

Ionic Bonding

Electrostatic attraction between cations and anions

Formed due to large difference (>2) in electronegativity

Ionic bonding is not always present between nonmetal and metal (eg. AlCl_3 is covalent molecule)

Transfer of electrons from a metal atom to a non metal atom

Metal atom gives away electrons and becomes a cation

Non- metal atom accepts electrons and becomes anion

Giant Ionic Structure

In solid state, anions and cation are held in fixed alternate positions in a giant ionic crystal lattice

Cations attract anions in every direction around them

Ionic bonds exist extensively throughout the structure

Strength of ionic bond

Indicated by lattice energy (LE)

LE is the amount of heat energy evolved when 1 mole of solid ionic compound was formed from its gaseous ions

Directly translates to the amount of heat energy required to break the ionic bond

Magnitude of LE : Product of respective charges of the ions/ sum of the respective radius of both ions

More LE \rightarrow stronger electrostatic attraction between cation and anion \rightarrow more stronger ionic bond

Greater numerator \rightarrow higher charge \rightarrow greater LE required \rightarrow stronger ionic bond

Smaller denominator \rightarrow lower radius \rightarrow greater LE required \rightarrow stronger ionic bond

Strength of ionic bond (cont)

Explain answers in terms of value of $(q+ \times q-)$ and $(r+ + r-)$ and then link to the LE formula

Physical properties of Giant ionic structure

High MP/BP : large amount of energy required to overcome strong electrostatic forces of attraction between cations and anions

Discussing difference in MP/BP: structure - $>$ compare $(q+ \times q-)$ and $(r+ + r-)$ \rightarrow compare LE \rightarrow strength of esf \rightarrow energy required to overcome esf \rightarrow link

Electrical Conductivity: ionic compounds are good electrical conductors in molten/aqueous state as the ions are free from their fixed, alternate positions in the giant ionic lattice \rightarrow presence of mobile ions able to carry charges throughout the compound

Hardness: When a force is applied along a particular plane \rightarrow layers of ions slide \rightarrow ions of same charge meet and repel one another \rightarrow shatters crystal along fault line
Very hard (large amount of energy to overcome strong esf) but they are brittle

Solubility

Ionic compounds are soluble in water (not non-polar solutions)

when ionic compound is added to water \rightarrow ion-dipole attraction established between oppositely charged ions and the polar water molecules (ions are completely solvated) \rightarrow when ion-dipole attraction releases sufficient energy \rightarrow enough to overcome the strong esf between the cations and anions \rightarrow breakdown of the solid ionic crystal lattice \rightarrow solid dissolved

Covalent character in ionic bond

not all ionic bonds are pure \rightarrow some possess a certain degree covalent character

in these cases, cations will polarise the anion (attract the electron cloud towards itself \rightarrow part of the electron cloud of O^{2-} gets drawn to the region in between both ions \rightarrow electron cloud ends up being shared between ions

factors affecting extent of covalent character \rightarrow increased polarising power of cation (increased charge density \rightarrow small size and higher charge) and larger anions (easier to polarise) \rightarrow size of anions decreases down the group



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Not published yet.

Last updated 21st March, 2024.

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