



Leaving Cert Chemistry

Free Notes

Chemical Bonding

Chemical Bonding:

Molecule: Group of atoms which are chemically joined e.g. H₂O, CO₂ and CH₄. A molecule can be polar or non polar.

Difference between polar and non polar atoms

Polar	Non polar
Atoms in the molecule have slight charges because they share a pair of electrons unequally e.g. H ^{δ+} - Cl ^{δ-}	Atoms in the molecule have no charges because they share a pair of electrons equally e.g. H - H

Covalent bond: This is the bond formed when two or more atoms attract a shared pair of electrons

Electronegativity: This is the measure of the tendency of an atom to attract a shared pair of electrons in a covalent bond.

Note:

- Every atom is given an EN value found in a table.
- **Small** non metal atoms are **better at attracting** a shared pair rather than a large metal one.
- The most electro negative attracting element is fluorine.

EN values vary going across a period of elements:

- The EN values **increase** going **across** the period of elements
- This means the small non metal **atoms on the RHS are better at attracting shared pair of electrons.**

Reasons:

Nuclear charge increases

- 1) The number of protons or positive charges in the nucleus increases.
- 2) The atomic radius decreases.
 - The smaller atomic radius means that the shared pair will be closer to the increasing nuclear charge.

EN values change going down a group:

EN values **decrease**, Reasons:

- The atomic radius **increases**.
- The nuclear charge increases, **BUT** its affect is screened by an extra shell of electrons.

Li³ – 2, 1, Na¹¹ – 2, 8, 1 K¹⁹ – 2, 8, 8, 1

Use of EN values in chemistry: EN values are used to predict the type of bond which forms between atoms.

How?



E. N. Equal to or > 1.7 = **ionic** bond

E. N. > 0.4 but < 1.7 = **polar covalent** (share pair of electrons unequally)

E.N. = 0 to 0.4 **pure covalent** bond (share pair of electrons equally)

Q) What is the difference between a pure covalent bond and a polar covalent bond?

Pure Covalent	Polar Covalent
Bond formed between two atoms when they share a pair of electrons equally. $\Delta EN = 0$	Bond formed between two atoms when they share a pair of electrons unequally
e.g. H – H, Cl – Cl	e.g. H ₂ O

Note: Linus Pauling measured the electronegativity of each element and put them in a table. If you read various books or sources the Noble gases are not in this table because they do not form bonds.

Dative covalent bond: Bond formed between two atoms when they share a pair of electrons but the shared pair comes from one of the atoms.

Polarity:

- To show if a compound [usually a liquid] is polar, pour the liquid from a burette past a charged rod, for example rub a pen vigorously on a woollen cloth.
- If the liquid is not polar it will pass the rod un-deflected
- The stream will be deflected if it is polar
- If the charge of the rod is reversed the stream still bends – opposite end of molecule is attracted

Bond formation

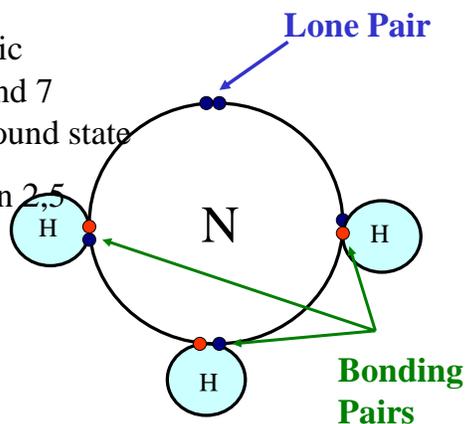
Q) Using a dot and cross diagram to show the bonding in an ammonia, NH₃, molecule. (2009, HI, 7 marks)

- ✚ Join N with three H atoms.
- ✚ N (group 5) > valency of 3 i.e. needs 3 electrons from other atom(s) for it to become stable.
- ✚ H (group 1) > valency of 1 i.e. needs one more electron to be stable.
- ✚ NOTE THE RELEVANCE OF VALANCY IN FUTURE

NH₃ Ammonia

N has an Atomic Number of 7 and 7 electrons in ground state

Electron pattern 2,5



- ✚ N has 5 e⁻ on outer shell
- ✚ 3 of these 5 are involved in bonding
- ✚ The NH₃ has a pyramidal shape.

Q) Write the chemical formula for hydrogen sulphide. Use clear cross and dot diagrams to show the binding in Hydrogen sulphide. Would you expect hydrogen sulphide molecule to be linear or non linear? Justify your answer

Formula: H₂S

- ✚ S with two hydrogen atoms
- ✚ S (group 6) > valency of 2
- ✚ S has 6 electrons in its outer shell, 2 of these are involved in bonding.
- ✚ Molecule with two lone pairs.
- ✚ As a result it is V – shape
- ✚ Therefore it is non – linear

Valance shell electron pair repulsion theory (VSEPR)?

- 1) This is a theory used in chemistry to predict the shape which molecules have.

Main points of theory:

The shape of a molecule depends on the:

- 1) Number of electron pairs around a central atom and
- 2) The type of these electron pairs i.e. lone pairs and bond pairs.

The different pairs of electrons repel each other and try to be as far as possible away from each other.

The strongest repulsion is between the two lone pairs with the weakest are between two bond pairs.

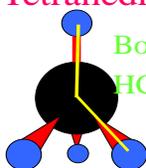
The presence of a lone pair on the central atom:

- Forces bond pairs closer together
- Reduces the bond angle

Results:

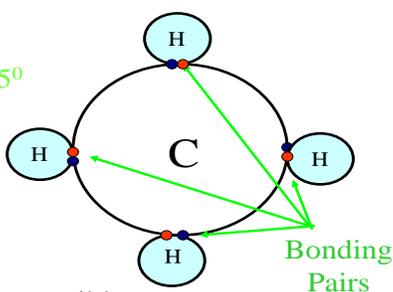
- 4 bond pairs (around central atom) – tetrahedral shape e.g. CH₄ (methane)

Tetrahedral



Bond Angle
HCH = 109.5°

Methane CH₄



- 4 bonding pairs
- All repel equally
- Move as far apart as possible
- Note they are NOT on the equator
- but one at the pole and three below the equator

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