Stoichiometry

Intro: Atoms interact with each other at the atomic level. We use stoichiometry to connect these atomic level interactions to the macroscopic observations that occur in the lab. We will usually describe the relative # of particles that react and are produced in a balanced chemical equation.

Propane

C_3H_8

* in order for propane and oxygen to react they MUST collide!

$$C_3H_8 \xleftarrow{\text{React}} O_2 \Longrightarrow \text{Products of Reaction } CO_2 + H_2O$$

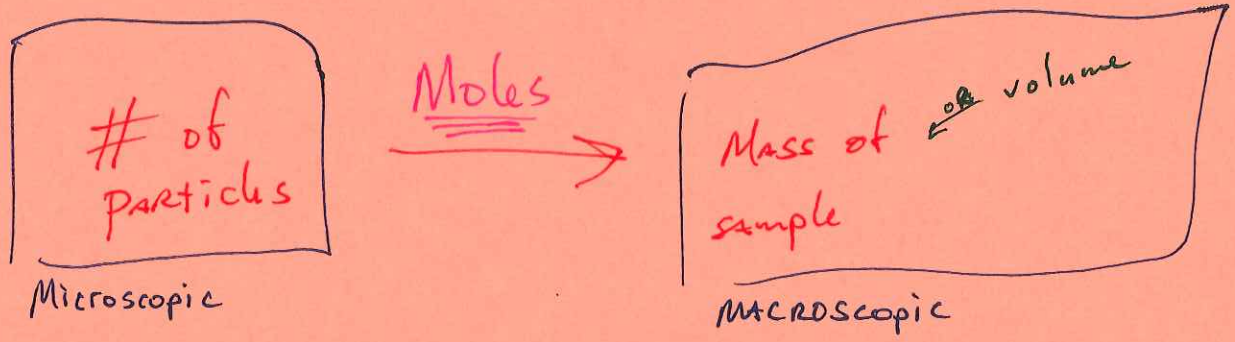
(*) Law of Conservation of Matter: # of atoms on reactants side must be equal to # of atoms on products side

Balanced Chemical Equation: shows relative # of particles consumed and produced in a reaction

$$\underbrace{C_3H_8 + 5O_2}_{\text{describes \# of particles consumed}} \rightarrow \underbrace{3CO_2 + 4H_2O}_{\text{describes \# of particles produced}}$$

Problem: We can't work/see at the atomic scale

Solution: find a way to relate # of particles to mass/volume that we can measure



Moles relates the microscopic to the macroscopic

$$\boxed{1 \text{ mole} = 6.023 \times 10^{23} \text{ particles}}$$

✱✱✱ Now: for any sample we have a numerical relationship between the # of particles present at the atomic scale and the # of moles, mass, volume of our samples

where did Avagadro's number come from?

Based on the # of particles in 12 g of ${}^{12}_{6}C$ sample

$$\boxed{\text{\# of particles}} \times {}^{12}_{6}C = 12.0\ g \text{ of Carbon}$$

Solving equation gives us 6.023×10^{23} particles

* Mass of Carbon-12 is exactly 12 g so it also allows us to use amu (atomic mass units) interchangably with $\frac{g}{mol}$ when going from atomic scale to macroscopic level!

Carbon

1 atom = 12.01 amu

Atomic level ⟶

Carbon

1 mole = 12.01 g

Macroscopic level

$\boxed{\text{amu}}$ → atomic level

$\boxed{\frac{\text{g}}{\text{mol}}}$ → moles, macroscopic level

CO_2

1 molecule = 44.01 amu

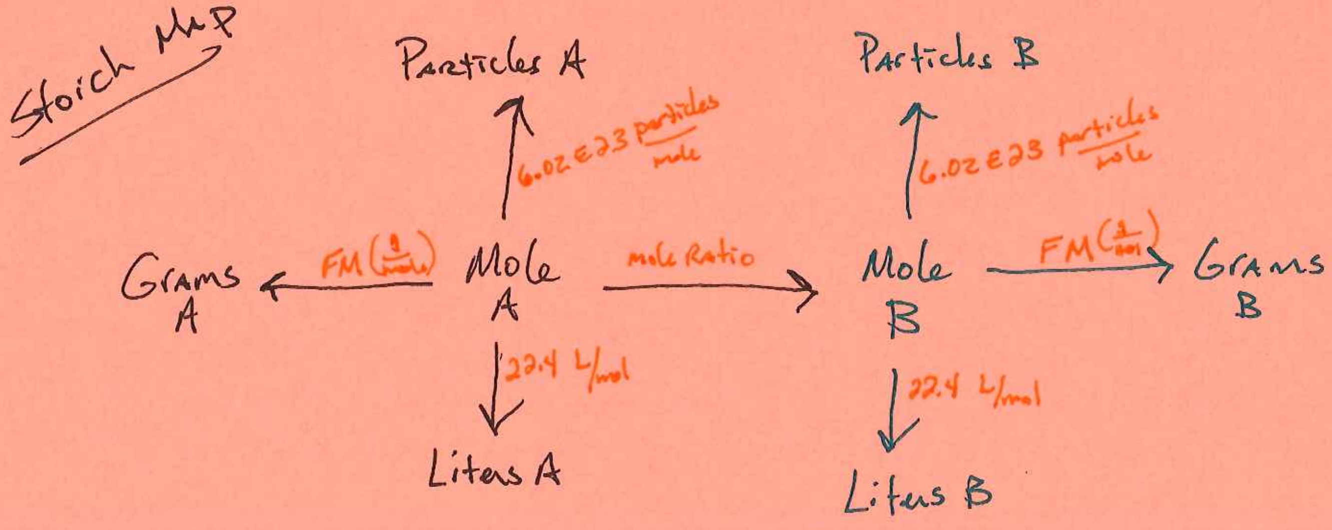
Atomic level ⟶

CO_2

1 mole = 44.01 g

macroscopic level

Stoichiometry: All about relating macroscopic level to chemical processes which occur at the Atomic level


Stoich Map