CHM 1010 **GAGE**

REVIEW PROBLEMS FOR SOLUTIONS

1. For each pair below decide if a solution is likely to form or not and explain briefly why or why not:

   1. H_2O (l) and Na_3PO_4 (s)

   Yes because water is polar with strong hydrogen bonding IMFs and sodium phosphate is an ionic compound. There is a possibility for strong ion-dipole interactions so the materials will mix.

   2. N_2 (g) and H_2O (l)

   No. Since nitrogen is non-polar it exhibits weak dispersion forces between molecules while polar water has strong hydrogen bonds between molecules. Water molecules are more likely to be attracted to each other than to nitrogen.

   3. $CH_3CH_2CH_2CH_2CH_3$ (l) and C_6H_6 (s)

   Yes. Both of these molecules are non-polar and may interact through weak dispersion forces.

   4. H_2O (l) and $CH_3CH_2CH_2CH_2CH_3$ (l)

   No. Since $CH_3CH_2CH_2CH_2CH_3$ is non-polar it exhibits weak dispersion forces between molecules while polar water has strong hydrogen bonds between molecules. Water molecules are more likely to be attracted to each other than to $CH_3CH_2CH_2CH_2CH_3$.

2. How many grams of potassium sulfate are needed to make 250.0 mL of a 0.155 M solution?

$$M = \frac{\text{mol}}{\text{L}} \quad M \times L = \text{mol} = 0.155 \frac{\text{mol}}{\text{L}} \times 0.2500\ \text{L} = 0.0388\ \text{mol}$$

$$0.0388\ \text{mol}\ K_2SO_4 \times \frac{174.3\ \text{g}\ K_2SO_4}{1\ \text{mol}\ K_2SO_4} = 6.76\ \text{g}\ K_2SO_4$$

3. Explain why the boiling point of a 0.5 M $CaCl_2$ solution is higher than the boiling point of pure water.

$CaCl_2$ ionizes in water and forms strong ion-dipole interactions with water molecules. This lowers the vapor pressure of the water. As a result, more energy is needed to overcome the interactions and raise the vapor pressure to atmospheric pressure (to boil). The net result is that the boiling point is increased.

4. Explain what happens step-by-step when the following materials are mixed with water and why: $MgSO_4$; Gasoline (C_8H_{18})

$MgSO_4$ units in a crystal lattice are attracted by the polar ends of water molecules. The oxygen end attracts the Mg^{2+} and the hydrogen ends attract the SO_4^{2-}. The ions are separated from the lattice, surrounded by water molecules, and dispersed in the water to form a solution.

The gasoline molecules exert weak dispersion forces while the water molecules interact through the strongest dipole-dipole forces, hydrogen bonding. The water molecules are more attracted to each other than they are to the gasoline and therefore no mixing will occur. The result will be two layers of liquid.

5. How many mL of 0.344 M $BaCl_2$ are needed to react to provide 5.50 g of silver chloride based on the unbalanced equation below:

$BaCl_2$ (aq) + 2 $AgNO_3$ (aq) ---------> 2 AgCl (s) + $Ba(NO_3)_2$(aq)

$$5.50\text{ g AgCl} \times \frac{1\text{ mol AgCl}}{143.4\text{ g AgCl}} \times \frac{1\text{ mol } BaCl_2}{2\text{ mol AgCl}} \times \frac{1.00\text{ L}}{0.344\text{ mol } BaCl_2} = 0.0557\text{ L } BaCl_2 = 55.7\text{ mL } BaCl_2$$

6. Indicate whether each of the following statements is true or false. If it is false, explain why. (6)

a. If you stir magnesium acetate as you are dissolving it in water you can increase its solubility.

False. Stirring will increase the rate of solution formation but cannot change the amount that will dissolve.

b. A 100 mL of 22% solution of NaCl contains the same number of moles as 100 mL of 22% solution of NaF.

False. 22% means 22 g of solution per 100 mL of solution. 22 grams of NaCl will not contain the same number of moles (and therefore particles) as 22 g of NaF since their molar masses are different.

c. In solutions, like dissolves like.

True. If the natures of the molecules are the same (polar or non-polar or ionic) then the intermolecular forces will be similar and the chances for mixing effectively will be increased.

7. What is the molarity of a solution that contains 3.65 g of acetic acid in 450 mL of solution? What is the g/v% of the same solution?

$$3.65\text{ g } HC_2H_3O_2 \times \frac{1\text{ mol } HC_2H_3O_2}{60.0\text{ g } HC_2H_3O_2} = 0.0608\text{ mol } HC_2H_3O_2$$

$$M = \frac{\text{mol}}{\text{L}} = \frac{0.0608\text{ mol}}{0.450\text{ L}} = 0.135M$$

$$\frac{3.65\text{ g}}{450\text{ mL}} \times 100\% = 0.811\%$$

Answers:

1. a = yes, b = no, c = yes, d = no
2. 6.80 g
5. 55.7 mL
7. 0.135M, 0.811%