Definitions

Electronegativity is the ability of an atom to attract a pair of electrons towards itself in a covalent bond

Ionic bonding is the electrostatic attraction between oppositely charged ions (positively charged cations and negatively charged anions

Metallic bonding is the electrostatic attraction between positive metal ions and delocalised electrons

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

Bond energy is the energy required to break one mole of a particular covalent bond in the gaseous state

Bond length is the internuclear distance of two covalently bonded atoms

Sigma bond is the covalent bond formed by 'head on' overlap of atomic orbitals

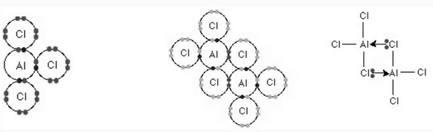
Pi Bond is the covalent bond formed by sideways overlap of atomic orbitals

Dipole-Dipole Forces are intermolecular attractions between molecules which are permanently polarised

Hydrogen Bond is the electrostatic attraction between a hydrogen atom which is bonded to a very electronegative atom and an electronegative atom of a neighbouring molecule

Van Der Waals Forces are intermolecular forces of attraction which arise from temporary dipoles in molecules

Dative bonding



Properties of water

High melting & boiling points	Water has high melting and boiling points which is caused by the strong intermolecular forces of hydrogen bonding between the molecules
High surface tension	Surface tension is the ability of a liquid surface to resist any external forces. The water molecules at the surface of liquid are bonded to other water molecules through hydrogen bonds These molecules pull downwards on the surface molecules causing the surface them to become compressed and more tightly together at the surface

Properties of water (cont)

Density	In ice the water molecules are packed in a 3D hydrogen-bonded network in a rigid lattice. Each oxygen atom is surrounded by hydrogen atoms. This way of packing the molecules in a solid and the relatively long bond lengths of the hydrogen bonds means that the water molecules are slightly further apart than in the liquid form

Hydrogen bonding in water, causes it to have anomalous properties such as high melting and boiling points, high surface tension and anomalous density of ice compared to water

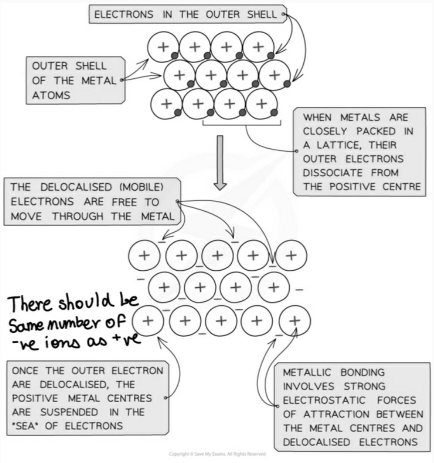
Factors influencing electronegativity

Nuclear charge	Increase in nuclear charge increases electronegativity
Atomic radius	Increase in atomic radius decreases electronegativity
Shielding by inner shells	Shielding causes decrease in electronegativity

Paulings electronegativity to predict bonds

Paulings electronegativity	Bond
< 1.0	Covalent
1.0 - 2.0	Polar covalent
> 2.0	Ionic

Metallic bonding



In a metal, atoms are packed together in a lattice

Electrostatic attraction increases with:

- Increase in positive charge
- Decrease in size of metal ions
- Increase in number of mobile electrons

σ and π bonds

A pi bond is weaker than a sigma bond because the overlapping of charge clouds is less than in a sigma bond

H_2 has 1 σ bond

C_2H_6 has only σ bonds

C_2H_4 has 1 σ and 1 π bond

HCN has 1 σ and 2 π bonds

N_2 has 1 σ and 2 π bonds

VSEPR Theory and Molecular Shapes

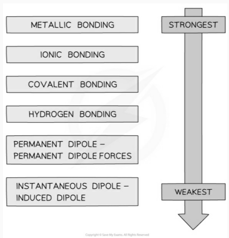
Number of electron pairs	Electron pair geometries: 0 lone pair	1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	180° Linear				
3	120° Trigonal planar	<120° Bent or angular			
4	109° Tetrahedral	<109° Trigonal pyramid	<<109° Bent or angular		
5	90° 120° Trigonal bipyramid	<90° <120° Sawhorse or seesaw	<90° T-shape	180° Linear	
6	90° Octahedral	<90° <90° Square pyramid	90° Square planar	<90° T-shape	180° Linear

Van der Waals' Forces & Dipoles

Id - id forces increase with	Increasing number of electrons (and atomic number) in the molecule
	Increasing the places where the molecules come close together

For small molecules with the same number of electrons, pd - pd forces are stronger than id - id

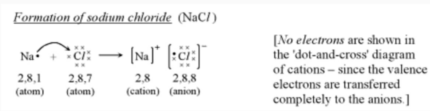
Order of bond strength



Electronegativity relations

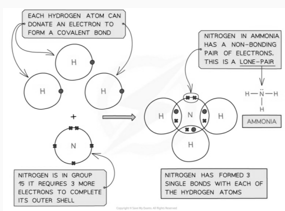
	Down a Group	Across a Period
Nuclear charge	Increases	Increases
Shielding	Increases	Reasonably constant
Atomic radius	Increases	Decreases
Electronegativity	Decreases	Increases

Ionic bonding



Ionic bonds are non-directional, each cation will attract any neighbouring anion and vice versa to form a huge ionic lattice

Covalent bonding dot and cross



Special octets

Hybridisation: sp, sp², sp³

sp	two different bonds(one may be triple bond)
sp^2	three different bonds(one may be double bond)
sp^3	four different bonds

Hydrogen bonding

Hydrogen bonding is the strongest form of intermolecular bonding

For hydrogen bonding to take place the following is needed:

A species which has an O or N (very electronegative) atom with an available lone pair of electrons	A species with an -OH or -NH group

For hydrogen bonding to take place, the angle between the -OH/-NH and the hydrogen bond is 180^{o}

Bond Energy and Bond Length: Reactivity

Shorter bond length generally means higher bond energy, making molecules less reactive

Triple bonds are the shortest and strongest covalent bonds due to the large electron density between the nuclei of the two atoms

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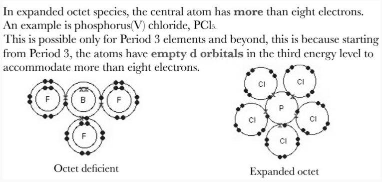
The reactivity of a covalent bond is greatly influenced by: The bond polarity, the bond strength, the bond type (σ/π)


In expanded octet species, the central atom has **more** than eight electrons.
An example is phosphorus(V) chloride, PCl_5.
This is possible only for Period 3 elements and beyond, this is because starting from Period 3, the atoms have **empty d orbitals** in the third energy level to accommodate more than eight electrons.

Octet deficient

Expanded octet

If the central atom is from Period 2 of the Periodic Table, the total number of electrons surrounding it cannot exceed-eight(but can less than eight).
If the central atom is from Period 3 and beyond, the total number of electrons-surrounding it can exceed eight