4.1 Ionic bonding and structure	
Nature of science: Use theories to explain natural phenomena—molten ionic compounds conduct electricity but solid ionic compounds do not. The solubility and melting points of ionic compounds can be used to explain observations. (2.2)	
Understandings: • Positive ions (cations) form by metals losing valence electrons. • Negative ions (anions) form by non-metals gaining electrons. • The number of electrons lost or gained is determined by the electron configuration of the atom. • The ionic bond is due to electrostatic attraction between oppositely charged ions. • Under normal conditions, ionic compounds are usually solids with lattice structures. **Applications and skills:** • Deduction of the formula and name of an ionic compound from its component ions, including polyatomic ions. • Explanation of the physical properties of ionic compounds (volatility, electrical conductivity and solubility) in terms of their structure. **Guidance:** • Students should be familiar with the names of these polyatomic ions: NH_4^+, OH^-, NO_3^-, HCO_3^-, CO_3^{2-}, SO_4^{2-} and PO_4^{3-}.	**Theory of knowledge:** • General rules in chemistry (like the octet rule) often have exceptions. How many exceptions have to exist for a rule to cease to be useful? • What evidence do you have for the existence of ions? What is the difference between direct and indirect evidence? **Utilization:** • Ionic liquids are efficient solvents and electrolytes used in electric power sources and green industrial processes. Syllabus and cross-curricular links: Topic 3.2—periodic trends Topic 21.1 and Option A.8—use of X-ray crystallography in structural determinations Physics topic 5.1—electrostatics **Aims:** • **Aim 3**: Use naming conventions to name ionic compounds. • **Aim 6**: Students could investigate compounds based on their bond type and properties or obtain sodium chloride by solar evaporation. • **Aim 7**: Computer simulation could be used to observe crystal lattice structures.

UNIT 4.1 – IONIC BONDS AND STRUCTURES

CATIONS VS ANIONS

Cation	Anion
- Positively charged - Formed by metals losing valence electrons $Mg - 2e^- \rightarrow Mg^{2+}$	- Negatively charged - Formed by non-metals gaining electrons $Cl + e^- \rightarrow Cl$

Ionic bonds are formed between the electrostatic attractions between oppositely charged ions.

Ionic compounds usually make a lattice structure.

POPERTIES

BRITTLE

When two positive/negative particles come in contact with each other, they repel, causing the substance to shatter.

CONDUCTIVE IN SOLUTION/MOLTEN

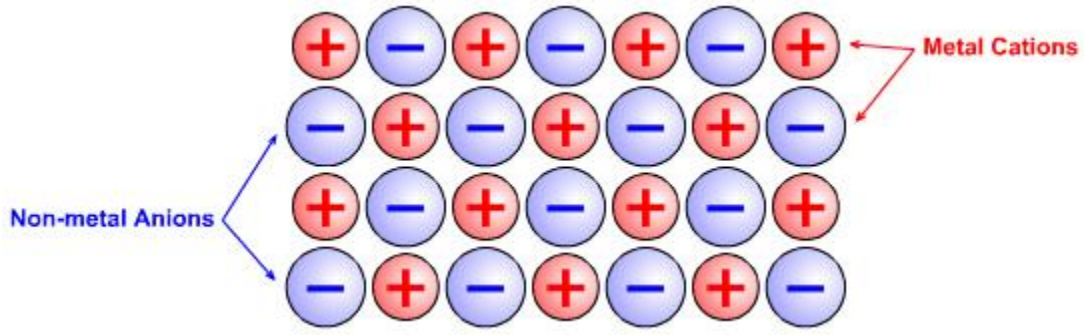
When in solution or molten, there are free flowing charged particles in the substance. This means that it can carry electricity, meaning it is conductive.

NON-CONDUCTIVE IN SOLID STATE

Inn solid (crystal form), the ions are locked in a lattice and are not freely moving. It is not conductive.

HIGH MELTING POINT

Because ionic compounds have strong electrostatic bonds between particles, they generally have high melting and boiling points.



lattice structure

NAMING IONIC COMPOUNDS

Most ionic compounds have two word names.

FIRST WORD

Always the **cation.**

For cations of elements in **groups 1 – 8**, the cation is just the name of the element.
E.g. Potassium is just a Potassium Ion

But, when dealing with **transition metals**, always check if there is more than one possible charge for the element.
E.g. Iron can exist as +2, +3 Cation

SECOND WORD

Always the **anion.**

When naming anions with only one atom in it, we start with the name of the element, the add **–ide**.

COMPOUND ENDINGS

-ide: Tells us there is one element in the anion of the compound

-ate: Tells us there is more than one element in the ion, and that one is oxygen (more oxygen than in **–ite** ions)
Hydrogen Sulfate: H_2SO_4

-ite: Is the same as for **–ate** endings but the number of oxygen is **one** less.
Hydrogen Sulfite: H_2SO_3

POLYATOMIC IONS

Groups of atoms that carry a charge. They can be positively or negatively charged and have specific endings that we use when naming them in ionic compounds.

Ion	Name
NH_4^+	ammonium
OH^-	hydroxide
NO_3^-	nitrate
HCO_3^-	hydrogencarbonate
CO_3^{2-}	carbonate
SO_4^{2-}	sulfate
PO_4^{3-}	phosphate

▲ Table 1 Names of various ions