PP Q#121 – 128

121 $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

$1.3\times10^{-5}\ \frac{mol}{L}$ $\quad 1.3\times10^{-5}\ \frac{mol}{L}$ $\quad 1.3\times10^{-5}\ \frac{mol}{L}$

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

$= (1.3\times10^{-5})(1.3\times10^{-5})$

$= 1.7\times10^{-10}$

∴ the solubility-product constant is 1.7×10^{-10}

122. $MgF_{2(s)} \rightleftharpoons Mg^{2+}_{(aq)} + 2F^-_{(aq)}$

$2.7\times10^{-3}\ \frac{mol}{L}$ $\quad 2.7\times10^{-3}\ \frac{mol}{L}$ $\quad 2(2.7\times10^{-3}\ \frac{mol}{L})$

$= 5.4\times10^{-3}\ \frac{mol}{L}$

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

$= (2.7\times10^{-3})(5.4\times10^{-3})^2$

$= 7.9\times10^{-8}$

∴ the solubility-product constant is 7.9×10^{-8}

123 $Ag_2S_{(s)} \rightleftharpoons 2Ag^+_{(aq)} + S^{2-}_{(aq)}$

I			
C	$-x$	$+2x$	$+x$
E	$-x$	$+2x$	$+x$

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

$5.6\times10^{-49} = (2x)^2(x)$

$5.6\times10^{-49} = 4x^3$

$x = 5.2\times10^{-17}$ mol/L

∴ the molar solubility of Ag_2S is 5.2×10^{-17} mol/L

124. $PbBr_{2(s)} \rightleftharpoons Pb^{2+}_{(aq)} + 2Br^-_{(aq)}$

I			
C	$-x$	$+x$	$+2x$
E	$-x$	$+x$	$+2x$

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

$6.6\times10^{-6} = (x)(2x)^2$

$6.6\times10^{-6} = 4x^3$

$x = 0.01182 \text{ mol/L}$

$M_{PbBr_2} = 207.2 + 2(79.904)$

$= 367.008 \frac{g}{mol}$

solubility $= \frac{367.008\ g}{mol} \times \frac{0.01182\ mol}{L}$

$= 4.3 \frac{g}{L}$

∴ the solubility is $4.3 \frac{g}{L}$

125. $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

M	$143.321 \frac{g}{mol}$	$+x$	$+x$

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

$1.77\times10^{-10} = x^2$

$x = 1.33\times10^{-5} \frac{mol}{L} \times 143.321 \frac{g}{mol}$

$= 0.00191 \frac{g}{L}$

∴ 0.00191g in 1L

$CuCl_{(s)} \rightleftharpoons Cu^{2+}_{(aq)} + Cl^-_{(aq)}$

M	$98.999 \frac{g}{mol}$	$+x$	$+x$

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

$1.72\times10^{-9} = x^2$

$x = 4.15\times10^{-5} \frac{mol}{L} \times 98.999 \frac{g}{mol}$

$= 0.00411 \frac{g}{L}$

∴ 0.00411 g in 1L

∴ CuCl will have more mass ionize

12.6 $Ni_3(PO_4)_{2\,(s)} \rightleftharpoons 3\,Ni^{2+}_{(aq)} + 2\,PO_4^{3-}{}_{(aq)}$ M =

$M_{Ni_3(PO_4)_2} = 366.020 \frac{g}{mol}$

$[Ni_3(PO_4)_2] = \frac{7.8 \times 10^{-5} g}{L} \times \frac{1\ mol}{366.020 g}$

$= 2.13 \times 10^{-7}\ mol/L$

$[Ni^{2+}] = 3\,[Ni_3(PO_4)_2] = 3\,(2.13 \times 10^{-7}\ mol/L)$

$= 6.39 \times 10^{-7}\ mol/L$

$[PO_4^{3-}] = 2\,[Ni_3(PO_4)_2] = 2\,(2.13 \times 10^{-7}\ mol/L)$

$= 4.26 \times 10^{-7}\ mol/L$

$K_{sp} = [Ni^{2+}]^3[PO_4^{3-}]^2$

$= (6.39 \times 10^{-7})^3 (4.26 \times 10^{-7})^2$

$= 4.74 \times 10^{-32}$

∴ the solubility product constant is 4.74×10^{-32}

12.7 $M_{SrF_2} = 87.62 + 2(18.998) = 125.616 \frac{g}{mol}$

$SrF_{2\,(s)} \rightleftharpoons Sr^{2+}_{(aq)} + 2F^-_{(aq)}$

$[SrF_2] = \frac{12.2 mg}{100 mL} = \frac{0.122 g}{L} \times \frac{1\ mol}{125.616 g} = 0.000971 \frac{mol}{L}$

$[Sr^{2+}] = 9.71 \times 10^{-4}\ mol/L$

$[F^-] = 2(9.71 \times 10^{-4}\ mol/L) = 1.94 \times 10^{-3}\ mol/L$

$K_{sp} = [Sr^{2+}][F^-]^2$

$= (9.71 \times 10^{-4})(1.94 \times 10^{-3})^2$

$= 3.65 \times 10^{-9}$

∴ the solubility-product constant is 3.65×10^{-9}

128. $AgNO_3(aq)$ + $NaCl$

1.00 mL — 1.00 L

0.100 mol/L — 1.00×10^{-5} mol/L

$[AgNO_3] =$

① $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

$n\ AgNO_3 = 0.100 \frac{mol}{L} \times 0.001\ L$

$= 0.0001$ mol

$n\ NaCl = 1.00 \times 10^{-5} \frac{mol}{\cancel{L}} \times 1.00 \cancel{L}$

$= 1.00 \times 10^{-5}$ mol

~~total~~ $V = 1.00\ L + 0.001\ L$

$= 1.001\ L$

$[Ag]^+ = \frac{0.0001\ mol}{1.001\ L}$

$= 9.99 \times 10^{-5}$ mol/L

$[Cl^-] = \frac{1.00 \times 10^{-5}\ mol}{1.001\ L}$

$= 9.99 \times 10^{-6}$ mol/L

$Q_{sp} = [Ag^+][Cl^-]$

$= (9.99 \times 10^{-5})(9.99 \times 10^{-6})$

$= 9.98 \times 10^{-10}$

$K_{sp} = 1.77 \times 10^{-10}$

$Q_{sp} > K_{sp}$.

∴ a precipitate forms.