Solution Stoichiometry

Chem Worksheet 15-6

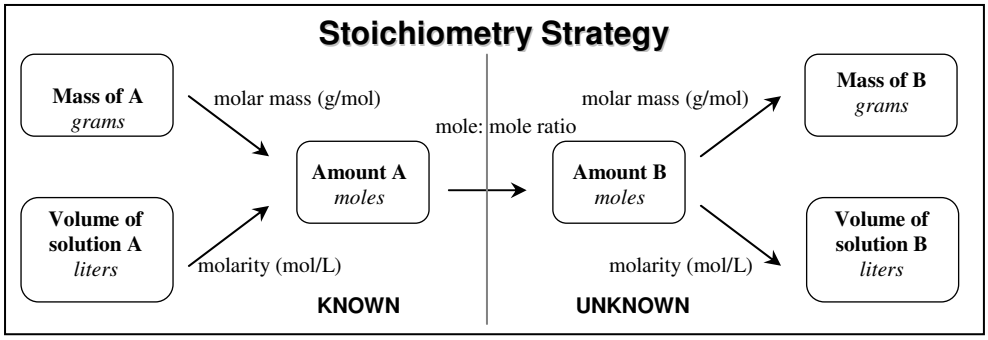
Name _____

The **molarity** of a solution is a ratio of the moles of solute per liters of solution. The units for molarity are written as mol/L or *M*. This measurement is used to perform stoichiometric calculations. The strategy used for solving these solution stoichiometry problems is to set up the problem so that the units cancel.

USEFUL EQUATIONS

$$\text{molarity} = \frac{\text{mol solute}}{\text{L solution}} \qquad 1\ \text{L} = 1000\ \text{mL}$$

When the volume of a solution is multiplied by the molarity of a solution the resulting units are moles. A balanced equation allows us to convert from moles of a known substance to moles of an unknown. Finally, the moles of an unknown substance can be converted into grams, liters of solution, molarity, or other units.



Example

How many grams of solid calcium hydroxide, $Ca(OH)_2$, are required to react with 350 mL of 0.40 *M* HCl?

$$\_\_HCl + \_\_Ca(OH)_2 \rightarrow \_\_CaCl_2 + \_\_H_2O$$

- balance the equation: $2\ HCl + \_\_Ca(OH)_2 \rightarrow \_\_CaCl_2 + 2\ H_2O$

- convert mL to L: $\frac{350\ \cancel{\text{mL}}\ \text{HCl}}{1} \times \frac{1\ \text{L}}{1000\ \cancel{\text{mL}}} = 0.350\ \text{L HCl}$

- write the 'given' and 'unknown' units: $\frac{350\ \text{L HCl}}{1} \times \_\_\_\_ \times \_\_\_\_ \times \_\_\_\_ = \quad \text{grams } Ca(OH)_2$

- fill in factors and solve: $\frac{0.350\ \cancel{\text{L HCl}}}{1} \times \frac{0.40\ \cancel{\text{mol HCl}}}{1\ \cancel{\text{L HCl}}} \times \frac{1\ \cancel{\text{mol Ca(OH)}_2}}{2\ \cancel{\text{mol HCl}}} \times \frac{74.10\ \text{g Ca(OH)}}{1\ \cancel{\text{mol Ca(OH)}_2}} = 5.19\ \text{grams Ca(OH)}_2$

Answer the following questions. Show all work and report answers with units.

1. How many grams of aluminum are required to react with 35 mL of 2.0 *M* hydrochloric acid, HCl?
   $\_\_ HCl + \_\_ Al \rightarrow \_\_ AlCl_3 + \_\_ H_2$

2. How many grams of sodium can be reacted with 750 mL of a 6.0 *M* solution of sulfuric acid, H_2SO_4?
   $\_\_ Na + \_\_ H_2SO_4 \rightarrow \_\_ Na_2SO_4 + \_\_ H_2$

3. If 45 mL of a 1.5 *M* $AgNO_3$ is added to KCl how many grams of AgCl can be formed?
   $\_\_ AgNO_3 + \_\_ KCl \rightarrow \_\_ AgCl + \_\_ KNO_3$

4. How many liters of a 0.75 *M* solution of $Ca(NO_3)_2$ will be required to react with 148 g of Na_2CO_3?
   $\_\_ Ca(NO_3)_2 + \_\_ Na_2CO_3 \rightarrow \_\_ CaCO_3 + \_\_ NaNO_3$

5. How many liters of a 3.0 *M* H_3PO_4 solution are required to react with 4.5 g of zinc?
   $\_\_ H_3PO_4 + \_\_ Zn \rightarrow \_\_ Zn_3(PO_4)_2 + \_\_ H_2$

6. How many milliliters of 0.10 *M* $Pb(NO_3)_2$ are required to react with 75 mL of 0.20 *M* NaI?
   $\_\_ Pb(NO_3)_2 + \_\_ NaI \rightarrow \_\_ PbI_2 + \_\_ NaNO_3$

7. How many grams of solid $BaSO_4$ will form when Na_2SO_4 reacts with 25 mL of 0.50 *M* $Ba(NO_3)_2$?
   $\_\_ Ba(NO_3)_2 + \_\_ Na_2SO_4 \rightarrow \_\_ BaSO_4 + \_\_ NaNO_3$

8. If 525 mL of 0.80 *M* HCl solution is neutralized with 315 mL of $Sr(OH)_2$ solution what is the molarity of the $Sr(OH)_2$?
   $\_\_ HCl + \_\_ Sr(OH)_2 \rightarrow \_\_ SrCl_2 + \_\_ H_2O$