Formulas

Intro: Applying the fact that Molecules are composed of specific combinations of Atoms allows us to use chemical Analysis to determine the chemical formula of a substance. This info can Also be used to determine purity of a sample.

4 Different formulas:

CO_2	H_2SO_4	$C_6H_{12}O_6$	CH_2O
carbon Dioxide	Sulfuric Acid	glucose	formaldehyde

??? How can we be sure the above formulas are correct "in real life"? ???

↙

Because: compounds are composed of atoms/elements with known masses their is a correspondence between the mass percentages (% Composition by mass) of elements present and the relative # of atoms present in a compound

Example

$C_6H_{12}O_6$	CH_2O
Relative Ratio of elements 1:2:1	1:2:1 ← simplest ratio present

problem: ~~ratios~~ simplest whole # ratios are same for 2 different compounds!

⇓

means % Composition by mass will be the same

⇓

So we have to be more specific about which formula we are describing!

Empirical formula: lowest whole # molar ratio of atoms in a compound

↓

Is directly linked to % Composition by mass data

Molecular formula: Not Simplest Ratio

↓

will always be a multipe of empirical

↳ includes subscripts ! Formula masses

↓

This happens because atoms have defined / constant average atomic masses

Formula Mass $C_6H_{12}O_6$ = 180.162 $\frac{g}{mol}$

Formula Mass CH_2O = 30.027 $\frac{g}{mol}$

Glucose

$C_6H_{12}O_6$ → simplify (÷6) → CH_2O ← empirical

molecular formula →

* * * * *
* Dividing molecular FM by empirical FM gives us our multiple !!!!
* * * * * *

Notice

$\frac{180.162}{30.027} = 6$

formaldehyde

molecular → CH_2O → doesn't simplify ...

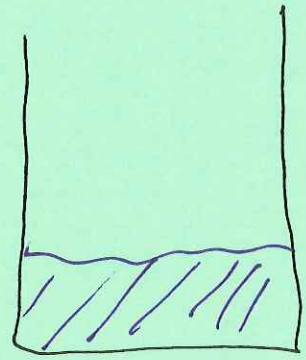
* sometimes the molecular and empirical formulas can be the same

Glucose

$C_6H_{12}O_6$

C - 40%
H - 7%
O - 53%

} % Composition by mass



glucose Sample

chemical analysis →

Question? Is glucose sample pure?
↳ look at % Comp data to determine

Results:

C - 50%
H - 3%
O - 47%

Based on data ~~we~~ sample NOT pure

(*) whatever the impurity is ...

Contains C at a higher % Composition and either NO H or O or Both at a much lower % Comp than glucose