ELEMENTS AND CHEMICAL BONDING

An element is a substance which is made up of one kind of an atom only.

STRUCTURE OF AN ATOM

An atom is a smallest unit/particle of a substance.

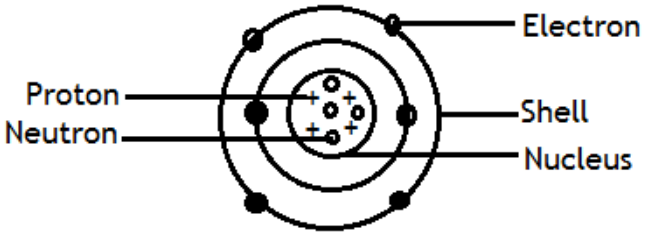
It consists of protons, neutrons and electrons.

Protons and neutrons are found in the central part of an atom called Nucleus.

Electrons revolve around the nucleus of an atom in orbits called **shells or energy levels**.

Electrons are negatively charged while protons are positively charged and neutrons have a charge of zero.

Below is a diagram showing the structure of an atom (atomic structure).



Structure of an atom

In a neutral atom, the number of protons is always equal to the number of electrons.

Atomic number: This is the number of protons in an atom.

Mass number : Is the number of protons plus neutrons is an atom.

Electrons are not included when calculating mass number because they don't have mass.

The atomic number is always equal to the number of electrons in order to make an atom neutral.

ELECTRON CONFIGURATION

Electron configuration is the number and arrangement of electrons in shells of an atom.

The periodic table of the first 20 elements uses the following format in electron configuration.

Number of shell	*Number of maximum electrons to be filled*
1	2
2	8
3	8
4	18

GUIDELINES FOR FILLING ELECTRONS IN SHELLS OF ATOMS

1. The lowest energy level (closest to the nucleus) must be filled first and it contains a maximum of two electrons.
2. Each shell is filled with a particular maximum number of electrons as seen from the above.
3. The shells are filled one after another. Some shells are completely filled while others are partly filled.

THE PERIODIC TABLE

A periodic table is a chart in which elements are arranged according to their atomic number.

PERIODICITY : Is the arrangement of elements in the chart using their atomic number.

PERIODS : These are horizontal rows of elements in the periodic table.

The number of periods indicates the number of energy levels/shells in an atom.

GROUPS : These are the vertical columns of elements in the periodic table. The number of groups is equal to the number of electrons in outmost shell [valence shell] of an atom.

VALENCE ELECTRONS: Electrons in the outmost shells.

VALENCE SHELL : Outmost shell.

Below is a periodic table of the first 20 elements:

I	II	III	IV	V	VI	VII	VIII
$^{1}_{1}H$							$_{2}He$
$_{3}Li$	$_{4}Be$	$_{5}B$	$_{6}C$	$_{7}N$	$_{8}O$	$_{9}F$	$_{10}Ne$
$_{11}Na$	$_{12}Mg$	$_{13}Al$	$_{14}Si$	$_{15}P$	$_{16}S$	$_{17}Cl$	$_{18}Ar$
$_{19}K$	$_{20}Ca$						

Table: **First 20 elements of the periodic table.**

NAME	NAME

Hydrogen (H)	Oxygen (O)
Helium (He)	Fluorine (F)
Lithium (Li)	Neon (Ne)
Beryllium (Be)	Sodium (Na)
Boron (B)	Magnesium (Mg)
Carbon (C)	Aluminium (Al)
Nitrogen (N)	Silicon (Si)
Phosphorus (P)	Sulphur (S)
Chlorine (Cl)	Argon (Ar)
Potassium (K)	Calcium (Ca)

TRENDS IN THE PERIODIC TABLE

Atomic radius increases with increase in energy levels.

ATOMIC RADIUS: This is the distance from the centre of the nucleus to the outmost shell.

Elements in groups 1-3 are metals.

Metalloids are elements that exist as metals or non-metals e.g. Boron, Carbon and Silicon.

Groups 5 - 8 are non-metals.

As you go down the group, the atomic radius increases and the number of shells increase.

Similarly, melting and boiling points increase because intermolecular forces increase too.

ELEMENTS IN THE SAME GROUP HAVE;

1. The same number of electrons in the outmost shell.

2. Similar chemical properties.

3. Related melting and boiling points.

4. Similar electron configuration.

GROUP ONE ELEMENTS (ALKALI METALS)

Group 1 elements are called alkali metals because when they react with water, they produce a basic solution and hydrogen gas.

Example of alkali metals are; hydrogen, lithium, sodium, potassium and rubidium.

These are the most reactive metals in the periodic table.

PHYSICAL PROPERTIES OF ALKALI METALS

1. They are soft metals.

2. They are easily cut by a knife.

3. They have low density.

4. They are good conductor of heat and electricity.

5. They are malleable; i.e. can be hammered into any shape.

6. They are ductile i.e. can be easily be drawn into wires.

7. They are shiny when freshly cut.

CHEMICAL PROPERTIES OF ALKALI METALS

1. They react with water to produce a basic solution and hydrogen gas.

$2Na(s) + 2\ H_2O(l) \rightarrow 2NaOH(l) + H_2(g)$

2. They react with oxygen to produce a white solid oxide.

$4Li(s) + O_2(g) \rightarrow 2LiO(s)$ (Lithium oxide)

3. They react with chlorine to produce a white solid.

$2Na\ (s)\ Cl_2\ (g) \rightarrow 2NaCl$ (Sodium Chloride)

As you go down the group 1, atomic radius increases. The number of shells increases hence valence electron experience less attractive force by the nucleus. Therefore;

a) Metals become softer.

b) Melting and boiling points decreases.

c) Burn more easily in air.

d) Density of the metals decreases.

e) React faster with chlorine.

Electron Configuration of Group 1 Elements:

Hydrogen	H (1)
Lithium	Li (2,1)
Sodium	Na (2,8,1)
Potassium	K (2,8,8,1)

GROUP SEVEN ELEMENTS (THE HALOGENS)

Halogens are poisonous non-metals.

They are made up of diatomic molecules e.g.; Fluorine, Chlorine, Bromine, Iodine.

The electron configuration of halogens is

Fluorine	Fl (2,7)
Chlorine	Cl (2,8,7)
Bromine	Br (2,8,18,7)
Iodine	I (2,8,18,18,7)

PHYSICAL PROPERTIES OF HALOGENS

1. They have a pungent smell.

2. They are slightly soluble in water.

3. They have varying colours e.g.

Fluorine (very pale yellow gas)

Chlorine (yellowish green gas)

Bromine (reddish brown liquid)

Iodine (blue-black shiny solid)

4. They exist as diatomic molecules e.g F_2, Cl_2, Br_2.

5. Since they are non-metals, they have low melting and boiling points.

6. Some halogens are gases (Fluorine and Chlorine) and others are either liquids (Bromine) or solids (Iodine).

The boiling and melting points of halogens increase as we go down the group. This is so because the sizes of the molecules increase as you go down the group. This in turn causes larger attraction forces (intermolecular forces) holding the molecules to increase, hence the need for larger heat and higher temperatures to separate the molecules.

Reactivity decreases as you go down the group 7. As the atomic radius increases the reactivity of the elements decreases because the incoming electron is less attracted to the nucleus.

Halogens are the most-reactive non-metals in the periodic table because each element requires a single electron to reach stability.

CHEMICAL PROPERTIES OF HALOGENS

1. They react with hydrogen to produce hydrogen halides, which dissolves in water to form acidic solution.

e.g. $H_2 + Cl_2 \rightarrow 2HCl$

2. They react with metals to produce ionic metal halides.

e.g. $2Fe + 3Cl_2 \rightarrow 2FeCl_3$

3. React with phosphorus to produce covalent phosphorus pentahalide.

e.g. $2P\ (s) + 5Cl_2(g) \rightarrow 2PCl_5(s)$ Phosphorus pentachloride.

HALOGEN DISPLACEMENT REACTIONS

Halogen displacement reaction is the reaction where one halogen displaces another in the solution.

The halogen displacing the other is in a neutral state (gas/liquid) while the one being displaced is in the form of ions (in aqueous state).

The halogen displacing the other gains an electron and becomes an ion while the one being displaced loses an electron and it becomes neutral.

The halogens at the top can displace the one below it and the opposite is impossible. Thus, fluorine can displace chlorine, chlorine can displace bromine and bromine can displace iodine. But bromine can not displace chlorine.

The following are equations of halogen displacement reactions:

i) $F_2(g)$ + $2Cl^-(aq) \rightarrow$ $2F^-$ + Cl_2 (g)

ii) Cl_2 (g) + $2Br^-(aq) \rightarrow$ 2Cl- + Br_2 (l)

USES OF HALOGENS

1) Fluorine

a) It is used in the form of fluorides in tooth paste because it reduces tooth decay by hardening the enamel.

b) It is used to separate isotopes of uranium.

c) It is used to make polytetraflouroethene (PTFE) which is used to manufacture plastic utensils and electrical insulators.

2) Chlorine

a) It is added to water in order to kill germs (as disinfectant)

b) In the human body, a chlorine ion (Cl^-) is an essential ion in extracellular and intracellular fluid.

c) Sodium hypochlorite is used in family household laundry as a bleaching agent for clothes.

d) It is used in the making of pesticides.

e) It is used in making of weed killer (herbicides) chemicals in agriculture.

f) It is used in the making of plastics such as PVC (poly vinyl chloride)

3) Bromine

a) It is used to make fuel additives, dyes and pesticides.

b) Combine with silver to form silver bromine (AgBr) which is used in the photographic film.

4) Iodine

a) It is used to make drugs (i.e. hospital drugs)

b) It is used to make dyes and printing ink.

c) It is used in making animal feeds (salts)

d) An iodine solution in ethanol is used to treat wounds.

e) It is used in the body for proper functioning of thyroid gland to prevent goitre.

GROUP EIGHT ELEMENTS (THE NOBLE GASES)

These are also known as noble gases.

These are Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe) and Radon (Ra).

They are non reactive, because their outmost shell have full electrons.

They can not lose or gain electrons.

Electron configuration of group 8 elements;

Helium (2)

Neon (2, 8)

Argon (2, 8, 18)

Inert gases have weak intermolecular forces therefore they have very low melting and boiling points.

The larger the molecule, the greater the IMF. This gives increases in Melting and Boiling points down the group.

USES OF NOBLE GASES

1 Argon is used

a. To fill ordinary and long life bulbs to prevent the tungsten from reacting with oxygen in the air and forming an oxide.

b. To provide an inert atmosphere in the arc welding and in the production of titanium metal

2 Neon is used

a. In the advertisement signs because it glows red when electricity is passing through it.

b. In the helium – neon gas laser used in the eye surgery

c. In Geiger Muller tubes which are used for the detection of radioactivity.

3 Helium is used

a. To provide an inert atmosphere in the arc welding

b. As coolant in the nuclear reactor

c. With 20% oxygen as breathing gas used by deep sea divers.

d. To inflate the tyres of large aircrafts.

e. In the helium – neon laser

f. To fill ship and weather balloons.

CHEMICAL BONDING

Chemical bonding is the joining of two or more atoms together.

Chemical bonding happens by gaining or losing electrons as well as sharing electrons.

REASONS FOR CHEMICAL BONDING

a) To attain a state of stability.

b) To experience a state of greater attractive forces.

c) To attain lower potential energy.

LOCALISED : Refers to an object that is unstable, has higher potential energy and experiences less attractive forces.

DELOCALISED : Refers to an object that is stable, has low potential energy and experiences more attractive forces.

TYPES OF CHEMICAL BONDING

There are three types of chemical bonding:

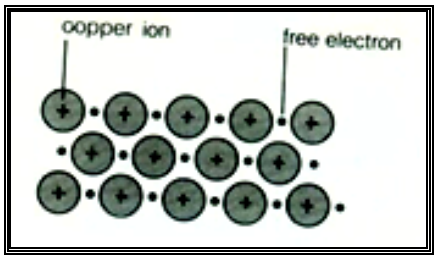
a) Metallic bonding

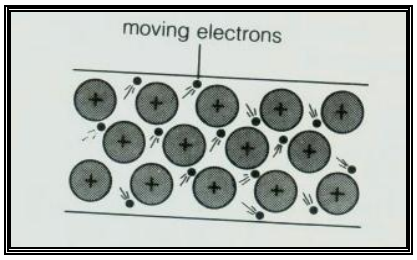
b) Ionic bonding

c) Covalent bonding.

1) METALLIC BONDING

A metallic bond is the bond formed by the attraction between fixed metal ions in a piece of metal and the electrons that move around them.





In a gaseous state, metal atoms are far apart. The atoms move randomly at high speed. Each atom keeps its valence electrons held in position in the valence shells. They are said to be localized.

Upon cooling to form solid, the metal atoms come together forming bonding thereby making a wire. Metal atoms take up fixed positions in the solid state. The valence electrons are set free fro valence shells of each atom. The electrons are able to move freely and are delocalized.

In the gas, a single localized electron in its shell experiences the single attraction of its own nucleus. Finally in the solid state, an electron feels three attractions from nearby nuclei, plus weaker attractions from other nuclei further away. These attractions make up the metallic bond.

PHYSICAL PROPERTIES OF METALS

a) Metals are shiny. They are used in the making of jewelry and ornaments e.g. silver and gold.

b) They are good conductors of heat and electricity. Thus used for electrical wires e.g. copper.

c) Metals are hard wearing. They are used for bridge structures e.g. steel. They are also used in making cutting materials e.g. knife.

d) They are strong.

e) They are insoluble in water.

f) They are sonorous. They produce a ringing sound.

g) Metals are ductile (easily changed to wires). Thus are used in making electric wires, fences.

h) They are malleable (easily hammered). They can be used to make hoes, axes and pots.

i) They have high density.

j) Metals have high melting and boiling points. Thus used for cooking utensils.

The intermolecular force in metals is very strong.

CHEMICAL PROPERTIES OF METALS

a) Metals react with oxygen to form metals oxides.

e.g. $2Zn(s) + O_2(g) \rightarrow 2ZnO(s)$ (Zinc oxide)

b) Metal oxides react with acids to form salts.

e.g. $ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

Some metals are;

i) Liquids at room temperature (25°C) e.g. mercury.

ii) Magnetic e.g. Iron.

iii) Soft e.g. alkali metals.

2) IONIC OR ELECTRO-VALENT BONDING

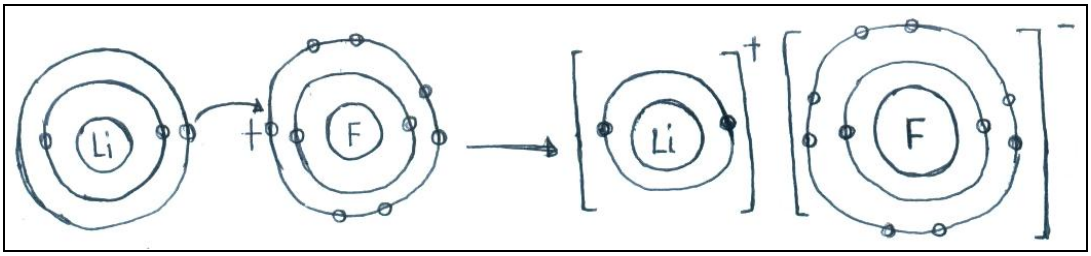
These are bonds that are formed when atoms lose or gain electrons.

The ionic bonds form between metals and non metals.

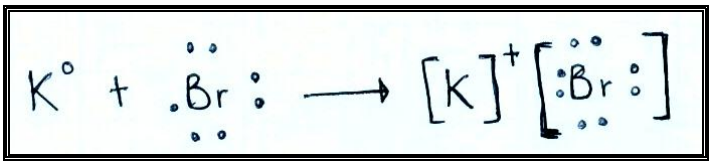
Metals lose electrons while nonmetals gain the electrons thereby forming bonds.

EXAMPLE:

$2Li\ (s) + F_2(g) \rightarrow 2LiF$ (Lithium Fluoride)



K + Br → KBr



CATION: Is a positively charges ion e.g. Ca^{2+}

ANIONS : Is a negatively charges ion e.g. Cl^-.

Metals lose electrons to become cations.

Non metals gain electrons and become anions.

Metals	Cation	Non-metals	Anion
Li	Li^+	F	F^-
Na	Na^+	Cl	Cl^-
Be	$Be2^+$	Br	Br^-
Mg	$Mg2^+$	O	$O2^-$

PROPERTIES OF IONIC COMPOUNDS

1) They are made up ions and not atoms neither molecules.

2) When melted (fused) they conduct electricity.

3) They have strong intermolecular force.

4) They have high boiling and melting points.

5) They are hard brittle solids at room temperature.

6) They are soluble in water.

7) They are good electrolyte (conduct electricity by means of ions in liquid state).

ELECTROLYTE

It is the substance that conduct electricity by means of ions in the liquid state

TYPES OF THE ELECTROLYTES

1. **STRONG ELECTROLYTE**

   It is a liquid that allows large electric current to pass through the conductivity circuit. A strong electrolyte ionize completely

   For example $HCl + H_2O \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$

   Ionize means changing to positive or negative ions

2. **WEAK ELECTROLYTE**

   Is the liquid that allows a small current to pass through conductivity circuit. It ionizes partially. Partial ionization is shown by double arrows, meaning that not all the substance is changing to ions or vice versa

   For example $AgCl_{(s)} + H_2O \leftrightarrow Ag^+_{(aq)} + Cl^-_{(aq)}$

   $H_2O_{(l)} \leftrightarrow H^+_{(aq)} + OH^-_{(aq)}$

3. **NON – ELECROLYTE**

   It is the liquid that does not allows current to pass through the conductivity circuit. It does not ionize.

   For example paraffin and sulphur

   CONDUCTIVITY means the ability of a substance to allow the flow of current.

   The diagram below shows the conductivity circuit

An ammeter is used to show that the current is flowing in the circuit.

An anode is the positive charge electrode

A Cathode is the negative charge electrode

Voltmeter is the container for electrolyte

Therefore Electrolysis is the process in which substance conduct electricity by ions in liquid state.

USES OF CONDUCTIVITY CIRCIUT

1. Act as apparatus for electrolysis
2. To find the kind of electrolyte in the beaker
3. To show that current flow in all parts of the circuit.

VALENCE is the combining of ions or atoms

The size of charge of an ion is the measure of all its valence or combing power.

VALENCE ELECTRONS is the number of electrons found in the outermost shell of an atom

CATION is the positive charge ion, for example Ca^{2+}

ANION is the negative charge ion, for example Cl^{-}

Metals lose electron to become ions

The charge and valence of metals is equal to the number of valence electrons.

Example

Metals	**Valence electrons**	**valence**	**charge**	**cation**	**name**
Li	1	1	+1	Li^{+}	Lithium
Mg	2	2	+2	Mg^{+}	Magnesium

The charge and valence nonmetals is equal to the difference between valence electrons and inert gas configuration.

Nonmetals form ions by gaining electrons.

Examples

Nonmetal	**valence electrons**	**valence**	**charge**	**anion**	**name**
F	7	1	-1	F^{-}	Fluorine
O	6	2	-2	O^{-}	Oxygen

3) COVALENT BONDING

Covalent bonding is the sharing of valence electrons between atoms.

In most cases, these bonds are formed between non-metals, metalloids or both.

In this case, each atom involved donates an electron which is shared between them.

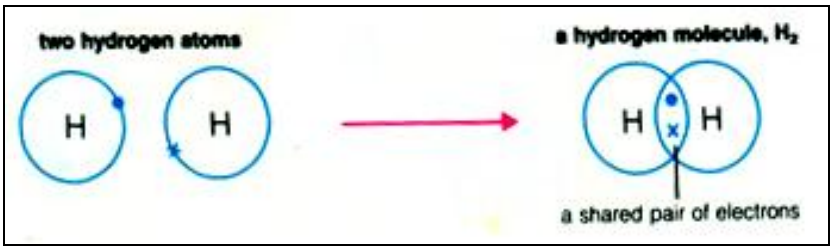
A pair of electrons forms one covalent bond.

A) Single covalent bonding

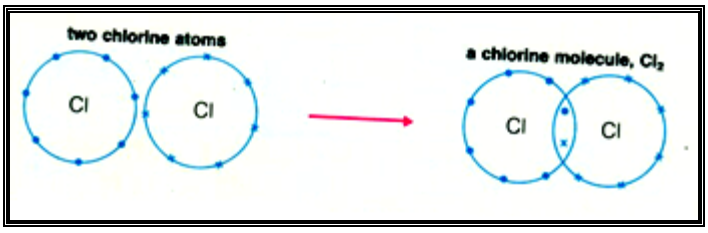
This is where there is only one covalent bond.

Examples:

i) Hydrogen gas (H_2)



ii) Chlorine gas (Cl_2)

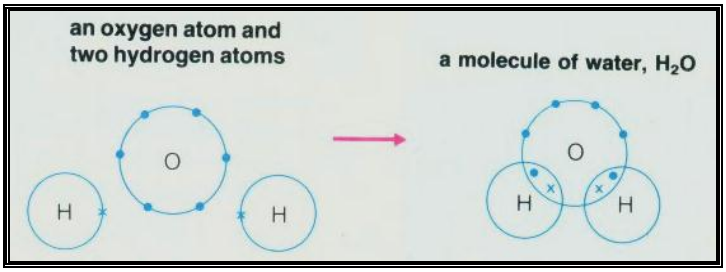


B) Double covalent bonding

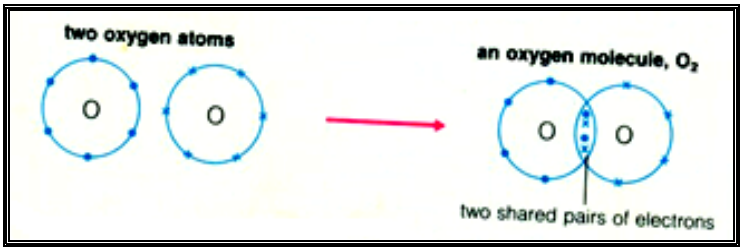
This is where you have two covalent bonds.

Example:

i) Water molecule bonding. (H_2O)



ii) Oxygen molecule (O_2)

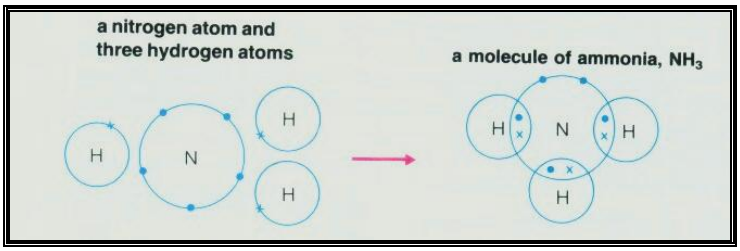


C) Triple covalent bonding

This is where you have three covalent bonds.

Example:

i) Ammonia molecule (NH_3)

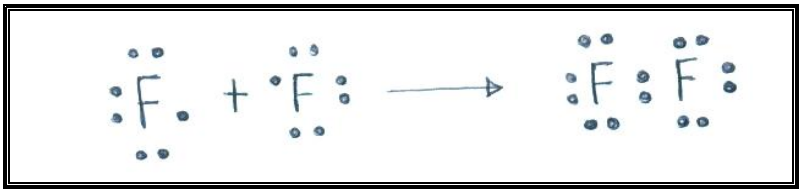


DOT AND CROSS DIAGRAMS FOR BONDS

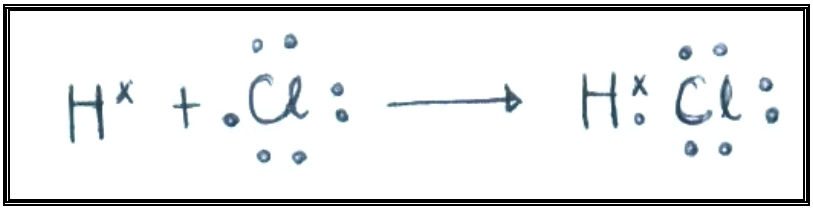
In dot and cross diagrams, only the outmost shell electrons are considered. If you are working with elements, either crosses or dots are used to dignify the bonding while as if working with compounds, both crosses and dots are used.

Examples:

i) Fluorine atoms bonding.



ii) Hydrogen chloride (Hydrochloric acid)



PROPERTIES OF COVALENT BONDING (MOLECULAR COMPOUNDS)

1. They have low intermolecular force.

2. They have low melting and boiling points.

3. They can be vapourized (volatile) and have a particular smell e.g. camphor.

4. They are non electrolyte.

5. They are insoluble in water.

6. They are made up of molecules and not ions.

DIFFERENCES BETWEEN IONIC COMPOUNDS AND COVALENT COMPOUNDS

IONIC COMPOUNDS	MOLECULAR COMPOUNDS
Generally soluble in water	Generally insoluble in water.
Have high melting and boiling points	Have low melting and boiling points
Conduct electricity in the molten or aqueous state	Does not conduct electricity in the molten or aqueous state
Insoluble in organic solvents	Soluble in organic solvents
Have strong intermolecular force	Have weak intermolecular force.
Bonded by electrical attraction between positively and negatively charged ions.	They are bonded by sharing of electrons

POLAR AND NON-POLAR COVALENT BONDS

Covalent bonds are further divided into polar and non-polar covalent bonds.

This happens due to the electronegativity of the atoms involved in the chemical bonding.

ELECTRONEGATIVITY: This is the ability of an atom to attract electrons towards itself in a chemical bond.

A) POLAR COVALENT BOND

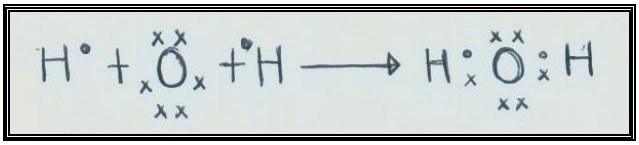
It is formed between two atoms which have combined where one element is more electronegative than the other.

The electron density favours the more electronegative element because the electrons spend more time in its vicinity.

This is popular in diatomic molecules that contain atoms of different elements.

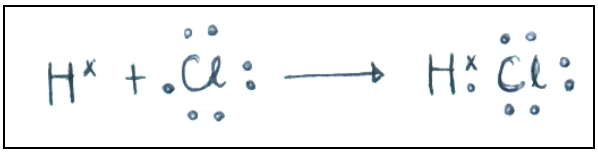
EXAMPLES:

i) Water molecule



- Oxygen is more electronegative than hydrogen.

ii) Hydrochloric acid



- Chlorine is more electronegative than hydrogen.

B) NON-POLAR COVALENT BOND

This is the bond formed between two atoms which have combined and have the same electronegativity.

The electron density is equally shared.

This is common in diatomic molecules that are made up of one type of atom.

H_2, O_2, F_2, N_2, Cl_2 etc

WORKING OUT FORMULAR OF COMPOUNDS GIVEN VALENCES

EXAMPLES:

1) Reaction between Sodium (Na) and Chlorine (Cl)

Na loses one electron in the outmost shell and it becomes Na^+ while Cl gains the electron from Na and it becomes Cl^-. So the formula of the compound becomes.

$Na^+ + Cl^- \rightarrow Na^+Cl^-$

$\rightarrow NaCl$

2) Reaction between Magnesium (Mg) and Oxygen atom (O)

Mg loses two electrons which make it to become Mg^{2+} whilst Oxygen atom gains the two electrons from Mg and becomes O^{2-}. The combination of the two atoms offers stability on the resulting ions that are then ionically bonded.

The half equations are;

$Mg - 2e \rightarrow Mg^{2+}$

$O + 2e \rightarrow O^{2-}$

The full equation is represented by;

$Mg^{2+} + O^{2-} \rightarrow Mg^{2+}O^{2-}$

$\rightarrow MgO$

3) Reaction between Aluminium (Al) and Oxygen (O)

Al loses three electrons which make it to become Al^{3+} but Oxygen is ready to to accept two electrons to make it O^{2-}. The resulting stable ions are bonded together ionically.

The half equations are;

$Al - 3e \rightarrow Al^{3+}$

$O + 2e \rightarrow O^{2-}$

The full equation is as follows;

$2Al^{3+} + O^{2-} \longrightarrow Al_2^{3+}O_3^{2-}$

$\longrightarrow Al_2O_3$

SULPHUR

Sulphur is an element which is yellow solid at room temperature. It is in Group 6 and period 3.

SOURCES OF SULPHUR

1. Sulphur is found as underground deposits that come out through volcanic eruption in countries like; Poland, Mexico and USA.
2. Found in petroleum gases as hydrogen sulphide (H_2S).
3. It is also found mixed with minerals on earth's crust. Its ores are iron pyrites (FeS_2), galena (lead sulphide) etc.

ALLOTROPES OF SULPHUR

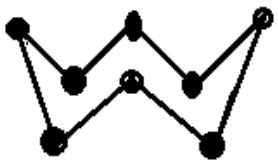
Allotropes are different forms in which the same element can be found.

Solid sulphur has two crystalline forms of allotropes namely.

a) Rhombic sulphur (α -sulphur).

d) Monoclinic sulphur (β -sulphur).

Both forms consist of sulphur-8 (S_8) molecules.



I) RHOMBIC SULPHUR

Rhombic sulphur is a yellow crystalline solid with an octahedral shape.

Crysals are formed when a solution of sulphur in methylbenzene is heated and allowed to cool below 96°C.

Rhombic sulphur is more stable due to the interlocking arrangement of sulphur rings.

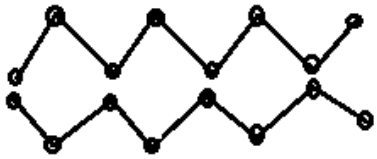
Because the rings are closely packed together, they pose stronger intermolecular forces.

II) MONOCLINIC SULPHUR

Monoclinic sulphur is a yellow crystalline solid with a long prism needle like shape.

Crystals are formed when a solution of sulphur in methylbenzene is heated and allows to cool above 96°C.

Monoclinic sulphur is less stable because its rings are loosely packed which makes them to have weaker intermolecular force.



PHYSICAL PROPERTIES OF SULPHUR

a) Sulphur is a yellow solid (non metallic)

b) It has a low melting point, such that 114°C for rhombic and 119°C for monoclinic.

c) It is insoluble in water

d) It is soluble in organic solvents like methylbenzene.

e) It is brittle (breaks when bent).

f) It does not conduct electricity.

CHEMICAL PROPERTIES OF SULPHUR

a) It reacts with oxygen to form sulphur dioxide.

$$S(s) + O_2 \rightarrow SO_2\ (g)$$

b) It reacts with metals to form sulphides, e.g. with iron to form Iron sulphide.

$$Fe(s) + S(s) \rightarrow FeS\ (s)$$

c) It reacts with sulphuric acid to form sulphur dioxide.

$$S(s) + 2H_2SO_4\ (aq) \rightarrow 3SO_2\ (g) + 2H_2O(aq)$$

USES OF SULPHUR

a) It is used to make sulphuric acid.

b) It is used in the making of matches and gun powder.

c) Used in vulcanization (hardening) of rubber.

d) Used in making insecticides, germicides and fungicides.

e) Used in the making fireworks.

f) Used in making of artificial hair colours or dyes.

g) Used in making medicine.

h) Used in making paper.

i) Added to cement to make it resistant to attack by acid.

j) Used as a bleaching agent.

USES OF SULPHURIC ACID (H_2SO_4)

a) Mostly it is used to make fertilizers such as ammonium sulphate.

b) It is used as an electrolyte (battery acid).

c) It is used in making paint, plastics and soap.

d) Used for cleaning metals from stains.

e) It is used in refining petroleum.

f) Used in the production of synthetic fibres.

g) Used to make soaps and detergents.

h) Used to make dyes, drugs and explosives.

i) Concentrated sulphuric acid is a *dehydrating agent*. It dehydrates sucrose (sugar).

Sucrose ⟶ Carbon + Water

$C_{12}H_{22}O_{11}(s) \xrightarrow[H_2SO_4]{\text{Conc.}} 12C(s) + 11H_2O(g)$

USES OF SULPHATES (SO_4^{2-})

Sulphates are salts of sulphuric acid and they can be used to;

a) Ammonium sulphate $(NH_4)_2SO_4$

Used in the manufacturing of nitrogenous fertilizers.

b) Zinc sulphate ($ZnSO_4$)

Used to treat skin diseases and eye ointment

c) Magnesium sulphate ($MgSO_4$)

Used to heal bruises, sores, strained muscles, ankles and constipation

d) Calcium sulphate ($CaSO_4$)

Calcium sulphate is used to make plaster (*plaster of paris*).

e) ***Sodium sulphate ($NaSO_4$)***

This is used as a laxative; which loosens the intestines and relieves constipation

f) ***Copper sulphate ($CuSO_4$)***

This is used fungicides (used in orchards) and pigments.

g) ***Ferrous sulphate ($FeSO_4$)***

This is used for making ink.

THE END

REMINDERS

1) Intermolecular forces (IMF)

These forces act outside and between the molecules of a substance. IMF causes molecules to stick together in fixed positions in the solid state. These forces are also called ***Van der Waals*** forces after the man who discovered them.

2) What is 'periodic' about the periodic table?

Periodic means 'something that repeats itself'. So in the periodic table we must look for;

a) *One quality that repeats itself.*

(This is the electron configuration).

b) *Another that keeps on increasing.*

(This is the atomic number).

3) Formation of rhombic sulphur.

It is made by dissolving sulphur in methylbenzene which is heated excessively and the insoluble sulphur is filtered while hot. The filtrate (hot solution) is allowed to cool and two types of crystals are formed.

a) Crystals that are formed above 96°C. These are needle like and are called Monoclinic or ß-sulphur.

b) Crystals that are formed below 96°C. This is called rhombic sulphur.

4) Environmental Hazards associated with chloro-fluoro carbons (CFCs)

a) CFCs

These are used in air conditioners, refrigerators, in aerosols and as solvents in electronics industry.

When CFCs leak into the atmosphere, they react with the ozone (O_3) layer breaking it to Oxygen, causing or making holes in the ozone layer.

$Cl(g) + O_3(g) \rightarrow OCl(g) + O_2(g)$

Depletion of the ozone layer allows ultraviolet radiation from the sun to fall on matter on earth.

This causes cancer, eye problems and crop and animal damage.

b) Sulphur dioxide

Is a gas formed when sulphur burns in air.

$S + O_2 \rightarrow SO_2$

During the burning of cool, oil and gas oil, sulphur dioxide is formed.

This gas attacks lungs, seriously affecting people suffering from asthma.

It also dissolves in rain water to give acid rain. Acidic rain damage buildings, metal work, plants and kills animals especially fish.

Proverbs 5;10: ***A sensible person gathers the crop when they are ready; it is a disgrace to sleep through the time of harvest.***