Chem 2 AP Homework #4-2: Molarity and Precipitation Reactions-KEY
Problems pg. 152 #16, 18, 22, 24, 60, 62, 64(a), 69, 72, 74

4.16 What is the advantage of writing net ionic equations?
Net ionic equations allow us to focus on just those species participating in the reaction.

4.18 Two aqueous solutions of KOH and $MgCl_2$ are mixed. Which of the following diagrams best represents the resulting mixture?

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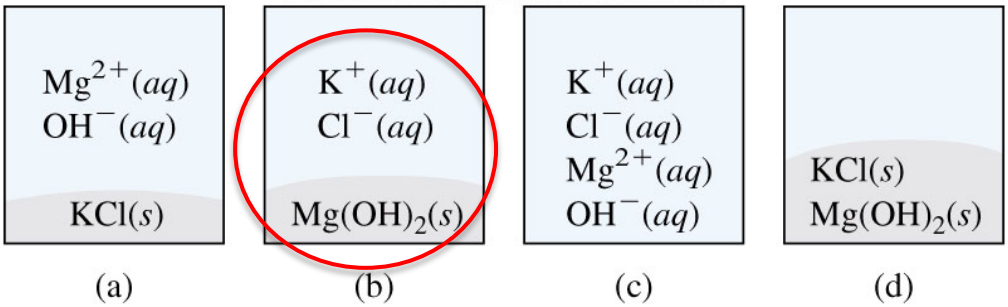

Refer to Table 4.2 of the text to solve this problem. $Mg(OH)_2$ is insoluble in water. It will precipitate from solution. KCl is soluble in water and will remain as K^+ and Cl^- ions in solution. Diagram **(b)** best represents the mixture.

4.22 Complete the molecular equations for the following reactions. Also, write the total ionic and net ionic equations for each.

(a) ***Molecular***: **$Na_2S(aq) + ZnCl_2(aq)$** → $ZnS(s) + 2NaCl(aq)$

***Ionic*:** $2Na^+(aq) + S^{2-}(aq) + Zn^{2+}(aq) + 2Cl^-(aq) \rightarrow ZnS(s) + 2Na^+(aq) + 2Cl^-(aq)$

***Net ionic*:** $Zn^{2+}(aq) + S^{2-}(aq) \rightarrow ZnS(s)$

(b) ***Molecular*:** **$K_3PO_4(aq) + 3\ Sr(NO_3)_2(aq)$** → $Sr_3(PO_4)_2(s) + 6KNO_3(aq)$

***Ionic*:** $6K^+(aq) + 2PO_4^{3-}(aq) + 3Sr^{2+}(aq) + 6NO_3^-(aq) \rightarrow Sr_3(PO_4)_2(s) + 6K^+(aq) + 6NO_3^-(aq)$

***Net ionic*:** $3Sr^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Sr_3(PO_4)_2(s)$

(c) ***Molecular*:** **$Mg(NO_3)_2(aq) + 2\ NaOH(aq)$** → $Mg(OH)_2(s) + 2NaNO_3(aq)$

***Ionic*:** $Mg^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s) + 2Na^+(aq) + 2NO_3^-(aq)$

***Net ionic*:** $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$

4.24 By using Table 4.2 (or solubility rules), suggest one method by which you might separate:

(a) K^+ from Ag^+: Add chloride ions. KCl is soluble, but AgCl is not.

(b) Ba^{2+} from Pb^{2+}: Add hydroxide ions. $Ba(OH)_2$ is soluble, but $Pb(OH)_2$ is insoluble.

(c) NH_4^+ from Ca^{2+}: Add carbonate ions. $(NH_4)_2CO_3$ is soluble, but $CaCO_3$ is insoluble.

(d) Ba^{2+} from Cu^{2+}: Add sulfate ions. $CuSO_4$ is soluble, but $BaSO_4$ is insoluble.

4.60 Describe how you would prepare 250. mL of a 0.707 *M* $NaNO_3$ solution from solid $NaNO_3$. *(In addition to calculation, include a sentence for how to do it and what glassware to use,)*

$$\text{Moles } NaNO_3 = 250.\text{ mL soln} \times \frac{0.707\text{ mol } NaNO_3}{1000\text{ mL soln}} = 0.177\text{ mol}$$

$$\text{mass } NaNO_3 = 0.177\text{ mol } NaNO_3 \times \frac{85.00\text{ g } NaNO_3}{1\text{ mol } NaNO_3} = \boxed{15.0\text{ g } NaNO_3}$$

To make the solution, add 15.0 g of $NaNO_3$ to a 250 mL volumetric flask. Add enough water to dissolve all solid. Fill flask to the mark to make 250 mL of solution using a pipet.

4.64 Calculate the molarity of the following solution:
(a) 6.57 g of CH_3OH in 150. mL of solution.

$$?\text{ mol } CH_3OH = 6.57\text{ g } CH_3OH \times \frac{1\text{ mol } CH_3OH}{32.04\text{ g } CH_3OH} = 0.205\text{ mol } CH_3OH$$

$$M = \frac{0.205\text{ mol } CH_3OH}{0.150\ L} = \boxed{\mathbf{1.37\ M}}$$

4.69(mod) **Describe how to prepare 500.0 mL of 0.646 M HNO_3 solution, starting with a 16.0 M HNO_3 solution. *(Remember-- for concentrated acids, "Do what you oughter, add acid to water!")***

$$M_{conc}V_{conc} = M_{dil}V_{dil}$$

$$V_{conc} = \frac{(M_{dil})(V_{dil})}{M_{conc}} = \frac{(0.646\ M)(0.500\text{ L})}{16.0\ M} = \boxed{\mathbf{0.0202\text{ L} = 20.2\text{ mL}}}$$

- Since 16 M HNO_3 is fully concentrated solution of the strong acid, HNO_3, it is crucial that this concentrated acid is added slowly to water so that it does not violently splatter.
- Thus, to prepare the 0.646 *M* solution, you would first fill a 500 mL volumetric flask halfway with water. Then, carefully measure out 20.2 mL of 16.0 *M* HNO_3 solution (use a graduated pipet or buret) and slowly add it to the volumetric flask. Shake. Fill with water to the mark.

4.72 You have 505 mL of a 0.125 *M* HCl solution and you want to dilute it to exactly 0.100 *M*. How much water should you add?

$$V_{dil} = \frac{M_{conc}V_{conc}}{M_{dil}} = \frac{(0.125\ M)(505\text{ mL})}{(0.100\ M)} = 631\text{ mL}$$

$$V_{added} = V_{dil} - V_{conc} = 631\text{ ml} - 505\text{ mL} = \boxed{126\text{ mL}}$$

4.74 A 46.2-mL of a 0.568 *M* calcium nitrate [$Ca(NO_3)_2$] solution is mixed with 80.5 mL of 1.396 *M* calcium nitrate solution. Calculate the concentration of the final solution.

Moles of calcium nitrate in the first soln: $\frac{0.568\text{ mol}}{1000\text{ mL soln}} \times 46.2\text{ mL soln} = 0.0262\text{ mol } Ca(NO_3)_2$

Moles of calcium nitrate in the second soln: $\frac{1.396\text{ mol}}{1000\text{ mL soln}} \times 80.5\text{ mL soln} = 0.112\text{ mol } Ca(NO_3)_2$

The volume of the combined solutions = 46.2 mL + 80.5 mL = 126.7 mL.

The concentration of the final solution is: $M = \frac{(0.0262 + 0.112)\text{mol}}{0.1267\text{ L}} = \mathbf{1.09\ M\ Ca(NO_3)_2}$