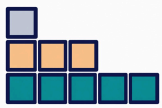
Electron Configuration Map

AQA A-level Chemistry · 3.1.1 Atomic structure: electron configuration and ionisation energy

1 Orbitals and sub-shells

3.1.1.3 i

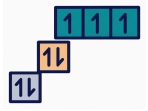
- **Orbital**: up to two electrons, **opposite spins**
- s: 1 orbital (2 e⁻); p: 3 (6 e⁻); d: 5 (10 e⁻)
- Shell n has n sub-shells; holds **$2n^2$**
- Within a shell: **s < p < d**
- 1s < 2s < 2p < 3s < 3p < 3d



2 Configurations

3.1.1.3 i

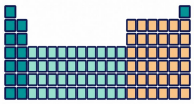
- Lowest energy first: **4s before 3d**
- Superscripts add up to Z; [Ar] = 18
- **Singly before pairing** in boxes
- **Cr** [Ar] $3d^5\ 4s^1$; **Cu** [Ar] $3d^{10}\ 4s^1$
- Half-full and full 3d: more stable

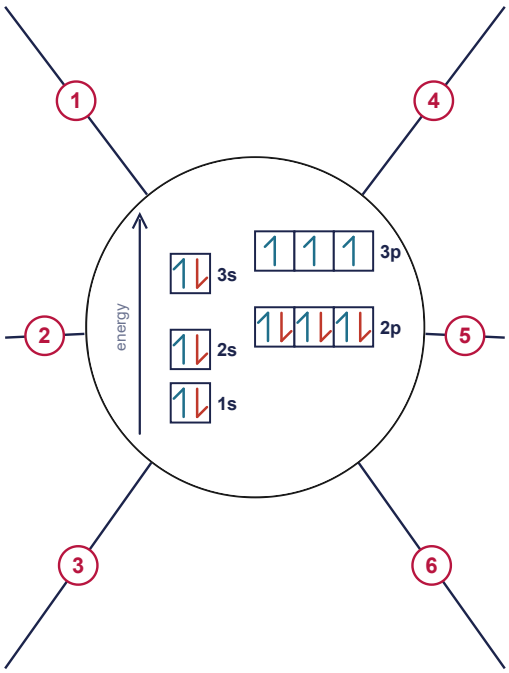


3 Ions and blocks

3.1.1.3 i, 3.2.1.1

- s, p ions: remove or add electrons
- **d-block ions lose 4s first**: Fe^{2+} [Ar] $3d^6$
- Isoelectronic: Na^+, Mg^{2+}, F^-, O^{2-}
- Block: sub-shell of the highest-energy electron
- s: Groups 1–2; p: 13–18; d; f





4 Ionisation energies

3.1.1.3 ii–iii

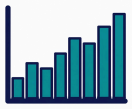
- **First IE**: 1 mol of e^- from 1 mol of **gaseous** atoms
- $Na(g) \rightarrow Na^+(g) + e^-$
- Successive: $Na^+(g) \rightarrow Na^{2+}(g) + e^-$
- All **endothermic**
- Charge, distance, **shielding**



5 Period 3: sub-shells

3.1.1.3 iv

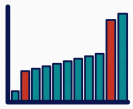
- Rise Na → Ar: more protons, same shell
- **Mg → Al** dip: 3p electron, higher energy
- **P → S** dip: paired 3p electron repelled
- A smooth rise would mean one shell
- Dips: evidence for **sub-shells**



6 Group 2 and successive IEs

3.1.1.3 iv

- Down Group 2: first IE **falls**
- Extra shell: further, more shielded
- **Big jumps**: an inner shell
- Mg jumps after 2 and 10: 2,8,2
- Electrons before the first jump: the **group**



Configurations from hydrogen to krypton

AQA groups 1-2 and 13-18

Species	Z	Configuration	Unpaired	Block
P	15	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$	3	p
K	19	[Ar] $4s^1$	1	s
Cr	24	[Ar] $3d^5\ 4s^1$	6	d
Fe^{2+}	26	[Ar] $3d^6$	4	d
Cu	29	[Ar] $3d^{10}\ 4s^1$	1	d
Br	35	[Ar] $3d^{10}\ 4s^2\ 4p^5$	1	p

The traps

4s in and out

- 4s fills before 3d
- 4s empties before 3d
- Ti^{2+} [Ar] $3d^2$, not [Ar] $4s^2$

Ionisation equations

- Always gaseous
- One electron per equation
- $Ca(s) \rightarrow Ca^{2+} + 2e^-$ is wrong

Reading jumps

- Count before the first big jump
- p block: add 10 for the group
- The 11th IE of Na: from 1s

These trends return in 3.2.1 Periodicity: atomic radius, first ionisation energy and melting point across Period 3.

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