

- $$\text{BaC}_2\text{O}_4(s) \rightleftharpoons \text{Ba}^{2+}(aq) + \text{C}_2\text{O}_4^{2-}(aq)$$

$$K_{sp} = [\text{Ba}^{2+}][\text{C}_2\text{O}_4^{2-}]$$

formula mass of $\text{BaC}_2\text{O}_4 = 137.3 + 2(12.0) + 4(16.0) = 225.3 \text{ g/mol}$
 $[\text{BaC}_2\text{O}_4] = 7.8 \times 10^{-2} \text{ g} \div 225.3 \text{ g/mol} \div 1.0 \text{ L} = 3.46 \times 10^{-4} \text{ M}$
 $[\text{Ba}^{2+}] = [\text{C}_2\text{O}_4^{2-}] = [\text{BaC}_2\text{O}_4] = 3.46 \times 10^{-4} \text{ M}$
 $K_{sp} = (3.46 \times 10^{-4})^2 = 1.2 \times 10^{-7}$
- $$\text{PbCl}_2(s) \rightleftharpoons \text{Pb}^{2+}(aq) + 2\text{Cl}^-(aq)$$

$$K_{sp} = [\text{Pb}^{2+}][\text{Cl}^-]^2$$

$$[\text{Cl}^-] = 0.042 \text{ mol} \div 0.400 \text{ L} = 0.105 \text{ M}$$

$$[\text{Pb}^{2+}] = 0.105 \text{ M} \div 2 = 0.0525 \text{ M}$$

$$K_{sp} = [0.0525][0.105]^2 = 5.8 \times 10^{-4}$$
- $$\text{PbSO}_4(s) \rightleftharpoons \text{Pb}^{2+}(aq) + \text{SO}_4^{2-}(aq)$$

$$K_{sp} = [\text{Pb}^{2+}][\text{SO}_4^{2-}]$$

let $x = [\text{Pb}^{2+}] = [\text{SO}_4^{2-}]$
 $K_{sp} = x^2 = 1.3 \times 10^{-8}$
 $x = 1.1 \times 10^{-4} \text{ M}$
 $n = \text{MV} = 1.1 \times 10^{-4} \text{ M} \times 5.0 \text{ L} = 5.7 \times 10^{-4} \text{ mol}$

formula mass of $\text{PbSO}_4 = 207.2 + 32.1 + 4(16.0) = 303.3 \text{ g/mol}$
 $5.7 \times 10^{-4} \text{ mol} \times 303.3 \text{ g/mol} = 0.17 \text{ g}$
- $$\text{AgCl}(s) \rightleftharpoons \text{Ag}^+(aq) + \text{Cl}^-(aq)$$

$$\text{NaCl}(s) \longrightarrow \text{Na}^+(aq) + \text{Cl}^-(aq)$$

$[\text{Cl}^-]$ increases so the stress is an increase in $[\text{Cl}^-]$ and the system responds by using up some of the Cl^- shifting the equilibrium to the left, making more of the reactant. common ion effect
- Answers vary, could precipitate the Pb^{2+} first using KCl , then the Ba^{2+} next using K_2SO_4 , and finally the Ni^{2+} using KOH .
- $$\text{Ag}_2\text{CO}_3(s) \rightleftharpoons 2\text{Ag}^+(aq) + \text{CO}_3^{2-}(aq)$$

$$K_{sp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}] = 8.1 \times 10^{-12}$$

$$[\text{Ag}^+] = [\text{AgNO}_3] = 0.100 \text{ M}$$

$$K_{sp} = (0.100 \text{ M})^2[\text{CO}_3^{2-}] = 8.1 \times 10^{-12}$$

$$[\text{CO}_3^{2-}] = 8.1 \times 10^{-10} \text{ M}$$

mols of $\text{CO}_3^{2-} = \text{MV} = 8.1 \times 10^{-10} \text{ M} \times 8.00 \text{ L} = 6.5 \times 10^{-9} \text{ mol}$
- Answers vary, could precipitate the Pb^{2+} first using KCl , then the Ba^{2+} next using K_2SO_4 , and finally the Mg^{2+} using KOH .
- Answers vary, could precipitate the Ag^+ first using KCl , then the Ca^{2+} next using K_2SO_4 , and finally the Fe^{2+} using KOH , this would leave behind the Na^+ which is always soluble.
- $$\text{Ag}_2\text{CO}_3(s) \rightleftharpoons 2\text{Ag}^+(aq) + \text{CO}_3^{2-}(aq)$$

$$K_{sp} = [\text{Ag}^+]^2[\text{CO}_3^{2-}]$$

mols of CO_3^{2-} already present = $\text{MV} = 0.200 \text{ M} \times 1.00 \text{ L} = 0.200 \text{ mol}$
mols of CO_3^{2-} dissolved = $6.00 \times 10^{-6} \text{ mol}$
mols of $\text{CO}_3^{2-} = 0.200 \text{ mol} + 6.00 \times 10^{-6} \text{ mol} = 0.200 \text{ mol}$
 $[\text{CO}_3^{2-}] = 0.200 \text{ mol} \div 1.00 \text{ L} = 0.200 \text{ M}$
mols of Ag^+ dissolved = $2 \times 6.00 \times 10^{-6} \text{ mol} = 1.20 \times 10^{-5} \text{ mol}$
 $[\text{Ag}^+] = 1.20 \times 10^{-5} \text{ mol} \div 1.00 \text{ L} = 1.20 \times 10^{-5} \text{ M}$
 $K_{sp} = (1.20 \times 10^{-5} \text{ M})^2(0.200 \text{ M}) = 2.88 \times 10^{-11}$
- $$\text{Ag}_2\text{CrO}_4(s) \rightleftharpoons 2\text{Ag}^+(aq) + \text{CrO}_4^{2-}(aq)$$

$$K_{sp} = [\text{Ag}^+]^2[\text{CrO}_4^{2-}] = 1.1 \times 10^{-12}$$

$$[\text{Ag}^+] = 0.050 \text{ M} \times 10 \text{ mL}/100 \text{ mL} = 5.0 \times 10^{-3} \text{ M}$$

$$[\text{CrO}_4^{2-}] = 0.0025 \text{ M} \times 90 \text{ mL}/100 \text{ mL} = 2.25 \times 10^{-3} \text{ M}$$

$$\text{TIP} = (5.0 \times 10^{-3})^2(2.25 \times 10^{-3}) = 5.6 \times 10^{-8}$$

$\text{TIP} > K_{sp}$ therefore a precipitate of Ag_2CrO_4 forms.