Molarity

1. What is molarity?

   Molarity is one of the units used to describe the concentration of a solution.

2. What are the units of molarity?

$$\frac{moles\ of\ solute}{L\ of\ sol'n} = Molarity\ (M)$$

3. Calculate the molar concentration of all the ions in the following *strong* electrolytes.

   a. 75g of KCl dissolved in 250 mL of water.

$$75\ g\ KCl \quad \frac{1.0\ mol\ KCl}{74.55g\ KCl} = 1.0\ mol\ KCl$$

$$\frac{1.0\ mol\ KCl}{250 \times 10^{-3}\ L\ sol'n} = 4.0\ M\ KCl \rightarrow K^+ \quad Cl^-$$

It is important to note that the solution is not one made up of KCl molecules, but is a solution made up of K^+ and Cl^- ions. That is why the question asked for the concentration for the *ions* in solution. That means that we are not concerned with the concentration of KCl as whole, but as individual components.

$$\frac{4.0\ \cancel{mol\ KCl}}{L\ of\ sol'n} \quad \frac{1\ mol\ K^+}{1\ \cancel{mol\ KCl}} = 4.0\ M\ K^+$$

$$\frac{4.0\ \cancel{mol\ KCl}}{L\ of\ sol'n} \quad \frac{1\ mol\ Cl^-}{1\ \cancel{mol\ KCl}} = 4.0\ M\ Cl^-$$

b. 100.0g of MgF_2 dissolved in 500.0 mL of water

$$100.0\ g\ MgF_2 \frac{1\ mol\ MgF_2}{62.31\ g\ MgF_2} = 1.605\ mol\ MgF_2$$

$$\frac{1.605\ mol\ MgF_2}{0.500L\ sol'n} = 3.21M\ MgF_2$$

$MgF_2 \rightarrow Mg^{2+} + 2F^-$

Now we solve for the concetrations of the individual ions in solution, just like the previous example.

$$\frac{3.21\ \cancel{mol\ MgF_2}}{L\ of\ sol'n} \frac{1\ mol\ Mg^{2+}}{1\ \cancel{mol\ MgF_2}} = 3.21\ M\ Mg^{2+}$$

$$\frac{3.21\ \cancel{mol\ MgF_2}}{L\ of\ sol'n} \frac{2\ mole\ F^-}{1\ \cancel{mol\ MgF_2}} = 6.42\ M\ F^-$$

4. What is a dilution?

In a dilution the volume of a solution is increased but the moles of solute remains the same.

5. What equation is useful in a dilution?

$$\mathbf{M_1V_1 = M_2V_2}$$

M_1 = Initial molarity M_2 = Final molarity

V_1 = Initial sol'n volume V_2 = Final sol'n volume

*Caution – Only use this equation when a substance is NOT undergoing a reaction.

6. How much water must be added to a 2.00M stock sol'n of NaOH to make 100.0 mL of a 0.100M NaOH sol'n?

We know that this is a dilution question because we are told that all we are doing is adding water to the solution. Adding water will increase the volume of solution, but not affect the moles of solute (NaOH) present in solution. This means that it is completely fine to use $M_1V_1 = M_2V_2$

$(100.0\ mL)\ (0.100\ M) = (V_2)\ (2.00M)$
V_2 =5.00 mL of **stock** solution needed

It is important to note that the question is asking for the amount of water required – we just solved for the amount of the concentrated stock solution we would need to dilute down.

Amount of water that must be added is
100.0 mL – 5.00 mL = **95.0 mL water**