

2.1 Relative masses of atoms and molecules

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS relative atomic mass • unified atomic mass unit
 • relative formula mass • relative molecular mass • isotope

Objective

Build the skills to answer exam questions on **relative masses of atoms and molecules** – the **unified atomic mass unit** and the relative masses A_r , M_r and relative formula mass.

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

1 Key knowledge and worked examples

■ The relative masses

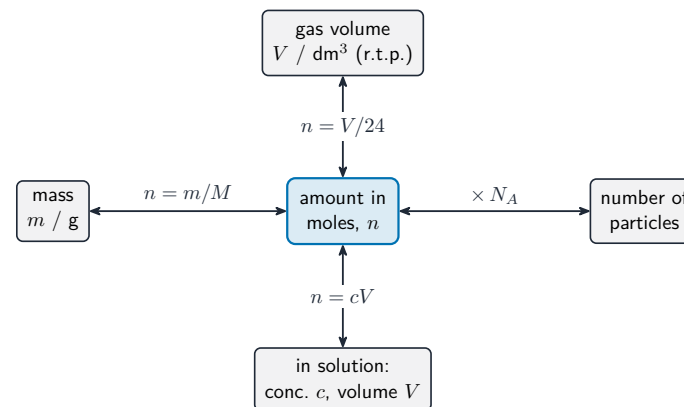
The **unified atomic mass unit** (u) is $\frac{1}{12}$ of the mass of a carbon-12 atom. Masses are then simple numbers relative to it.

- **relative atomic mass** A_r – the weighted average mass of an element's atoms, over all **isotopes**.
- **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.



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

A_r is a weighted average: $75\% \text{ } ^{35}\text{Cl} + 25\% \text{ } ^{37}\text{Cl} \rightarrow A_r = 35.5$



Relative masses connect to amount in moles

■ Calculating M_r

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

2 Practice

2.1 Define relative atomic mass.

[2]

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

[1]

3 Exam-style questions

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

[1]

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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

3.2 What is the relative formula mass of magnesium hydroxide, $\text{Mg}(\text{OH})_2$ (A_r : Mg 24, O 16, H 1)? [1]

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- A** 41
B 49
C 58
D 74

3.3 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. [3]

(b) Explain why this value is not a whole number. [1]

3.4 Calculate the relative molecular mass of ethanol, $\text{C}_2\text{H}_5\text{OH}$ (A_r : C 12, H 1, O 16). [2]