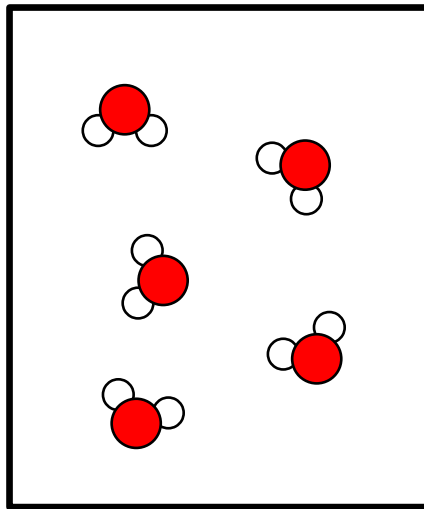


Essential Question

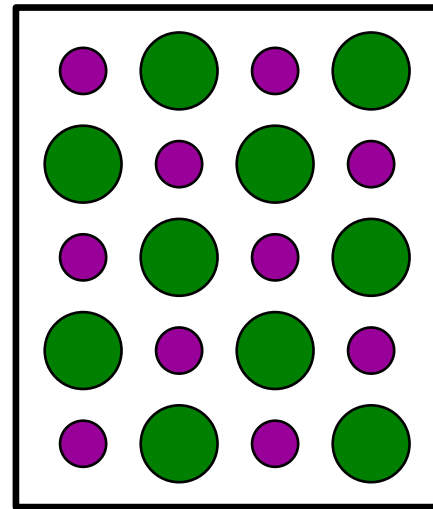
Is the recipe for a compound always the same?

Pure Substances

- Made of only one kind of particle
- Molecules: atoms bonded as a unit
- Formula units: ions in a fixed ratio



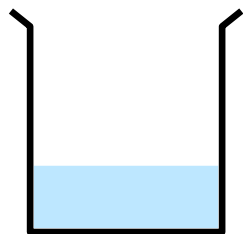
Molecules (H_2O)



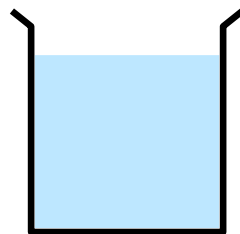
Formula units (NaCl)

Law of Definite Proportions

- A compound always has the same mass ratio of its elements
- Sample size and source do not matter



9 g of water
1 g H, 8 g O



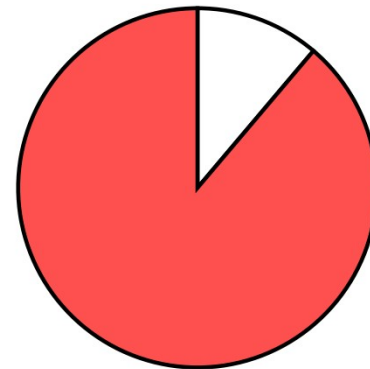
90 g of water
10 g H, 80 g O

Always $\text{H} : \text{O} = 1 : 8$ by mass

Percent Composition

- Percent of a compound's mass from each element
- Use the molar mass for 1 mol

$$\% \text{ element} = (\text{mass of element} \div \text{mass of compound}) \times 100$$



□ H 11.2% ■ O 88.8%

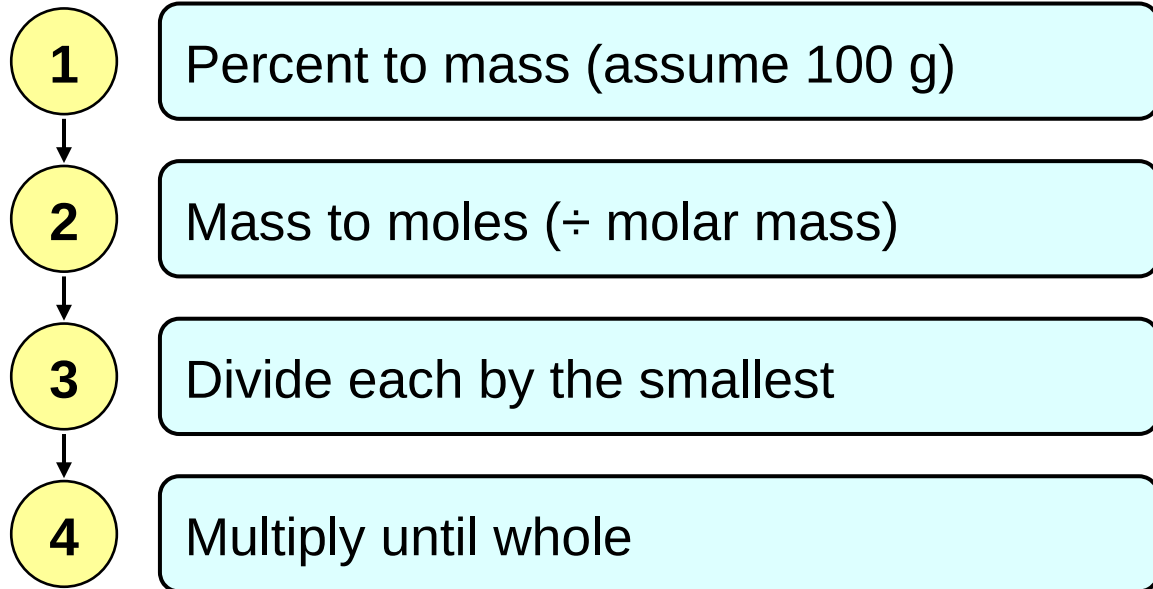
Water, H₂O, by mass

Empirical vs. Molecular Formula

- Molecular formula: actual atoms in one molecule
- Empirical formula: lowest whole-number ratio

Molecular		Empirical	
$C_6H_{12}O_6$	→	CH_2O	<i>Glucose</i>
H_2O_2	→	HO	<i>Hydrogen peroxide</i>
H_2O	→	H_2O	<i>Water</i>

Finding an Empirical Formula



*Percent to mass,
mass to mole,
divide by small,
multiply 'til whole*

Fixing Decimal Ratios

- Round only if very close: $1.98 \rightarrow 2$
- Otherwise multiply ALL by the same number

ends in .5

$\times 2$

$1.5 \rightarrow 3$

ends in .33 or .67

$\times 3$

$1.33 \rightarrow 4$

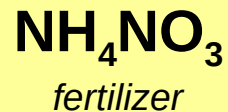
ends in .25 or .75

$\times 4$

$1.25 \rightarrow 5$

Example: Percent Composition

What is the percent by mass of nitrogen in ammonium nitrate, NH_4NO_3 ?



Example: Empirical Formula

A compound is 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen by mass. Find its empirical formula.

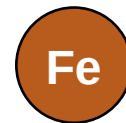
C 40.0%

H 6.7%

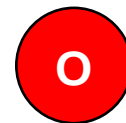
O 53.3%

Example: Empirical Formula with a Ratio Fix

A compound contains 69.9% iron and 30.1% oxygen by mass. Find its empirical formula.



69.9%



30.1%

Example: Definite Proportions

Sample 1 of a compound contains 4.00 g Ca and 7.10 g Cl. Sample 2 contains 8.00 g Ca and 14.20 g Cl. Could these samples be the same compound? Justify your answer.

Sample 1

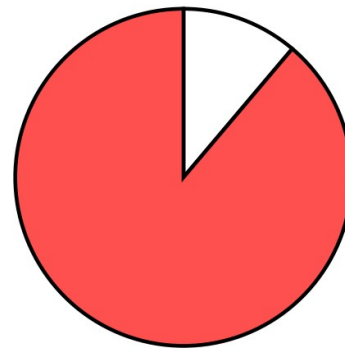
4.00 g Ca, 7.10 g Cl

Sample 2

8.00 g Ca, 14.20 g Cl

Big Ideas

- A pure compound has a fixed mass ratio
- $\% \text{ element} = \text{part} \div \text{whole} \times 100$
- Empirical formula = lowest whole-number ratio
- Percent $\rightarrow$ mass $\rightarrow$ moles $\rightarrow$ divide $\rightarrow$ whole



□ H 11.2% ■ O 88.8%