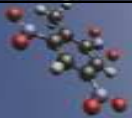


## Bond Types - Intermolecular

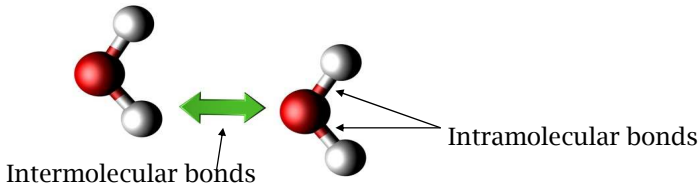
Intermolecular bonds  
Temporary dipoles  
Permanent dipoles  
Hydrogen bonding  
States of matter

Author: J R Reid



## Intermolecular Bonds

- As we have seen already, certain types of bonds hold atoms together. These are called intramolecular bonds
- Like all forces in chemistry they are caused by opposites attracting (positive attracts negative)
- Intermolecular bonds are forces that cause separate molecules to be drawn together.

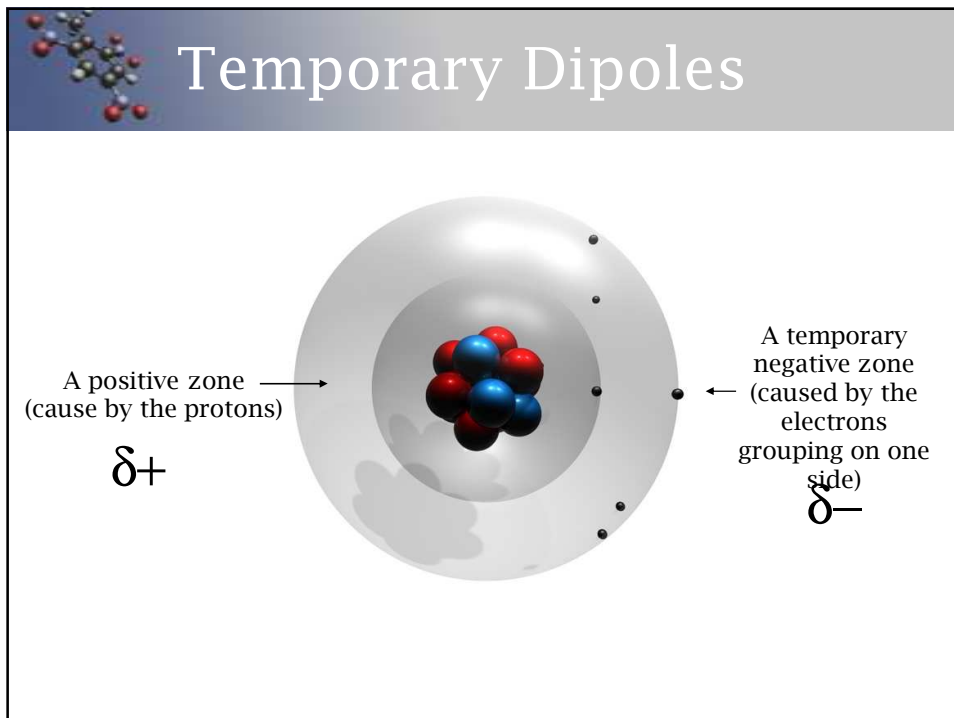


Intermolecular bonds

Intramolecular bonds

## Temporary Dipoles

- Two poles are needed for attraction to occur. This is why its called a **dipole**. Like all positive and negatives in chemistry they come from charged particles in the atom
  - electrons = negative
  - protons = positive
- A temporary dipole is set up when an atom or molecule gains a uneven balance of positive and negative charges. This can be caused by:
  - The electrons orbiting the atoms move to one side for a short time (causing a negative zone on one side and therefore a more positive zone on the other side)
  - A charged particle nearby pushes or pulls the electrons to one side (this is called an induced dipole)
- These are weak forces because they only exist for brief moments



## Permanent Dipoles

- These are caused by permanent attractions of electrons to certain zones within a molecule.

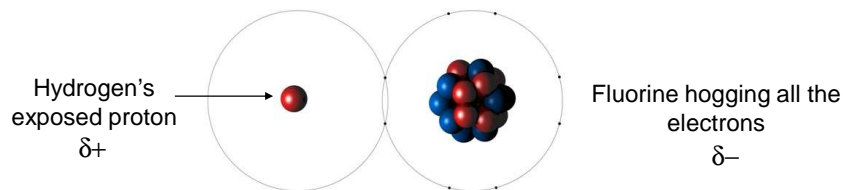
- These permanent zones of extra electrons are caused because different atoms have different amounts of attraction for their valence (bonding) electrons. This is called electronegativity. High electronegativity = high electron attraction
- The diagram above shows HF (hydrogen fluoride). The fluoride (green) has the highest electronegativity so it attracts more electrons to itself and becomes negative.
- Molecules with permanent dipoles are called **polar** molecules
- Polar molecules can dissolve other polar molecules e.g. water (polar) can dissolve ethanol (also polar)

## Strengths of Permanent Dipoles

- The permanent dipoles mean that the forces are stronger than temporary dipoles but there are a range of strengths of permanent dipoles.
- The strength of dipole depends how the 'tug of war' between the electron turns out. If one side has a greater attraction for electrons there will be a strong dipole. If both sides are evenly matched there will a weak dipole (if any) because no one has more electrons that the other
- The strongest form of permanent dipole is called Hydrogen bonding

## Hydrogen Bonding

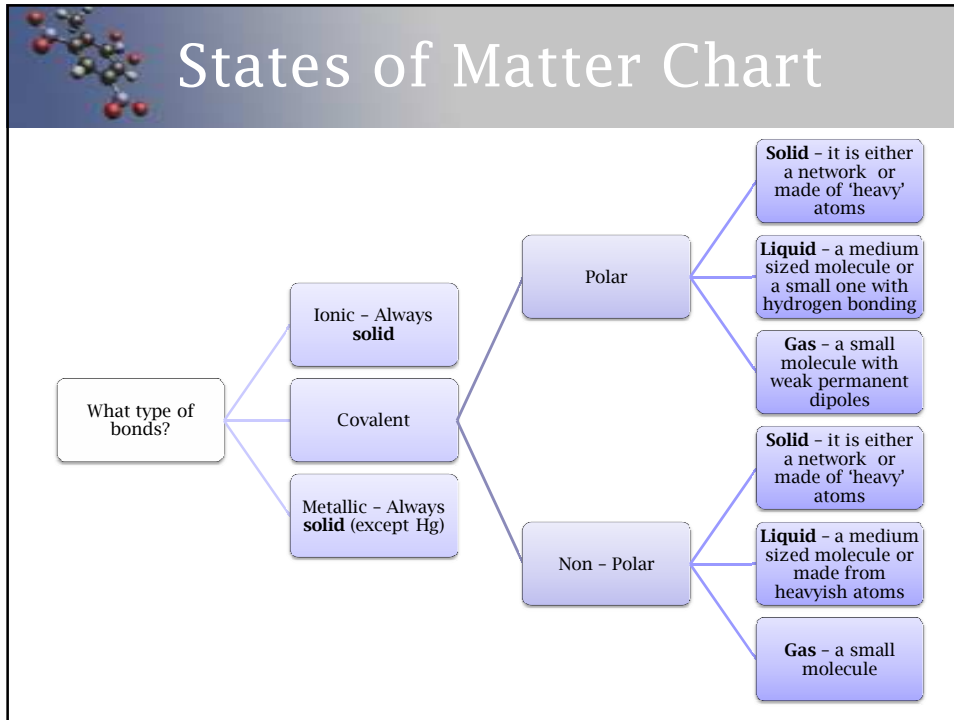
- Hydrogen only has one electron of its own. If it is bonded with a highly electronegative atom such as F, O or N then the electron gets pulled away exposing a very positive proton



- This is the strongest intermolecular force

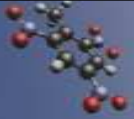
## States of Matter

- A state of matter is the solid, liquid or gas state that the matter is in
- The state of a chemical depends on two things
  - The heat of the substance (how fast the particles are vibrating)
  - The bonds holding the substance together.
- Basically if the heat is stronger than the bonds then the substance melts or vaporises (it falls to bits)
- The bonds holding the substance together can be intermolecular or intra molecular bonds. If a substance is a solid or a liquid then there must be some strong bonds holding it together



## Explaining States?

Name	State	Bonds (Inter and Intra)	Explain why it is a solid, liquid or gas
Diamond	Solid	Intramolecular - Covalent (Network)	All the covalent bonds holding it together need a lot of heat to break them
Water	Liquid		
Chlorine gas (Cl <sub>2</sub> )	Gas		
Table salt (NaCl)			
Copper metal			



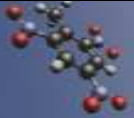
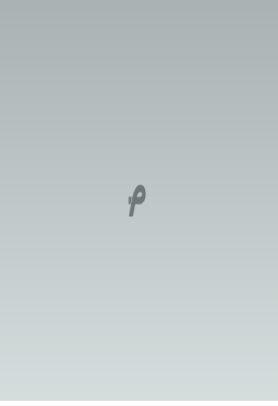
## Exam Practice - 2005

Have a go at Questions:

- Two
- Three
- Six

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## Exam Practice - 2006

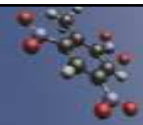
Have a go at Questions:

- Two
- Three
- Six

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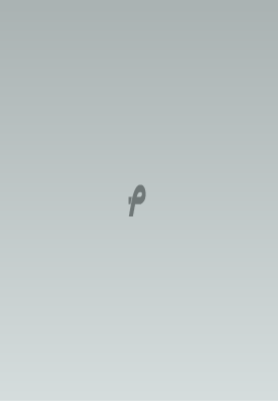
## Exam Practice - 2007

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