Chemical Bonding

Q-1) What is ionic bonding?

-> The strong force of attraction between the oppositely charged positive and negative ions is ionic bonding

metals + non-metals (also electrovalent bonding)

→ Have high melting + boiling points because of strong electrostatic forces (+ + - ions) that are hard to break + they are regularly arranged in a lattice. (usually solids)

→ They are soluble in water as the polar water molecules are attracted to the ions.

→ They conduct electricity when molten as the ions are free to move.

Q-2) What is covalent bonding?

→ When two non-metal atoms combine, they share one or more pairs of electrons. This is covalent bonding.

non-metal + non-metal

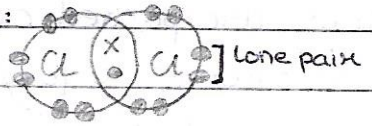
1 = single covalent bond / bond pair

2 = double covalent bond

3 = triple covalent bond.

→ The outer shell electrons not used in bonding are called lone pairs.

eg:



→ Have low melting + boiling points due to weak intermolecular forces (weak van der waals forces) (usually liquids or gases)

→ most are insoluble in water as they are non-polar ∴ are not attracted to water.

Some small molecules are soluble as they can form hydrogen bonds with water eg: ethanol. C_2H_5OH

Some react with water rather than dissolving in it.

eg: $HCl \rightarrow H^+ + Cl^-$

hydrolysis reaction.

-> They don't conduct electricity because there are no free ions or electrons.

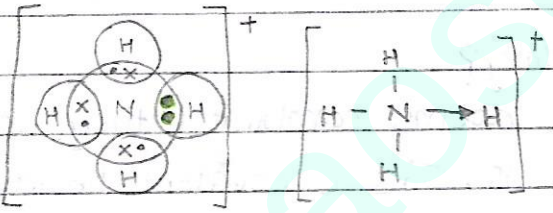
Q-3) What is co-ordinate bonding?

-> A co-ordinate bond (aka dative covalent bond) is when one atom provides both the electrons needed for a covalent bond.

It needs:

- one atom with lone pair of electrons.
- another atom with unfilled orbit that will accept the lone pair e^-. (electron deficient compound)

eg



the arrow shows the e^- being given.

NH_4^+, Al_2Cl_6.

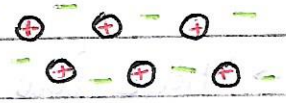
Q-4) What is metallic bonding?

-> Metallic bonding is the force of attraction between positive ions & sea of electrons.

The metal atoms are packed close together in a lattice.

most atoms lose outer e^- to form positive ions.

These are delocalised electrons



-> metallic bonding is strong as the ions are held by strong electrostatic forces.

It can be increased by:

- increasing positive charge on ions
- decreasing size of positive ions (metal ions)
- increasing no. of delocalised e^- per atom

→ Metals have high melting & boiling points.
→ Metals don't dissolve in water
→ Conduct electricity & heat as the electrons are free to move
→ they are maleable (broken into sheets) & ductile (broken into wires) because the layers can slide over each other.

Q-5) What is the VSEPR theory?
→ Valence Shell Electron Pair Repultion Theory.
During formation of compounds, the electron pairs repel each other & move far apart from each other within the confines of the bond (limited area of repultion) giving the molecule a regular shape

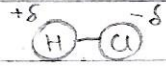
total no. of e^- pairs	no. of BP	no. of LP	~~angle~~ shape	angle
2	2	0	linear	180°
3	3	0	Trigonal planar	120°
3	2	1	Angular	
4	4	0	Tetrahedron	109.5°
4	3	1	Pyramidal	107°
4	2	2	Angular (v-shape)	104.5°
5	5	0	Trigonal bipyramidal	120°, 90°
5	4	1	Distorted tetrahedral	120°, 90°
5	3	2	T-shape	90°
6	6	0	Octahedron (square bipyramdal)	90°
6	5	1	Square pyramidal	90°
6	4	2	Square planar.	90°

Q-6) What is electronegativity?
→ Electronegativity is the ability of an atom, that is covalently bonded to another atom, to attract the bond pair of

electrons towards itself.
[most electronegative = F, O, N, Cl]

periodic table.
electronegativity increases →
electronegativity decreases ↓

> Polar molecules:-
molecules made of electropositive (↳ give electrons) and electronegative (↳ accept electrons) charge.



eg: HCl, H_2O

Have a difference in ~~polarity~~ electronegativity

> Non-polar molecules:-
molecules made of one type of atom only.
No difference in electronegativity

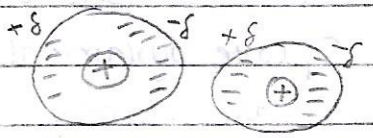
eg: H_2, Cl_2, Br_2.

The electronegativity is shown by a sign


with the arrow pointing towards the partially negative dipole.

Q-7) What are van der waals forces?

> Van der waals forces are weak forces of attraction between non-polar molecules. All atoms and molecules have VVF.
VVF arise as in a non-polar molecule, the electron charge clouds are constantly moving. This means for a short moment, electrons are more on one side of the cloud than the other, causing a small charge on either sides. A temporary dipole is set which can ~~id~~ induce a dipole on the other molecules, creating force of attraction between +δ and -δ



eg: CH_4

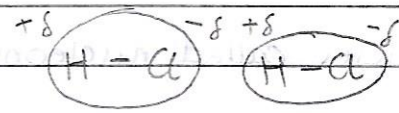
VVF can be increased by:
- increasing the no. of electrons and protons in the molecule
- increasing the no. of contact points between the molecules.

The strength of VVF depends on the molar mass and surface area of the molecule.

Q-8) What are permanant dipole-dipole forces?

> The forces of attraction between two molecules having permanant dipole (polar molecules) are called permanant dipole-dipole forces. They are stronger than VVF

eg: HCl, H_2O, NaCl, H_2SO_4, BrF_3.



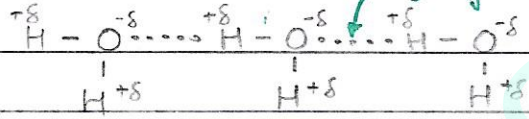
Q-9) What is hydrogen bonding?

> It is the strongest type of intermolecular force.

For hydrogen bonding you need:

- hydrogen atom covalently bonded to F, O or N
- second molecule having F, O or N with a lone pair

eg: H_2O, NH_3, HF, HNO_3



Q-10) Properties of water

> Water has high enthalpy change (energy transferred) of vapourisation & boiling point. This is due to extensive hydrogen bonding which means that more energy is required to break the bonds.

> It has high surface tension & viscosity (density) because hydrogen bonding reduces the ability of water molecules to slide over each other so it has high visosity
hydrogen bonding exerts a downward force at the surface of the liquid so water has high surface tension.

> ice has a 3D hydrogen bonded network of water molecules. It produces a rigid lattice in which each oxygen is surrounded by a tetrahedron of hydrogen atoms. This open arrangement allows the water molecules to be further apart in a solid than in a liquid ∴ ice is less dense than water.