The Mole and % Composition

The mole

- The mole is simply a counting number just like a dozen.
- The mole is an extremely large number!
- 6.02×10^{23}
- This is only useful for counting amounts of very small things. (like atoms and molecules)
- It is called Avogadro's number, and it was determined to be the exact amount of particles necessary to make the atomic mass on the periodic table to be in grams.

Molar Mass

- To get the mass of one mole of a substance, just add up its atomic masses of each atom from the periodic table.
- Ex. 1 mole C = 12.01g
- 1 mole O_2 = 2(16.00) = 32g
- 1 mole H_2S = 2(1.01) + 32.06 = 34.08g
- 1 mole $BaSO_4$ = 137.33 + 32.06 + 4(16.00)= 233.39g
- This is what you use every time you convert from grams to moles or moles to grams.

Molar Volume

- All gases act the same because their molecules are so far apart.
- Therefore the volume per mole of any gas is the same.
- Volumes of gases are greatly effected by temperature and pressure, so standard conditions are determined called STP (0^oC and 1 atmosphere of pressure).
- The volume of 1 mole of any gas at STP = 22.4L
- Sooooo… 1 mole of He, CO_2, or O_2 = 22.4L

Not a Gas

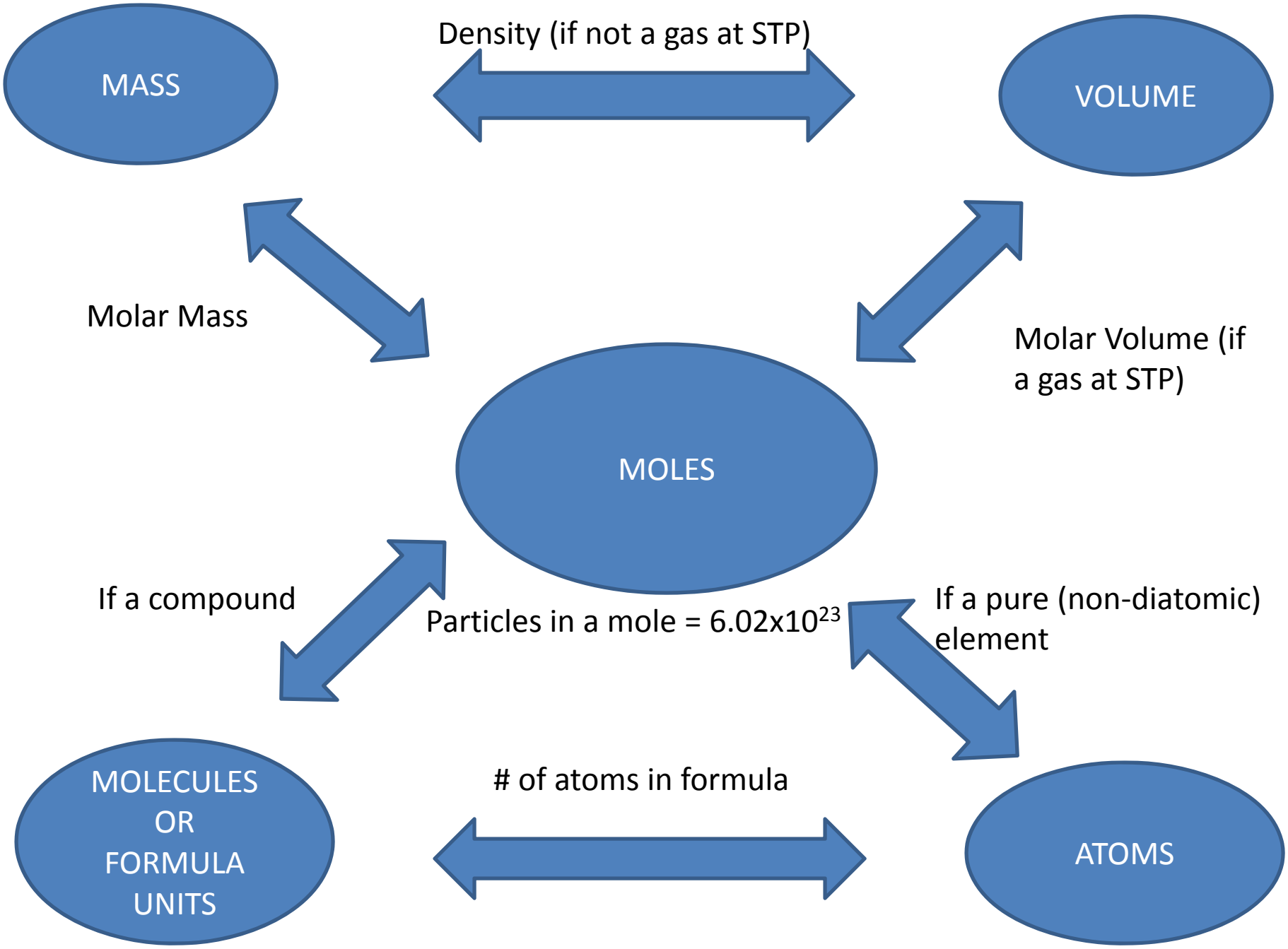
- The molar volume relates a gas at STP to one mole, if it is a gas that is not at STP, we will deal with it in a later chapter.
- If it is not a gas at all, then you can not go directly from volume to moles, you must use the density.
- Use density to covert volume to grams, then use atomic mass to convert from grams to moles.

Numbers of particles

- Numbers of particles in a mole is always equal to 6.02×10^{23}.
- The type of particle is determined by the chemical make-up of a substance:
  - Element (non diatomic) – atoms
  - Molecular compound or diatomic element – molecule
  - Ionic compound – formula unit (F.U.)
- So 1 mole of Fe = 6.02×10^{23} atoms
- 1 mole of O_2 = 6.02×10^{23} molecules
- 1 mole of NaCl = 6.02×10^{23} formula units

From compounds to atoms

- If you need to know how many atoms are in a certain number of moles of a compound, then you can't go direct, you have to convert to molecules/F.U.'s first.
- Figure out by looking at the formula for the compound how many atoms are present.
- Ex. H_2SO_4 = 7 atoms
- How many atoms are in a 3.2mole sample of sulfuric acid?
- $\frac{3.2\text{mole}}{1} \times \frac{6.02\times10^{23}\text{F.U.'s}}{1\text{ mole}} \times \frac{7\text{ atoms}}{1\text{ F.U.}} = 1.35\times10^{25}$ atoms


MASS
Density (if not a gas at STP)
VOLUME
Molar Mass
Molar Volume (if a gas at STP)
MOLES
If a compound
Particles in a mole = 6.02x10^23
If a pure (non-diatomic) element
MOLECULES OR FORMULA UNITS
# of atoms in formula
ATOMS

Percent Composition

- All percent composition is by mass.
- It is used to determine the amount of one element in a compound.
- $\frac{\text{Grams of element}}{\text{total g in compound}} \times 100 = \%\text{composition}$
- Percent composition is always the same regardless of sample size.
- This means that if you find it using molar masses, those percents will apply to any other size sample.