

# Chem 1062

Note Title

7/28/2008

- \* Today is the last day to withdraw
- \* Mistake in Key to Ch 17 Homework Quiz #8 (17.72) has been fixed. Let me know if you believe your answer is correct and it was marked wrong.
- \* ACS Final Exam Handout
- \* Exam 3 tomorrow - Ch. 16, 17, 18
  - \* may begin at 7:45 - lecture resumes at 9:10

look @ p. 721

What is the pH of a solution to which 5.0 mL of 0.100 M NaOH is added to 25.0 mL of 0.100 M HCl?

(moles)	NaOH(aq)	HCl(aq)	NaCl(aq)	H <sub>2</sub> O(l)
Init	0.00050	0.00250	0	
Change	-0.00050	-0.00050	+0.00050	
End	0	0.00200	0.00050	

$$25.0 \text{ mL} \times \frac{0.100 \text{ mol HCl}}{1000 \text{ mL}} = 0.00250 \text{ mol HCl}$$

$$5.0 \text{ mL} \times \frac{0.100 \text{ mol NaOH}}{1000 \text{ mL}} = 0.00050 \text{ mol NaOH}$$

$$\frac{0.00200 \text{ mol HCl}}{0.0300 \text{ L}} = 0.0667 \text{ M HCl}$$

For a strong acid  $\Rightarrow [H_3O^+] = [acid]$

$$[H_3O^+] = 0.0667$$

$$pH = -\log [H_3O^+] = -\log (0.0667) = \boxed{1.176}$$

30.0 mL of 0.100 M NaOH (aq) + 55.0 mL + 25.0 mL of 0.100 M HCl (aq)  $\rightarrow$  NaCl (aq) + H<sub>2</sub>O (l)

(moles)			
Init	0.00300	0.00250	0
Change	-0.00250	-0.00250	+0.00250
End	0.00050	0	0.00250

$30.0 \text{ mL} \times \frac{0.100 \text{ mol}}{1000 \text{ mL}} = 0.00300 \text{ mol NaOH}$

$0.00050 \text{ mol NaOH} = 0.00909 \text{ M NaOH}$   
0.0550 L

$$[OH^-] = 0.00909 \text{ M}$$

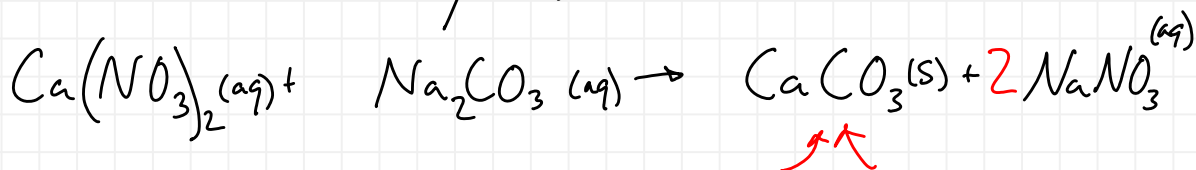
$$pOH = -\log [OH^-] = -\log (0.00909) = 2.04$$

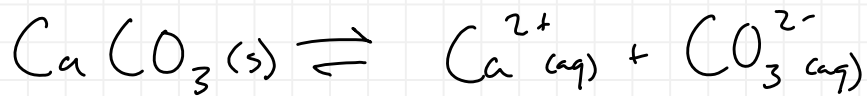
14.00

11.96

In the lab, we will discuss the half way point - half the volume of titrant required to reach the equivalence point.

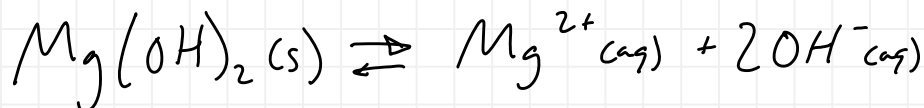
### Solubility Equilibria



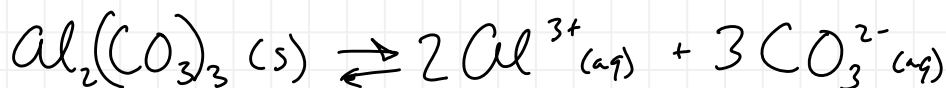


$$K_{sp} = [\text{Ca}^{2+}][\text{CO}_3^{2-}]$$

Solubility  
product  
constant



$$K_{sp} = [\text{Mg}^{2+}][\text{OH}^-]^2$$



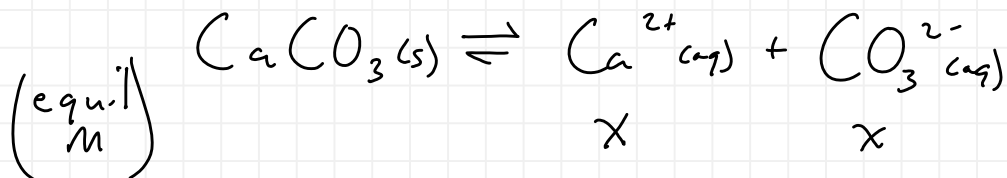
$$K_{sp} = [\text{Al}^{3+}]^2[\text{CO}_3^{2-}]^3$$

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Ch. 16 Quiz  $\Rightarrow$  #3 (16.52) - the tolerance was set too low, so you may have had it marked wrong. I will manually score this question.

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Determine the molar solubility of  $\text{CaCO}_3$ . Then determine its solubility in g/L.



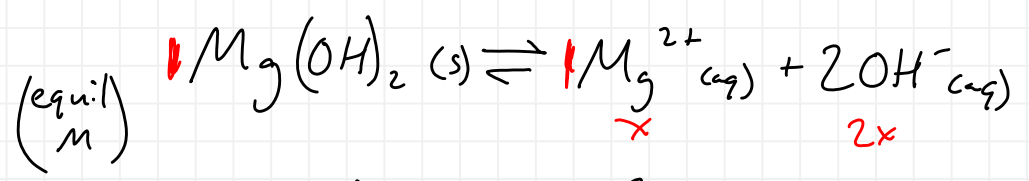
$$K_{sp} = [\text{Ca}^{2+}][\text{CO}_3^{2-}]$$
$$\sqrt{3.8 \times 10^{-9}} = \sqrt{x^2} = x = \boxed{6.16 \times 10^{-5} \text{ M}} = [\text{Ca}^{2+}] = [\text{CO}_3^{2-}]$$

Molar solubility is  $6.2 \times 10^{-5} M$ .

$$\frac{6.16 \times 10^{-5} \text{ mol CaCO}_3}{L} \times \frac{100.09 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} = \underline{\underline{0.0062 \frac{\text{g}}{L}}}$$

stalactite & stalagmite

Find molar solubility of  $Mg(OH)_2$ . Then find its solubility in g/L.



$$K_{sp} = [Mg^{2+}][OH^{-}]^2$$

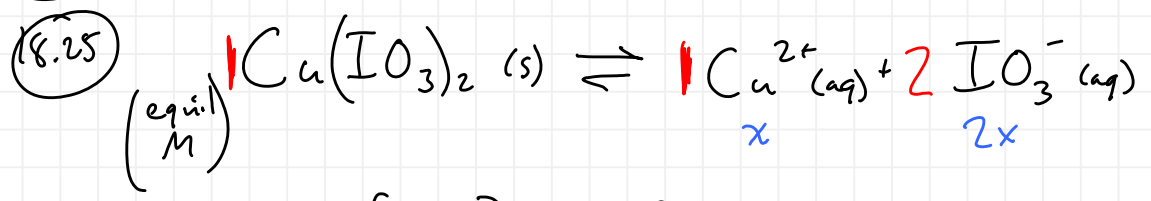
$$1.8 \times 10^{-11} = (x)(2x)^2$$

$$\frac{1.8 \times 10^{-11}}{4} = \frac{4x^3}{4}$$

$$\sqrt[3]{4.5 \times 10^{-12}} = \sqrt[3]{x^3} = x = [Mg^{2+}] = \overset{[Mg(OH)_2]}{1.65 \times 10^{-4} M}$$

Molar solubility of  $Mg(OH)_2$  is  $1.7 \times 10^{-4} M$ .

$$\frac{1.65 \times 10^{-4} \text{ mol Mg(OH)}_2}{L} \times \frac{58.33 \text{ g Mg(OH)}_2}{1 \text{ mol Mg(OH)}_2} = \underline{\underline{0.0096 \frac{\text{g Mg(OH)}_2}{L}}}$$



$$K_{sp} = [Cu^{2+}][IO_3^{-}]^2$$

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

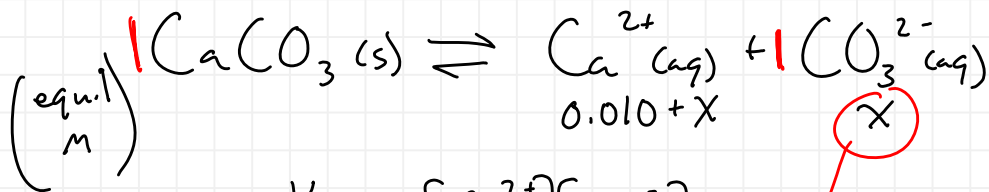
$$K_{sp} = 4x^3 = 4(0.00315)^3 = \underline{\underline{1.2 \times 10^{-7}}}$$

$$\frac{0.13 \text{ g } \text{Ca}(\text{IO}_3)_2}{100 \text{ mL}} \times \frac{1 \text{ mol } \text{Ca}(\text{IO}_3)_2}{413.34 \text{ g } \text{Ca}(\text{IO}_3)_2} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 0.00315 \frac{\text{mol } \text{Ca}(\text{IO}_3)_2}{\text{L}}$$

$x = [\text{Ca}^{2+}]$  1:1 ↙

### Common Ion Effect

Find the solubility of  $\text{CaCO}_3$ , in  $\text{g/L}$ , in  $0.010 \text{ M } \text{CaCl}_2$ .



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

$$\frac{3.8 \times 10^{-9}}{0.010} = \frac{(0.010 + x)(x)}{0.010}$$

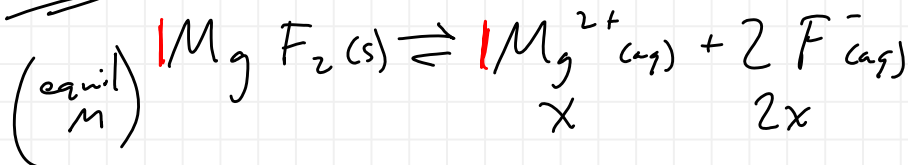
$$3.8 \times 10^{-7} \text{ M} = x = [\text{CO}_3^{2-}] = [\text{CaCO}_3]$$

$$\frac{3.8 \times 10^{-7} \text{ mol } \text{CaCO}_3}{\text{L}} \times \frac{100.09 \text{ g } \text{CaCO}_3}{1 \text{ mol } \text{CaCO}_3} = 3.8 \times 10^{-5} \frac{\text{g } \text{CaCO}_3}{\text{L}}$$

Assume  $x \ll 0.010$   
Assumption is valid.

18.35 What is the solubility of  $\text{MgF}_2$  in  $0.020 \text{ M } \text{NaF}$ ? The solubility of  $\text{MgF}_2$  is  $0.016 \text{ g/L}$  in water.

in water



$$K_{sp} = [\text{Mg}^{2+}][\text{F}^{-}]^2$$

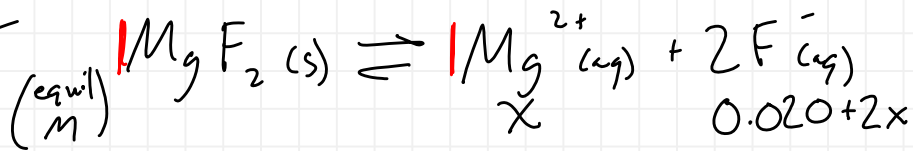
$$= (x)(2x)^2$$

$$= 4x^3 = 4(2.57 \times 10^{-4})^3$$

$$K_{sp} = 6.77 \times 10^{-11}$$

$$\frac{0.016 \text{ g } \cancel{\text{MgF}_2}}{L} \times \frac{1 \text{ mol } \cancel{\text{MgF}_2}}{62.31 \text{ g } \cancel{\text{MgF}_2}} = 2.57 \times 10^{-4} \frac{\text{mol } \text{MgF}_2}{L} \rightarrow = [\text{Mg}^{2+}] = x$$

in 0.020 M  
NaF



$$K_{sp} = [\text{Mg}^{2+}][\text{F}^-]^2$$

Assume  
 $2x \ll 0.020$

$$\frac{6.77 \times 10^{-11}}{(0.020)^2} = \frac{(x)(0.020 + 2x)^2}{(0.020)^2}$$

$$1.69 \times 10^{-7} \text{ M} = x = [\text{Mg}^{2+}] \rightarrow [\text{MgF}_2]$$

$$\frac{1.69 \times 10^{-7} \text{ mol } \cancel{\text{MgF}_2}}{L} \times \frac{62.31 \text{ g } \cancel{\text{MgF}_2}}{1 \text{ mol } \cancel{\text{MgF}_2}} = 1.1 \times 10^{-5} \text{ g/L}$$