THE MOLE

Background: Atomic Masses

- Look at the "atomic masses" on the periodic table What do these represent?
  - The **MASS** of an atom **(in amu)**

1 Carbon-12 atom = 12.00 amu

The Mole

The **MOLE** ***(M)*** is the amount of a substance that contains as many elementary entities as there are atoms in exactly 12.00 grams of ^{12}C

1 Mole = Avogadro's # = 6.02×10^{23}

The Mole

Dozen = 12

A mole is like a "dozen"

1 mole of ANYTHING = 6.02×10^{23} of what it is made up of

1 dozen apples = 12 apples

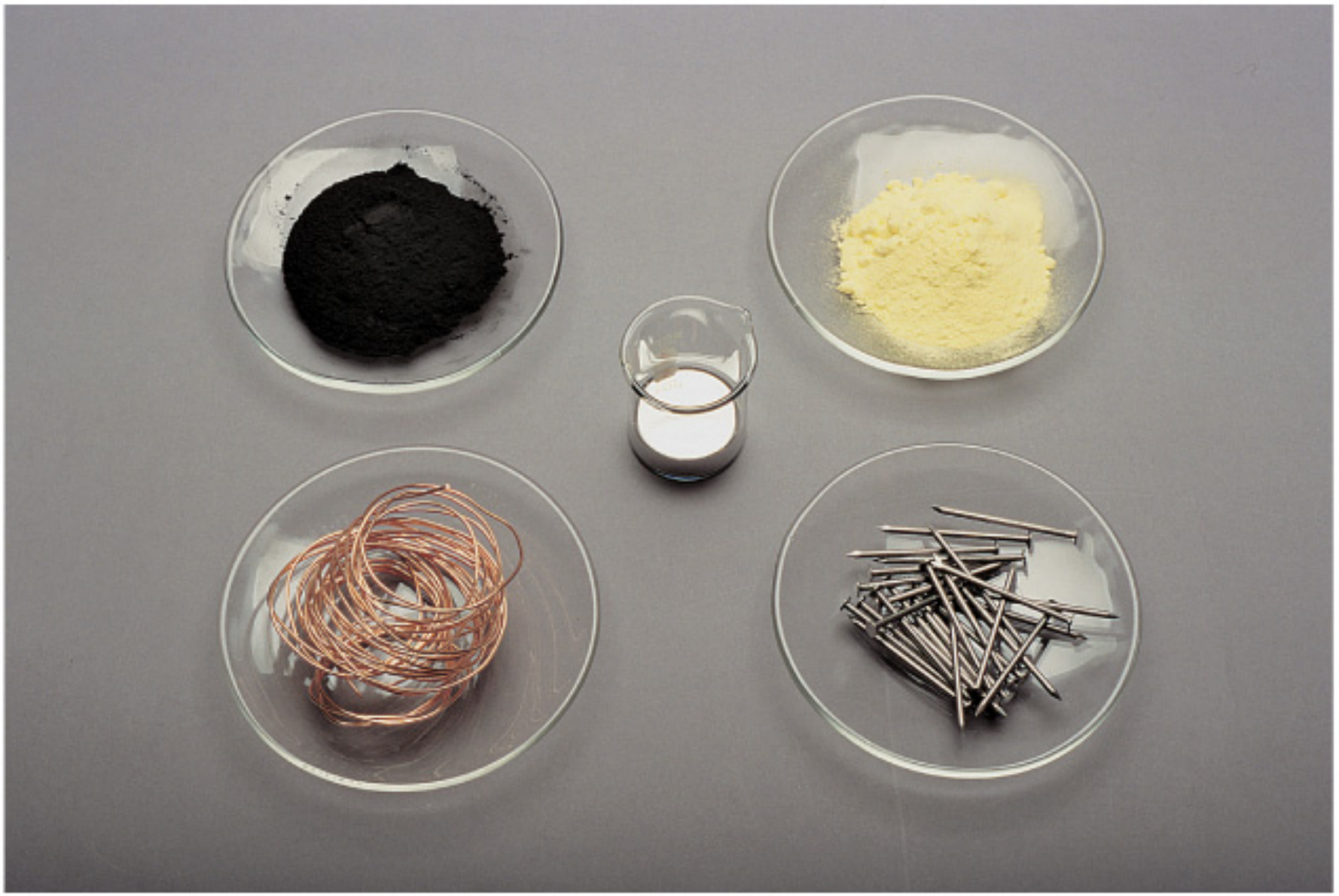
1 mole of C = 6.02×10^{23} atoms of C

1 dozen baseballs = 12 baseballs

1 mole of Na = 6.02×10^{23} atoms of Na

3 dozen muffins = (12x3) = 36 muffins

3 moles of H = $(6.02 \times 10^{23} \times 3) = 1.81 \times 10^{24}$ atoms of H



Molar Mass

- Is the mass of 1 mole of a substance (in g)
- Examples:
  - 1 mole Na = 23.0 g
  - 1 mole C = 12.0 g
  - 1 mole Li = 6.9 g

Molar Mass

- Example: Calculate the molar mass of $CaCl_2$

  - 1 Ca = 40.1 g/M
  - + 2 Cl = (35.5 g/M) × 2

  $CaCl_2$ = 111.1 g/M

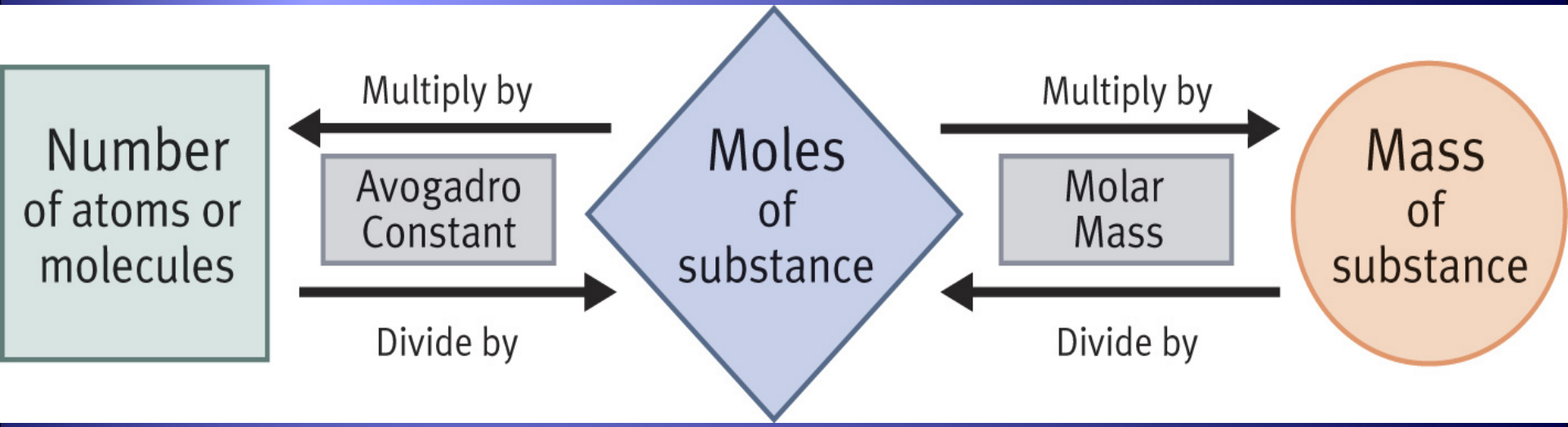
NOTES
- The units for molar mass are g/M

Mole Conversions

- Using simple equation triangles, we can convert moles of a substance into
  - Grams
  - Particles/Molecules
  - Liters

  - And vise-versa….

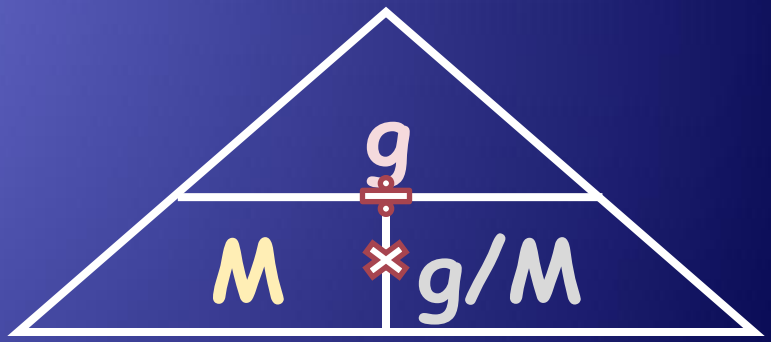
Summary Conversion Chart



Converting Between Grams and Moles

- If we are given the # of grams of a compound we can determine the # of moles, & vise-versa
- In order to convert from one to the other you must first calculate molar mass

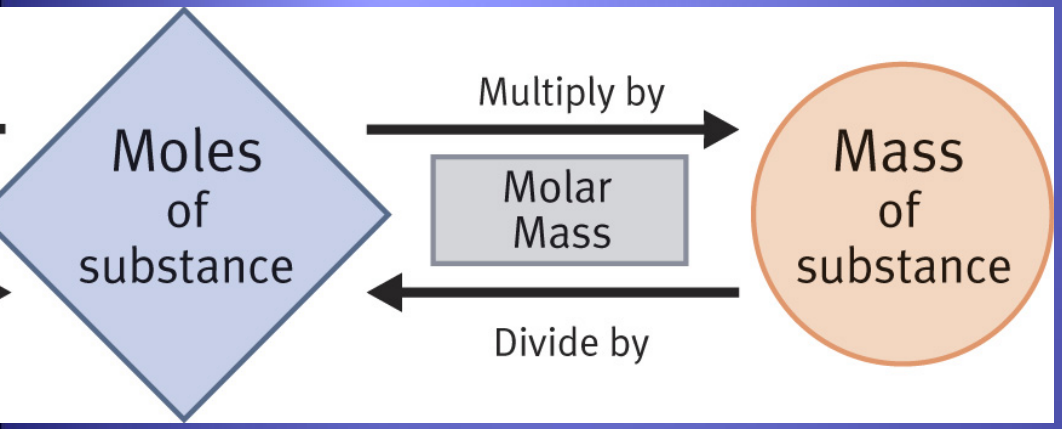
$$g = M \times g/M$$
$$M = g \div g/M$$

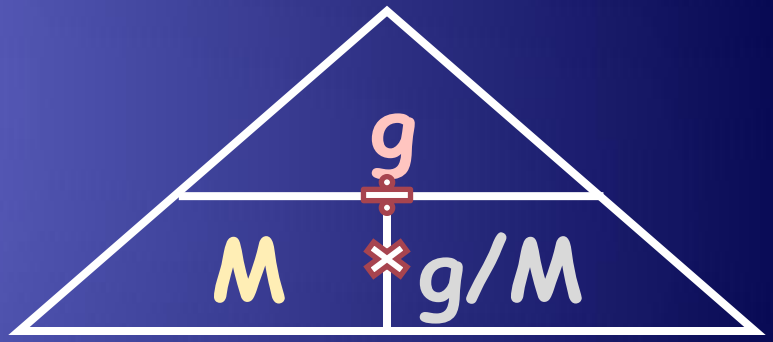


- This can be represented in an "equation triangle"

Ex: Converting Between Grams and Moles

Question: How many moles are in 22.0 g of copper metal?





Solution: Mass of substance ÷ Molar Mass = Moles

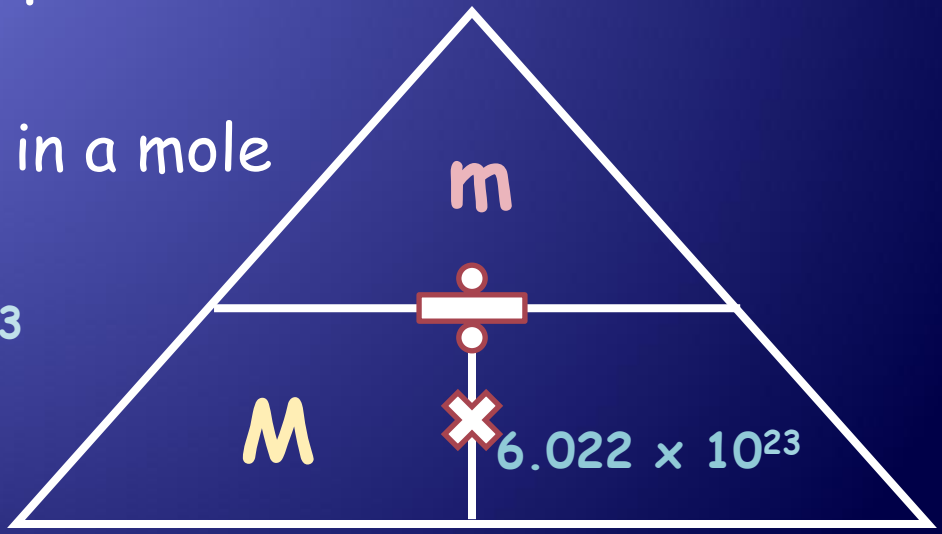
22.0 grams ÷ 63.5 g/M = 0.346 M

Converting Between Moles & Molecules

- If we are given the # of moles (M) of a compound , we can determine the # of particles/molecules (m) in the compound & vise-versa
- In order to convert moles to particles you must know how many particles are in a mole
  - Avogadro's Number
  - 6.022×10^{23} particles in a mole

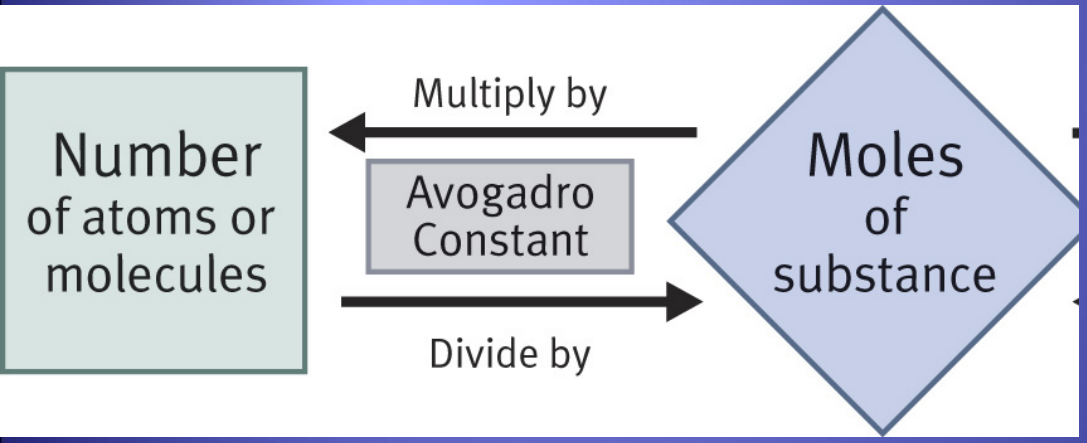
$m = M \times 6.022 \times 10^{23}$

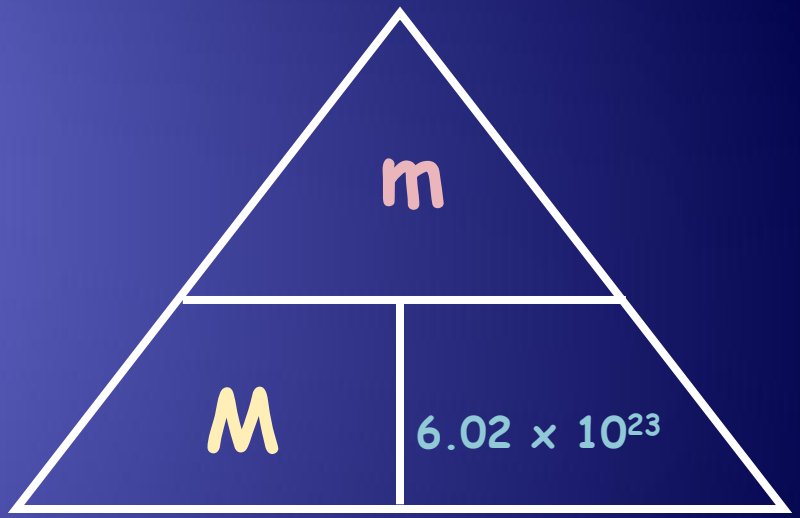
$M = m \div 6.022 \times 10^{23}$



Example:
Converting Between Moles & Molecules

Question: How many molecules are in 0.7 Moles of Oxygen?





Solution: # Moles × Avogadro's # = # molecules

$0.7\ M \times 6.02 \times 10^{23} =$ _____

Converting Between Moles & Liters of Gas

- Gases are measured in liters
- Under certain conditions……

1 mole of any gas = 22.4L

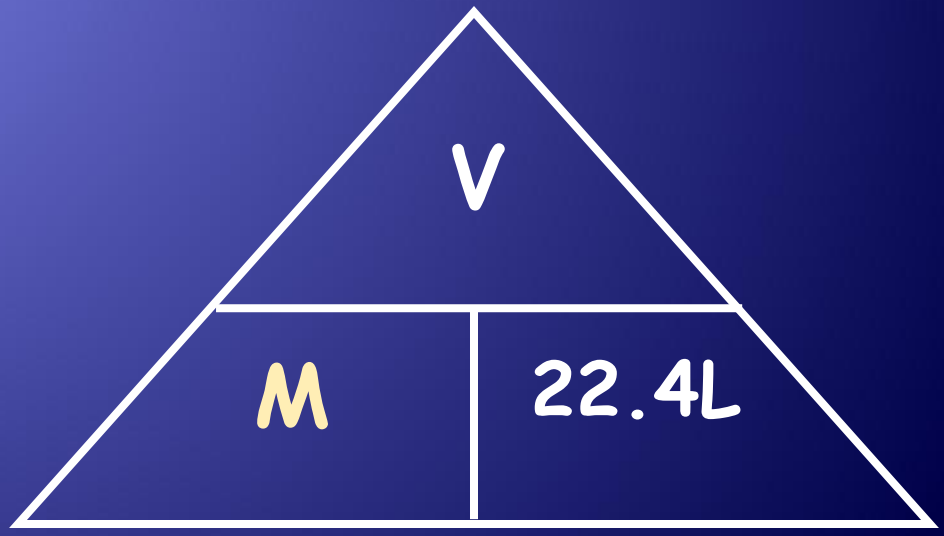
- These conditions are known as STP….
  - Standard Temperature and Pressure
  - Pressure = 1 atm
  - Temperature = 273K

Converting Between Moles & Liters of Gas

- If we are given the #of Moles of a gas, we can determine its volume in Liters, at STP.
- In order to convert Moles to liters you must know that…
  - 1M of gas = 22.4L

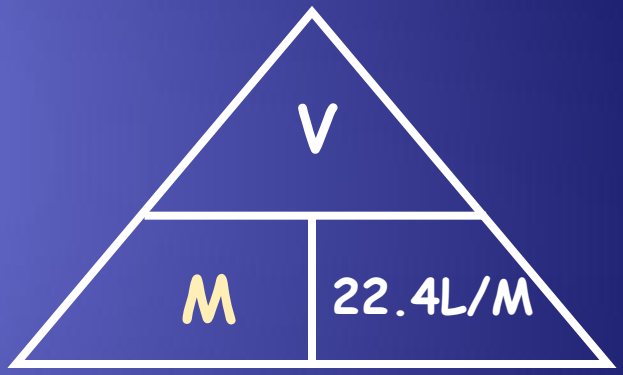
V = M x 22.4L

M = V ÷ 22.4L



Example:
Converting Between Moles & Liters of Gas

Question: How many moles are in 65.7 L of sodium?



Solution: Moles = Volume ÷ $\frac{22.4\ L}{Mole}$

Moles = 65.7 L ÷ 22.4 L/M

Moles = **2.93 M**