Name:_____
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Chemistry 12
Solubililty Lesson #2

CALCULATING *SOLUBILITY* AND *ION CONCENTRATIONS*

SOLUBILITY (g/L) is defined as: the maximum amount of a substance that can dissolve in a given amount of solvent at a given temp.

MOLAR SOLUBILITY (mol/L) is: the equilibrium concentration of a substance in a saturated solution at a given temp.

Example 1 : It is determined experimentally that 1 L of saturated $AgBrO_3$ (aq) contains 1.96 g of $AgBrO_3$. What is the MOLAR SOLUBILITY of $AgBrO_3$?

Ag = 107.9
Br = 79.9
3 O = 48.0
235.8 g $AgBrO_3$ / 1 mol

$$\frac{1.96\ g\ AgBrO_3}{1\ L} \cdot \left(\frac{1\ mol}{235.8\ g}\right) = 8.31 \cdot 10^{-3}\ M\ AgBrO_3$$

Example 2: The Molar solubility of PbI_2 is 1.37×10^{-3} M. Express this value in grams per Litre. (solubility)

Pb = 207.2
2 I = 253.8
461.0 g PbI_2 / 1 mol

$$\frac{1.37 \cdot 10^{-3}\ mol\ PbI_2}{1\ L} \cdot \left(\frac{461.0\ g\ PbI_2}{1\ mol}\right) = 0.632\ g/L\ PbI_2$$

Example 3: Experimentally it is found that 250.0 mL of saturated $CaCl_2$ contains 18.6 g of $CaCl_2$ at 20 °C. What is the molar solubility of $CaCl_2$? M = mol/L

Ca = 40.1
2 Cl = 71.0
111.1 g / 1 mol

$$\frac{18.6\ g\ CaCl_2}{250.0\ mL} \cdot \left(\frac{1\ mol}{111.1\ g\ CaCl_2}\right)\left(\frac{1\ mL}{1 \cdot 10^{-3}\ L}\right) = 6.70 \cdot 10^{-1}\ M\ CaCl_2$$

OR 0.670 M

CALCULATING ION CONCENTRATIONS

Example 1: What are the individual ion concentrations contained in 1 M of Na_3PO_4 (aq) ?

$$1\ Na_3PO_4(aq) \rightarrow 3\ Na^+(aq) + 1\ PO_4^{3-}(aq)$$

1 M → 3 M, 1 M

solid

Example 2: What is the concentration of all ions present in a saturated solution of Ag_2CO_3 having a molarity of 1.2×10^{-4} M?

$1\,Ag_2CO_3(s) \rightleftharpoons 2\,Ag^+(aq) + 1\,CO_3^{2-}(aq)$

$1.2 \cdot 10^{-4}$ M → $2.4 \cdot 10^{-4}$ M, $1.2 \cdot 10^{-4}$ M

Example 3: If 5.0 mL of 0.020 M Cl^{1-} is added to 15.0 mL of 0.012 M Br^{1-}, what is the molarity of Cl^{1-} and Br^{1-} ions in this mixture?

RECALL the Dilution Equation $M_I V_I = M_F V_F$

$$[Cl^-]_F = \frac{0.020\,M \cdot 0.0050\,L}{0.0200\,L} = 5.0 \cdot 10^{-3}\,M\ Cl^-$$

$$[Br^-]_F = \frac{0.012\,M \cdot 0.0150\,L}{0.0200\,L} = 9.0 \cdot 10^{-3}\,M\ Br^-$$

Example #4: Calculate the conentration of all ions present when 10.0 mL of 0.100 M $Ba(NO_3)_2$ is mixed with 40.0 mL of 0.300 M $AgNO_3$

$Ba(NO_3)_2 \rightarrow 1\,Ba^{2+}(aq) + 2\,NO_3^-(aq)$

$AgNO_3 \rightarrow Ag^+(aq) + NO_3^-(aq)$

$$[Ba(NO_3)_2]_F = \frac{0.100\,M \cdot 0.0100\,L}{0.0500\,L} = 0.0200\,M\ Ba(NO_3)_2$$

$\therefore\ Ba^{2+}(aq) = 0.0200\,M\ Ba^{2+}$

$NO_3^- = 2\,(0.0200\,M) = 0.0400\,M\ NO_3^-$

$$[AgNO_3]_F = \frac{0.300\,M \cdot 0.0400\,L}{0.0500\,L} = 0.240\,M\ AgNO_3$$

$[Ag^+] = 0.240$ M ; $NO_3^- = 0.240$ M

Seat work/HOMEWORK: 8, 14 pg 77-78, 18, 20 (odd letters) pg 81

PLO's: G1, G2, G3, G4, G5, G6, and G8

$$[NO_3^-] = 0.0400\,M + 0.240\,M = 0.280\,M\ NO_3^-$$