IMF and gases worksheet 1

(To be completed after research project)

You have already covered the basics of IMF and gases in your research project

The aim of this worksheet is to reinforce the basics, build on that foundation and to look at the more complex questions in this section

To stay on track: The IMF worksheets should take you one week to complete.

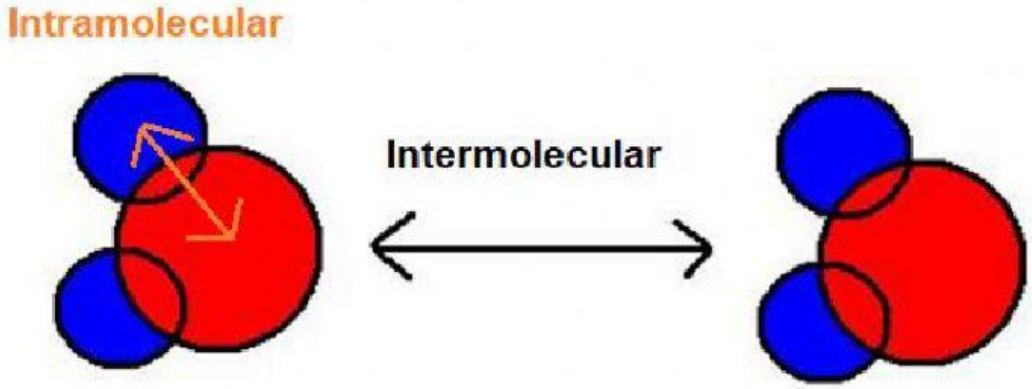
At the end of the week the memo's to the exam question given on the last worksheet will be sent.

Bonding	
Chemical bond	a mutual attraction between two atoms resulting from the simultaneous attraction between their nuclei and the outer electrons.
Covalent bond	The sharing of electrons between two atoms to form a molecule.
Bonding pair	a pair of electrons that is shared between two atoms in a covalent bond.
Lone pair	a pair of electrons in the valence shell of an atom that is not shared with another atom.
Electronegativity	a measure of the tendency of an atom in a molecule to attract bonding pair of electrons.
Bond length	average distance between the nuclei of two bonded atoms.
Bond energy	the energy needed to break one mole of its molecules into separate atoms.
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 at equilibrium.
Vapour pressure	the pressure exerted by a vapour at equilibrium with its liquid in a closed system
Solubility	the property of a solid, liquid or gaseous chemical substance (solute) to dissolve in a solid, liquid or gaseous solvent to form a homogeneous solution.

LIVEWORKSHEETS

Intramolecular bonds

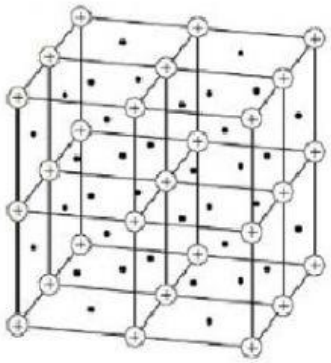
Intramolecular forces are strong forces between atoms that hold the atoms in molecules together. They act over very short distances. They are also called interatomic forces or chemical bonds



Ionic bonding:
Occurs between a metal and a non-metal. The metal gives off electrons (becomes a positive ion, cation) and the non-metal gains electrons (becomes a negatively charged ion, anion). The cations and anions then pack together in a **crystal lattice**. Ionic or coulombic forces hold these molecules together and these forces are strong, thus ionic compounds have high melting and boiling points.

e.g 1) $Na + 2\,Cl \rightarrow Na^{+1}\ [Cl]^{-1}$

e.g 2) $Al + 3\,F \rightarrow Al^{+3}\ 3\,[F]^{-1}$



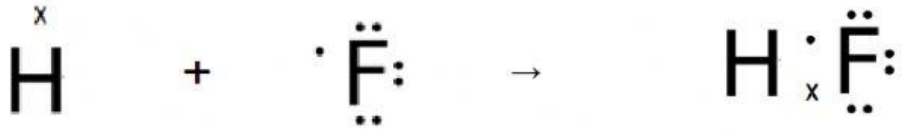
A lewis structure is a representation of a covalent bond in which the shared electron pairs are shown as pairs of dots or crosses between two atoms.
Only **valence electrons** are shown in lewis structures.
The **valence electrons on each atom is equal to the group no**
Eg H – group 1 only has one valence electron
C – group 4 only has 4 valence electrons

LIVEWORKSHEETS

Covalent bonding

Occurs between 2 non-metals and involves a sharing of electrons. Simple covalent molecules have low melting and boiling points.

e.g 1)

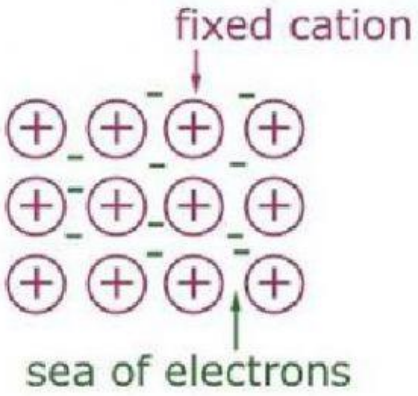


2)

3)

Metallic bonding:

Atoms of metals are closely packed in a crystal lattice. As a result of the close packing the valence orbitals of adjacent atoms overlap. The valence electrons then become delocalised, and they do not belong to a particular atom anymore. They form a 'sea' of delocalised electrons. The atoms which lose these electrons in effect gain a positive charge. They are called positive atomic kernels. The bonding forces is coulombic or electrostatic in nature, due to the negative electrons and positive kernels.



LIVEWORKSHEETS

State the type of **intramolecular bonds** in the following

Use only the following words (ionic, covalent or metallic)

Molecule	Type of **intra**molecular force
NaCl	
Cu	
CO_2	
NH_3	
Cu	
Al_2O_3	
Mg	
PCl_5	
H_2O	
N_2	
MgO	

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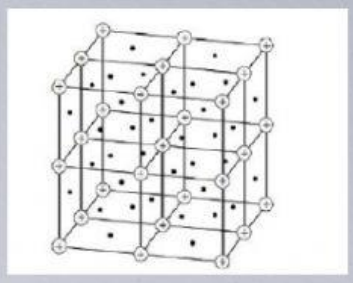
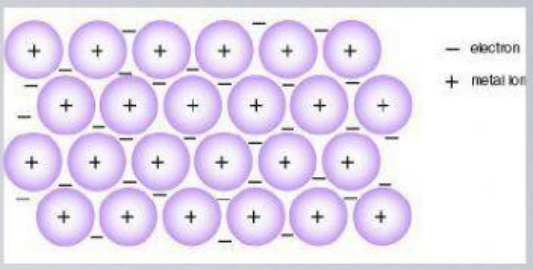
The metallic and ionic intramolecular forces are quite simple

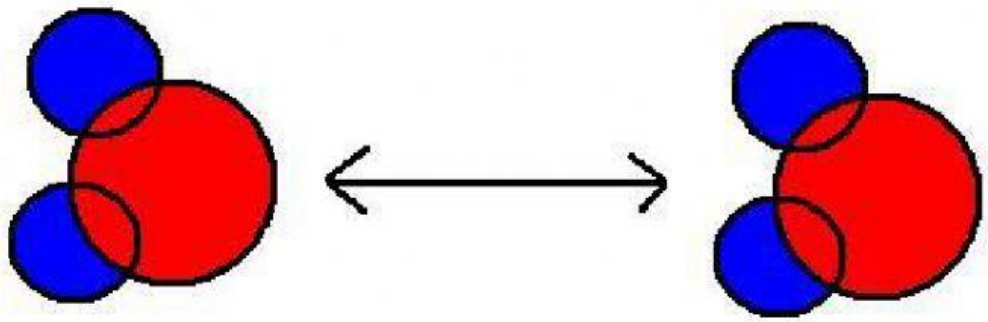
Type of intramolecular bond	Shape	Type of intermolecular force
Ionic	Crystal lattice 	Ionic or Coulombic
Metallic	Layers of positive atomic kernels and delocalised electrons 	Ionic or Coulombic
Covalent	Depends on the molecule	Depends on the molecule

Thus covalent molecules have the more complicated shapes and intermolecular forces

LIVEWORKSHEETS

Intermolecular Forces

Intermolecular forces are forces of attractions between molecules



In solids

The intermolecular forces are strong
The particles have very little KE

Small spaces between particles (vibrate in fixed positions)

In liquids

The intermolecular forces are weaker than between solid molecules but stronger than between gas molecules

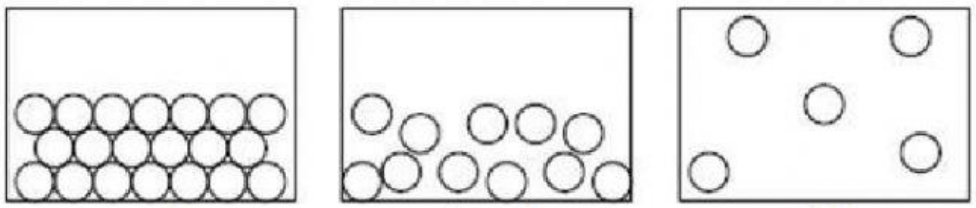
The particles have less KE than in gases but hight KE than solid particles

Spaces are larger than between solid particles, but smaller than between gas particles

In gases

The intermolecular forces are very
weak The particles have very high KE

Spaces are very big between gas particles



LIVEWORKSHEETS

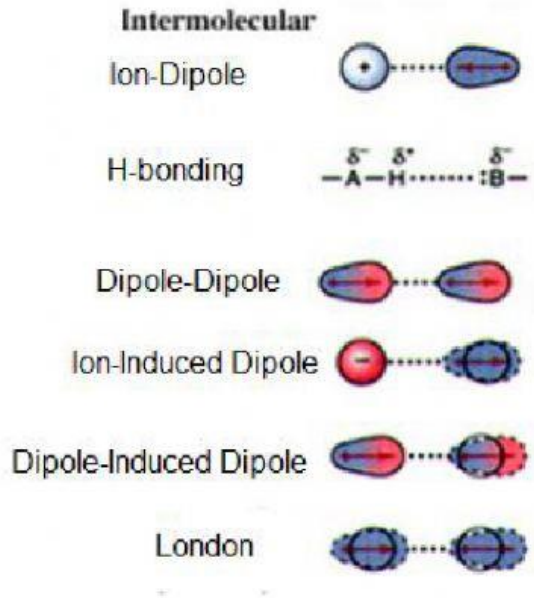
The types of intermolecular forces are:

- Dipole – Dipole
- Induced-dipole also called london
- Dipole – Induced dipole

} Van der Waals' Forces

- Ion – Dipole
- Ion – Induced dipole
- Hydrogen bond (special strong type of dipole – dipole)

Strength of forces decreases



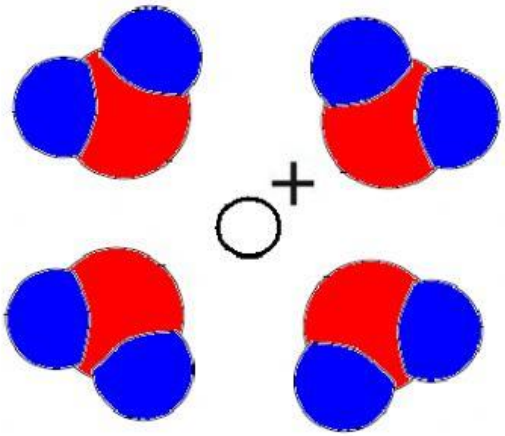
LIVEWORKSHEETS

Ion dipole forces

Occur between an ion (charged atom, with either a positive or negative charge) and a polar molecule or atom.

Example - NaCl dissolves in water because:

- Na^+ is attracted to the slightly negative oxygen atom in H_2O
- Cl^- is attracted to the slightly positive hydrogen atom in H_2O
- The intermolecular forces weaken the ionic bonds between the sodium and chlorine ions

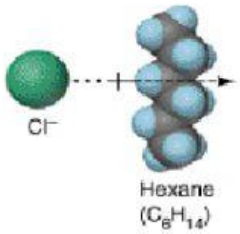


This force usually occurs when an ionic substance is dissolved in a polar solvent

Ion induced dipole forces

Occur between an **ion (charged atom) and a non-polar molecule or atom**
The ion induces (forces) a dipole in the non polar molecule causing a weak short lived force holding the compound together.

Example - force between Cl^- and non-polar hexane. The negative hexane induces a weak dipole in the non-polar hexane



This force occurs when an ionic substance in mixed with a non-polar solvent

LIVEWORKSHEETS

There are 3 types of Van der Waals forces:

- Dipole – Dipole (relatively strong)
- Dipole – Induced dipole (weaker force)
- Induced dipole / London (weakest)

Decreasing strength

Dipole dipole forces

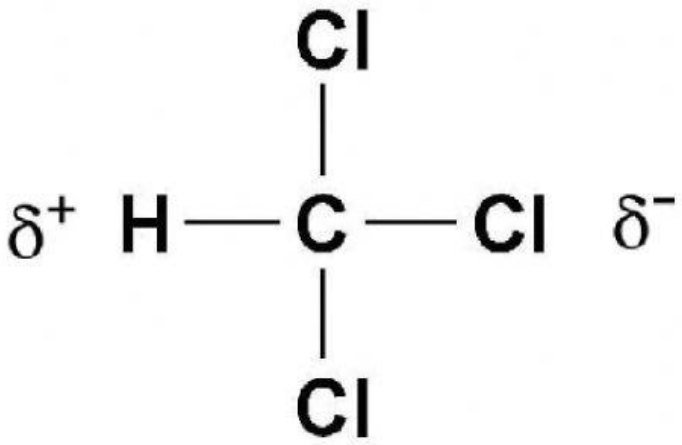
Occur when **two polar or dipole molecules** come into contact.
The negative side of the molecule attracts the positive side of the adjacent molecule

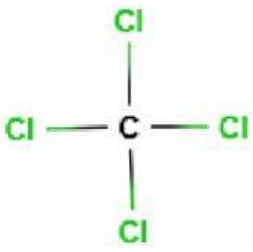
Example - force between Cl^- and non-polar hexane. The negative hexane induces a weak dipole in the non-polar hexane

Other examples:
$CHCl_3$ (chloroform)
SO

Dipole induced dipole forces

Occur when polar molecules come into contact with a non polar molecule.
The polar molecule will induce a dipole in the non-polar molecule, because the electrons shift
Example - Chloroform in Carbon Tetrachloride





Other examples:
Argon in HCl

LIVEWORKSHEETS