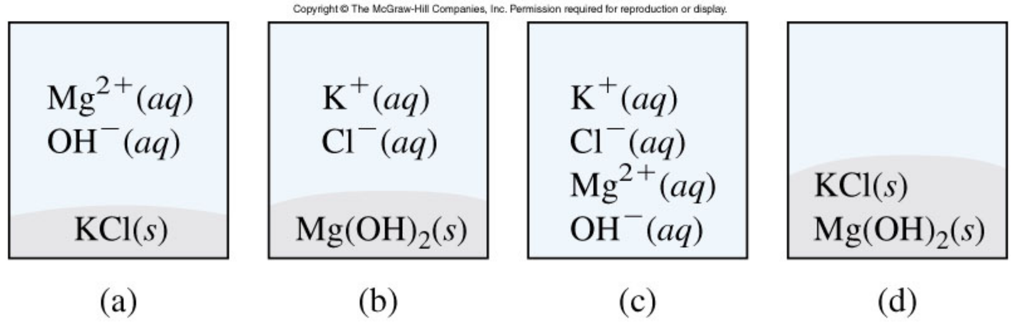
Chem 2 AP Homework #4-2: Problems pg. 152 #4.16, 4.18, 4.22, 4.24, 4.60, 4.62, 4.64(a), 4.66(a), 4.68, 4.69, 4.70, 4.72, 4.74

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.

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



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.

22 **Write ionic and net ionic equations for the following reactions.**
(a) $Na_2S(aq) + ZnCl_2(aq) \rightarrow$

Molecular: $Na_2S(aq) + ZnCl_2(aq) \longrightarrow ZnS(s) + 2NaCl(aq)$

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

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

(b) $K_3PO_4(aq) + 3\ Sr(NO_3)_2(aq) \rightarrow$

Molecular: $2K_3PO_4(aq) + 3Sr(NO_3)_2(aq) \longrightarrow Sr_3(PO_4)_2(s) + 6KNO_3(aq)$

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

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

(c) $Mg(NO_3)_2(aq) + 2\ NaOH(aq) \rightarrow$

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

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

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

24 **With reference to Table 4.2, 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.

60 Describe how you would prepare 250. mL of a 0.707 *M* $NaNO_3$ solution.

First calculate the moles of $NaNO_3$ needed to prepare 250 mL of 0.707 *M* solution:

$$\text{Moles NaNO}_3 = \frac{0.707\text{ mol NaNO}_3}{1000\text{ mL soln}} \times 250\text{ mL soln} = 0.177\text{ mol}$$

Next, find the mass of $NaNO_3$ needed ($\mathcal{M}$ ($NaNO_3$) = 85.00 g/mol).

$$\text{mass NaNO}_3 = 0.177\text{ mol NaNO}_3 \times \frac{85.00\text{ g NaNO}_3}{1\text{ mol NaNO}_3} = 15.0\text{ g NaNO}_3$$

To make the solution, **put 15.0 g of $NaNO_3$ in a 250-mL volumetric flask and fill ~¾ full with water. Stopper and shake to dissolve $NaNO_3$. Fill flask to just below the calibration mark with water, stopper and shake to make solution uniform. Using a dropper, fill with water to calibration mark to make 250 mL of solution**.

62 How many grams of KOH are present in 35.0 mL of a 5.50 *M* solution?

First use volume and molarity (in moles/L or moles/1000 mL) to find moles KOH:

$$\text{? moles KOH solute} = \frac{5.50\text{ moles solute}}{1000\text{ mL solution}} \times 35.0\text{ mL solution} = 0.193\text{ mol KOH}$$

The molar mass of KOH is 56.11 g/mol. Use this conversion factor to calculate grams of KOH.

$$\textbf{? grams KOH} = 0.193\text{ mol KOH} \times \frac{56.11\text{ g KOH}}{1\text{ mol KOH}} = \textbf{10.8 g KOH}$$

64 Calculate the molarity of each of the following solutions:

(a) 6.57 g of CH_3OH in 1.50×10^2 mL of solution.

$$\text{? mol CH}_3\text{OH} = 6.57\text{ g CH}_3\text{OH} \times \frac{1\text{ mol CH}_3\text{OH}}{32.04\text{ g CH}_3\text{OH}} = 0.205\text{ mol CH}_3\text{OH}$$

$$\boldsymbol{M} = \frac{0.205\text{ mol CH}_3\text{OH}}{0.150\ L} = \mathbf{1.37}\ \boldsymbol{M}$$

66 Determine how many grams of each of the following solutes would e needed to make 2.50×10^2 mL of a 0.100 *M* solution:

(a) Cesium iodide (CsI)

$$\text{? g CsI} = 250.\text{ mL} \times \frac{0.100\ M\text{ CsI}}{1000\text{ mL}} \times \frac{259.8\text{ g CsI}}{1\text{ mol CsI}} = \textbf{6.50 g CsI}$$

68 Write the equation that enables us to calculate the concentration of a diluted solution. Give units for all the terms.

$$M_{\text{dilute}}\ (\text{M}) = \frac{\text{M}_{\text{concentrated}}\ (\text{M}) \times \text{V}_{\text{concentrated}}\ (\text{L})}{\text{V}_{\text{dilute}}\ (\text{L})} \text{ or } \text{M}_2 = \frac{\text{M}_1\text{V}_1}{\text{V}_2}$$

4.69 Describe how to prepare 1.00 L of a 0.646 M HCl solution, starting with a 2.00 M HCl solution.

First determine the volume of the stock solution needed from the equation $M_{\text{initial}}V_{\text{initial}} = M_{\text{final}}V_{\text{final}}$:

$$V_{\textbf{initial}} = \frac{M_{\text{final}} \times V_{\text{final}}}{M_{\text{initial}}} = \frac{0.646\ M \times 1.00\ \text{L}}{2.00\ M} = \mathbf{0.323\ L = 323\ mL}$$

To prepare the 0.646 *M* solution, since you are starting with a relatively concentrated acid you would first add about 500 mL of water to a 1-L volumetric flask and then you would use a graduated cylinder to precisely measure 323 mL of the 2.00 *M* HCl solution into the flask. Swirl to mix, then add water to a final volume of 1.00 L, using a dropper to add the last amount of water just to the calibration mark. Stopper the flask and mix well. If the volume has dropped due to mixing, again use a dropper to add water to the calibration mark, stopper and mix well.

70 Water is added to 25.0 mL of a 0.866 *M* KNO_3 solution until the volume of the solution is exactly 500 mL. What is the concentration of the final solution?

We prepare for the calculation by tabulating our data.

$M_i = 0.866\ M \qquad M_f = ?$

$V_i = 25.0\ \text{mL} \qquad V_f = 500\ \text{mL}$

We substitute the data into Equation (4.2) of the text.

$$M_iV_i = M_fV_f$$

$$(0.866\ M)(25.0\ \text{mL}) = M_f(500\ \text{mL})$$

$$M_f = \frac{(0.866\ M)(25.0\ \text{mL})}{500\ \text{mL}} = \mathbf{0.0433\ M}$$

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?

You need to calculate the final volume of the dilute solution. Then, you can subtract 505 mL from this volume to calculate the amount of water that should be added.

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

$$(631 - 505)\ \text{mL} = \mathbf{126\ mL\ of\ water\ added}$$

74 A 46.2-mL, 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 solution:

$$\frac{0.568\ \text{mol}}{1000\ \text{mL soln}} \times 46.2\ \text{mL soln} = 0.0262\ \text{mol}\ Ca(NO_3)_2$$

Moles of calcium nitrate in the second solution:

$$\frac{1.396\ \text{mol}}{1000\ \text{mL soln}} \times 80.5\ \text{mL soln} = 0.112\ \text{mol}\ Ca(NO_3)_2$$

The volume of the combined solutions = 46.2 mL + 80.5 mL = 126.7 mL. The concentration of the final solution is:

$$\boldsymbol{M} = \frac{(0.0262 + 0.112)\,\text{mol}}{0.1267\ \text{L}} = \mathbf{1.09}\ \boldsymbol{M}$$