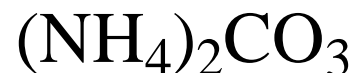


Calculations Based on Formulas

Atom Counting



2 N 8 H (4x2) 1 C 3 O

Molar Mass- sum of all atoms masses in a compound
for $(\text{NH}_4)_2\text{CO}_3$

} Note: all atomic masses
rounded to two decimal places

Q1

How many of each type of atom are there in aluminum sulfate?

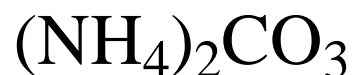


Q2

What is the molar mass of aluminum sulfate?

Percent Composition

How much each element contributes to the molar mass



$$\% \text{ O} = \frac{48.00 \text{ u}}{96.11 \text{ u}} \times 100 = 49.94 \%$$

$$2 \times 14.01 = 28.02 \text{ u}$$

$$8 \times 1.01 = 8.08 \text{ u}$$

$$1 \times \text{C} = 12.01 \text{ u}$$

$$3 \times \text{O} = \underline{48.00 \text{ u}}$$

$$96.11 \text{ u}$$

Q3

Calculate the % S in aluminum sulfate

% as an Identity- Dimensional Analysis

What mass of oxygen is contained in 385 g of $(\text{NH}_4)_2\text{CO}_3$?

since % O = 49.94%

Another Way

$$2 \times 14.01 = 28.02 \text{ u}$$

$$8 \times 1.01 = 8.08 \text{ u}$$

$$1 \times \text{C} = 12.01 \text{ u}$$

$$3 \times \text{O} = \underline{48.00 \text{ u}}$$

$$96.11 \text{ u}$$

Q4

What mass of sulfur is contained in 1231 g of aluminum sulfate?

OR

The mol concept

**Since the atomic mass scale is relative,
taking the molar mass in grams of
any substance is taking the same number
of atoms/molecules, etc.**

We call that number "a mol"

Since the molar mass of ammonium carbonate is 96.11 u,
1 mol of ammonium carbonate weighs 96.11 g and contains
the same number of particles as 12.01 g of carbon.

As Identities

How many mols is 156 g of ammonium carbonate?

Q5

Convert the following

86.92 g iron to mols

35.54 g NaNO_3 to mols

2.39×10^{-4} mols calcium sulfate to grams

Problem

How many molecules are contained in 165 g of CO₂?

Diagram the problem

g CO₂ \longrightarrow molecules CO₂

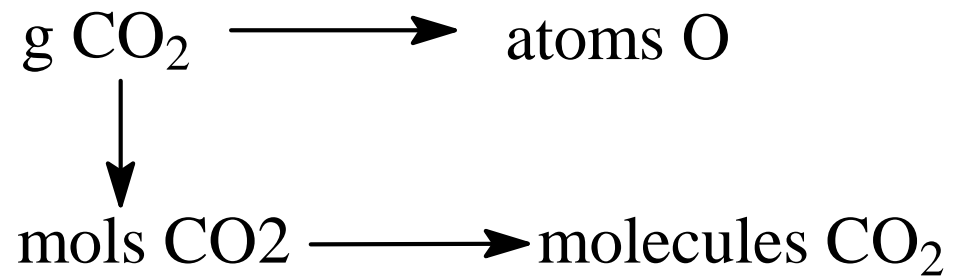
Q6

Calculate the mass of 2.34×10^{24} molecules of C_2H_6



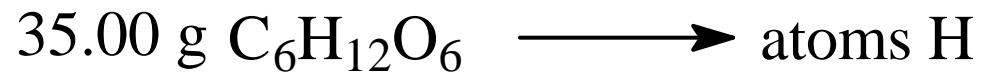
With atom counting

How many O atoms are contained in 165 g of CO₂?



Q7

How many hydrogen atoms are contained
in 35.00 g of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$?



Empirical (simplest) Formula

simplest integer ratio of atoms in a compound

atoms of each = # mols each atom

grams of each atom

from % composition

directly weighed

From % Composition Data

**A compound is analyzed to contain 85.7% carbon and 14.3% hydrogen by mass.
Determine the empirical formula.**

- 1.** assume 100.0 grams of compound
(this directly converts % into grams)
- 2.** calculate mols of each atom

Continuing

3. divide the smallest number of mols into all the mols of atoms

$$7.286 \text{ mol C} / 7.286 = 1 \text{ C}$$

$$14.2 \text{ mol H} / 7.286 = 1.95 \sim 2 \text{ H}$$

4. if not integers in 3., then multiply all numbers by an integer that makes them all integers

if results were:

1 A

2.5 B

Q8

A compound is analyzed to contain 40.68% C, 5.13% H, and 54.19% O by mass. Determine the empirical formula.

Molecular Formula



all have the same empirical formula, CH_2

To determine the true molecular formula:

divide the molar mass [MM] of the compound (given in the problem)
by the empirical mass [EM] (add up the masses in the empirical formula)

From the previous problem, the molar mass
of the compound is 56.12 g/mol.

Determine the molecular formula for the compound.

$$\frac{\text{MM}}{\text{EM}} = \frac{56.12\text{g/mol}}{14.03\text{g/mol}}$$

Q9

A compound was analyzed to contain
42.84% C, 7.20% H, and 49.96% N.

The molar mass of the compound is 140.20 g/mol.
Determine the molecular formula for the compound.