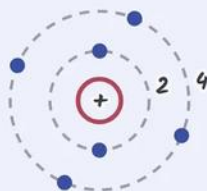


one element, two very different crystals, and the millions of compounds its bonding allows

Why carbon is special *

- carbon has four valence electrons, so it needs four more to complete its shell
- gaining or losing four electrons would take far too much energy, so carbon shares instead and forms covalent bonds
- tetravalency means it forms four bonds, so it can attach four different atoms or groups
- catenation is its ability to bond to other carbon atoms, forming chains, branches and rings of great length
- the carbon to carbon bond is unusually strong and stable, which is why those chains survive
- these together are why carbon has millions of compounds while all the other elements together have far fewer



carbon's two shells with four electrons in the outer one: exactly halfway to full, so sharing four times costs far less than transferring four electrons either way, and every carbon bond is therefore covalent

Diamond and graphite

Diamond

- each carbon bonded to four others
- a rigid three dimensional network
- the hardest natural substance
- does not conduct, no free electrons
- used for cutting, drilling and jewellery

Graphite

- each carbon bonded to three others
- flat layers held together only weakly
- soft and slippery, the layers slide
- conducts electricity, one electron per atom is free
- used in pencils, as a lubricant and for electrodes

both are pure carbon, so the difference comes entirely from how the atoms are arranged. That is what allotropy means, and this pair is the clearest example of it there is

