Chem 1010 Introductory Chemistry
Dr. Davies

## I. Grams, moles and molecules:

1. What is the molecular weight of sodium carbonate, $Na_2CO_3$?

2. What is the mass in grams of 3.7 moles of sodium chloride, NaCl?

3. How many moles of water are there in 25mL of pure water? (Hint: Density of water = 1g/mL)

4. A sample of magnesium metal contains $12.04 \times 10^{23}$ atoms. What is the mass in grams of this sample?

5. Thallium sulfate, $Tl_2SO_4$, is a powerful poison used to kill coyotes in the 1970's Hundreds of bald eagles were also inadvertently killed as well. How many moles of $Tl_2SO_4$ are in a 1 kg can of this substance?

## II. Concentrations:

1. How many grams of $CaCO_3$ are in 25mL of a 5% solution of calcium carbonate in water?

2. If a 150mL aqueous solution contains 25 moles of sodium acetate, $CH_3CO_2Na$, what is the molarity of the solution?

3. What is the molarity of a solution containing 15g of sodium chloride, NaCl, dissolved in 250mL of water.

4. How many grams of HCl are contianed in 200mL of a 5M HCl aqueous solution?

5. Given 350mL of 5M HCl aqueous solution, state the number of HCl molecules contained in this solution.

Key

Chem 1010 Introductory Chemistry
Dr. Davies

## I. Grams, moles and molecules:

1. What is the molecular weight of sodium carbonate, $Na_2CO_3$?

$2\ Na = 2(23) = 46$
$1\ C = 1(12) = 12$
$3\ O = 3(16) = 48$
$106$

106 g/mol

2. What is the mass in grams of 3.7 moles of sodium chloride, NaCl?

Given: 3.7 moles NaCl
Need: g NaCl
C.F. = m.w. NaCl: 23+35.5
58.5 g NaCl / 1 mol NaCl

$$\frac{3.7\ \text{mol NaCl}}{1} \left| \frac{58.5\ \text{g NaCl}}{1\ \text{mol NaCl}} \right. = 216.5\ \text{g NaCl}$$

3. How many moles of water are there in 25mL of pure water? (Hint: Density of water = 1g/mL)

Given: 25mL $H_2O$
Need: ? mol $H_2O$
C.F. = d: 1g $H_2O$ / 1mL $H_2O$
$H_2O$ M.W. = 18g $H_2O$ / 1 mol $H_2O$

(d) (m.w.)

$$\frac{25\ \text{mL}\ H_2O}{1} \left| \frac{1\ \text{g}\ H_2O}{1\ \text{mL}\ H_2O} \right| \frac{1\ \text{mol}\ H_2O}{18\ \text{g}\ H_2O} = 1.4\ \text{mol}\ H_2O$$

4. A sample of magnesium metal contains 12.04 X $10^{23}$ atoms. What is the mass in grams of this sample?

Given: $12.04 \times 10^{23}$ atoms (Mg)
Need: g Mg
C.F. = $6.02 \times 10^{23}$ atoms Mg / 1 mol Mg
24.3 g Mg / 1 mol Mg

$$\frac{12.04 \times 10^{23}\ \text{atoms Mg}}{6.02 \times 10^{23}\ \text{atoms Mg}} \left| \frac{1\ \text{mol Mg}}{1\ \text{mol Mg}} \right| \frac{24.3\ \text{g Mg}}{1\ \text{mol Mg}} = 48.6\ \text{g Mg}$$

5. Thallium sulfate, $Tl_2SO_4$, is a powerful poison used to kill coyotes in the 1970's Hundreds of bald eagles were also inadvertently killed as well. How many moles of $Tl_2SO_4$ are in a 1 kg can of this substance?

Given: 1Kg $Tl_2SO_4$
Need: moles $Tl_2SO_4$
C.F. = 1kg = 1,000g

$2\ Tl = 2(204) = 408$
$1\ S = 1(32) = 32$
$4\ O = 4(16) = 64$
$504$
504g $Tl_2SO_4$ / mol

$$\frac{1\ \text{Kg}\ Tl_2SO_4}{1} \left| \frac{1{,}000\ \text{g}\ Tl_2SO_4}{1\ \text{Kg}\ Tl_2SO_4} \right| \frac{1\ \text{mol}\ Tl_2SO_4}{504\ \text{g}\ Tl_2SO_4} = 2\ \text{mol}\ Tl_2SO_4$$

## II. Concentrations:

1. How many grams of $CaCO_3$ are in 25mL of a 5% solution of calcium carbonate in water?

Given: 25mL
5% soln: $\frac{5\text{g solute}}{100\text{g solution}}$
Need: g $CaCO_3$ (solute)

$$\frac{25\text{mL soln}}{1}\left|\frac{1\text{g soln}}{1\text{mL soln}}\right|\frac{5\text{g }CaCO_3}{100\text{g solution}} = 1.25\text{g }CaCO_3$$

2. If a 150mL aqueous solution contains 25 moles of sodium acetate, $CH_3CO_2Na$, what is the molarity of the solution?

Given: 150mL soln
25 moles S.A.
Need: Molarity (M)

$$M = \frac{\text{moles solute}}{\text{L of solution}} = \frac{25\text{ mol S.A.}}{150\text{mL soln}}\left|\frac{1{,}000\text{mL soln}}{1\text{ L soln}}\right. = 167\text{ M}$$

3. What is the molarity of a solution containing 15g of sodium chloride, NaCl, dissolved in 250mL of water.

Given: 15g NaCl
250mL $H_2O$
Need: Molarity
C.F.: 58.5g NaCl/1mol NaCl
1,000mL/1L

$$\frac{15\text{g NaCl}}{250\text{mL }H_2O}\left|\frac{1\text{mol NaCl}}{58.5\text{g NaCl}}\right|\frac{1{,}000\text{mL }H_2O}{1\text{ L }H_2O} = \frac{1.0\text{ mol NaCl}}{1\text{ L }H_2O} = 1\text{ M}$$

4. How many grams of HCl are contianed in 200mL of a 5M HCl aqueous solution?

Given: 200mL
5M HCl: $\frac{\text{mol}}{\text{L}}$
Need: g HCl
C.F.: 36.5g HCl/1mol HCl
1L = 1,000mL

$$\frac{200\text{mL soln}}{1}\left|\frac{1\text{ L soln}}{1{,}000\text{mL}}\right|\frac{5\text{mol HCl}}{1\text{ L soln}}\left|\frac{36.5\text{g HCl}}{1\text{ mol HCl}}\right. = 36.5\text{g HCl}$$

5. Given 350mL of 5M HCl aqueous solution, state the number of HCl molecules contained in this solution.

Given: 350mL soln
5M HCl: $\frac{5\text{mol HCl}}{1\text{ L soln}}$
Need: # of HCl molecules
C.F.: $6.02\times10^{23}$ molec./mol
1,000mL = 1L

$$\frac{350\text{mL soln}}{1}\left|\frac{1\text{ L soln}}{1{,}000\text{mL soln}}\right|\frac{5\text{mol HCl}}{1\text{ L soln}}\left|\frac{6.02\times10^{23}\text{ molec. HCl}}{1\text{ mol HCl}}\right.$$

$$= 1.05\times10^{24}\text{ molec. of HCl}$$