ANSWER KEY.

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7.11 Introduction to Solubility Equilibria

AP Chemistry | ANSWER KEY

Write the solid on the left and the ions on the right. K_{sp} leaves out the solid. Molar solubility, s, is the moles of salt that dissolve per liter.

1. Write the dissolving equation and the K_{sp} expression for each salt.

(a) $BaSO_4$

$BaSO_4(s) \rightleftharpoons Ba^{2+} + SO_4^{2-}$; $K_{sp} = [Ba^{2+}][SO_4^{2-}]$

(b) Ag_2CO_3

$Ag_2CO_3(s) \rightleftharpoons 2Ag^{+} + CO_3^{2-}$; $K_{sp} = [Ag^{+}]^2[CO_3^{2-}]$

(c) $Ca_3(PO_4)_2$

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

2. K_{sp} for $BaSO_4$ is 1.1×10^{-10}. Calculate its molar solubility.

$K_{sp} = s^2$, so $s = \sqrt{(1.1 \times 10^{-10})} = 1.0 \times 10^{-5}$ M

3. K_{sp} for Ag_2CO_3 is 8.1×10^{-12}. Find s and $[Ag^{+}]$.

$K_{sp} = (2s)^2(s) = 4s^3$, so $s^3 = 2.0 \times 10^{-12}$ and $s = 1.3 \times 10^{-4}$ M. $[Ag^{+}] = 2s = 2.5 \times 10^{-4}$ M

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4. The molar solubility of $Mg(OH)_2$ is 1.1×10^{-4} M. Calculate K_{sp}.

$[Mg^{2+}] = s$, $[OH^-] = 2s$. $K_{sp} = 4s^3 = 4(1.1 \times 10^{-4})^3 = 5.3 \times 10^{-12}$

5. Which is more soluble in water, BaF_2 ($K_{sp} = 1.0 \times 10^{-6}$) or $BaSO_4$ ($K_{sp} = 1.1 \times 10^{-10}$)? Justify with s.

BaF_2: $4s^3 = 1.0 \times 10^{-6}$, $s = 6.3 \times 10^{-3}$ M. $BaSO_4$: $s = 1.0 \times 10^{-5}$ M. BaF_2 is more soluble. The ion ratios differ, so compare s, not K_{sp}.

6. Convert the molar solubility of $BaSO_4$ from question 2 to grams per liter (233.40 g/mol).

$(1.05 \times 10^{-5}$ mol/L)(233.40 g/mol) $= 2.4 \times 10^{-3}$ g/L

7. A student writes $K_{sp} = 2s^3$ for Ag_2CO_3. Find and fix the mistake.

The 2 must be squared too: $(2s)^2(s) = 4s^3$, not $2s^3$.

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