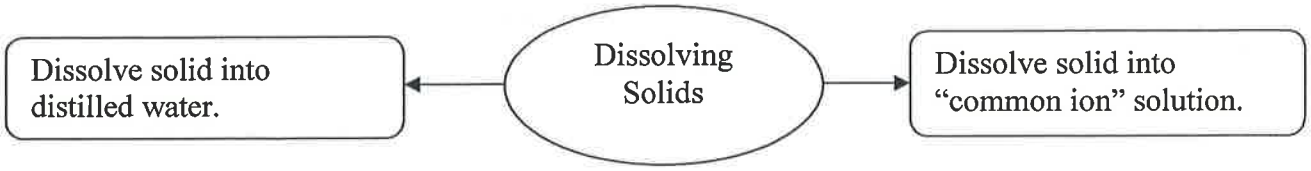
Mr. Bracken
AP Chemistry

Name BRACKEN KEY
Period ____

Ksp Problems Worksheet #2 (2011)
(Dissolving Solids)



1. Based on the Ksp value, what is the maximum molarity (molar solubility) of $PbSO_4$ in distilled water?

$PbSO_4 \rightleftharpoons Pb^{2+} + SO_4^{2-}$

$K_{sp} = 6.3 \times 10^{-7} = [Pb^{2+}][SO_4^{2-}]$

	Pb^{2+}	SO_4^{2-}
	0	0
	+x	+x
	x	x

x = Max. Molarity

$6.3 \times 10^{-7} = [x][x]$

$x = 7.9 \times 10^{-4}$ M

2. The maximum molarity of $BaCrO_4$ in distilled water is 1.5×10^{-5} M. Based on this, calculate the K_{sp}.

$BaCrO_4 \rightleftharpoons Ba^{2+} + CrO_4^{2-}$

$K_{sp} = [Ba^{2+}][CrO_4^{2-}]$

	Ba^{2+}	CrO_4^{2-}
	0	0
	+x	+x
	x	x

x = max molarity

$K_{sp} = [x][x]$

from problem $x = 1.5 \times 10^{-5}$ M

$K_{sp} = [1.5 \times 10^{-5}][1.5 \times 10^{-5}]$

$K_{sp} = 2.3 \times 10^{-10}$

3. Solid $BaSO_4$ is added to water and the resulting saturated concentration of the Ba^{2+} is 1.04×10^{-5} M. What is the K_{sp} for $BaSO_4$?

$BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$

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

	Ba^{2+}	SO_4^{2-}
	0	0
	+x	+x
	x	x

x = max. molarity

$K_{sp} = [1.04 \times 10^{-5}][1.04 \times 10^{-5}]$

$x = 1.04 \times 10^{-5}$ M

$K_{sp} = 1.08 \times 10^{-10}$

4. Calculate the maximum molarity for $Mn(OH)_2$ in a solution that contains 0.20 M NaOH.

$Mn(OH)_2 \rightleftharpoons Mn^{2+} + 2\,OH^-$

$K_{sp} = 1.6 \times 10^{-13} = [x][.20 + 2x]^2$

	Mn^{2+}	$2\,OH^-$
	0	.20M
	+x	+2x
	x	.20 +2x

$x = 4.0 \times 10^{-12}$ M

5. Calculate the maximum molarity for $PbCl_2$ in a solution that contains 0.42 M KCl.

$PbCl_2 \rightleftharpoons Pb^{2+} + 2\,Cl^-$

	Pb^{2+}	$2\,Cl^-$
	0	.42 M
	+x	+2x
	x	.42 + 2x

X = max. molarity

$K_{sp} = 1.7 \times 10^{-5} = [Pb^{2+}][Cl^-]^2$

$1.7 \times 10^{-5} = [x][.42 + 2x]^2$

$X = 9.6 \times 10^{-5}\ M$

6. Calculate the maximum molarity for $SrCO_3$ in a solution that contains 0.15 M $Sr(NO_3)_2$.

$SrCO_3 \rightleftharpoons Sr^{2+} + CO_3^{2-}$

	Sr^{2+}	CO_3^{2-}
	.15 M	0
	+ x	+x
	.15 + x	x

X = max. molarity

$K_{sp} = 9.3 \times 10^{-10} = [Sr^{2+}][CO_3^{2-}]$

$9.3 \times 10^{-10} = [.15 + x][x]$

$X = 6.2 \times 10^{-9}\ M$

7. (a) What is the maximum molarity of $Ca(OH)_2$ in pure water?

$Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2\,OH^-$

	Ca^{2+}	$2\,OH^-$
	0	0
	+x	+2x
	x	2x

X = max. molarity

$K_{sp} = 6.5 \times 10^{-6} = [Ca^{2+}][OH^-]^2$

$6.5 \times 10^{-6} = [x][2x]^2$

$6.5 \times 10^{-6} = 4x^3$

$X = 0.012\ M$

(b) What is the maximum molarity of $Ca(OH)_2$ in a pH = 12.0 buffer solution?

→ pOH = 2.0 $\quad [OH^-] = 1.0 \times 10^{-2}\ M$

$Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2\,OH^-$

	Ca^{2+}	$2\,OH^-$
	0	1.0×10^{-2}
	+x	+2x
	x	$1.0 \times 10^{-2} + 2x$

$6.5 \times 10^{-6} = [x][1.0 \times 10^{-2} + 2x]^2$

$X = .0087\ M$

(c) Compare your solubility values from parts **a** and **b**. Is $Ca(OH)_2$ more or less soluble under basic conditions?

Because the "max molarity" is larger in (a) (pure H_2O), the $Ca(OH)_2$ is more soluble under neutral conditions, less soluble under basic conditions. Le Chatelier's Principle would predict this.