2 Atoms, molecules and moles – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	**Write it 3 times** (English)		
relative atomic mass			
mole			
relative molecular mass			
isotopes			
Avogadro constant			
molar mass			

Recall

At IGCSE you used **relative atomic mass** and the idea of the **mole** . Now we make those tools sharp, ready for AS calculations.

- Atoms are too light to weigh in grams, so we compare every mass to one standard.
- The mole lets us count huge numbers of particles by weighing.

Nothing here is harder than IGCSE – it just lines up the tools.

New ideas

Read these first, then do the Practice.

1 Relative masses

- the **relative atomic mass** (A_r) is the average mass of an element's atoms compared with $\frac{1}{12}$ of a carbon-12 atom.
- the **relative molecular mass** (M_r) is the sum of the A_r values of all the atoms in a molecule.

A_r is a **weighted average** over the **isotopes** . For chlorine (75% ^{35}Cl, 25% ^{37}Cl):

$$A_r = (0.75 \times 35) + (0.25 \times 37) = 35.5$$

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2 The mole and the Avogadro constant

One **mole** contains the **Avogadro constant** of particles:

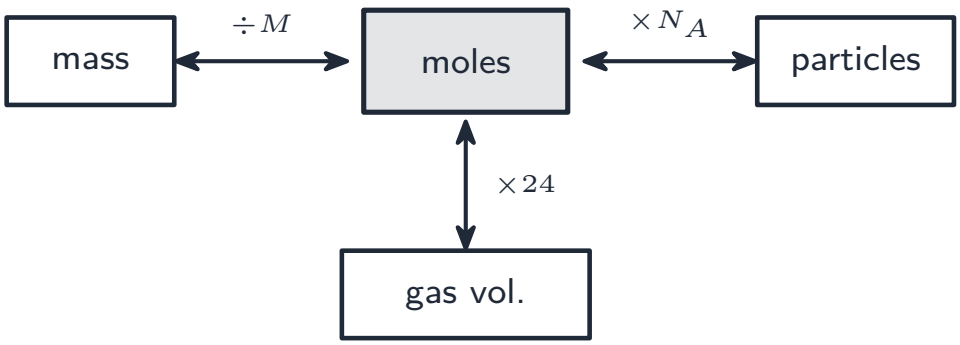
$$N_A = 6.02 \times 10^{23}\ \text{mol}^{-1}$$

The mass of one mole in grams equals the relative mass – the **molar mass** (M, in g mol^{-1}).

3 The key equation

$$n = \frac{m}{M}$$

where n = amount (mol), m = mass (g), M = molar mass.



Worked example. Moles in 8.0 g of CH_4 ($M = 16$): $n = 8.0/16 = 0.50$ mol.

Watch out: when finding M_r, multiply each atom's A_r by how many of that atom there are – H_2O is $2(1) + 16 = 18$, not $1 + 16$.

Practice

Try these in order. Use A_r: H = 1, C = 12, N = 14, O = 16, Na = 23.

2.1 State the value of the Avogadro constant, with its units. [1]

2.2 Work out the relative molecular mass, M_r, of (a) H_2O, (b) CO_2. [2]

2.3 How many moles are in 11.5 g of sodium ($A_r = 23$)? [2]

2.4 How many moles are in 36 g of water, H_2O? [2]

2.5 Bromine has two isotopes: 50% ^{79}Br and 50% ^{81}Br. Calculate its relative atomic mass. [2]

2.6 How many molecules are in 0.50 mol of carbon dioxide? [1]

2.7 Challenge. How many oxygen atoms are there in 8.8 g of carbon dioxide, CO_2 ($M = 44$)? [3]