Concentration Calculations

PART #1:   The Solution Equation

$$C = \frac{n}{V} \quad or \quad n = CV$$

C = concentration in mol/L = M   *

n = amount in mol **

V = volume in L

*   the unit M is molar and is equivalent to mol/L.

     M = mol/L

**   you will frequently need to convert between mass
     and amount

eg. determine the mass of Na_2SO_4 required to make 250 mL
     of 0.4 M solution.

n = ? (need to find before you can find mass)

C = 0.4 mol/L

V = 250 mL $\Rightarrow$ 0.250 L

n = CV

n = 0.4 mol/L x 0.250 L

n = 0.1 mol Na_2SO_4

0.1 mol Na_2SO_4 x $\underline{142.05 \text{ g } Na_2SO_4}$ = 14.205 g Na_2SO_4
             1 mol Na_2SO_4

eg 2   What concentration will result if 100.0 g of
        NaCl is placed in 1500 mL of solution.

n = 100.0 g NaCl x $\underline{\text{1 mol NaCl}}$ = 1.711 mol NaCl
                    58.44 g NaCl

C = ?

V = 1500 mL ⇨ 1.5 L

C = $\dfrac{n}{V}$

C = $\dfrac{1.711 \text{ mol}}{1.5 \text{ L}}$

C = 1.141 M

PART #2: The Dilution Equation

$$C_1V_1 = C_2V_2$$

This is known as the dilution equation. Concentration
and volume of one solution is converted to a
concentration and volume of a second solution. The 1
and 2 subscripts are used to keep the solutions in
order. Sometimes, the 1s are replaced by S which
stands for stock solution and the 2s are replaced by D
which stands for dilute solution. When making a
solution through dilution, you can only go one way,
from stock to dilute.

$$C_SV_S = C_DV_D$$

eg determine the concentration of 2.0 L of solution
made from 165 mL of 12.1 M stock HCl solution?

C_S = 12.1 M

V_S = 165 mL*

C_D = ?

V_D = 2.0 L $\Rightarrow$ 2000 mL*

$C_D = \dfrac{C_SV_S}{V_D}$

$C_D = \dfrac{12.1 \text{ M} \times 165 \text{ mL}}{2000 \text{ mL}}$

C_D = 0.998 M

* In this equation the volume units must agree. The
same answer would have been achieved by converting 165
mL to 0.165 L instead of converting the 2.0 L. When
using C = n/V, volume units must be in L