

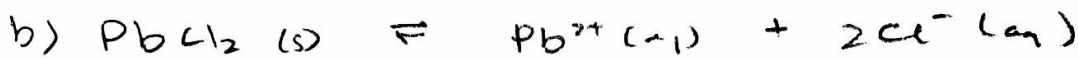
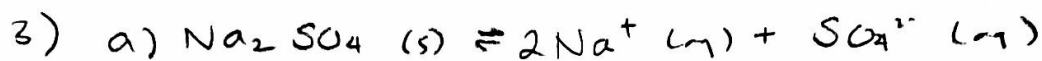
Problem Set - Solubility

1) $[Ba^{2+}] = 0.200 M$ $[Cl^-] = 0.400 M$

2 a) equal

b) dissolution \rightarrow precip

c) precip \rightarrow dissolution



4) a) $K_{sp} = [Na^+]^2 [SO_4^{2-}]$

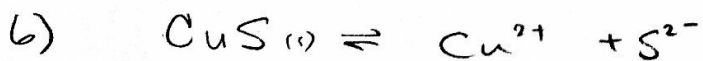
b) $K_{sp} = [Pb^{2+}] [Cl^-]^2$

c) $K_{sp} = [Ca^{2+}]^3 [PO_4^{3-}]^2$



$\therefore Zn^{2+} : CO_3^{2-}$ is 1:1, $[CO_3^{2-}] = [Zn^{2+}] = 3.87 \times 10^{-6} M$

$\therefore K_{sp} = [Zn^{2+}] [CO_3^{2-}] = (3.87 \times 10^{-6})^2 = 1.50 \times 10^{-11}$



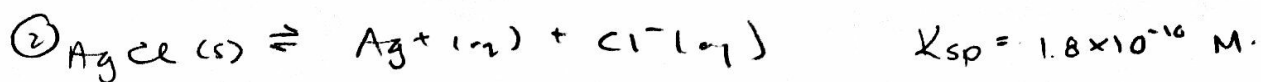
I - 0 0

C - +x +8.89 $\times 10^{-19}$

E - 8.89 $\times 10^{-19}$ 8.89 $\times 10^{-19}$

$K_{sp} = [Cu^{2+}] [S^{2-}]$
 $= (8.89 \times 10^{-19})^2$

$K_{sp} = 7.90 \times 10^{-37}$



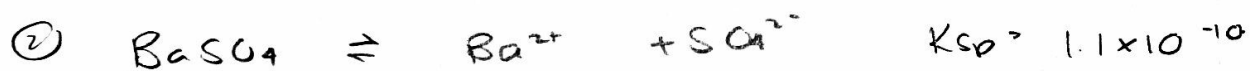
③ $[\text{Ag}^+] = \frac{0.100 \times 0.001 \text{ L}}{1.001 \text{ L}} = 9.99 \times 10^{-5} \text{ mol/L}$

$[\text{Cl}^-] = \frac{(1.00 \times 10^{-5}) (1.00 \text{ L})}{1.001 \text{ L}} = 9.99 \times 10^{-6} \text{ mol/L}$

④ $Q = [\text{Ag}^+][\text{Cl}^-] = (9.99 \times 10^{-5})(9.99 \times 10^{-6})$

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

⑤ $Q > K \therefore$ precipitate will form.



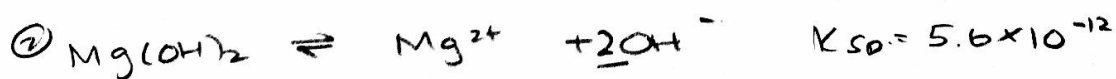
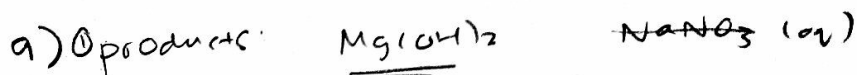
③ $[\text{Ba}^{2+}] = \frac{0.020 \times 75.0 \text{ mL}}{200 \text{ mL}} = 0.0075 \text{ M}$

$[\text{SO}_4^{2-}] = \frac{0.040 \times 125 \text{ mL}}{200 \text{ mL}} = 0.0250 \text{ M}$

④ $Q = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$

$Q = (0.0075)(0.0250) = 1.9 \times 10^{-4}$

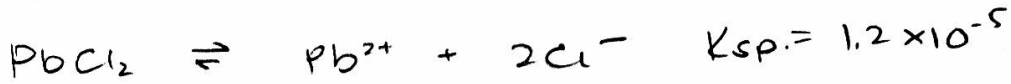
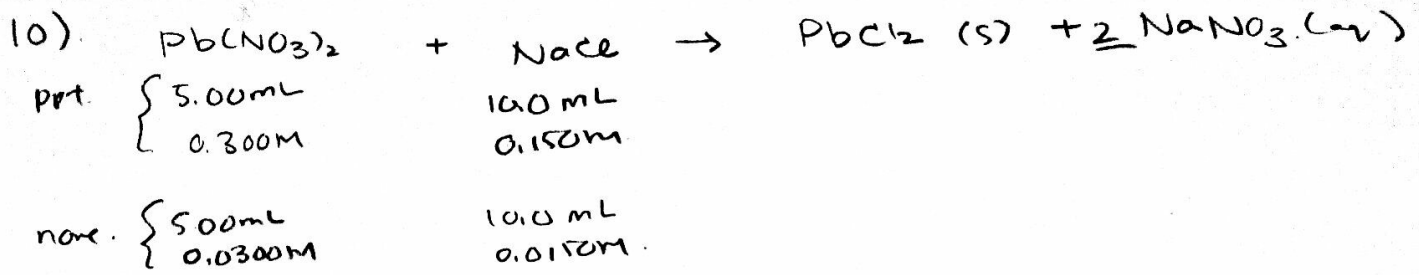
⑤ $Q > K \therefore$ precipitate will form



③ $[\text{Mg}^{2+}] = \frac{(1.0 \times 10^{-4})(100.0 \text{ mL})}{200.0 \text{ mL}} = 0.0002 \text{ M}$

$[\text{OH}^-] = \frac{(2.0 \times 10^{-4})(100.0)}{200.0}$

④ $Q = [\text{Mg}^{2+}][\text{OH}^-]^2 =$



Scenario 1 - PPT

$$\textcircled{1} [\text{Pb}^{2+}] = \frac{0.300 \text{ M} \times 5.00 \text{ mL}}{15.0 \text{ mL}} = 0.100 \text{ M}$$

$$[\text{Cl}^-] = \frac{0.150 \text{ M} \times 10.0 \text{ mL}}{15.0 \text{ mL}} = 0.100 \text{ M}$$

$$\textcircled{2} Q = [\text{Pb}][\text{Cl}]^2$$

$$= (0.100)(0.100)^2$$

$$Q = 0.001$$

$$\boxed{Q > K \therefore \text{PPT}}$$

Scenario 2 - NO PPT

$$\textcircled{1} [\text{Pb}^{2+}] = \frac{0.0300 \text{ M} \times 5.00 \text{ mL}}{15.0} = 0.0100 \text{ M}$$

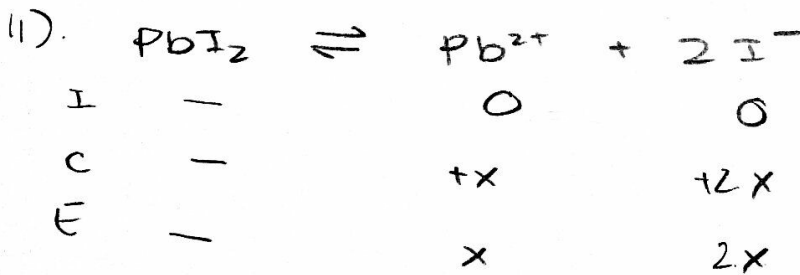
$$[\text{Cl}^-] = \frac{0.0150 \text{ M} \times 10.00 \text{ mL}}{15.0} = 0.0100 \text{ M}$$

$$\textcircled{2} Q = [\text{Pb}][\text{Cl}]^2$$

$$= (0.0100)(0.0100)^2$$

$$Q = 1.00 \times 10^{-6}$$

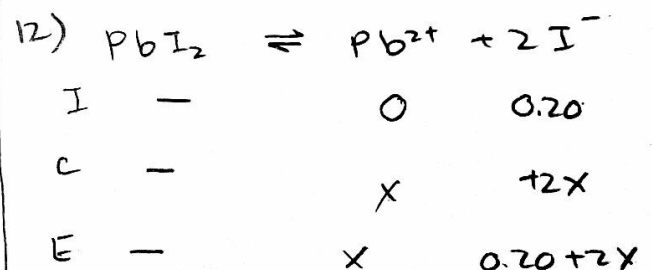
$$\boxed{Q < K \therefore \text{NO PPT}}$$



$$K_{sp} = 5.0 \times 10^{-7} = [\text{Pb}][\text{I}]^2$$

$$5.0 \times 10^{-7} = x(2x)^2 = 4x^3$$

$$\therefore \boxed{x = 5.0 \times 10^{-3} \text{ mol/L}} \text{ in pure H}_2\text{O}$$

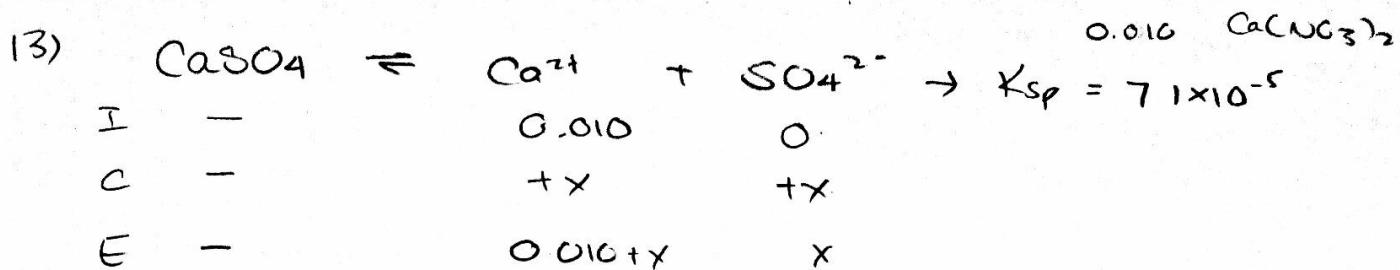


$$5.0 \times 10^{-7} = x(0.20 + 2x)^2 \quad \frac{0.20}{K} > 100$$

$$5.0 \times 10^{-7} \approx x(0.20)$$

$$\therefore \boxed{x = 2.5 \times 10^{-6} \text{ M}} \quad \frac{2x}{0.20} < 5\%$$

in 0.20 M KI(aq)



$$K_{sp} = [\text{Ca}][\text{SO}_4]$$

$$7.1 \times 10^{-5} = (0.010 + x)(x) \quad \checkmark \frac{0.010}{K} > 100$$

$$7.1 \times 10^{-5} = (0.010)x$$

$$x \stackrel{a}{=} 7.1 \times 10^{-3} \text{ M. } \checkmark \frac{x}{0.010} \underline{\underline{> 5\%}}$$

\therefore assumption not valid. $\ddot{\smile}$

go solve long way!

$$7.1 \times 10^{-5} = 0.010x + x^2$$

$$0 = x^2 + 0.010x - (7.1 \times 10^{-5})$$

$$x_1 = 0.00480 \quad \left(x_2 = \cancel{-0.0148} \right)$$

$$x = \text{molar solubility of CaSO}_4 = \boxed{0.00480 \text{ mol/L}}$$