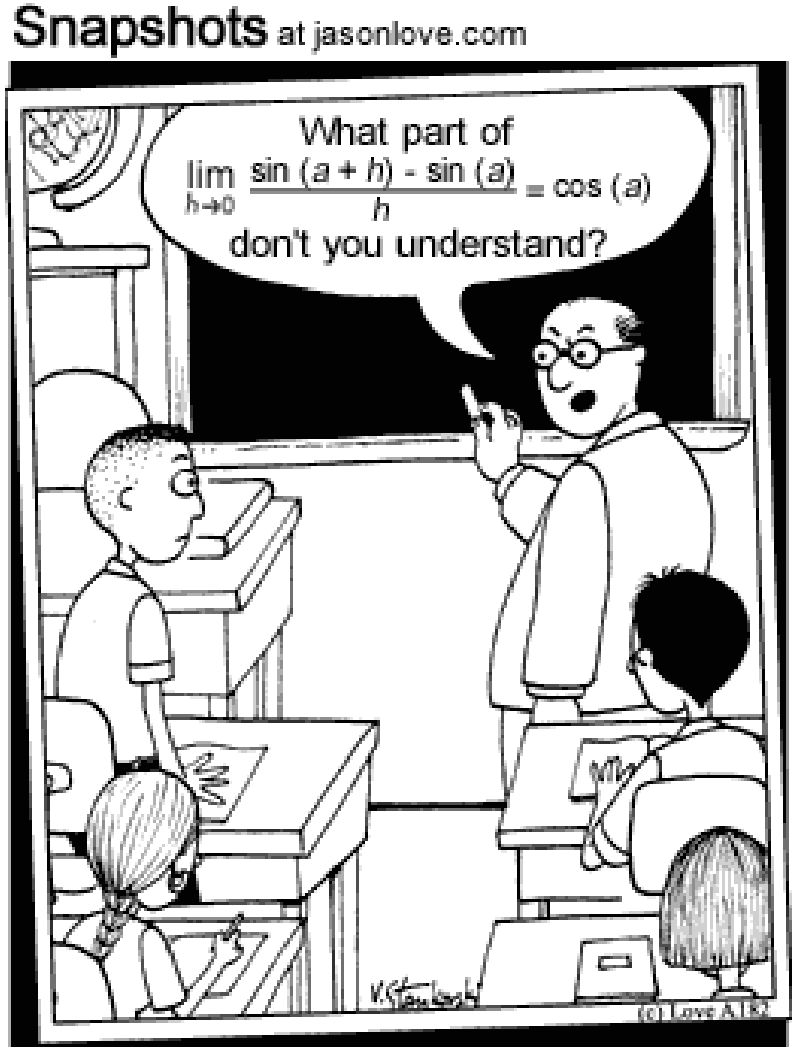
Solubility Calculations



Outcome:

Solve problems involving Ksp

Solubility Calculations…

We have already seen how to work between Ksp and **SOLUBILITY**, now we will look at some different types of solubility problems.

Examples:

1. ***Comparing solubilities…***
   - To compare the **SOLUBILITY** of two **SALTS**, compare the **Ksp VALUES**.
   - The **LARGER** the **Ksp**, the **GREATER** the **SOLUBILITY** (more **IONS** produced → more **PRODUCT**).

Ex) Which of the following salts has the greatest solubility in water?

Lead (II) Chloride ($K_{sp} = 1.6 \times 10^{-5}$)

OR

Copper (I) Iodide ($K_{sp} = 1.1 \times 10^{-12}$)

* Larger Ksp = more ions in Sol^n
∴ more has dissolved
(more soluble)

Solubility Calculations…

2. Find ion concentration given Ksp…

- Use an **ICE TABLE** and plug unknown values into Ksp expression.

Example:

The Ksp of magnesium hydroxide is 8.9×10^{-12}. Find the concentration of the dissolved ions in a saturated solution of $Mg(OH)_2$.

$Mg(OH)_{2(s)} \rightleftharpoons Mg^{2+}_{(aq)} + 2OH^-_{(aq)}$

X	0	0
−X	+x	2x
∅	x	2x

$K_{sp} = [Mg^{2+}][OH^-]^2$

$8.9 \times 10^{-12} = (x)(2x)^2$

$8.9 \times 10^{-12} = 4x^3$

$x = \sqrt[3]{\frac{8.9 \times 10^{-12}}{4}}$

$x = 1.31 \times 10^{-4} \frac{mol}{L}$ = solubility of $Mg(OH)_2$

$[Mg^{2+}] = x = 1.31 \times 10^{-4} \frac{mol}{L}$

$[OH^-] = 2x = 2.62 \times 10^{-4} \frac{mol}{L}$

Note: This is the same as finding the solubility. We can use our answer to find solubility as before…

Solubility Calculations…

3. ***Maximum amount of ions before precipitation…***
   - Ksp tells us the **PRODUCT** of the **MAXIMUM ION CONCENTRATIONS** that can be **DISSOLVED**.
   - Any ion **PRODUCT** that **EXCEEDS** the **Ksp** will result in **PRECIPITATION**.
   - Simply solve for the ion **CONCENTRATION** as before → this is the **MAXIMUM AMOUNT** of that **IONS** that can be present before **PRECIPITATION**.

Ex) The Ksp of CuCl is 3.2×10^{-7}. If the concentration of Cl^- is 4.1×10^{-5} mol/L, what is the concentration of Cu^+ that will start the precipitation?

$CuCl_{(s)} \rightleftharpoons Cu^+_{(aq)} + Cl^-_{(aq)}$

$4.1 \times 10^{-5}\ \frac{mol}{L}$

$K_{sp} = [Cu^+][Cl^-]$

$3.2 \times 10^{-7} = [Cu^+](4.1 \times 10^{-5})$

$[Cu^+] = 0.0078\ \frac{mol}{L}$