(#11-2 #11-1)

Modeling and determining equilibrium of solubility

A salt KOH is dissolved by the following reaction.

lots of ions! $K^+ + OH^{-1} \Leftrightarrow KOH_{(S)}$ $K = \frac{1}{[K^+][OH^-]}$ larger amount on bottom

a. Write out the equilibrium expression

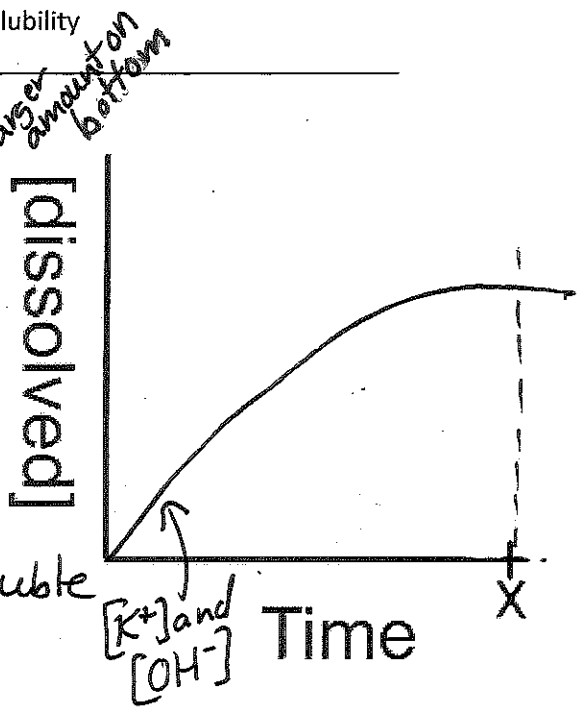
b. What happens to the value of K if this substance is really soluble? K is small

A salt KOH is dissolved by the following reaction.

Use this one! $KOH_{(s)} \Leftrightarrow K^+ + OH^{-1}$ $K = \frac{[K^+][OH^-]}{1}$

a. Write out the equilibrium expression.

b. What happens to the value of K if the substance is really soluble. K is large if really soluble



To allow K to correspond with solubility, industrial scientist who created this method chose to always write the dissolving reaction with the solid on the left as see below.

$KOH(s) \Leftrightarrow K^+(aq) + OH^{-1}$ *To distinguish this method they gave it a special name "solubility product"*

$$Ksp = [K^+][OH^{-1}]$$

NaCl

You take a sample of salt (table) and you start to dissolve it in water. You continue to add and stir the solution. After a period of time it appears solid is forming on the bottom.

a. Write the (Ksp) solubility equation. $NaCl \Leftrightarrow Na^{+1} + Cl^{-1}$ $Ksp = [Na^{+1}][Cl^{-1}]$

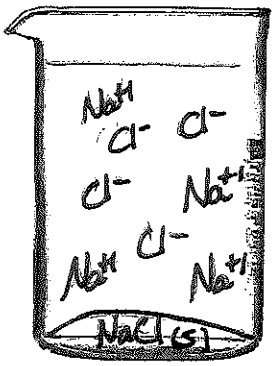
b. This chemical reaction goes to (completion/equilibrium).

c. To the right draw a picture of table salt dissolving. The reaction gets saturated at time X.

d. A student hypothesizes that stirring increases solubility. Confirm or counter this statement. Stirring will increase the rate of dissolving, but will not effect solubility

e. How might you increase the solubility of table salt in water. increase temperature

f. Draw the picture of table salt in the beaker to the right at time X.



$5g \left| \frac{1mol}{311.9g} \right. = 0.016 mol$ $(107.9\times2)+32+(4\times16)$ Ag_2SO_4 $311.9 g/mol$

A student dissolved Ag_2SO_4 in 100mL of water. The student added 5g of silver sulfate to the solution and measured the concentration of SO_4^{-2} to be 0.0135M and solid is on the bottom. Answer the following questions. $0.0135M = \frac{X}{0.1L}$

a. Draw the beaker. $Ag_2SO_4 \rightleftharpoons 2Ag^{+1} + SO_4^{-2}$

b. Based on your picture, if the $SO4^{-2}$ = 0.0135, what is the $[Ag^+]$? $2\times0.0135=$ 0.027M
$[Ag^{+1}]$ will be 2x's the concentration of SO_4^{-2}

c. How might these concentrations change if 5 more grams of solid is added? No Change. The solution is already saturated (solid on bottom)

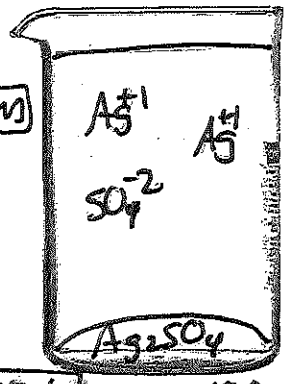
d. Create an ISE reaction table, Fill it out and determine the K value.

moles in 1L

	$Ag_2SO_4 \leftrightarrows 2Ag^{+1}$	$+ SO_4^{-2}$
I	0	0
S	+0.027	+0.0135
E	0.027	0.0135

$K_{sp} = [Ag^{+1}]^2[SO_4^{-2}]$

$K_{sp} = [0.027]^2[0.0135] = 9.8E-6$



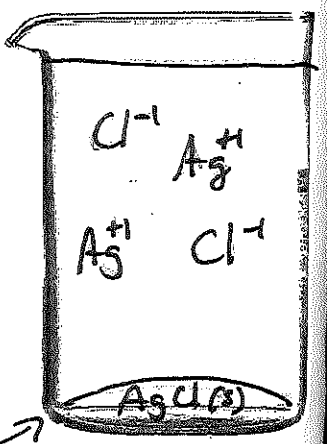
Two salts are dissolving, AgBr (Ksp = 5E-13) and AgCl (Ksp = 1.6E-10), Answer the following questions.

a. Write out the dissolving equation for each.

$AgBr \rightleftharpoons Ag^{+1} + Br^{-1}$ $AgCl \rightleftharpoons Ag^{+1} + Cl^{-1}$

b. Write out the solubility expression.

$K_{sp} = [Ag^{+1}][Br^-]$ $K_{sp} = [Ag^{+1}][Cl^{-1}]$



c. A large K value means what relative to solubility?
A large K means lots of ions (as product) & is very soluble

d. Which of the two salts is more soluble?
$K_{sp} = 1.6E-10$ is larger than $K_{sp} = 5E-13$
AgCl is more soluble than AgBr

e. Draw a saturated solution of the *more* soluble salt.
AgCl

A student comes across a solution that is saturated solution of lead(II) chloride. The lead ion has a concentration of 1.5E-5M. Answer the following questions.

a. Write out the solubility reaction.

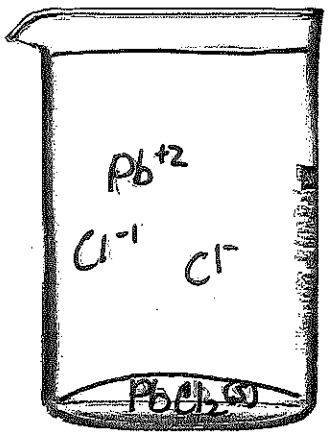
$PbCl_{2(s)} \rightleftharpoons Pb^{+2} + 2Cl^{-1}$

x 2x

b. Write out the solubility equilibrium expression.

$K_{sp} = [Pb^{+2}][Cl^{-1}]^2$

c. Draw a picture of this reaction mixture.



d. What is the concentration of the Chloride ion?

$[Pb^{+2}] = 1.5E-5M$

$[Cl^{-1}] = 2(1.5E-5M) = 3.0E-5M$

e. What is the equilibrium constant for this reaction?

$K_{sp} = [Pb^{+2}][Cl^{-1}]^2 = [1.5E-5][3.0E-5M]^2 = 1.35E-14$