1. $BaCl_2(s) \rightleftharpoons Ba^{2+}(aq) + 2Cl^-(aq)$

		$Ba^{2+}(aq)$	$2Cl^-(aq)$
I		0	0
C		x	$2x$
E		x	$2x$

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

$23.6 = (x)(2x)^2$

$4x^3 = 23.6$

$x = 1.81$

solubility $BaCl_2 = [Ba^{2+}] = \frac{1}{2}[Cl^-]$

$= 1.81 \frac{mol}{L}$

solubility $BaCl_2 = 1.81 \frac{mol\ BaCl_2}{L} \times \frac{208.23\ g\ BaCl_2}{1\ mol\ BaCl_2}$

$= 229.05 \frac{g\ BaCl_2}{L}$

2. $Ag_3PO_4(s) \rightleftharpoons 3Ag^+(aq) + PO_4^{3-}(aq)$

solubility $Ag_3PO_4 = \frac{1}{3}[Ag^+] = [PO_4^{3-}] = 2.47 \times 10^{-5} \frac{mol}{L}$

$[PO_4^{3-}]$ eq'm $= 2.47 \times 10^{-5} \frac{mol}{L}$

$\frac{1}{3}[Ag^+]$ eq'm $= 2.47 \times 10^{-5} \frac{mol}{L}$

$[Ag^+]$ eq'm $= 7.41 \times 10^{-5} \frac{mol}{L}$

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

$= (7.41 \times 10^{-5})^3 (2.47 \times 10^{-5})$

$= 1.00 \times 10^{-17}$

3. $Pb(NO_3)_2(aq) + 2KCl(aq) \rightleftharpoons PbCl_2(s) + 2KNO_3(aq)$

$Pb^{2+}(aq) + 2Cl^-(aq) \rightleftharpoons PbCl_2(s)$ $\quad K_{sp} = 1.2 \times 10^{-5}$

$PbCl_2(s) \rightleftharpoons Pb^{2+}(aq) + 2Cl^-(aq)$

$$[Pb^{2+}] = [Pb(NO_3)_2] \times \frac{V}{V_T} \times \text{mol ratio} = 0.15 \frac{\text{mol } Pb(NO_3)_2}{L} \times \frac{1 \text{ mol } Pb^{2+}}{1 \text{ mol } Pb(NO_3)_2} \times \frac{50.0 \text{ mL}}{125 \text{ mL}}$$

$$= 0.0600 \frac{\text{mol } Pb^{2+}}{L}$$

$$[Cl^-] = [KCl] \times \frac{V}{V_T} \times \text{mol ratio} = 0.40 \frac{\text{mol } KCl}{L} \times \frac{1 \text{ mol } Cl^-}{1 \text{ mol } KCl} \times \frac{75 \text{ mL}}{125 \text{ mL}}$$

$$= 0.24 \frac{\text{mol } Cl^-}{L}$$

$$Q_{sp} = [Pb^{2+}][Cl^-]^2$$
$$= (0.0600)(0.240)^2$$
$$= 3.46 \times 10^{-3}$$

$Q_{sp} > K_{sp}$

$\therefore$ ppt will form

4. a)

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

I	0	0
C	2x	x
E	2x	x

$K_{sp} = 8.5 \times 10^{-12}$

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

$8.5 \times 10^{-12} = (2x)^2(x)$

$4x^3 = 8.5 \times 10^{-12}$

$x = 1.29 \times 10^{-4}$

solubility $Ag_2CO_3 = \frac{1}{2}[Ag^+] = [CO_3^{2-}]$

$= 1.3 \times 10^{-4} \frac{mol}{L}$

b)

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

I	0	0.10
C	+2x	+x
E	2x	0.1+x
		≈0.1

check

$\frac{[\ ]_I}{K_{sp}} = \frac{0.1}{8.5 \times 10^{-12}} > 100$

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

$8.5 \times 10^{-12} = (2x)^2(0.1)$

$(2x)^2 = 8.5 \times 10^{-11}$

$x = 4.6 \times 10^{-6}$

proof

$\frac{x}{[CO_3^{2-}]_I} \times 100\%$

$\left(\frac{4.6 \times 10^{-6}}{0.1}\right) 100\%$

$= 4.6 \times 10^{-3}\% < 5\%$

∴ assumption valid

solubility $Ag_2CO_3 = \frac{1}{2}[Ag^+]$

$= 4.6 \times 10^{-6} \frac{mol}{L}$