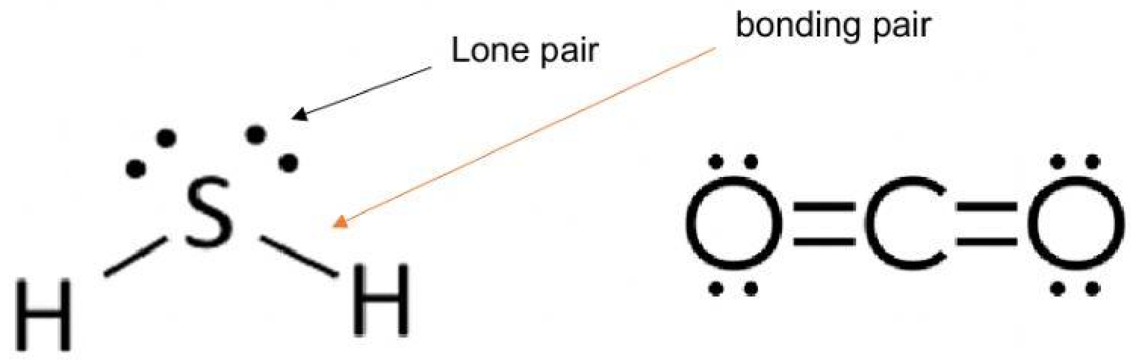
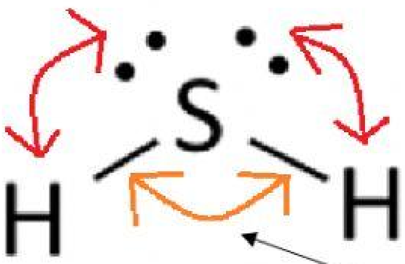
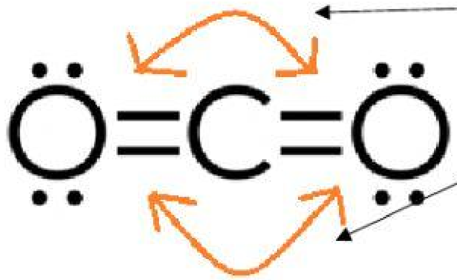
Compare the examples of CO_2 and H_2S





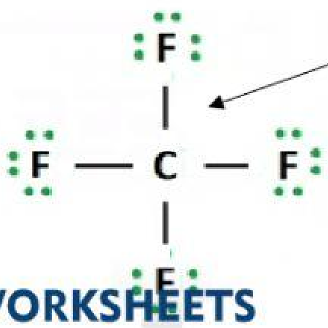
All electrons have a negative charge and thus repel each other. But lone pairs repel bonding pairs with a greater force than bonding pairs repel other bonding pairs.

This forces the Hydrogens down and causes this angle to be smaller



Equal strength of bonding pair-bonding pair repulsion

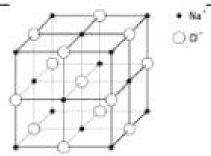
Another example: CF_4

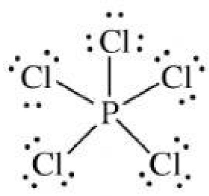
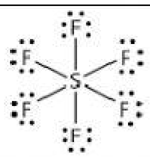


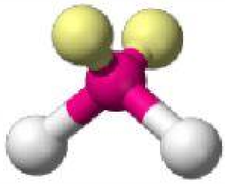
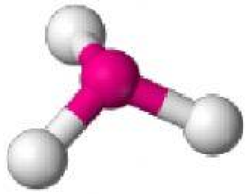
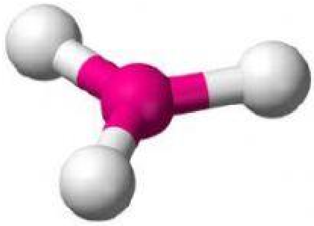
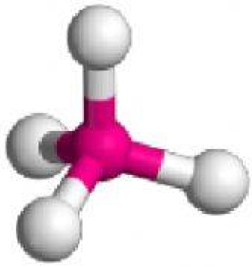
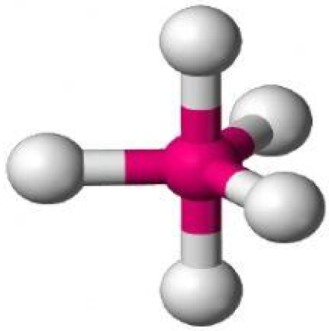
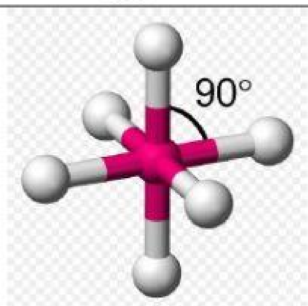
There are no lone pairs

Thus the force of repulsion is equal everywhere and the angle between all the bonding pairs will be equal.

Summary of common shapes: Complete the following

Chemical formula	Shape	Couper structure	Bond polarity	Molecular polarity
H_2		H-H		
O_2		O=O		
F_2		F-F		
N_2		N≡N		
HCl		H-Cl		
Cl_2		Cl-Cl		
HF		H-F		
NaCl (just to throw in an interesting ionic one)			not applicable	not applicable
CO		C≡O		
CO_2		O=C=O		
CHN		H-C-N	For H-C bond: For C-N bond:	
H_2O		H H \ / O		
H_2S		H H \ / S		
SO_2		O O \\ // S		

OF_2		F F \ / O		
HOCl		H Cl \ / O	For H-O bond: For O-Cl bond:	
NH_3		H I H-N-H		
BF_3		F I F-B-F		
CCl_4		Cl I Cl-C-Cl I Cl		
CH_3F		H I H-C- F I H	For C-H bond: For C-F bond:	
PCl5				
SF6				

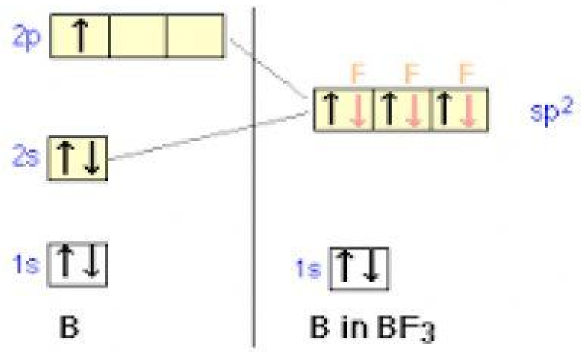
Shape Key:	
Name:	3D molecular shape:
Linear	
Bent/angular (with lone pairs in yellow)	
Trigonal Pyramidal	
Trigonal planar	
Tetrahedral	
Trigonal bipyramidal	
Octahedral	

Orbital hybridisation

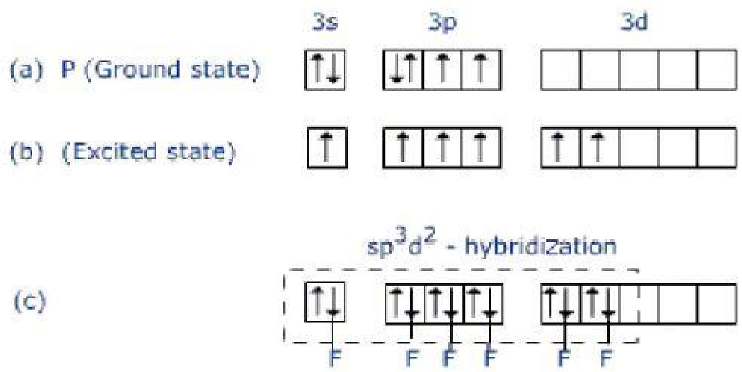
Why does BF3 look the way it does? Why does it not follow the octet rule.

Why does it only have 6 valence electrons after bonding with F?

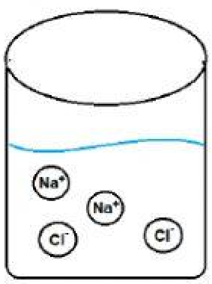
Orbital hybridisation explains this. The 2s and 2p orbitals overlap and join.



Orbital hybridisation also occurs in PCl_5, but it involves the s,p,d and f orbitals



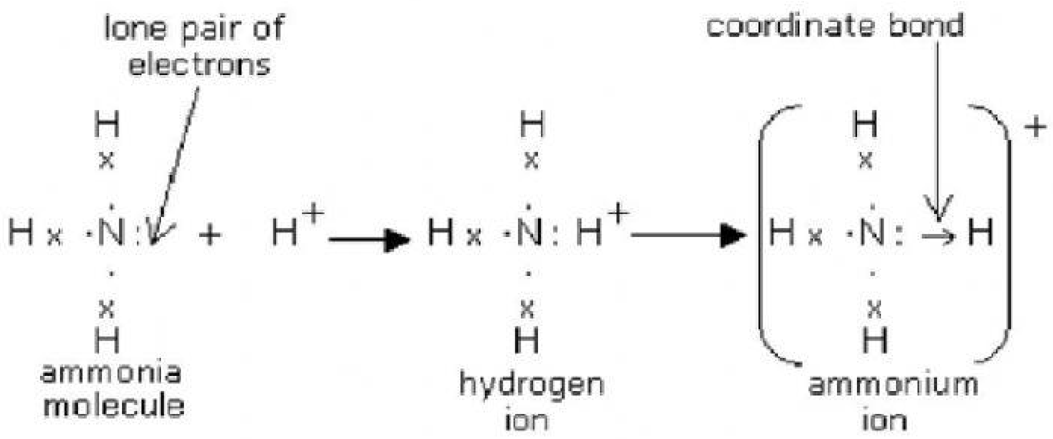
<u>Complete the following table for the type of intermolecular forces :</u>

Molecule	Type of intermolecular force Choose between the following: **London** **Dipole-dipole** **Dipole induced-dipole** **Hydrogen** **Ion-dipole** **Ion-induced dipole** **(type the above terms exactly as they appear here)**
Between H_2S molecules	
CH_4 molecules	
Between H_2S and N_2	
He atoms	
NH_3	
H_2O_2	
Mg^{+2} and H_2O	
Na^+ and N_2	
BF_3	
NaCl and H_2O *remember ionic substances break up in polar solvents So essentially it is asking for Na^+ or Cl^- in water 	
HF molecules	
HCl	

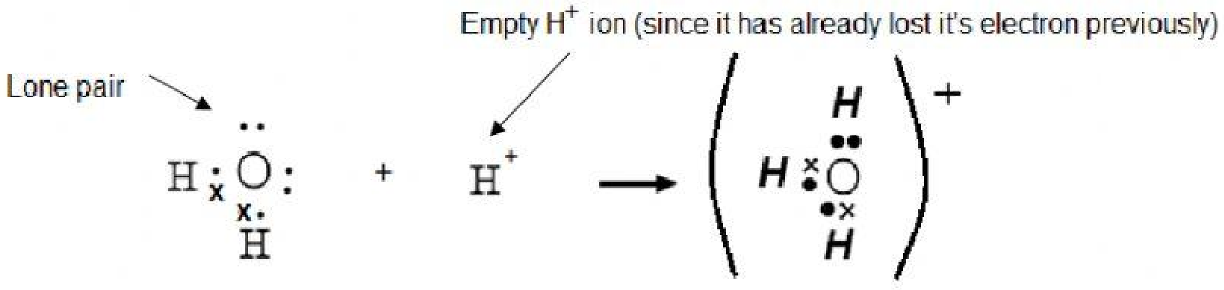
Coordinate covalent bonds/dative covalent bonds

If atoms in compounds do not have 8 electrons around them in the valence shell then they can share a lone pair of electrons with another atom to form a coordinate covalent bond. A coordinate bond is shown by an arrow.

Showing the formation of NH_4^{+1}



Showing the formation of H_3O^+

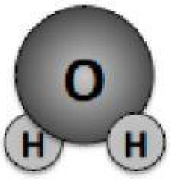


The chemistry of water

Water behaves in a very unique way compared to other substances

AMAZING WATER MOLECULE

- Non-symmetrical polar molecule.



- Intramolecular covalently bonds.
- Bent/angular molecular shape.
- Contains hydrogen bonding between molecules. These strong IMF need a large amount of energy to overcome.
- Water vapour acts as a greenhouse gas by absorbing the sun's radiation.
- The ocean acts as a heat reservoir and regulates the temperature of earth.

PROPERTIES OF WATER

Specific heat capacity

The amount of energy needed to raise the temperature of 1 kg of water by 1 °C. Water has a high specific heat capacity.

A high heat capacity requires more energy for the temperature to change. This helps with heat regulation on the earth.

Melting and boiling points

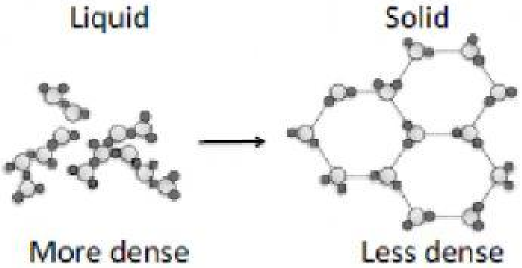
Strong hydrogen bonding IMF's require large amounts of energy to overcome intermolecular forces.

Melting point: 0 °C

Boiling point: 100 °C at atmospheric pressure.

Density

As water freezes the molecules orientate themselves so that the volume expand and the density decreases. Ice forms a crystal lattice.



Decrease in density of ice helps regulate the temperature of the earth and the climate.

Ice floats on water forming an insulating layer between water and the atmosphere keeping the water from freezing and preserving aquatic life.

The above summary is from Science clinic gr 11 2016 notes

Watch this video on IMF strength and boiling point of substances before starting the next section

Whenever a question asks you to compare the boiling point, melting point, viscosity and vapour pressure of substance, what they are really asking if for you to compare the IMF strenght first.

Definitions

Boiling point: The temperature at which the vapour pressure of a substance equals atmospheric pressure.

Melting point: The temperature at which the solid and liquid phases of a substance are a equilibrium.

Vapour pressure: The pressure exerted by a vapour at equilibrium with its liquid in a clos system.

Viscosity is the resistance to flow of a liquid
{Honey is very viscous whereas water has a low viscosity)

Relationship between strength of IMF and

- **boiling**
- **melting point**
- **viscosity**
- **vapour pressure**

✓ The stronger the IMF is the higher the melting and boiling point

✓ The stronger the IMF is the lower the vapour pressure (because substance is less likely to be a vapour)

✓ The stronger the IMF is the higher the viscosity (the thicker the substance is)

Relationship between molecular or molar maass and

- **boiling**
- **melting point**
- **viscosity**
- **vapour pressure**

✓ The **larger** the molecule the stronger the intermolecular van der Waals forces holding the molecules together, the more energy is needed to break those forces and for the substance to boil.Thus higher melting and boiling points

✓ The larger the molecule the stronger the IMF the higher the viscosity

✓ The larger the molecule the stronger the IMF the lower the