

Chemical bonding

Ionic bonding

metal + nonmetal

electrostatic attraction between oppositely charged ions (cations + anions)

Covalent bonding

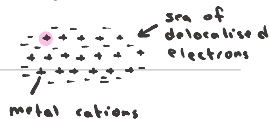
nonmetal + nonmetal

electrostatic attraction between the nuclei of two atoms and a shared pair of electrons

Metallic bonding

metal + metal

electrostatic attraction between positive ions and delocalised electrons

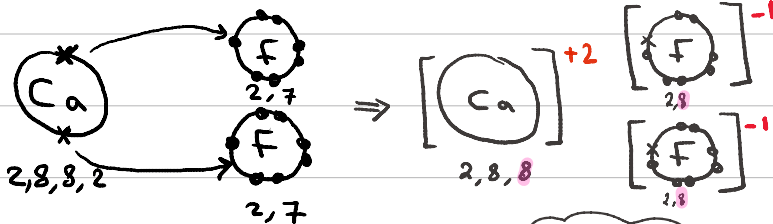


Dot and cross diagrams

Ionic bonding



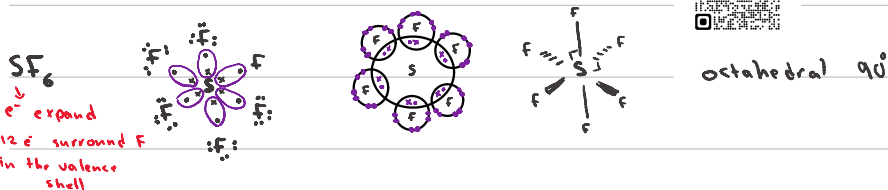
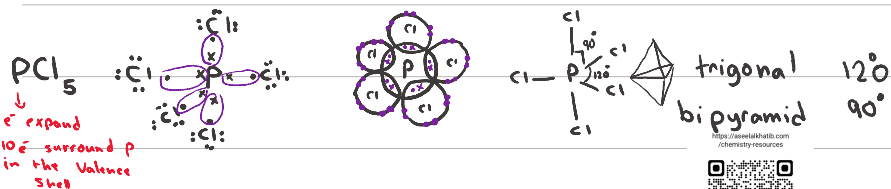
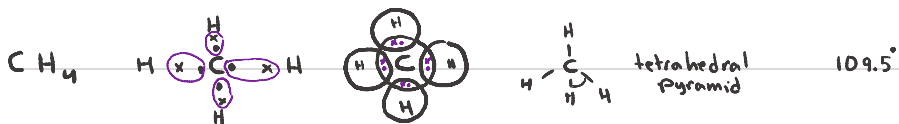
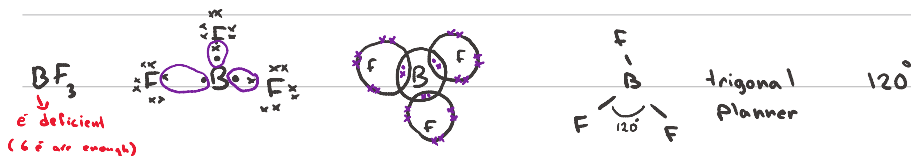
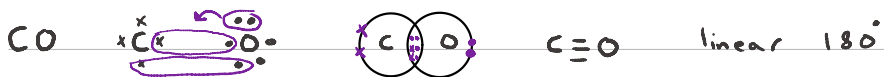
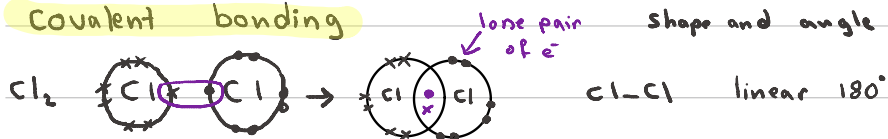
formula: CaF_2



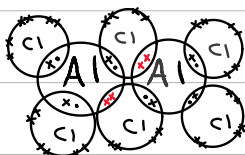
octet Rule

8 e⁻ in the valence shell

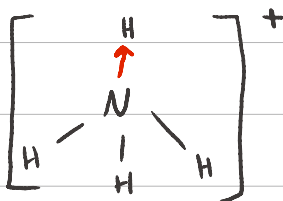
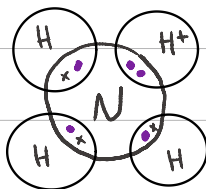
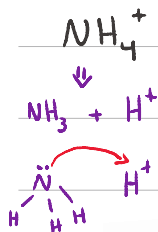
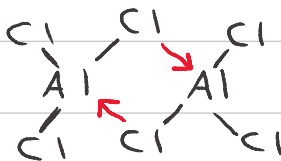
Covalent bonding



dative bond in covalent structure.



two Cl atoms donate $2e^-$ to be shared with Al atoms to form dative bond



<https://www.khanacademy.com/a/chemistry-resources>



σ bonds and π bonds

direct overlapping

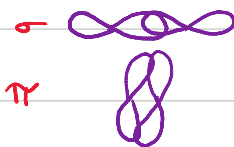
Stronger bond

sideways overlapping

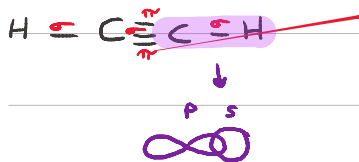
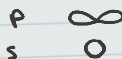
weaker bond



Valence e⁻ in
p subshell



look at valence e⁻
subshell:



single bond — σ

double bond = π

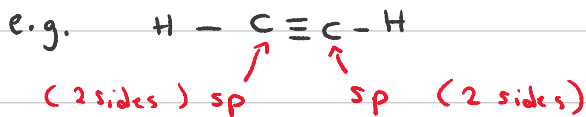
triple bond ≡ π
↑
strongest bond

<https://aseelakhatib.com/chemistry-resources>

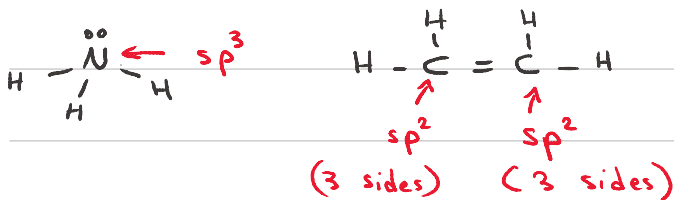
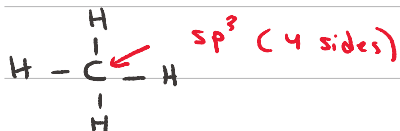


Hybridisation: overlapping orbitals

- sp (two sides around a middle atom)
- sp² (three sides around a middle atom)
- sp³ (four sides around a middle atom)

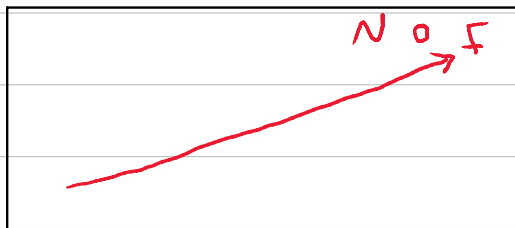


pair of electrons
are counted
with sides



★ Electronegativity: the power of an atom in a covalent bond to attract the bonding pair of e^-

→ increases up and right periodic table



Inter molecular forces (van der Waals') forces between covalent molecules

① hydrogen bond $H-F > H-O > H-N$

the strongest because F has the highest electronegativity

② permanent dipole - permanent dipole pd - pd

$+ \delta \quad \delta -$ when a molecule has two poles
 $C \equiv O$
 $\rightarrow$ $+ \delta$ and $- \delta$

③ instantaneous dipole induced dipole id - id
(London dispersion)

* exists in all molecules

* increasing e^- $\rightarrow$ stronger id - id $\rightarrow$
higher boiling and melting points

δ^+ δ^- when atoms approach each other
 e^- repel forming $+ \delta, - \delta$

H-bond $\xrightarrow{\text{stronger}}$ pd - pd $\xrightarrow{\text{stronger}}$ id - id

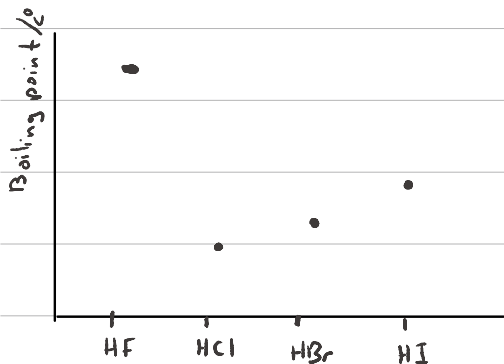
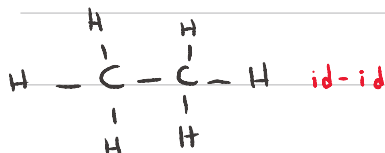
e.g. $\delta^+ \text{H} - \text{O}^{\delta-} - \text{H} \delta^+$ water has the three IMF
H-bond, pd-pd, id-id

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only id-id

[no pd-pd
charges cancel out
in opposite direction]



HF has the

highest B.p due to

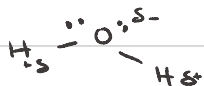
Hydrogen bond.

→ increasing Atomic number
 $\text{HCl} < \text{HBr} < \text{HI}$

all has dp-dp and id-id but H-I has the most e^-

→ strongest id-id forces.

properties of water



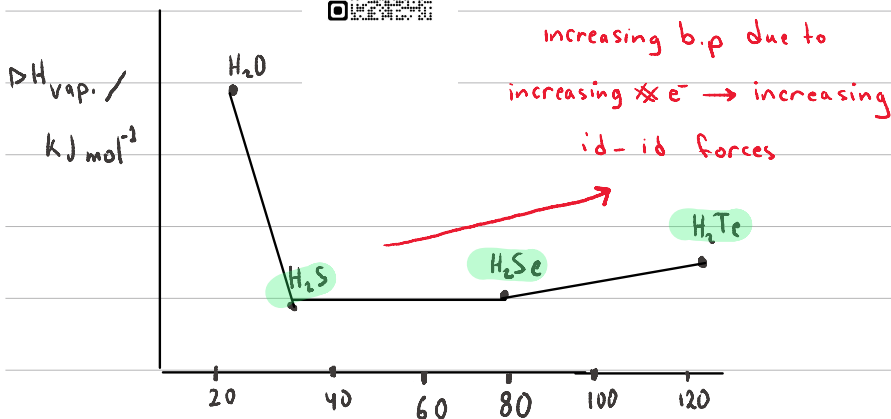
① high enthalpy change of vaporisation / high

boiling point due to H-bond

need high amount of energy to break bonds

between water molecules

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physical state at room temp. and pressure

Ionic compounds * electrostatic forces holding positive and negative ions together

* Ions are regularly arranged in lattice

* High m.p. and b.p., high ΔH_{vap} . (it takes high energy to overcome the strong electrostatic attractive forces)

Metals * High m.p., high b.p., high ΔH_{vap} .

it takes high energy to overcome the strong electrostatic attraction between positive ions and sea of e^-

Covalent compounds low m.p., low b.p., low ΔH_{vap} .

covalent bonded with simple covalent structure, weak IMF

<https://www.albath.com>
chemistry resources



Solubility

Ionic

Covalent

Metals

most ionic compounds

are soluble in water

polar water are attracted

to ions in compound

(ion dipole attraction)

most are insoluble in water

(non polar)

some has pd-pd

and are soluble in

water (polar)

don't dissolve in

water, because:

forces of attraction

between ions and free e^-

greater than water IMF

Some covalently bonded substances react with water

rather than dissolving (Hydrolysis)



Electrical conductivity

Free e^-

in metals

+ graphite



Free ions



molten and aqueous

ionic compounds