Ionic Bonding Map

Edexcel International A Level Chemistry · Unit 1 · Topic 3A Ionic Bonding

1 Forming ions 3.2

- Metals **lose** electrons: positive ions (cations)
- Non-metals **gain** electrons: negative ions (anions)
- Charge = electrons lost or gained
- Often a noble-gas configuration: Na^+ 2,8; Cl^- 2,8,8
- Groups 1–3: 1+, 2+, 3+; Groups 5–7: 3−, 2−, 1−

2 Dot-and-cross diagrams 3.3

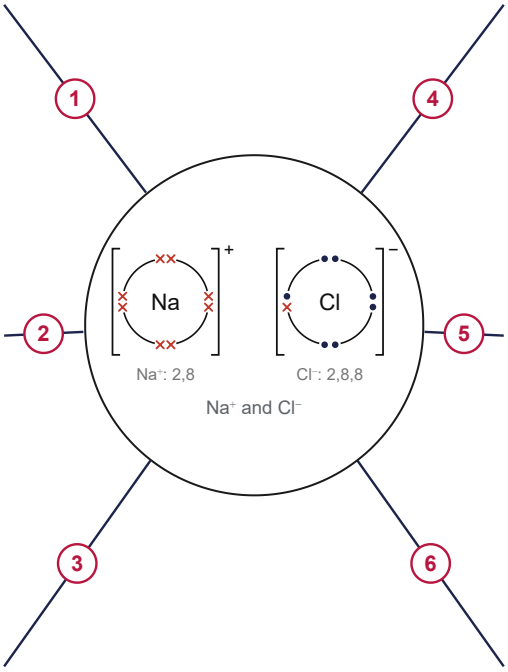
- Outer shells only; dots for one atom, crosses for the other
- Cation: its new outer shell (8) or drawn empty
- Anion: its own electrons + those gained
- **Square brackets** and the **charge** on every ion
- Ratio from electron transfer: CaF_2, Na_2O, Al_2O_3



3 The giant lattice 3.4–3.5

- A **giant lattice**: regular 3D array of ions
- NaCl: each ion has **six** opposite neighbours
- Ionic bonding: strong **net electrostatic attraction**
- Acts in all directions: no molecules
- The formula is only the ratio of ions





4 Bond strength 3.6

- **Higher charges**: stronger attraction
- **Smaller ions**: centres closer, stronger attraction
- Stronger bonding: higher melting temperature
- MgO 2852 °C against NaCl 801 °C
- NaF > NaCl > NaBr > NaI (anion grows)



5 Ionic radii 3.7

- Larger **down a group**: one more shell
- Cations smaller than their atoms; anions larger
- **Isoelectronic**: same electrons, more protons, smaller
- N^{3-} 146 > O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+} 54 pm
- The most negative ion of a set is largest



6 Polarisation 3.8–3.9

- A cation **distorts** an anion's electron cloud
- **Polarising power**: small, highly charged cations
- **Polarisability**: large, highly charged anions
- Distortion puts electron density between the ions
- Result: **covalent character** (AlI_3 more than AlF_3)

Charge, radius and melting temperature

radii are ionic radii in pm; melting temperatures in °C

Compound	Ion charges	Cation radius	Anion radius	Melting point
NaF	1+, 1−	102	133	993
NaCl	1+, 1−	102	181	801
KCl	1+, 1−	138	181	770
NaI	1+, 1−	102	220	661
CaO	2+, 2−	100	140	2613
MgO	2+, 2−	72	140	2852

Evidence for ions (3.1)

Physical properties

- High melting temperatures
- Conduct only when molten or dissolved
- Brittle: like charges meet and repel

Electron density maps

- Separate, near-spherical clouds
- Almost zero density between the ions
- Cl^- has the larger contours

Migration of ions

- Copper(II) chromate(VI) on moist paper
- Blue Cu^{2+} moves to the − electrode
- Yellow CrO_4^{2-} moves to the + electrode

Ionic bonding and covalent bonding are the two ends of a continuum (Topic 3B): polarisation moves a compound along it.

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