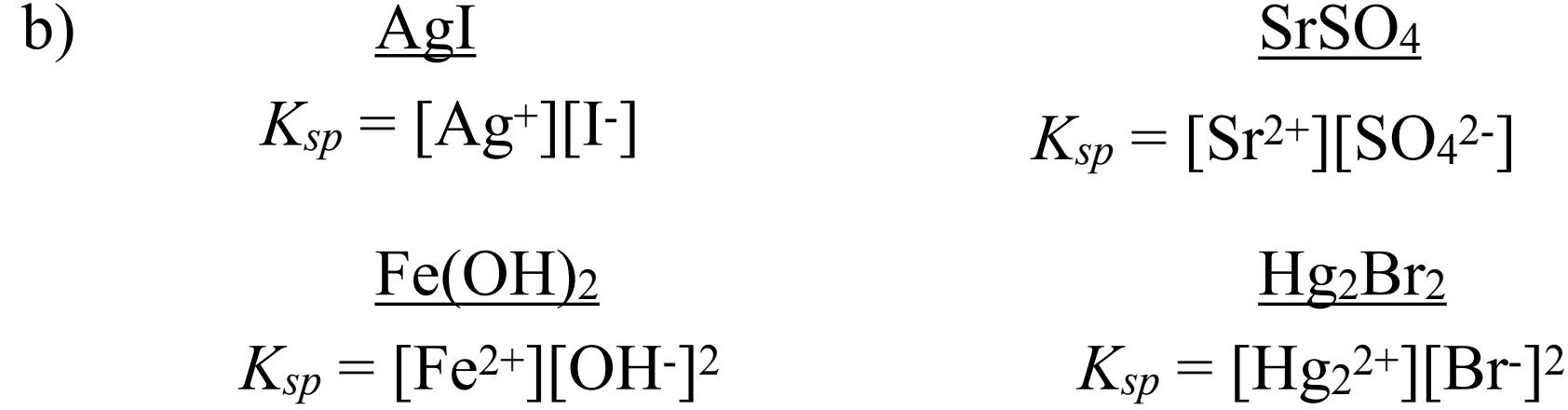
17.49 a) As with other heterogeneous equilibria, pure solids and liquids do not appear in the K expressions.

b)



17.50a) Solubility is a measure of how much solute will dissolve in a given amount of solvent, typically grams of solute per 100g of water. The solubility-product constant (K_{sp}) is an equilibrium constant represented by the product of the molar concentrations of all the dissolved ions in solution.

b) $\underline{MnCO_3}$ $\qquad$ $\underline{Hg(OH)_2}$

$K_{sp} = [Mn^{2+}][CO_3^{2-}]$ $\qquad$ $K_{sp} = [Hg^{2+}][OH^-]^2$

$\underline{Cu_3(PO_4)_2}$

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

17.53a) $K_{sp} = [Ca^{2+}][F^-]^2 = [1.24 \times 10^{-3}M][2.48 \times 10^{-3}M]^2 = 7.62 \times 10^{-9}$

17.53b) $M = \dfrac{\text{moles}}{\text{liters}} = \dfrac{1.1\text{x}10^{-2}\text{g}/125.6\text{gmol}^{-1}}{0.100 \text{ liter}} = 0.000876\ M\ SrF_2$

$K_{sp} = [Sr^{2+}][F^-]^2 = [0.000876M][0.00175M]^2 = 2.69 \times 10^{-9}$

17.53c)

	$Ba(IO_3)_2$	$\rightleftharpoons$	Ba^{2+}	+	$2\ IO_3^-$
I	xxxxx		0 M		0 M
C	xxxxx		+ x		+ 2x
E	xxxxx		x		2x

$$K_{sp} = [Ba][IO_3]^2$$

$$6.0 \times 10^{-10} = [x][2x]^2$$

$$4x^3 = 6.0 \times 10^{-10}$$

$$x = 5.3 \times 10^{-4}\ M$$

17.55 $CaC_2O_4 \rightleftharpoons Ca^{2+} + C_2O_4^{2-}$

$$M = \frac{\text{moles}}{\text{liters}} = \frac{0.0061\text{g}/128.1\text{gmol}^{-1}}{1.00\text{ liter}} = 4.76 \times 10^{-5}\ M\ CaC_2O_4$$

$$K_{sp} = [Ca^{2+}][C_2O_4^{2-}] = [4.76 \times 10^{-5}\ M][4.76 \times 10^{-5}\ M] = 2.27 \times 10^{-9}$$

17.58a)

	LaF_3	$\rightleftharpoons$	La^{3+}	+	$3F^-$
I	xxxxx		0 M		0 M
C	xxxxx		+ x		+ 3x
E	xxxxx		x		3x

$$K_{sp} = [La^{3+}][F^-]^3$$

$$2 \times 10^{-19} = [x][3x]^3$$

$$27x^4 = 2 \times 10^{-19}$$

$$x = 9.28 \times 10^{-6}\ M\ La^{3+}$$

$$\frac{9.28 \times 10^{-6}\text{ mol } LaF_3}{1\text{ L}} \left| \frac{195.9\text{ g } LaF_3}{1\text{ mol } LaF_3} \right. = 1.82 \times 10^{-3}\text{ g } LaF_3\text{/liter}$$

17.58b)

	LaF_3	$\rightleftharpoons$	La^{3+}	+	$3F^-$
I	xxxxx		0 M		0.010 M
C	xxxxx		+ x		+ 3x
E	xxxxx		x		0.010 + 3x

$K_{sp} = [La^{3+}][F^-]^3$

$K_{sp} = [x][0.010 + 3x]^3$ (assume 3x is small compared to 0.010*M*)

$2 \times 10^{-19} = [x][0.010]^3$

$x = 2 \times 10^{-13}\ M\ La^{3+}$

$$\frac{2 \times 10^{-13}\ \text{mol } LaF_3}{1\ \text{L}} \left| \frac{195.9\ \text{g } LaF_3}{1\ \text{mol } LaF_3} \right. = 3.92 \times 10^{-11}\ \text{g } LaF_3/\text{liter}$$

17.58c)	LaF_3	$\rightleftharpoons$	La^{3+}	+	$3F^-$
I	xxxxx		0.050 M		0 M
C	xxxxx		+ x		+ 3x
E	xxxxx		0.050 + x		3x

$K_{sp} = [La^{3+}][F^-]^3$

$K_{sp} = [0.050 + x][3x]^3$ (assume x is small compared to 0.050*M*)

$2 \times 10^{-19} = [0.050][3x]^3$

$1.35x^3 = 2 \times 10^{-19}$

$x = 5.3 \times 10^{-7}\ M\ La^{3+}$

$$\frac{5.3 \times 10^{-7}\ \text{mol } LaF_3}{1\ \text{L}} \left| \frac{195.9\ \text{g } LaF_3}{1\ \text{mol } LaF_3} \right. = 1.04 \times 10^{-4}\ \text{g } LaF_3/\text{liter}$$