Electronic Configuration Map

Edexcel A Level Chemistry · Topic 1 Atomic Structure · Electronic Configuration

1 Orbitals and spin

1.17

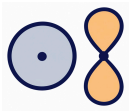
- **Orbital**: a region where an electron is likely to be
- Holds **up to two** electrons
- A pair has **opposite spins**: ↑↓
- Electrons repel: pairing costs energy
- Boxes: one box per orbital



2 s and p orbitals

1.18

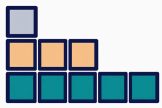
- **s**: a **sphere** centred on the nucleus
- 2s larger than 1s, 3s larger again
- **p**: a **dumbbell**, two lobes
- **Three** p orbitals: along x, y and z
- At 90° to each other, equal energy

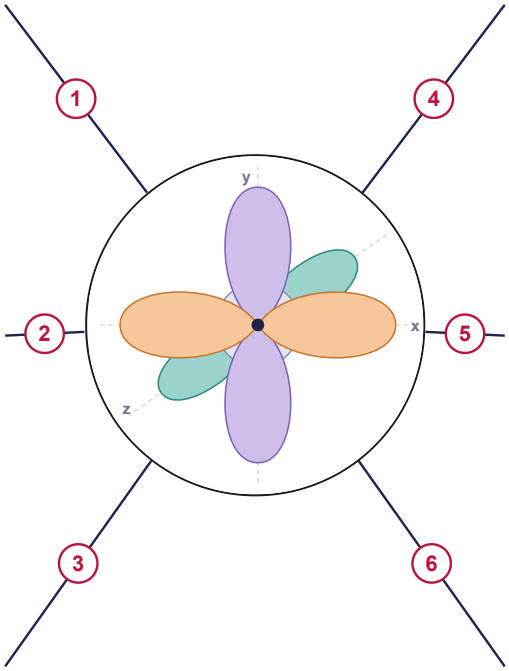


3 Shells and sub-shells

1.16, 1.19

- Shell n has **n sub-shells**
- s: 1 orbital (2 e^-); p: 3 (6 e^-)
- d: 5 orbitals (10 e^-); f: 7 (14 e^-)
- Shells hold 2, 8, 18, 32: **$2n^2$**
- No 2d: d starts at n = 3

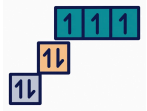




4 Filling order and boxes

1.20, 1.21

- Lowest energy first: 1s 2s 2p 3s 3p
- **4s before 3d**, then 4p
- **Singly before pairing**, spins parallel
- Then pair with **opposite spin**
- Superscripts add up to Z



5 Configurations of ions

1.21 ii

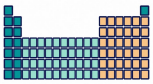
- Positive ions: **remove** electrons
- Negative ions: **add** electrons
- s and p blocks only (to Z = 36)
- Na^+ $1s^2\ 2s^2\ 2p^6$; Cl^- [Ne] $3s^2\ 3p^6$
- Isoelectronic: N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}



6 Blocks and chemistry

1.22, 1.23

- **Block**: sub-shell of the highest-energy electron
- s: Groups 1–2; p: Groups 3–7 and 0
- d: scandium to zinc
- Period = outer shell number
- **Same outer configuration: similar chemistry**



Configurations from hydrogen to krypton

unpaired electrons from electrons-in-boxes

Element	Z	Configuration	Unpaired	Block
Nitrogen	7	$1s^2\ 2s^2\ 2p^3$	3	p
Sodium	11	$1s^2\ 2s^2\ 2p^6\ 3s^1$	1	s
Sulfur	16	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$	2	p
Chromium	24	[Ar] $3d^5\ 4s^1$	6	d
Iron	26	[Ar] $3d^6\ 4s^2$	4	d
Copper	29	[Ar] $3d^{10}\ 4s^1$	1	d
Bromine	35	[Ar] $3d^{10}\ 4s^2\ 4p^5$	1	p

The exceptions and the traps

Chromium and copper

- Cr [Ar] $3d^5\ 4s^1$, not $3d^4\ 4s^2$
- Cu [Ar] $3d^{10}\ 4s^1$, not $3d^9\ 4s^2$
- Half-full and full 3d are more stable

4s before 3d

- 4s fills before 3d (K, Ca)
- Then 3d from Sc to Zn
- Ga to Kr fill 4p

Helium

- $1s^2$: s-block configuration
- Full outer shell: placed in Group 0
- No p electrons at all

Removing electrons one at a time gives ionisation energies: evidence for these shells and sub-shells (the Ionisation Energies and Periodicity section).

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