

The mole and molar mass

- There are 6.02×10^{23} particles in one mole
- Molar mass is calculated from PT
- # of particles $\rightarrow$ Mole $\rightarrow$ Mass and Mass $\rightarrow$ Mole $\rightarrow$ # of Particles

Percentage composition

- $(\text{Element mass} \div \text{Compound mass}) \times 100\%$

Empirical and Molecular Formula

- Determine simplest formula from % composition, grams of reactants, or moles
- Calculate molecular formula from simplest formula and molar mass

Stoichiometry

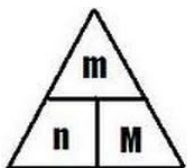
- grams A $\rightarrow$ moles A $\rightarrow$ moles B $\rightarrow$ grams B
- use mole ratio to find moles of sub. A to sub. B in bal eq'n

Limiting reagents

- Actual/Ideal chart for limiting reagents
- The limiting reagent is the "given quantity"
- Shortcut method of determining limiting reagent

Percentage yields

- Percentage yield = actual/theoretical $\times 100\%$
- Actual yield is given, theoretical is calculated
- 4 reasons why actual yield falls short

Important equations:

M = Molar Mass
n = Moles
m = Mass

PERCENT COMPOSITION =

$$\frac{(\text{TOTAL MASS OF ELEMENT PRESENT})}{(\text{MOLECULAR MASS})} \times 100$$

$$\% \text{ Yield} = 100 \times \frac{\text{Actual Yield}}{\text{Theoretical Yield}}$$

- Calculate the following:
 - How many moles are present in 8.5 g of magnesium nitrate, $\text{Mg}(\text{NO}_3)_2$?
 - How many atoms are there in 8.5 g of $\text{Mg}(\text{NO}_3)_2$?
 - How many moles are there in 4.20×10^{21} molecules of methane?
 - What is the mass of 1.0×10^{23} molecules of water?
- Titanium reacts with oxygen to produce titanium oxide, the pigment that gives paint and sunscreen a white colour.
 - If 15.6 g of titanium reacts with oxygen to form 20.0 g of titanium oxide, calculate the mass of oxygen that reacted. What chemistry law are you using?
 - Calculate the percent composition of titanium oxide.
 - How much titanium oxide can be produced from 500 g of titanium and unlimited oxygen? What law are you using to solve this?
- What is the percent composition of:
 - sodium carbonate (Na_2CO_3)?
 - aluminum oxide (Al_2O_3)?
- What is the empirical formula of a compound that is:
 - 30.4% N, 69.6% O (by mass)
 - 43.6% P, 56.4% O (by mass)
- What is the molecular formula of a compound with molar mass 60.0 g and composed of 39.97% C, 6.73% H, and 53.30% O (by mass)?

6. A certain compound has the following percent composition: C - 57.1 %, H - 4.8%, and O- 38.1 %. If the molar mass is 126 g, what is the molecular formula?
7. When 25.0 g of a certain organic compound containing C, H and O is subjected to combustion analysis, 27.8 g of CO₂ and 19.9 g of H₂O are recovered. Determine the empirical formula of the compound.
8. How many grams of lead (II) chloride will be produced when 6.7 g of lead (II) nitrate react with excess hydrochloric acid to form nitric acid and lead (II) chloride?
9. A reaction involved in the production of iron from iron ore is:
- $$\text{Fe}_2\text{O}_3 (\text{s}) + \text{CO} (\text{g}) \longrightarrow \text{Fe} (\text{s}) + \text{CO}_2 (\text{g})$$
- a) How many kilograms of CO must react to produce 3.50 kg of Fe?
b) What mass of CO₂ would be produced?
10. a) What is the maximum amount of iron (III) oxide than can be produced when 255 g of iron (II) sulfide are reacted with 71.4 g of oxygen gas in a closed container to produce iron (III) oxide and sulfur dioxide gas?
b) What mass of the excess reactant remains after the reaction?
11. a) What is the maximum theoretical yield of carbon dioxide when 8.50 g of methane (CH₄) react with 31.8 g of oxygen gas to form carbon dioxide and water?
b) If 20.5 g of carbon dioxide is actually produced in the reaction (actual yield), what is the percentage yield?
12. Calculate the mass of aluminum sulfate formed when 6.71 g of Al react with 12.95 g of H₂SO₄. Be sure to consider determine the reactant that is the limiting reactant.
- $$\text{Al} (\text{s}) + \text{H}_2\text{SO}_4 (\text{aq}) \longrightarrow \text{Al}_2(\text{SO}_4)_3 (\text{aq}) + \text{H}_2 (\text{g})$$

ANSWERS:

- 1 a) 0.057 mol b) 3.1×10^{23} c) 0.00697 mol d) 3.0 g 2a) 4.4g b) 76.0% Ti, 22.0% O c) 641 g
3. a) Na - 43.4%, C - 11.3%, O - 45.3% b) Al - 53.0%, O - 47.0%
4. a) NO₂ b) P₂O₅ 5. C₂H₄O₂ 6. C₆H₆O₃ 7. C₃H₇O₃
8. 5.6 g 9. a) 2.6 kg b) 1.13 kg 10. a) 102 g b) 143g FeS
11. a) 21.9 g b) 93.6 % 12. 15.1 g