Atomic Structure Map

Cambridge International AS & A Level Chemistry · Topic 1 Atomic structure

1 The particles

1.1.1–1.1.4

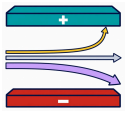
- **Proton**: mass 1, charge +1
- **Neutron**: mass 1, charge 0
- **Electron**: mass 1/1840, charge −1
- Tiny, dense **nucleus**: almost all the mass and + charge
- Electrons in shells in mostly **empty space**



2 Beams in an electric field

1.1.5

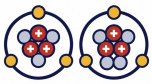
- **Neutrons**: no charge, straight on
- **Protons**: bend to the **negative** plate
- **Electrons**: bend to the **positive** plate
- Deflection depends on **charge ÷ mass**
- Electrons bend far more (1/1840 of the mass)

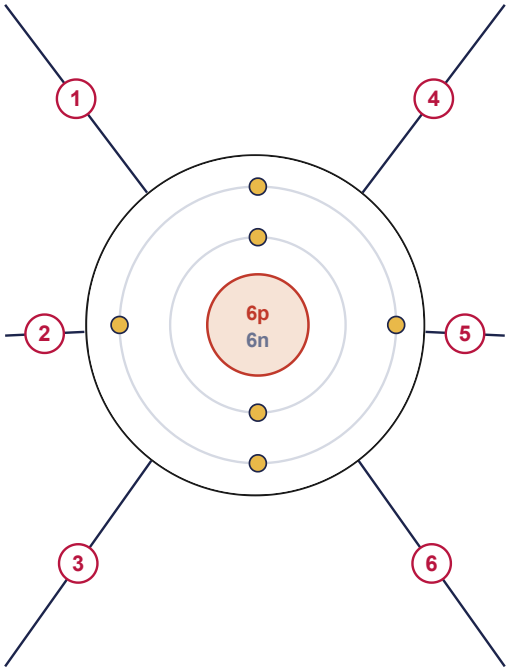


3 Counting particles and isotopes

1.1.6, 1.2

- Proton number Z; nucleon number A
- Neutrons = A − Z; ions: only electrons change
- **Isotopes**: same Z, different neutrons
- Same electrons: **same chemistry**
- Different mass: different **density**





4 Relative masses

2.1.1–2.1.2

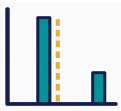
- **u** = $^{1}/_{12}$ of the mass of a ^{12}C atom
- **Relative isotopic mass**: one isotope
- **A_r**: weighted mean of the element
- **M_r**: molecules
- **Relative formula mass**: giant structures



5 Mass spectra and A_r

22.2.1–22.2.2

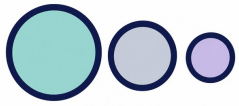
- One peak per isotope at its **m/e**
- Height or intensity: **abundance**
- A_r = Σ(m/e × abundance) ÷ **total**
- Reverse: x and 100 − x
- How the spectrometer works: not required



6 Atomic and ionic radii

1.1.7

- **Across** a period: smaller
- **Down** a group: larger
- **Cations** smaller than their atoms
- **Anions** larger than their atoms
- **Isoelectronic**: more protons, smaller



Isotopes and relative atomic masses

abundances in %; A_r = Σ(m/e × abundance) ÷ total

Element	Isotopes	Abundances	A_r	Notes
Chlorine	^{35}Cl, ^{37}Cl	75, 25	35.5	two peaks, 3 : 1
Magnesium	^{24}Mg, ^{25}Mg, ^{26}Mg	79.0, 10.0, 11.0	24.3	three peaks
Copper	^{63}Cu, ^{65}Cu	69.2, 30.8	63.6	two peaks, about 2 : 1
Lithium	^{6}Li, ^{7}Li	7.5, 92.5	6.9	^{7}Li dominates
Strontium	^{84}Sr … ^{88}Sr	0.6, 9.9, 7.0, 82.5	87.7	four peaks
Germanium	^{70}Ge … ^{76}Ge	20.5, 27.4, 7.8, 36.5, 7.8	72.7	five peaks

Radii in nm (data-booklet values)

Across Period 3

- Na 0.186 → Cl 0.099
- more protons, same shell
- similar shielding

Period 3 ions

- Na^+ 0.095 → Si^{4+} 0.041
- P^{3-} 0.212 → Cl^- 0.181
- jump: one more shell

Down Group 1

- Li 0.152 → Cs 0.262
- one more shell each time
- more shielding

Where the electrons are (shells, sub-shells and orbitals) is the Electronic configuration section; removing them is Ionisation energy.

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