Topic 6 – Ions & Ionic Compounds

6.1 Ionic Bonding (6.1 – 6.3)

Ions: charged particles formed from gain / loss of electrons in atoms

- Achieve completely filled valence shell → obtain stability
- Make up giant ionic lattice structure

Types of ions

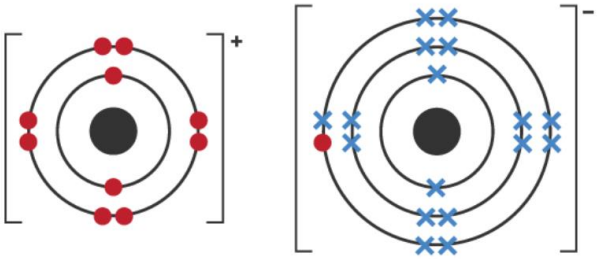
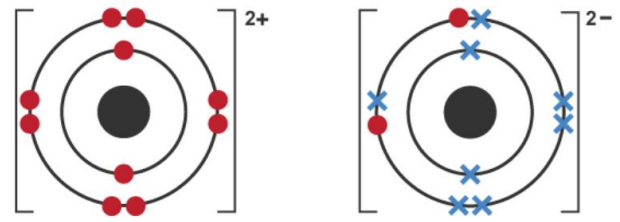
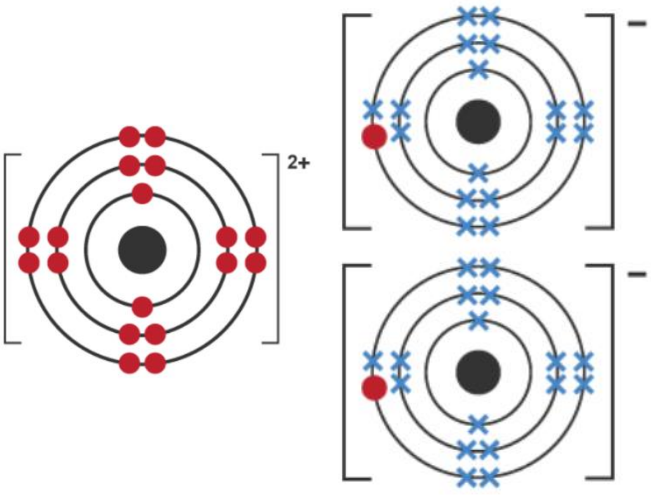
Cation	Anion
Positively charged (+)	Negatively charged (−)
Lose valence electrons	Gain valence electrons
Mostly metals	Non-metals

Ionic bond

Ionic bonds: strong electrostatic forces of attraction between positive & negative ions

- Formation of cations & anions
  - Metal reacts with non-metal
  - Metal atoms transfer valence electrons → non-metal atoms
- **Ionic compounds**: compounds that contain ionic bonds

Dot-and-cross diagram:

Compound	Chemical formula	Dot-and-cross diagram
Sodium chloride	NaCl	
Magnesium oxide	MgO	
Calcium chloride	$CaCl_2$	

6.2 Giant Ionic Lattice Structure (7.1, 7.2)

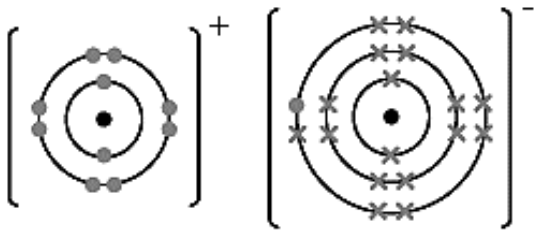
Strong electrostatic forces of attraction between oppositely charged ions
→ form giant ionic lattice structure

In the giant ionic lattice structure of sodium chloride,

- Each sodium ion: surrounded by 6 chlorine ions
- Each chlorine ion: surrounded by 6 sodium ions
- Ratio of sodium ions to chlorine ions = 1 : 1

From the ratio of sodium ions to chlorine ions,
deduce the chemical formula of sodium chloride – NaC*l*

Dot-and-cross diagram:



6.3 Properties of Ionic Compounds

Physical properties

<table>
<tr><th>Properties</th><th colspan="3">Explanation</th></tr>
<tr><td>1. Melting & boiling point: high</td><td colspan="3">• <u>Large amount</u> of energy is required to overcome the <u>strong electrostatic forces of attraction</u> between <u>oppositely charged ions</u> to melt the ionic compound
• Most ionic compounds: solid at r.t.p.
• Non-volatile</td></tr>
<tr><td rowspan="2">2. Solubility
• water: soluble
• organic solvent: insoluble</td><td colspan="2">Water</td><td>Organic solvent</td></tr>
<tr><td colspan="2">• Water molecules attracted to ions → weaken electrostatic forces between ions
• Ions pulled from lattice structure
• Compound dissolves → form aqueous solution</td><td>• No water present
• Ions tightly held in lattice structure</td></tr>
<tr><td rowspan="3">3. Electricity conductivity: √
1) molten
2) aqueous (dissolved)</td><td>molten</td><td colspan="2" rowspan="2">Free moving ions</td></tr>
<tr><td>aqueous</td></tr>
<tr><td>solid</td><td colspan="2">Ions held in place in the lattice structure,
no free-moving ions to conduct electricity</td></tr>
</table>

Why the melting point of magnesium oxide is much higher than sodium chloride?
The ions in magnesium oxide have double the charges thus the ionic bonds are stronger in sodium chloride. Larger amount of energy is needed to overcome the bonds in magnesium than sodium chloride.