46 pts Solution Composition

1. (4 pts) Calculate the mass percent of calcium chloride in each of the following solutions:
   a. 5.00 g calcium chloride in 95.0 g of water. Solute? Solvent?

$CaCl_2$ H_2O

$$\%\ CaCl_2 = \frac{5.00\ g\ CaCl_2}{100\ g\ Total} \times 100 = 5.00\%\ CaCl_2$$

   b. 2.00 mg of calcium chloride in 380. g of water. Solute? Solvent?

$CaCl_2$ H_2O

$$2.00\ mg \times \frac{1\ g}{1000\ mg} = \quad \%\ CaCl_2 = \frac{.00200\ g}{380\ g} \times 100 = 5.26 \times 10^{-4}\%\ CaCl_2$$

2. (4 pts) Calculate the mass, in grams, of NaCl present in each of the following solutions:
   a. 11.5 g of 6.25 % NaCl solution. Solute? Solvent?

NaCl H_2O

$$11.5\ g \times .0625 = .719\ g\ NaCl$$

   b. 452 g of 12.3% NaCl solution. Solute? Solvent?

NaCl H_2O

$$452\ g \times .123 = 55.6\ g\ NaCl$$

3. (4 pts) What is the molarity of a solution in which 40.0 g of sodium hydroxide are dissolved in 6.00 L of solution? Solute? Solvent?

NaOH H_2O

$$mol = 40.0\ g\ NaOH \times \frac{1\ mol\ NaOH}{40.00\ g\ NaOH} = 1.00\ mol\ NaOH$$

$$L = 6.00\ L$$

$$M = \frac{mol}{L} = \frac{1.00\ mol\ NaOH}{6\ L} = .167\ M\ NaOH$$

4. (4 pts) What is the molarity of a solution that contains 14.0 g of ammonium bromide dissolved in enough water to make 150.0 mL of solution? Solute? Solvent?

NH_4Br H_2O

$$M = \frac{mol}{L} = \frac{\left(14.0\ g\ NH_4Br \times \frac{1\ mol\ NH_4Br}{97.94\ g\ NH_4Br}\right)}{\left(150.0\ mL \times \frac{1\ L}{1000\ mL}\right)} = .953\ M\ NH_4Br$$

5. (4 pts) Calculate the grams of copper (II) nitrate needed to make 100.0 mL of a 3.50 M solution of copper (II) nitrate. Solute? Solvent?

$Cu(NO_3)_2$ H_2O

$$M = \frac{mol}{L} \qquad mol = M \times L = \left(\frac{3.50\ mol\ Cu(NO_3)_2}{L}\right)(.1000\ L) = .350\ mol\ Cu(NO_3)_2 \times \frac{187.6\ g\ Cu(NO_3)_2}{mol\ Cu(NO_3)_2}$$

$$= 65.7\ g\ Cu(NO_3)_2$$

6. (6 pts) A solution is made by dissolving 26.42 g of ammonium sulfate in enough water to make 50.00 mL of solution. What is the molarity of each ion in this solution? Write the dissociation equation. Solute? Solvent?

$(NH_4)_2SO_4$ H_2O

$M = ?$

$26.42\ g\ (NH_4)_2SO_4 \times \frac{1\ mol\ (NH_4)_2SO_4}{132.1\ g\ (NH_4)_2SO_4} = .200\ mol\ (NH_4)_2SO_4$

$L = 50.00\ mL \times \frac{1\ L}{1000\ mL} = .05000\ L$

$M = \frac{mol}{L} = \frac{.200\ mol}{.05000\ L} =$

$4.00\ M\ (NH_4)_2SO_4$

7. (6 pts) How many grams of sodium carbonate are needed to make 100.0 mL of 3.0 M solution of sodium carbonate? Solute? Solvent? What would the molarity of the solution be if the volume was increased by 44 mL?

Na_2CO_3 H_2O

$g = mm \times M \times L = \left(\frac{105.99\ g\ Na_2CO_3}{1\ mol}\right)\left(\frac{3.0\ mol\ Na_2CO_3}{L}\right)(.1000\ L) = 32\ g\ Na_2CO_3$

$M_1V_1 = M_2V_2 \qquad M_2 = \frac{(3.0\ M)(100.0\ mL)}{144.0\ mL} = 2.08\ M\ Na_2CO_3$

8. (6 pts) Calculate the moles of each ion present in each of the following solutions:

a. 10.2 mL of 0.451 M aluminum chloride solution

$M = \frac{mol}{L} \qquad mol = M \times L = \left(\frac{.451\ mol\ AlCl_3}{L}\right)(.0102\ L) = .0046\ mol\ AlCl_3$

$\times 3$

$.0046\ mol\ Al^{3+} \qquad .0138\ mol\ Cl^-$

b. 5.51 L of 0.103 M sodium phosphate solution.

$M = \frac{mol}{L} \qquad mol = M \times L = \left(\frac{.103\ mol\ Na_3PO_4}{L}\right)(5.51\ L) = .567\ mol\ Na_3PO_4$

$\times 3$

$1.70\ mol\ Na^+ \qquad .567\ mol\ PO_4^{3-}$

9. (8 pts) Calculate the mass percent and the molarity of a solution that is prepared by mixing 25 mL of pentane (C_5H_{12}, d = 0.63 g/cm^3) with 45 ml hexane (C_6H_{14}, d = 0.66 g/cm^3). Solute? Solvent?

pentane hexane

$25\ mL \times \frac{.63\ g}{mL} = 16\ g\ C_5H_{12} \times \frac{1\ mol\ C_5H_{12}}{72.15\ g\ C_5H_{12}} = .22\ mol\ C_5H_{12}$

$45\ mL \times \frac{.66\ g}{mL} = 30\ g\ C_6H_{14} \times \frac{1\ mol\ C_6H_{14}}{86.17\ g\ C_6H_{14}} = .35\ mol\ C_6H_{14}$

$M = \frac{mol}{L} = \frac{.22\ mol\ C_5H_{12}}{.070\ L}$

$= 3.14\ M$

$\%\ C_5H_{12} = \frac{16\ g\ C_5H_{12}}{46\ g\ total} \times 100 = 35\%\ C_5H_{12}$

$65\%\ C_6H_{14}$

$M = \frac{.35\ mol\ C_6H_{14}}{.070\ L} = 5.0\ M$