



why atoms pair up, and the shape, strength and energy that pairing leaves behind



Kossel-Lewis approach

- only outermost-shell electrons decide bond formation
- a bond forms by **loss/gain of electrons** (ionic) or by **sharing a pair** (covalent)
- Lewis pictured the atom as a positive kernel (nucleus + inner electrons) around a valence shell
- the valence shell holds at most eight electrons: the octet
- octet rule: an atom loses, gains or shares electrons until its shell holds eight
- H and Li are content with two, like He (a **duplet**), the rule breaking down there
- not valid generally: it fails incomplete octets, expanded octets and odd-electron species

Ionic bond: NaCl and CaCl₂

- Na (2,8,1) loses one electron to reach Ne (2,8)
- Cl (2,8,7) gains one to reach Ar (2,8,8): Na⁺ and Cl⁻ attract electrostatically
- CaCl₂: Ca (2,8,8,2) loses two electrons to two separate Cl atoms
- giving Ca²⁺ and two Cl⁻
- ionic bonds form readily between a low-ionisation-enthalpy metal and a large negative electron gain enthalpy element
- both processes happen in the gaseous phase before the solid crystallises

Ionic bond vs covalent bond *

Ionic

- complete transfer of electrons, metal to non-metal
- e.g. Na loses an electron, Cl gains it: Na⁺Cl⁻
- held by electrostatic attraction, no fixed direction
- conducts electricity molten or in solution

Covalent

- electrons shared, usually between two non-metals
- single bond shares one pair, double two, triple three
- e.g. two Cl atoms share one pair in Cl₂
- has a definite direction, which is why molecules have shape

the split isn't sharp: most real bonds sit somewhere between the two, exactly what bond polarity and Fajans' rules describe

