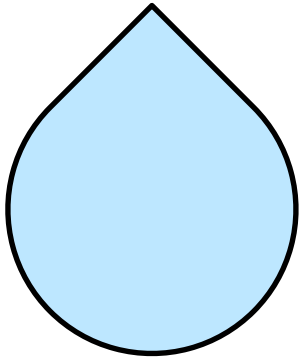
Essential Question

How can we count atoms by weighing them?

Why We Need the Mole

- Atoms are too small to count one by one
- We can measure mass with a balance
- The mole connects mass to the number of particles



One drop of water
≈ 1.7×10^{21} molecules

Avogadro's Number

$$1 \text{ mol} = 6.022 \times 10^{23} \text{ particles}$$

1 mol C
6.022×10^{23} atoms

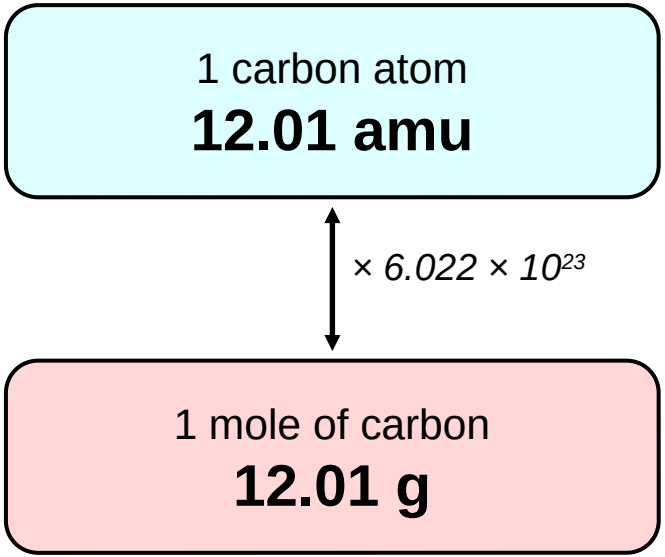
1 mol H_2O
6.022×10^{23} molecules

1 mol NaCl
6.022×10^{23} formula units

Just like 1 dozen = 12, 1 mole = 6.022×10^{23}

Atomic Mass Units and Molar Mass

- Mass of one atom: atomic mass units (amu)
- Molar mass (M): mass of 1 mol in g/mol
- Same number, different units!



Molar Mass of a Compound

- Add the molar masses of every atom in the formula
- Subscripts tell how many of each atom

H
2 × 1.008 g/mol

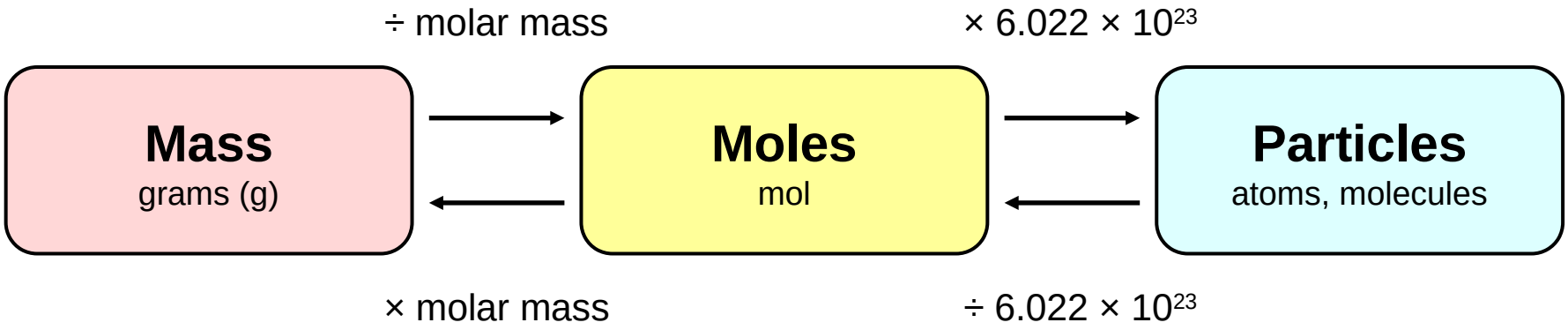
+

O
1 × 16.00 g/mol

=

H_2O
18.02 g/mol

The Mole Road Map



$$n = m/M$$

Dimensional Analysis

- Start with what you know
- Multiply by conversion factors
- Units cancel top to bottom

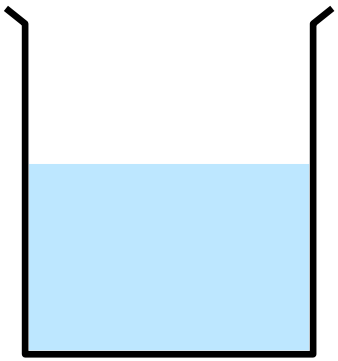
Setting up grams → particles

$$\text{grams} \times \frac{1\ \text{mol}}{___\ \text{g}} \times \frac{6.022 \times 10^{23}}{1\ \text{mol}}$$

Molar mass goes under grams so grams cancel

Example: Grams to Moles

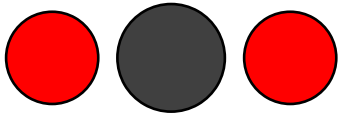
How many moles are in 45.0 g of water, H_2O?



45.0 g H_2O

Example: Grams to Particles

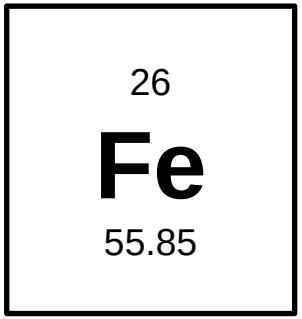
How many molecules are in 10.0 g of carbon dioxide, CO_2?



CO_2

Example: Particles to Grams

What is the mass of 3.01×10^{24} atoms of iron, Fe?



Example: Comparing Samples

Which sample contains the most atoms?

A. 1.0 mol He

B. 18 g H_2O

C. 3.0×10^{23} molecules CO_2

Moles and Molar Mass

Big Ideas

- 1 mol = 6.022×10^{23} particles
- amu for one particle = g/mol for one mole
- Molar mass connects grams and moles
- Set up units so they cancel

$$n = m/M$$