# Moles & Stoichiometry Cheat Sheet

**Calculating Molar Mass**

1. Write out formula of compound
2. Determine number of atoms of each element present
3. multiply number of atoms of the element by the atomic mass of the element
4. add up the values just determined for all of the elements present in the compound

**Calculating Percent Composition**

1. Calculate the molar mass of the compound
2. divide the mass contribution of each element by the total molar mass
3. multiply by 100 to make a percent

*Note: total of percents should equal 100%!*

**Mass** (grams) <---------- x by molar mass / ÷ by molar mass ----------> **Mole** <---------- x by Avogadro's # / ÷ by Avogadro's # ----------> **Particles** (atoms, molecules, formula units)

**Calculating Empirical Formula**

1. Change % of each element to grams of each element (if no sample amount is given assume 100 g)
2. convert grams of each element to moles of each element by dividing the grams by the molar (atomic) mass of that element
3. divide all molar values by the smallest molar value (to establish lowest whole number ratio)
4. if all values are not whole numbers, multiply all by a whole number factor to make the values whole (ex. 1.5 and 1 should be multiplied by 2 to get rid of the .5 = 3 and 2)
5. plug values in with the element they represent

**Calculating Molecular Formula**

1. calculate the empirical formula first
2. calculate the molar mass of the empirical formula
3. take the molar mass of the molecular formula (given in the problem) and divide it by the molar mass of the empirical formula. This will equal the number of times the e.f. is in the m.f.
4. distribute the number attained through the empirical formula

*Example:* $2(C_2H_5) = C_4H_{10}$

**Calculating the Formula of a Hydrate**

1. Determine the mass of water in the hydrate by subtracting the mass of the anhydrous from the mass of the hydrate (if necessary) -OR-convert %'s into grams by assuming a 100g sample
2. convert grams of each into moles of each by dividing by molar mass
3. divide the moles of water by the moles of the anhydrous to determine the number of moles of water in the formula
4. write the formula of the anhydrous followed by a dot then the # of moles of water and "$H_2O$"

*Example:* $CuSO4 \cdot 5H_2O$

**Naming a Hydrate**

1. write the name of the ionic compound
2. use a prefix for the number of water molecules (see below)
3. write "hydrate" after the prefix

1 = mono, 2 = di, 3 = tri, 4 = tetra, 5 = penta,
6 = hexa, 7 = hepta, 8 = octa, 9 = nona, 10 = deca

*Example: Copper (II) sulfate pentahydrate*

## Stoichiometry – Interpreting Chemical Equations

- "ANY TIME YOU HAVE MOLE AND MOLE IN THE SAME FRACTION ALWAYS LOOK AT THE BALANCED CHEMICAL EQUATION"
- Stoichiometry is used to convert from moles of one substance to moles of a different substances
    - These substances are related by their mole ratios established by the balanced chemical eq.

### Mole-to-Mole Conversion

1. start with a balanced chemical equation
2. start with substance A
3. multiply by the mole ratio with the substance you want to get "B" on top of the substance you are getting rid of "A"
4. insert the corresponding coefficient from the equation to the ratio for each substance

| # mols Substance "A" | # mols Substance "B" |
|---|---|
| | # mols Substance "A" |

*Example: $2H_2 + O_2 \rightarrow 2H_2O$*

| # mols $O_2$ | 2 mols $H_2O$ |
|---|---|
| | 1 mol $O_2$ |

### Mole-to-Mass Conversion

1. start information is the same but you are asked to find grams of new substance
2. follow steps listed above
3. multiply by the molar mass of the new substance to get the grams of the new substance

*Example: $2H_2 + O_2 \rightarrow 2H_2O$*

| # mols $O_2$ | 2 mols $H_2O$ | 18 g $H_2O$ |
|---|---|---|
| | 1 mol $O_2$ | 1 mol $H_2O$ |

### Mass-to-Mass Conversion

1. start information given in grams and asked to find grams
2. 3 step problem, grams substance A to moles sub. A, mole ratio, mole of sub. B to grams sub. B
3. divide by molar mass, mole ratio, multiply by new molar mass

*Example: $2H_2 + O_2 \rightarrow 2H_2O$*

| # g $O_2$ | 1 mol $O_2$ | 2 mol $H_2O$ | 18 g $H_2O$ |
|---|---|---|---|
| | 32 g $O_2$ | 1 mol $O_2$ | 1 mol $H_2O$ |

### Determining the Limiting Reactant

1. put amount of each reactant into moles
2. divide the moles of each reactant by its coefficient in the balanced equation.
3. the small amount is the limiting reactant; the other reactant(s) will be in excess

$N_2 + 3\ H_2 \rightarrow 2\ NH_3$

2 moles of $N_2/1 = 2$

3 moles of $H_2/3 = 1$ $H_2$ is limiting

*Remember, the limiting reactant determines the amount of product that will form!*

### Determining the Amount of Excess Reactant

1. Convert the moles of the limiting reactant into moles of the excess reactant. This will equal the number of moles USED
2. subtract this number of moles from the total # of moles available of the excess reactant. This will equal the AMOUNT OF EXCESS REACTANT LEFTOVER
3. convert this to grams by multiplying by molar mass

### Calculating Percent Yield

1. determine the theoretical yield by using your stoichiometry and a mass-to-mass conversion
2. divide the actual mass (given to you or measured in a lab) by the theoretical mass (calculated with stoichiometry)
3. multiply by 100 to make a percent