Worksheet #9

Calculating Molarity

1. What is the molarity of 950 mL of solution containing 22.4 g of silver nitrate?

2. What is the concentration of a solution that has 4.87 g of potassium permanganate dissolved in 187 mL of water?

3. Which of the following has the highest concentration of Na^+: a) 1.80 g Na_2SO_4 in
   a) 55.0 mL H_2O; b) a solution containing 1.05 g NaCl/100 mL; c) a solution having 14.7 mg Na^+/mL?

4. Determine the mass of $MgCl_2$ contained in a 35.0 mL aliquot of 0.241 M $MgCl_2$ solution.

5. How many Mg^{2+} ions are present in 1.3 mL of 0.184 M magnesium nitrate?

6. How much methanol (CH_3OH, d=0.792 g/mL) in mL, must be dissolved in water to produce 22.5 L of 0.485 M methanol?

Dilutions

7. How many liters of 12.0 M nitric acid are needed to make 4.00 L of a 4.39 M solution?

8. A stock solution of sodium hydroxide has a concentration of 5.00 M. How many mL of it are required to make 355 mL of a 1.35 M solution?

9. A dilution was prepared using a stock 2.50 M NaCl solution. A 20.00 mL aliquot was added to a 250.0 mL volumetric flask, which was then filled to the mark with deionized water. Calculate the concentration of the diluted solution.

Chapter 6 – Percentage Composition of Molecules

Section A

1. What is the weight percent O in MgO?

2. What is the weight percent Cl in $Mg(ClO_3)_2$?

3. What is the weight percent O in N_2O_5?

4. What is the weight percent C in C_2H_5OH?

5. What is the weight percent S in H_2S?

6. What relationship is there between the answers to Problem 5?

7. What is the weight percent O in SnO_2?
8. What is the weight percent H in $C_5H_9O_4N$?
9. What is the weight percent NH_3 in $Cu(OH)_2 \cdot 4NH_3$?
10. What is the percent PbO in $PbSO_4 \cdot PbO$?

Answers to Worksheet #9

Calculating Molarity

Molarity is a concentration expression. It tells how much solute is dissolved in the solvent. Solute is what dissolves in the solvent (small amount: example: NaCl in salt water). The solvent is what dissolves the solute (large amount: example: water in salt water). Put the solute and the solvent together, and you get a solution, which is a mixture with no visible boundaries between components (like a homogenous mixture, usually in the liquid phase but can be gaseous). A solution of anything has a concentration, which is a measure of the amount of solute dissolved in the solvent. There are many concentration expressions used in chemistry, but molarity is the most common. Molarity is a concentration term that expresses the moles of solute dissolved in 1 liter of solution (mol/L, represented as M). To solve molarity problems, put the mass over the volume, then convert to the correct units (moles over liters). When working with a molarity problem when a volume and a molarity has been given to you, start your dimensional analysis with the volume (one unit versus two – molarity is mol/L). Some definitions to remember:

1. $$M\left(\frac{mol}{L}\right)AgNO_3 = \left|\frac{22.4gAgNO_3}{950mL}\right|\frac{1molAgNO_3}{169.91g}\left|\frac{1000mL}{1L}\right| = 0.139M$$

2. $$M\left(\frac{mol}{L}\right)KMnO_4 = \left|\frac{4.87gKMnO_4}{187mL}\right|\frac{1molKMnO_4}{158.04g}\left|\frac{1000mL}{1L}\right| = 0.165M$$

3. a) $$M\left(\frac{mol}{L}\right)Na^+ = \left|\frac{1.80gNa_2SO_4}{55.0mL}\right|\frac{1molNa_2SO_4}{142.05g}\left|\frac{2molNa}{1molNa_2SO_4}\right|\frac{1000mL}{1L}\right| = 0.461M$$

   b) $$M\left(\frac{mol}{L}\right)Na^+ = \left|\frac{1.05gNaCl}{100mL}\right|\frac{1molNaCl}{58.44g}\left|\frac{1molNa^+}{1molNaCl}\right|\frac{1000mL}{1L}\right| = 0.180M$$

   c) $$M\left(\frac{mol}{L}\right)Na^+ = \left|\frac{14.7mgNa^+}{1mL}\right|\frac{1g}{1000mg}\left|\frac{1molNa^+}{22.99g}\right|\frac{1000mL}{1L}\right| = 0.639M$$

   The highest concentration of Na^+ is in solution C.

4. $$mass(g)MgCl_2 = 35.0mL\left|\frac{1L}{1000mL}\right|\frac{0.241molMgCl_2}{1L}\left|\frac{95.21g}{1molMgCl_2}\right| = 0.803gMgCl_2$$

5.

$$\#ionsMg^{2+} = 1.3mL\left|\frac{1L}{1000mL}\right|\frac{0.184molMg(NO_3)_2}{1L}\left|\frac{1molMg^{2+}}{1molMg(NO_3)_2}\right|\frac{6.02x10^{23}ions}{1molMg^{2+}}\right| = 1.44x10^{20}ions$$

Answer to Worksheet #9

6. $vol(mL)CH_3OH = 22.5L\left|\frac{0.485CH_3OH}{1.00L}\right|\frac{32.042g}{1molCH_3OH}\left|\frac{1.00mL}{0.792gCH_3OH}\right| = 441mL$

Dilutions

When you want to decrease the concentration of a solution, you must dilute it. When you dilute something, the concentration is decreased by adding more solvent. The formula used for calculating dilutions is $M_1V_1 = M_2V_2$. An aliquot is a small sample of a solution.

7. $M_1V_1 = M_2V_2 \qquad (12.0M)(V_1) = (4.39M)(4.00L) \qquad V_1 = \frac{17.56M \cdot L}{12.0M} = 1.46L$

8. $M_1V_1 = M_2V_2 \qquad (5.00M)(V_1) = (1.35M)(3.55mL) \qquad V_1 = \frac{479.25M \cdot mL}{5.00M} = 95.9mL$

9. $M_1V_1 = M_2V_2 \qquad (2.50M)(20.00mL) = M_2(250.0mL) \qquad M_2 = \frac{50.0M \cdot mL}{250.0mL} = 0.200M$

Answers to Chapter 6 – Percentage Composition of Molecules
Section A

1. 39.7% O (MW = 40.3 g/mol)

2. 37.1% Cl (MW = 191.3 g/mol)

3. 74.1% O (MW = 108.0 g/mol)

4. 52.2% C (MW = 46.0 g/mol)

5. 94.1% S (MW = 34.1 g/mol)

6. The sum of the weight percents is 100.

7. 21.2% O (MW = 150.7 g/mol)
8. 6.12% H (MW = 147.0 g/mol)
9. 41.1% NH_3 (MW = 165.5 g/mol)
10. 42.4% PbO (MW = 526.4 g/mol)