Chemistry 20

Unit D: Quantities in chemical change

Stoichiometry methods

Stoichiometry equipment

- The same balanced equation can start from grams on a balance, from millilitres in a pipette, or from litres in a gas syringe.
- Each tool measures a different quantity, and the equation still supplies the same kind of ratio.

Three lanes that meet at the mole

- Gravimetric work starts from a mass, solution work starts from a concentration and a volume, and gas work can end at a volume at SATP.
- A plan also names states, products, a theoretical yield, and the WHMIS step that comes first.

Key terms

stoichiometry

The use of a balanced equation to convert the amount of one substance into the amount of another. (mole ratio)

theoretical yield

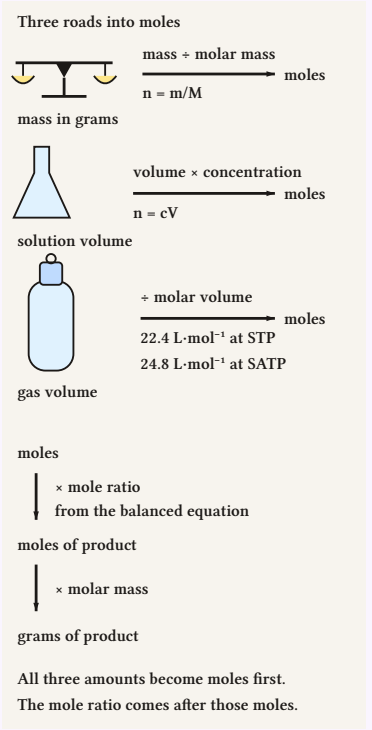
The amount of product calculated from the balanced equation and the starting measurement. (4.40 g CO_2)

molar volume

The volume of one mole of an ideal gas at a stated temperature and pressure. (24.8 $L \cdot mol^{-1}$ at SATP)

The ratio sits between two conversions

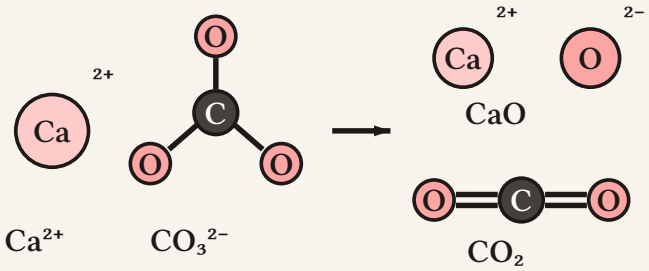
- Divide a mass by the molar mass, or multiply a concentration by the volume in litres, to reach moles.
- The mole ratio from the balanced equation then turns reactant moles into product moles.



Carbon dioxide from 10.0 g of carbonate

- Heating $CaCO_3(s)$ produces $CaO(s)$ and $CO_2(g)$ with a 1 to 1 mole ratio.
- The theoretical yield of carbon dioxide is the mass calculated from 10.0 g of reactant.

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$



1 mol $CaCO_3$ gives 1 mol CO_2

$10.0\ g \div 100.09\ g \cdot mol^{-1}$
$= 0.0999\ mol$

$0.0999\ mol \times 44.01\ g \cdot mol^{-1}$
$= 4.40\ g\ CO_2$

Moles of base that match the acid

- The sample is 25.0 mL of 0.200 mol·L^{-1} hydrochloric acid.
- The neutralization $\text{HCl(aq)} + \text{NaOH(aq)} \longrightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)}$ uses matching coefficients of 1 and 1.

Oxygen gas and a shared table

- Hydrogen peroxide decomposition uses the ratio in $2\ H_2O_2 \longrightarrow 2\ H_2O + O_2$.
- A group table keeps every trial, and an industrial use of a ratio still leaves some problems open.