

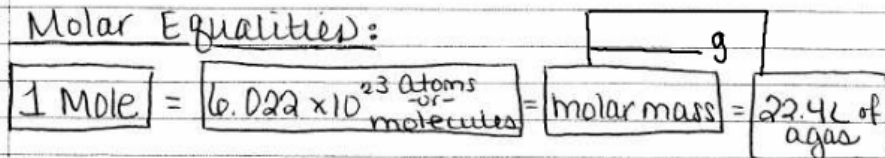
The Mole

(1)

The student will be able to:

- ① List the 4 molar equalities.
- ② Complete molar conversions
- ③ Determine molar mass
- ④ Determine % composition
- ⑤ Determine empirical formulas
- ⑥ Determine molecular formulas

Molar Equalities:



molar mass is equal to the atomic mass of an element expressed as grams per mole (g/mol) and comes from the periodic table.

For example:

$$1 \text{ mole of sodium} = 23.00 \text{ g/mol} \quad 1.01$$

$$1 \text{ mole of water (H}_2\text{O)} = 18.02 \text{ g/mol} \quad 1.01$$

$$\frac{16.00}{18.02 \text{ g/mol}}$$

Practice: Determine the molar mass of the following molecules/compounds

① KClO_3	② Al_2S_3	③ MgBr_2
39.10	(2 x 26.98)	24.31
35.45	+ (3 x 32.07)	+ (2 x 79.90)
+ (3 x 16.00)	150.17 g/mol	184.11 g/mol
122.55 g/mol		

Molar Conversions:

Because the 4 molar equalities can be set equal to each other they can also be used as conversion factors.

Example: ? atoms in 2.2 mol of Ca 2.2 mol Ca x $\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol Ca}}$

given amt.

$$2.2 \text{ mol Ca} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mole}} = 1.3 \times 10^{24} \text{ atoms}$$

$$\times 10 = \boxed{EE}$$

Steps:

Ex. How many atoms are in 2.2 mol of Ca?
 ① to start the problem choose the 2 equalities involved by looking at the labels in the problem.
 1 mole = 6.022×10^{23} atoms ← 2 equalities

The equalities can be written as a ratio
 $\frac{1 \text{ mol}}{6.022 \times 10^{23} \text{ atoms}}$ or $\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol}}$

② the ratio you pick depends on what label is being changed and what label you need
 ? atoms are in 2.2 mol of Ca?

↑ label needed ↑ label being changed
 ③ Set up the conversion problem.

amt given w/label × conversion unit needed = conversion unit changing
 for the example →
 $2.2 \text{ mol Ca} \times \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mol Ca}} = 1.3 \times 10^{24} \text{ atoms Ca}$

* Remember to finish with Sig. figs!

Practice:
 ① How many grams are in 3.4×10^{25} atoms of Sulfur? given
 $3.4 \times 10^{25} \text{ atoms S} \times \frac{32.06 \text{ g}}{6.022 \times 10^{23} \text{ atoms}} = 1800 \text{ g S}$

② How many moles are in 4.5 L of oxygen gas? given
 $4.5 \text{ L} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 0.20 \text{ mol O}_2$

mass before: _____

mass after: _____

mass of chalk (CaCO₃): 0.02 g

? mol of chalk are in your name:

$0.02 \text{ g} \times \frac{1 \text{ mol}}{100.09 \text{ g}} = 0.0002 \text{ mol} \quad 2 \times 10^{-4} \text{ mol}$

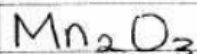
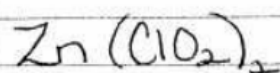
Homework:
1-15 & 26-30

? How many molecules of CaCO₃ did you put on the paper?

$0.02 \text{ g} \times \frac{6.022 \times 10^{23} \text{ molecules}}{100.09 \text{ g}} = 1.2 \times 10^{20} \text{ molecules}$

④

% Composition
Practice
BaO



Determining Empirical Formulas

The empirical formula is the simplest ratio of a group of elements in a compound.

Steps:

- ① Divide each % by the element's molar mass (creates ratio)
- ② Divide each ratio # by the smallest of the #
- this should create a whole # ratio that is the subscripts for the formula.
- ③ (if needed) if step 2 yields a decimal:
use the chart on the next page

Decimal	What to do
0.8 or higher	round # up to next whole #
0.75	multiply <u>all ratios</u> by 4
0.6	" " 3
0.5	" " 2
0.3	" " 3
0.25	" " 4
0.2 or less	round off to whole #

Example Ratio : Step 2 = 3 1.3 2
 you can't have 0.3 of an atom, multiply all # by 3

$$\begin{matrix} & \downarrow & \downarrow \\ 3 & 1.3 & 2 \\ 3(3) & 1.3(3) & 2(3) \\ \hline 9 & 4 & 6 \end{matrix}$$

 your subscripts ☺

Example:

$$\frac{88.8\% \text{ Cu}}{63.55} \quad \frac{11.2\% \text{ O}}{16.00} \quad \left. \vphantom{\frac{88.8\% \text{ Cu}}{63.55}} \right\} \text{ Step \#1}$$

$$\frac{1.4}{0.7} \quad \frac{0.7}{0.7} \quad \left. \vphantom{\frac{1.4}{0.7}} \right\} \text{ Step \#2}$$

