

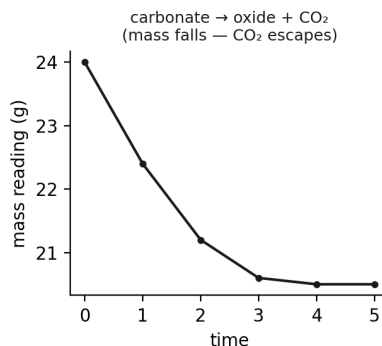
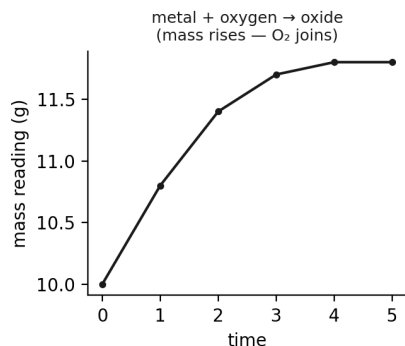
Exercise walk-through

3.3

Yield and atom economy – chemistry only, HT (4.3.3)

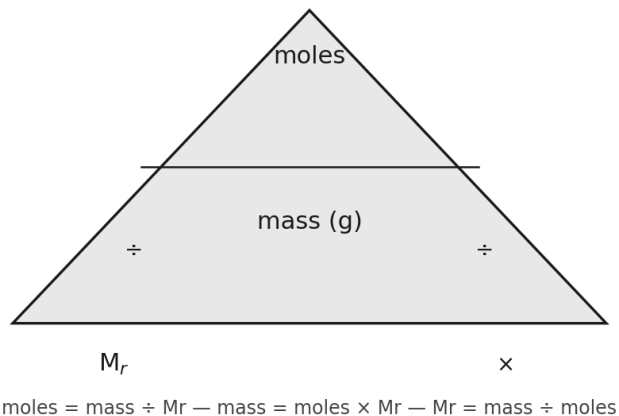
AQA · GCSE · Chemistry

Conservation of mass and Mr



- Conservation of mass and equations.
- Mass of products equals mass of reactants.
- Mr sums the atomic masses; percentage by mass follows.
- Gases explain any apparent mass change.

The mole



- Moles and reacting masses.
- One mole in grams = M_r ;
Avogadro constant 6.02×10^{23} .
- moles = mass divided by M_r .
- Ratio chain — mass to moles,
ratio, moles to mass.

Exercises 2.1·2.3

2.1 Give two reasons why yield is below 100 %. [2]

2.2 Theoretical mass 25 g, actual 20 g – percentage yield? [2]

2.3 Why do industries prefer high-atom-economy processes? [1]

Exercises 2.1·2.3

2.1 Give two reasons why yield is below 100 %. [2]

2.1 Any two of: reversible reaction does not go to completion; product lost on separation from the mixture; reactants react in unwanted/side reactions.

2.2 Theoretical mass 25 g, actual 20 g – percentage yield? [2]

2.2 $20 \div 25 \times 100 = 80 \%$.

2.3 Why do industries prefer high-atom-economy processes? [1]

2.3 Fewer raw materials are wasted and less needs disposing of – sustainable and cheaper.

Exercises 3.1·3.3

3.1 A reaction should give 12.0 g of product; 8.4 g is made. Calculate the percentage yield and explain two likely reasons for the loss. [5]

3.2 (*HT*) Hydrogen is made from methane and steam: $\text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3 \text{H}_2$ (C = 12, H = 1, O = 16). Calculate the atom economy when hydrogen is the desired product. [4]

3.3 (*HT*) State the difference between percentage yield and atom economy. [3]

Exercises 3.1·3.3

3.1 A reaction should give 12.0 g of product; 8.4 g is made. Calculate the percentage yield and explain two likely reasons for the loss. [5]

3.1 $8.4 \div 12.0 \times 100 = 70 \%$. Reasons: the reaction may be reversible and stop before completion; some product is lost when separated/filtered/purified; some reactants may react differently in side reactions.

3.2 (*HT*) Hydrogen is made from methane and steam: $\text{CH}_4 + \text{H}_2\text{O} \rightarrow \text{CO} + 3 \text{H}_2$ (C = 12, H = 1, O = 16). Calculate the atom economy when hydrogen is the desired product.[4]

3.2 $\text{Mr}(\text{CH}_4) = 16$, $\text{Mr}(\text{H}_2\text{O}) = 18 \rightarrow$ reactants total 34; Mr of desired product = $3 \times 2 = 6$ for the hydrogen; atom economy = $6 \div 34 \times 100 = 17.6 \% \approx 18 \%$.

3.3 (*HT*) State the difference between percentage yield and atom economy. [3]

3.3 Percentage yield compares what was actually made with what could theoretically be made from the reactant used – an experimental measure. Atom economy compares the Mr of the desired product with the total Mr of all reactants from the equation – a property of the reaction itself. A reaction can run at 100 % yield yet low atom economy if by-products form as the only other outcome.