Finding and Using Solubility Products

① $Cd(OH)_2(s) \rightleftharpoons Cd^{2+}(aq) + 2OH^-(aq)$

$[OH^-] = 2[Cd^{2+}]$

$= 2(1.7\times10^{-5})$

$= 3.4\times10^{-5}$

$K_{sp} = [Cd^{2+}][OH^-]^2$

$= (1.7\times10^{-5})(3.4\times10^{-5})^2$

$K_{sp} = \boxed{1.97\times10^{-14}}$

② $Ce(OH)_3(s) \rightleftharpoons Ce^{3+}(aq) + 3OH^-(aq)$

$[OH^-] = 3[Ce^{3+}]$

$= 3(5.2\times10^{-6})$

$= 1.56\times10^{-5}$

$K_{sp} = [Ce^{3+}][OH^-]^3$

$= (5.2\times10^{-6})(1.56\times10^{-5})^3$

$K_{sp} = \boxed{1.97\times10^{-20}}$

③ $Sr CO_3(s) \rightleftharpoons Sr^{2+}(aq) + CO_3^{2-}(aq)$

$[CO_3^{2-}] = [Sr^{2+}] = 4.0\times10^{-5}$

$K_{sp} = [Sr^{2+}][CO_3^{2-}]$

$= (4\times10^{-5})(4\times10^{-5})$

$K_{sp} = \boxed{1.6\times10^{-9}}$

④ $PbC_2O_4(s) \rightleftharpoons Pb^{2+}(aq) + C_2O_4^{2-}(aq)$

$[C_2O_4^{2-}] = [Pb^{2+}] = 5.23\times10^{-6}$

$K_{sp} = [Pb^{2+}][C_2O_4^{2-}]$

$= (5.23\times10^{-6})(5.23\times10^{-6})$

$K_{sp} = \boxed{2.74\times10^{-11}}$

⑤ $AgBr(s) \rightleftharpoons Ag^+(aq) + Br^-(aq)$

	—		
I	—	0	0
C	—	+x	+x
E	—	x	x

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

$5.4 \times 10^{-13} = (x)(x)$

$x^2 = 5.4 \times 10^{-13}$

$x = \boxed{7.35 \times 10^{-7} \text{ mol/L}}$

⑥ $Sn(OH)_2(s) \rightleftharpoons Sn^{2+}(aq) + 2OH^-(aq)$

	—		
I	—	0	0
C	—	+x	+2x
E	—	x	2x

$K_{sp} = [Sn^{2+}][OH^-]^2$

$1.4 \times 10^{-28} = (x)(2x)^2$

$4x^3 = 1.4 \times 10^{-28}$

$x^3 = 3.5 \times 10^{-29}$

$x = \boxed{3.27 \times 10^{-10} \text{ mol/L}}$

⑦ $CaF_2(s) \rightleftharpoons Ca^{2+}(aq) + 2F^-(aq)$

I	–	0	0
C	–	+x	+2x
E	–	x	2x

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

$3.9 \times 10^{-11} = (x)(2x)^2$

$4x^3 = 3.9 \times 10^{-11}$

$x^3 = 9.75 \times 10^{-12}$

$x = 2.14 \times 10^{-4}$

$[Ca^{2+}] = x = \boxed{2.14 \times 10^{-4}\ M}$

$[F^-] = 2x$

$= 2(2.14 \times 10^{-4})$

$[F^-] = \boxed{4.27 \times 10^{-4}\ M}$

⑧ $BaCrO_4(s) \rightleftharpoons Ba^{2+}(aq) + CrO_4^{2-}(aq)$

I	–	0	0
C	–	+x	+x
E	–	x	x

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

$1.2 \times 10^{-10} = (x)(x)$

$x^2 = 1.2 \times 10^{-10}$

$x = 1.1 \times 10^{-5}\ mol/L$

moles $= \boxed{1.1 \times 10^{-5}}$

⑨ $Fe(OH)_2(s) \rightleftharpoons Fe^{2+}(aq) + 2OH^-(aq)$

I	—	0	0
C	—	+x	+2x
E	—	x	2x

$K_{sp} = [Fe^{2+}][OH^-]^2$

$4.9 \times 10^{-17} = (x)(2x)^2$

$4x^3 = 4.9 \times 10^{-17}$

$x^3 = 1.225 \times 10^{-17}$

$x = 2.31 \times 10^{-6}$

$[Fe^{2+}] = x = \boxed{2.31 \times 10^{-6}\ M}$

$[OH^-] = 2x$

$= 2(2.31 \times 10^{-6})$

$[OH^-] = \boxed{4.61 \times 10^{-6}\ M}$

⑩ $Ag_2SO_4(s) \rightleftharpoons 2Ag^+(aq) + SO_4^{2-}(aq)$

I	—	0	0
C	—	+2x	+x
E	—	2x	x

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

$1.2 \times 10^{-5} = (2x)^2(x)$

$4x^3 = 1.2 \times 10^{-5}$

$x^3 = 3.0 \times 10^{-6}$

$x = 0.014$

$[Ag^+] = 2x$

$= 2(0.014)$

$[Ag^+] = \boxed{0.029\ M}$

$[SO_4^{2-}] = x = \boxed{0.014\ M}$