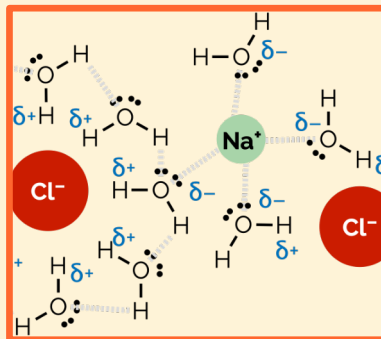


HIGHLIGHTS

- Electronegativity and polar bonds
- Bond dipoles and molecular dipoles
- Non-covalent interactions involving charged species
 - Ionic bonds
 - Ion-dipole
- Non-covalent interactions involving neutral species
 - Dipole-dipole interactions
 - Hydrogen bonding
 - Dipole-induced dipole
 - Dispersion forces



Non-covalent interactions, also known as intermolecular forces, between different molecules influence physical properties such as boiling points and solubilities. These same interactions can also have important repercussions on reactivity. Non-covalent interactions arise when electrons are unevenly distributed in a molecule. This is known as polarity and the molecule is said to have a molecular dipole. This summary looks at how the distribution of electrons in bonds can lead to common non-covalent interactions.

CHEMISTRY CLASSICS

NON-COVALENT INTERACTIONS

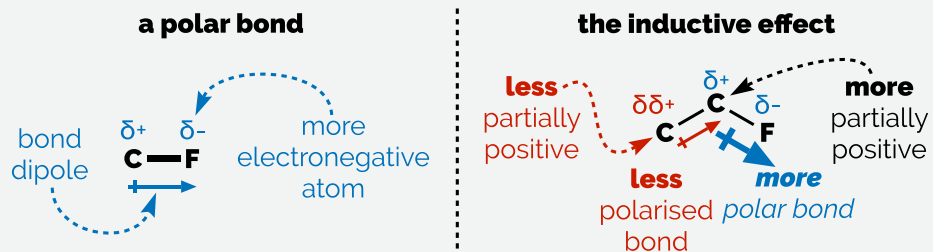
POLAR MOLECULES



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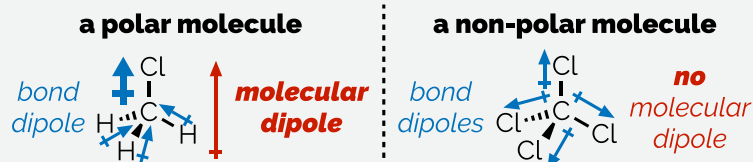
Polarity & Non-Covalent Interactions

1. Electronegativity & Bond Dipoles



A bond is **polar** when the electrons are closer to one end. The more **electronegative atom** attracts electrons and is slightly negatively charged (δ^-). The other end of the bond is slightly positive (δ^+). The bond has a **bond dipole**. The effect is communicated over more than one bond but diminishes rapidly.

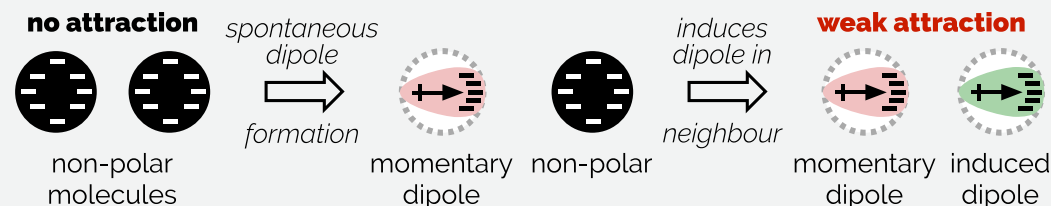
2. Polar Molecules & Molecular Dipoles



Individual **bond dipoles** combine to give the **molecular dipole**. Shape is important and strong dipoles can cancel out if they oppose one another. A molecule that has a molecular dipole is a **polar molecule**. A molecule with no bond dipoles or where the bond dipoles cancel out has no molecular dipole and is **non-polar**.

In large molecules it is difficult to assess if bond dipoles cancel and it is easier to discuss polar and non-polar parts of the molecule.

3. Induced & Temporary Dipoles



Electrons move. They can group together causing a **temporary** or **momentary dipole**. This attracts & repels electrons in neighbouring molecules & induces another dipole. There is a **weak attraction**. Then the electrons move & it vanishes.

4. Non-Covalent Interactions

The polarity of a molecule leads to interactions between molecules. Initially, we are interested in seven attractive electrostatic interactions or non-covalent interactions.

Charged interactions

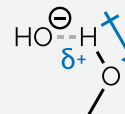
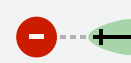
Listed in decreasing average strength

ionic bond



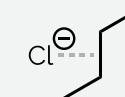
electrostatic attraction between two opposite charges

ion-dipole interactions



attraction between a charge & a polar molecule (permanent dipole)

ion-induced dipole interactions

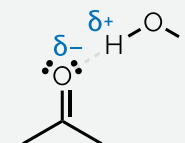


attraction between a charge & a temporary dipole in a non-polar molecule

van der Waals interactions

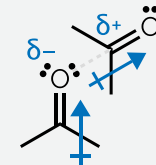
Listed in decreasing average strength

hydrogen bonds



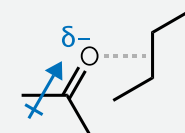
attraction between a hydrogen bonded to an oxygen or nitrogen (hydrogen bond donor) & a lone pair on an oxygen or nitrogen (hydrogen bond acceptor)

dipole-dipole interactions



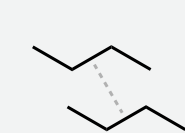
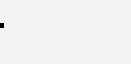
interaction between two polar molecules

dipole-induced dipole interactions



interaction between a polar molecular & a temporary dipole induced in a non-polar molecule

induced dipole-induced dipole interactions



interaction between two non-polar molecules - weakest but very important

London or dispersion forces