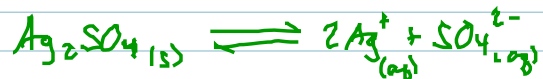




if $[\text{Ag}^+] = 0.0040\text{M}$, what is $[\text{SO}_4^{2-}]_{\text{min}}$ to ppt out the solid?



$$Q = K_{sp} = [\text{Ag}^+]^2 [\text{SO}_4^{2-}] \Rightarrow 1.4 \times 10^{-5} = (0.0040)^2 [\text{SO}_4^{2-}]$$

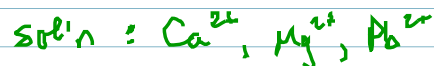
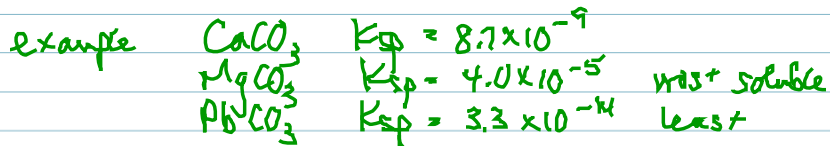
$$[\text{SO}_4^{2-}] = 0.88\text{M} \quad \text{SATURATED SOLN}$$

$$[\text{SO}_4^{2-}] > 0.88\text{M} \quad \text{ppt forms}$$

FRACTIONAL PRECIPITATION

→ used to separate one ion from another in a mixture

- ppt out the less soluble ion and leave the more soluble in solution



if $\text{Na}_2\text{CO}_3(aq)$ is slowly added... $\text{PbCO}_3(s)$ forms first; once Pb^{2+} is gone CaCO_3 ppts



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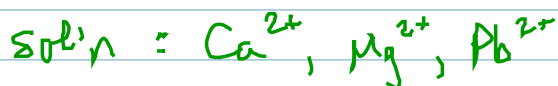
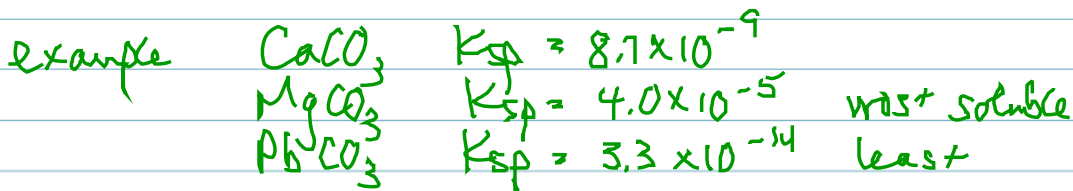
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if $\text{Na}_2\text{CO}_3(\text{aq})$ is slowly added to a solution where $[\text{Mg}^{2+}] = 0.020\text{M}$ & $[\text{Ca}^{2+}] = 0.020\text{M}$; what $[\text{CO}_3^{2-}]$ is needed to ppt CaCO_3 but not MgCO_3

$$\text{a) } \text{CaCO}_3 \quad K_{sp} = [\text{Ca}^{2+}][\text{CO}_3^{2-}]$$
$$[\text{CO}_3^{2-}] = \frac{K_{sp}}{[\text{Ca}^{2+}]} = \frac{8.7 \times 10^{-9}}{0.020} = 4.4 \times 10^{-7}\text{M}$$

$$\text{b) } \text{MgCO}_3 \quad K_{sp} = [\text{Mg}^{2+}][\text{CO}_3^{2-}]$$
$$[\text{CO}_3^{2-}] = \frac{K_{sp}}{[\text{Mg}^{2+}]} = \frac{4.0 \times 10^{-5}}{0.020} = 2.0 \times 10^{-3}\text{M}$$

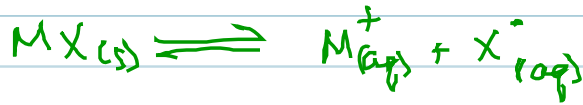
$$2.0 \times 10^{-3}\text{M} > [\text{CO}_3^{2-}] > 4.4 \times 10^{-7}$$

What % of the Ca^{2+} remain "unprecipitated" just before MgCO_3 forms?

$$[\text{CO}_3^{2-}] = 2.0 \times 10^{-3}\text{M} \quad [\text{Ca}^{2+}] = \frac{K_{sp}}{[\text{CO}_3^{2-}]} = \frac{8.7 \times 10^{-9}}{2.0 \times 10^{-3}} = 4.4 \times 10^{-6}\text{M}$$

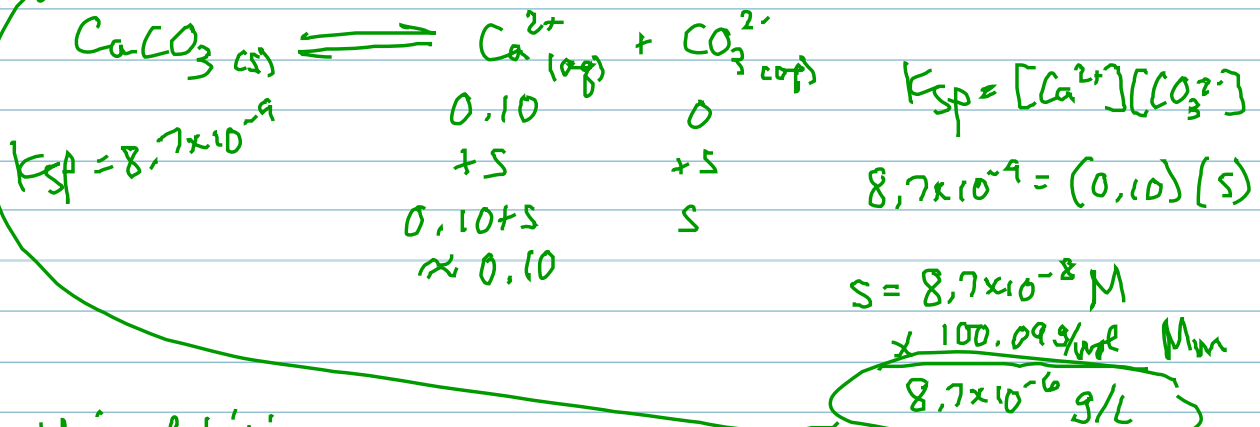
$$\frac{4.4 \times 10^{-6}\text{M}}{0.020\text{M}} \times 100\% = 0.022\% \text{ Ca}^{2+}$$

COMMON ION EFFECT:



the presence of dissolved ions in the solution from separate sources makes the solid LESS soluble

The solubility of $CaCO_3$ in pure H_2O is $9.3 \times 10^{-3} g/L$. What is the solubility of $CaCO_3$ in $0.10M CaCl_2$ solution?



pH & solubility

→ many compounds considered insoluble in H_2O are soluble in acidic solutions (H^+)

- insoluble metal hydroxides
- insoluble salts of weak acids

