Relative Masses and the Mole Map

AQA A-level Chemistry · 3.1.2 Amount of substance: relative masses and the mole

1 Relative masses

3.1.2.1 i–ii

- **A_r**: average mass of an atom vs 1/12 of a ^{12}C atom
- **M_r**: average mass of a molecule, same scale
- ^{12}C is exactly 12; no units
- Weighted for isotopes: Cl = 35.5
- M_r: add the A_r of every atom



2 Relative formula mass

3.1.2.1 iii

- **Ionic** compounds have no molecules
- Same sum: **relative formula mass**
- NaCl 58.5; CaF_2 78.1
- Brackets multiply everything inside
- $Ca(OH)_2$ = 40.1 + 2(17.0) = 74.1

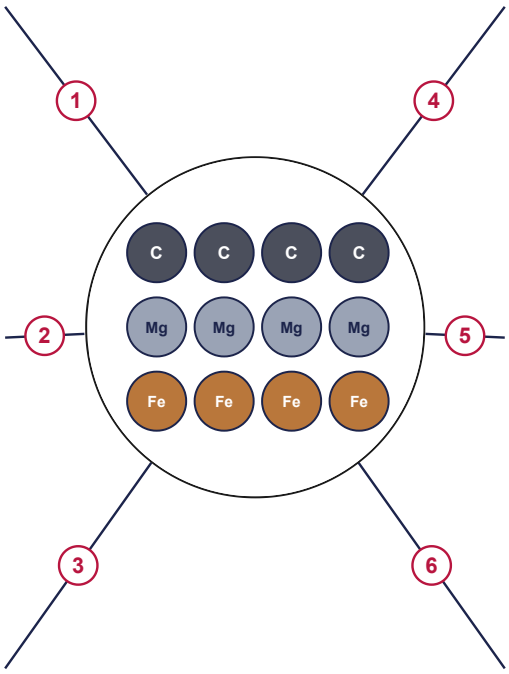


3 Hydrated salts

3.1.2.1

- The dot **adds** water to the formula
- Add **x × 18.0**
- $CuSO_4 \cdot 5H_2O$ = 249.6
- Find x: (M_r − salt) ÷ 18.0
- $BaCl_2 \cdot xH_2O$, 244.3: x = 2





4 The mole

3.1.2.2 i, iv

- **Mole**: the unit of amount of substance
- **n = m ÷ M**; m = n × M
- M in g mol^{-1}: the same number as M_r
- 4.40 g of CO_2 is 0.100 mol
- Answers to 3 significant figures



5 Counting particles

3.1.2.2 i, iii

- **$L = 6.022 \times 10^{23}$ mol^{-1}**
- Particles = **n × L**
- n = particles ÷ L
- One particle weighs **M ÷ L**
- Always say which particle



6 Ions, electrons, equations

3.1.2.2 ii

- $CaCl_2$: 3 mol of ions per mol
- Mg^{2+}: **10 mol** of electrons per mol
- An ion's electrons: Z − charge
- Equations in moles: $2H_2 + O_2 \rightarrow 2H_2O$
- $Al^{3+} + 3e^- \rightarrow Al$: 3 mol e^- per mol Al



The equations of relative masses and the mole

n in mol, m in g, M in g mol^{-1}, L = 6.022×10^{23} mol^{-1}

Quantity	Equation	Worked example
Relative atomic mass	Σ(mass × %) ÷ 100	^{69}Ga 60.1 %, ^{71}Ga 39.9 %: 69.8
Amount from mass	n = m ÷ M	6.35 g Cu: 6.35 ÷ 63.5 = 0.100 mol
Mass from amount	m = n × M	0.0500 mol $CaCO_3$: 5.01 g
Number of particles	N = n × L	0.200 mol H_2O: 1.20×10^{23} molecules
Mass of one particle	M ÷ L	H_2O: 18.0 ÷ L = 2.99×10^{-23} g
Particles per formula	n × count × L	0.0100 mol Mg^{2+}: 6.02×10^{22} electrons

Worked examples

Molecules to mass

- 2.00×10^{22} SO_2 ÷ L
- = 0.0332 mol × 64.1
- **2.13 g**

Electrons to deposit

- $Cu^{2+} + 2e^- \rightarrow Cu$
- 0.635 g Cu: 0.0100 mol
- **1.20×10^{22} electrons**

Find x

- $Na_2SO_4 \cdot xH_2O$, M_r 322.1
- water = 322.1 − 142.1 = 180.0
- **x = 10**

Moles link to equations and reacting masses, formulae, solutions and gases, and yield.

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