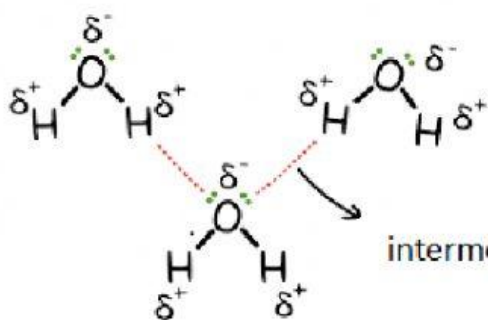


Organic chemistry IMF (Intermolecular forces)



Remember IMF are the forces of attraction between molecules

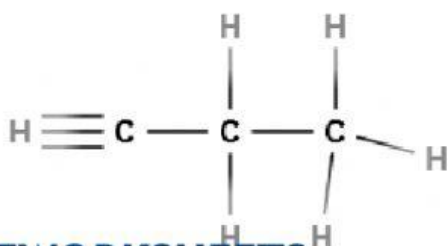
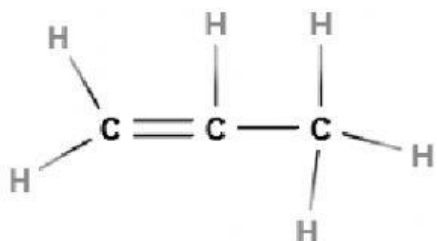
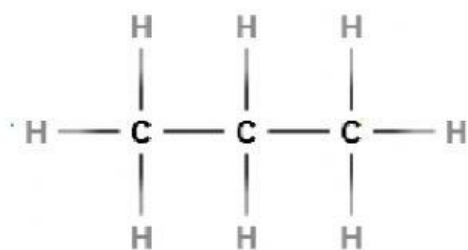
intermolecular forces

- ✓ First we need to identify if the molecules in a specific homologous series are polar or non-polar and
- ✓ then we can decide what type of IMF exists between them

Alkane, alkenes and alkynes

Are all non-polar

*For a molecule to be polar- it needs to have a slightly negative and slightly positive side of the molecule. Which these 3 homologous series don't have.



Thus the IMF are all Van der Waals, London

The site below is **Super** useful to, not only draw organic molecules but to check their names and properties.

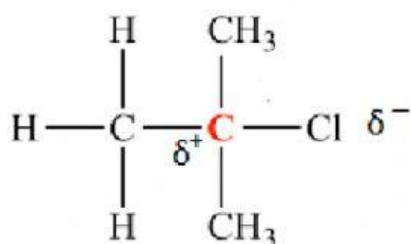
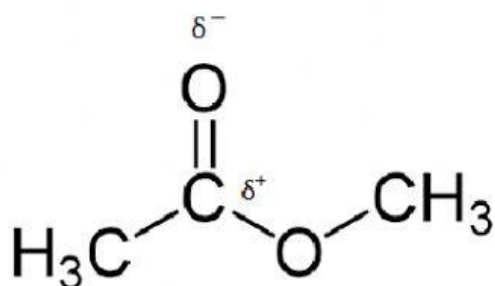
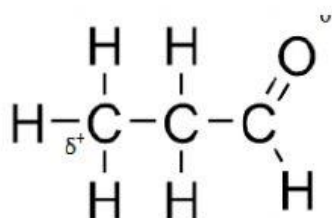
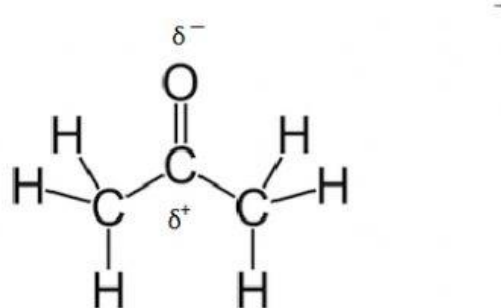
<http://molview.org/>

Just watch this quick video beforehand to show you how to use the site ☺

https://www.google.com/search?q=molview&source=lmns&bih=1180&biw=2400&client=firefox-b-d&hl=en-GB&ved=2ahUKEwiau4SQtaToAhVE2xoKHXmBCJMQ_AUoAHoECAEQAA

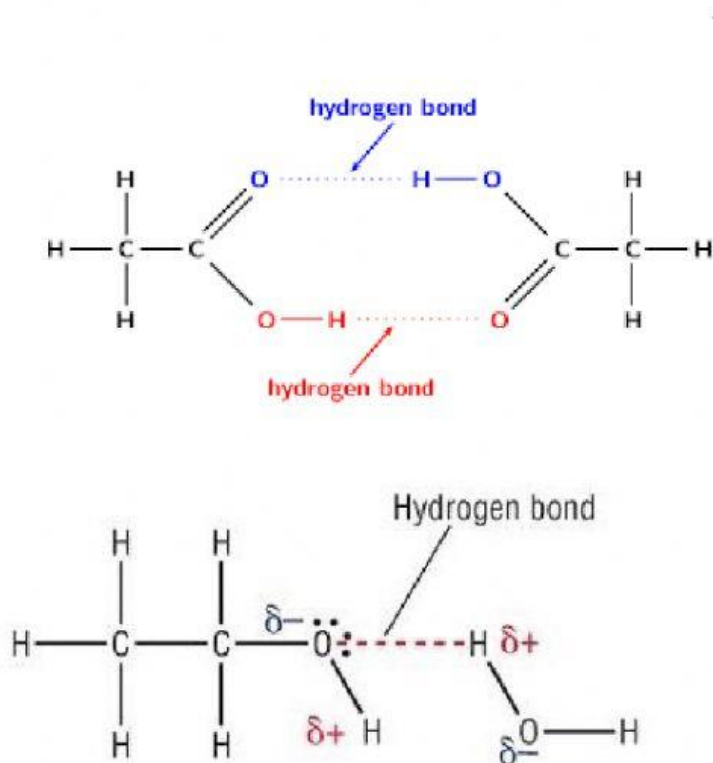
Halo alkanes/alkyl-halides, esters, ketones and aldehydes

Then there are the polar molecules



The IMF are all Van der Waals, dipole-dipole and Van Der Waals, London (in the rest of the molecule that is not polar)

But alcohols and carboxylic acids have a special type of strong IMF called Hydrogen bonding (this forms between H and N,O or F)



The IMF are: Hydrogen bonding

But remember

Alcohols have 1 site for hydrogen bonding and carboxylic acids have 2 sites for hydrogen bonding

And Van Der Waals, London (in the rest of the molecule that is not polar)

Strength of IMF decreases

Hydrogen bonding

Van der Waals, dipole-dipole

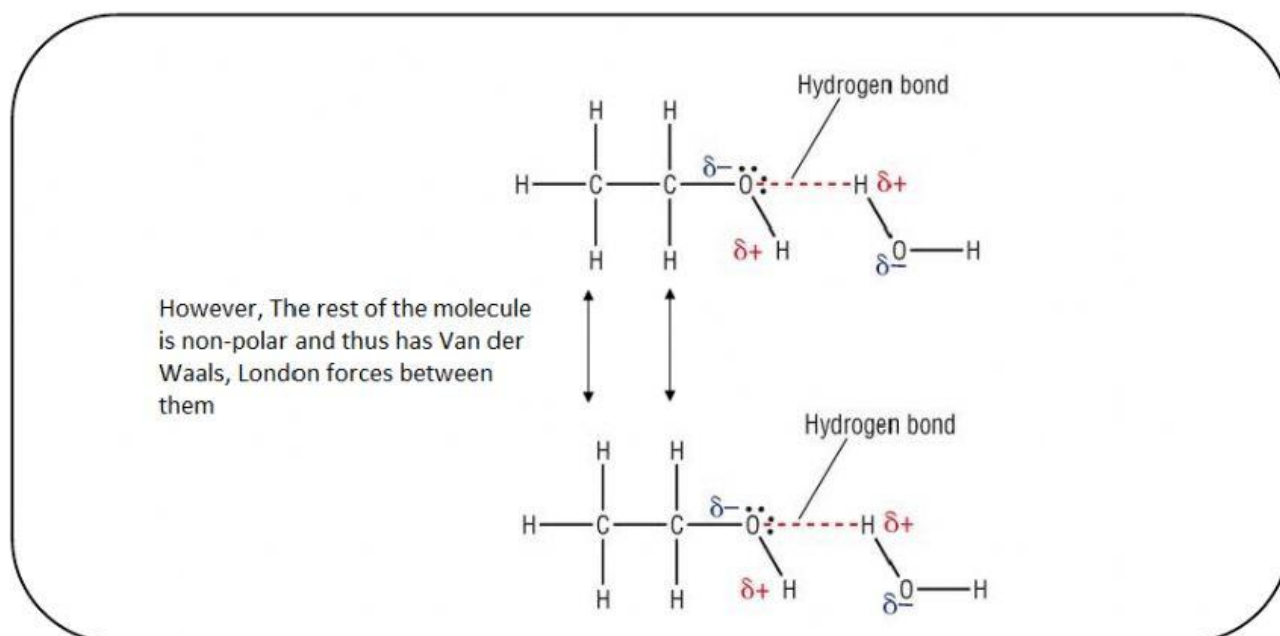
Van der Waals, London

Volatility: How easily the liquid changes to a vapour

Vapour pressure: the pressure caused by the produced vapour. It's an indication of the ease of evaporation of a liquid. The higher the vapour pressure of a liquid at a given temperature the lower the boiling point. (at atmospheric pressure)

Viscosity- measure the resistance of flow a fluid (thickness)

Eg. Water has a low viscosity and honey has a higher viscosity



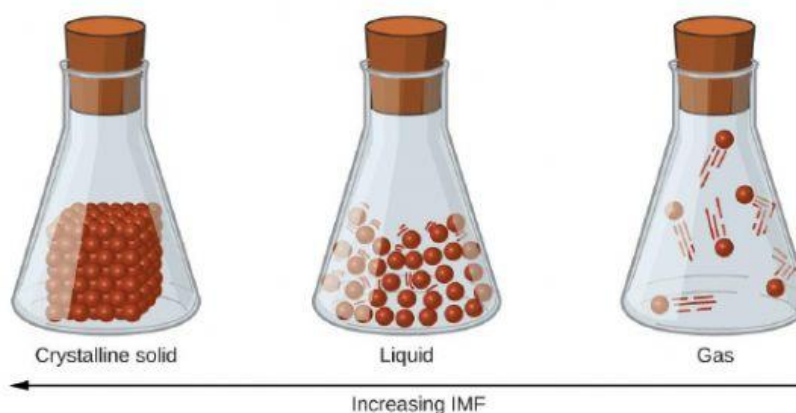
- ✓ The stronger the IMF – the higher the melting and boiling point of a substance, since it would require more energy to overcome intermolecular forces
- ✓ The stronger the IMF – the higher the viscosity of the substance, since it would have a higher resistance to flow.

(Think of a solid, liquid or gas- which of these has a higher viscosity: the solid.

And which has the strongest IMF: the solid

The higher the viscosity of a substance the stronger the IMF)

- ✓ The stronger the IMF of a substance the lower the vapour pressure and volatility (the 2 properties are closely linked). Thus substance is less likely to be a vapour.



It is important to note that when you compare compounds from different homologous series, the molar/molecular masses need to be the same or very close.

Example 1: comparing different homologous series

The example outlines the **key words** that need to be used when answering the questions

Ensure to compare **all** the compounds that they refer to

Experiment	Organic compound	Molar mass (g·mol ⁻¹)	Boiling point (°C)
I	A CH ₃ COOH	60,5	118
	B CH ₃ CH ₂ CH ₂ OH	60,1	97
	C CH ₃ CH ₂ CHO	58,1	48
II	D CH ₃ (CH ₂) ₂ COOH	88,1	163
	E CH ₃ (CH ₂) ₃ CH ₂ OH	88,1	137
	F CH ₃ (CH ₂) ₃ CHO	88,1	103

1.1) Which compound (A, B or C) in experiment 1 has the highest melting point?

A

Since it has the **strongest IMF (2 sites for Hydrogen bonding)**

Thus it **requires the most energy to weaker the intermolecular forces**

Compared to

B which has **slightly weaker Hydrogen bonding (because it only one site for Hydrogen bonding)**

And compared to

C which has the **weakest IMF of the three (Van der Waals, dipole-dipole)**

1.2) Which compound (A, B or C) in experiment 1 has the highest viscosity?

A

Since it has the **strongest IMF (2 sites for Hydrogen bonding)**

Thus it **has the greatest resistance to flow**

Compared to

B which has **slightly weaker Hydrogen bonding (because it only one site for Hydrogen bonding)**

And compared to

C which has the ***weakest IMF of the three (Van der Waals, dipole-dipole)***

1.3) Which compound (A, B or C) in experiment 1 has the highest volatility?

C

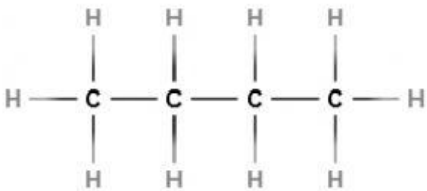
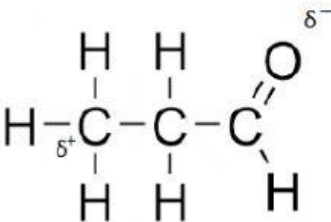
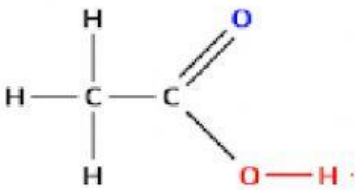
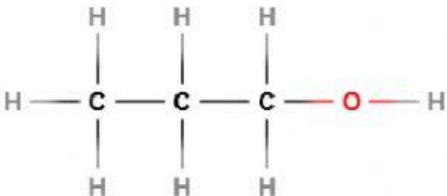
Since it has the ***weakest IMF of the three (Van der Waals, dipole-dipole)***

Compared to

B which has **stronger Hydrogen bonding (one site for Hydrogen bonding)**

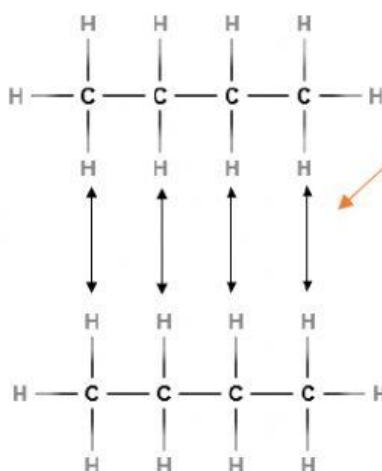
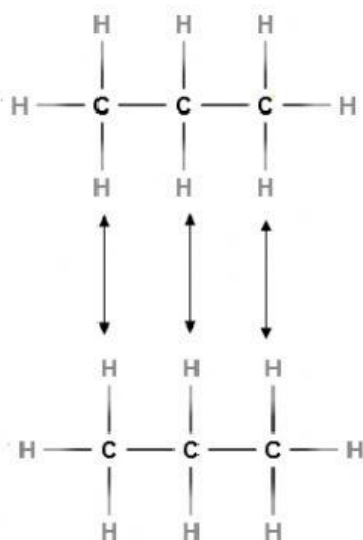
While A has the ***strongest IMF (2 sites for Hydrogen bonding)***

Question 2

Molecule	Type of IMF	Molar mass (g.mol ⁻¹)
	2.1a) Van der Waals, London Van der Waals, Dipole-Dipole Hydrogen bonding	58g.mol ⁻¹
	b) Van der Waals, London Van der Waals, Dipole-Dipole Hydrogen bonding	58g.mol ⁻¹
	c) Van der Waals, London Van der Waals, Dipole-Dipole Hydrogen bonding	60g.mol ⁻¹
	d) Van der Waals, London Van der Waals, Dipole-Dipole Hydrogen bonding	60g.mol ⁻¹

- 2.2) State the IUPAC name of the compound above that has the highest melting point.
- 2.3) State the IUPAC name of the compound above that has the lowest viscosity.
- 2.4) State the IUPAC name of the compound above that has the highest vapour pressure.
- 2.5) What is the controlled variable in the above experiment.

Chain length and IMF strength

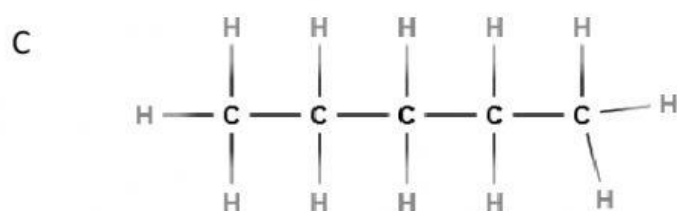
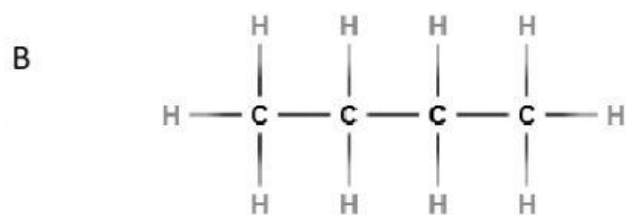
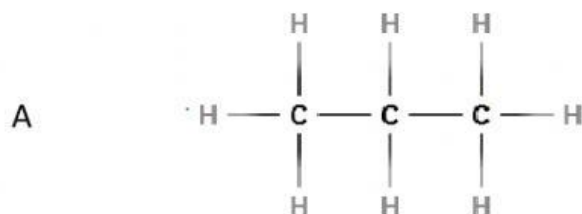


There is a larger surface area over which the forces can act

The longer the chain of carbons the

- ✓ stronger the IMF (Van der Waals, London)
- ✓ since it has a larger surface area

Example 1



1.1) Which molecule has the highest boiling point?

- C
- Since it has the largest surface area
- Thus the strongest intermolecular forces (Van der Waals, London)
- Thus requires the most energy to weaken the intermolecular forces

1.2) Which molecule has the lowest viscosity?

- A
- Since it has the largest surface area
- Thus the weakest intermolecular forces (Van der Waals, London)
- Thus it has the lowest resistance to flow.

1.3) Which molecule has the lowest vapour pressure?

- C
- Since it has the largest surface area
- Thus the strongest intermolecular forces (Van der Waals, London)
- Thus is least likely to be a vapour.

Question 2

A	Ethanol
B	Propan-1-ol
C	Butan-1-ol
D	Pentan-1-ol

State only the letter of the correct option:

2.1 Which compound has the highest boiling point?

A C

B D

2.2) Which compound has the lowest viscosity?

A C

B D

2.3 Which compound has the highest vapour pressure?

A C

B D