Exercise walk-through

Relative masses of atoms and molecules ▪ 2.1

eXercise

You must be able to

- define the unified atomic mass unit
- define relative atomic, isotopic, molecular and formula mass
- calculate A_r from isotopic abundances and M_r from a formula

Method — The relative masses

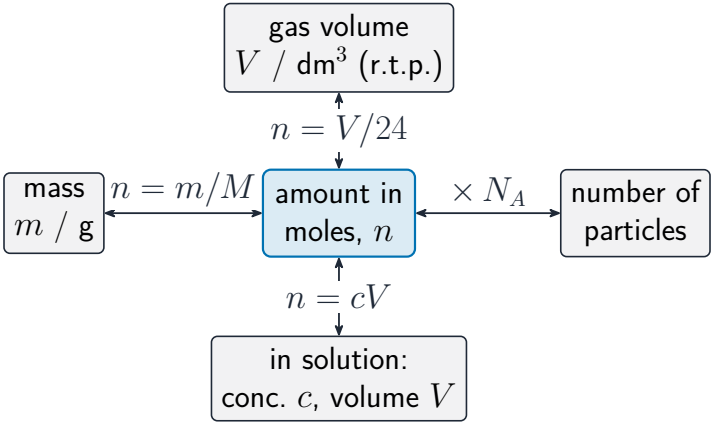
The **unified atomic mass unit** (u) is $\frac{1}{12}$ of the mass of a carbon-12 atom. Masses are then simple numbers relative to it.

- **relative atomic mass** A_r — the weighted average mass of an element's atoms, over all **isotopes** 同位素.
- **relative molecular mass** M_r — the sum of the A_r values of all atoms in a molecule.
- **relative formula mass** — the same, for an ionic compound.

Method — The relative masses

$$A_r = \frac{(75 \times 35) + (25 \times 37)}{100} = 35.5$$

Method — The relative masses



Relative masses connect to amount in moles

Method — Calculating M_r

For sulfuric acid, H_2SO_4 (A_r: H 1, S 32, O 16): $M_r = 2(1) + 32 + 4(16) = 98$.

Practice 2.1 ▪ 2 marks

Define **relative atomic mass**.

Solution 2.1

Method: The relative masses

Worked steps

the average mass of an element's atoms (over its isotopes) B1 compared with $\frac{1}{12}$ of a carbon-12 atom B1.

Practice 2.2 ▪ 1 mark

Calculate the relative molecular mass of calcium carbonate, $CaCO_3$ (A_r: Ca 40, C 12, O 16).

Solution 2.2

Method: The relative masses

Worked steps

$40 + 12 + 3(16) = 100$ B1.

Exam-style 3.1 ▪ 1 mark

Why is the relative atomic mass of chlorine 35.5 and not a whole number?

A chlorine atoms are damaged

B it is a weighted average of two isotopes

C chlorine has half a neutron

D the value is rounded

Solution 3.1

Method: The relative masses

A chlorine atoms are damaged

B it is a weighted average of two isotopes ✓

C chlorine has half a neutron

D the value is rounded

Worked steps

B. It is a weighted average of ^{3} Cl and ^{3} Cl.

Exam-style 3.2 ▪ 1 mark

What is the relative formula mass of magnesium hydroxide, $Mg(OH)_2$ (A_r: Mg 24, O 16, H 1)?

A 41

B 49

C 58

D 74

Solution 3.2

Method: The relative masses

A 41

B 49

C 58 ✓

D 74

Worked steps

C. $24 + 2(16 + 1) = 24 + 34 = 58$.

Exam-style 3.3 ▪ 3 marks

Magnesium has three isotopes: ^{24}Mg (79%), ^{25}Mg (10%) and ^{26}Mg (11%).
(a) Calculate the relative atomic mass of magnesium to 1 decimal place.
(b) Explain why this value is not a whole number.

Solution 3.3

Method: The relative masses

Worked steps

(a) $A_r = \dfrac{(24 \times 79) + (25 \times 10) + (26 \times 11)}{100} = \dfrac{2432}{100} = 24.3$ M1 M1 A1.

(b) it is a weighted average of isotopes of different mass B1.

Exam-style 3.4 ▪ 2 marks

Calculate the relative molecular mass of ethanol, C_2H_5OH (A_r: C 12, H 1, O 16).

Solution 3.4

Method: The relative masses

Worked steps

$2(12) + 6(1) + 16 = 24 + 6 + 16 = 46$ **M1** **A1**.