

Counting particles by mass: the mole · supported focus

International Baccalaureate · IB Diploma · Chemistry · SL

Scope and prerequisites

Supported SL focus. First assessment 2025; current brief acquired; full Chemistry guide not acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: read the stated quantities and units, use arithmetic and the model conditions below. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

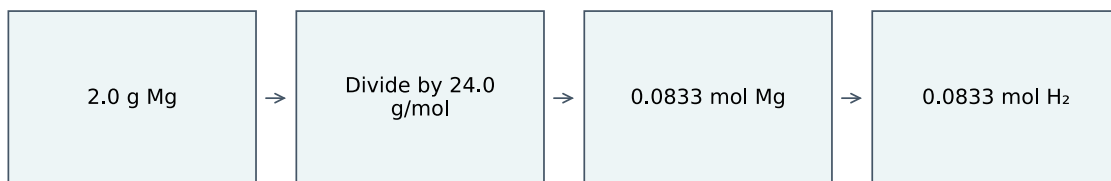
Amounts, equations and limiting reagents

■ What would explain this observation?

- The smallest mass of reactant is not necessarily the **limiting reagent**. The balanced equation compares particle amounts, not grams directly.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- The **mole** measures amount of substance. Use molar mass to convert mass into amount. Balanced equation coefficients give mole ratios; they do not give equal masses.
- mole: The SI unit of amount of substance; limiting reagent: The reactant that limits the possible product amount.



■ Choose evidence that can test it

- Calculate the amount available for each reactant and divide by its coefficient. The smaller ratio limits the reaction. Use that reactant to calculate the maximum product before comparing actual yield.
 - Write the balanced equation first, include units in molar masses, then convert each given mass or solution volume into amount. Convert cubic centimetres to cubic decimetres before using concentration in moles per cubic decimetre.
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■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: 2.0 g of Mg reacts with excess acid. Use $\text{amount} = \text{mass}/\text{molar mass}$. With molar mass $\text{Mg} = 24.0 \text{ g per mole}$, $\text{amount Mg} = 2.0/24.0 = 0.0833 \text{ mol}$. In $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$, $\text{amount H}_2 = \text{amount Mg} = 0.0833 \text{ mol}$.

Example:

Calculate amount in 5.0 g of a substance with molar mass 100 g per mole. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Excess acid means acid does not limit the stated calculation. A coefficient of 2 before HCl does not double the hydrogen amount.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Balanced equation coefficients always give reactant mass ratios. This claim is false: Excess acid means acid does not limit the stated calculation. A coefficient of 2 before HCl does not double the hydrogen amount.

Key:

Amounts, equations and limiting reagents: Calculate the amount available for each reactant and divide by its coefficient. The smaller ratio limits the reaction. Use that reactant to calculate the maximum product before comparing actual yield.