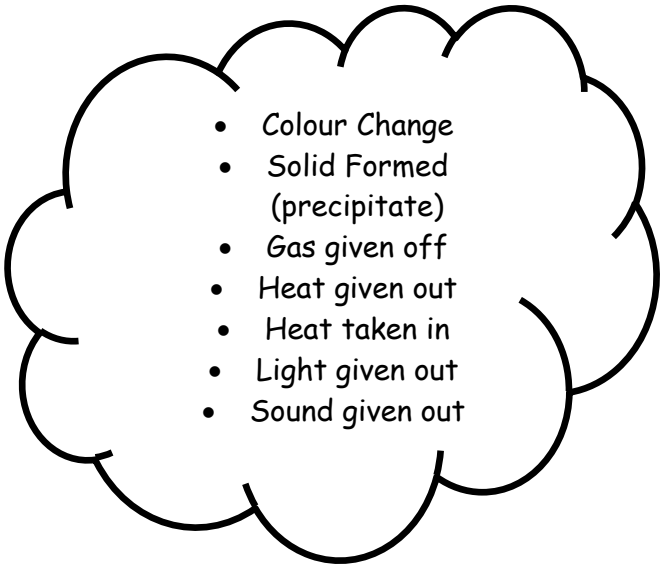
S3 CHEMISTRY SUMMARY NOTES

1. Can detect a chemical reaction when one or more of the following occur:



Exothermic reaction: Heat given out

Endothermic reaction: Heat taken in

2. Compound: is formed when 2 or more elements chemically join. e.g. sodium chloride

3. Naming compounds

End in "IDE" —> compound contains 2 elements

e.g. sodium chloride contains sodium + chlorine

End in "ATE" —> compound also contain OXYGEN

Or "ITE"

e.g. potassium nitrate contains potassium, nitrogen + oxygen

4. **WORD EQUATIONS**

These are used to represent a chemical reaction.

Eg. When magnesium metal reacts with oxygen a white powder called magnesium oxide forms.

magnesium + oxygen → magnesium oxide

Magnesium and oxygen are the REACTANTS and magnesium oxide is the PRODUCT.

5. **SOLUTIONS**

A solution is formed when a **SOLUTE** (substance getting dissolved) dissolves in a **SOLVENT** (liquid in which substance dissolves).

DILUTE SOLUTION – contains a **little solute**

CONCENTRATED SOLUTION – contains a **lot of solute**

SATURATED SOLUTION – no more solute will dissolve

6. **REACTION RATES**

The following can affect the **speed** of a reaction:

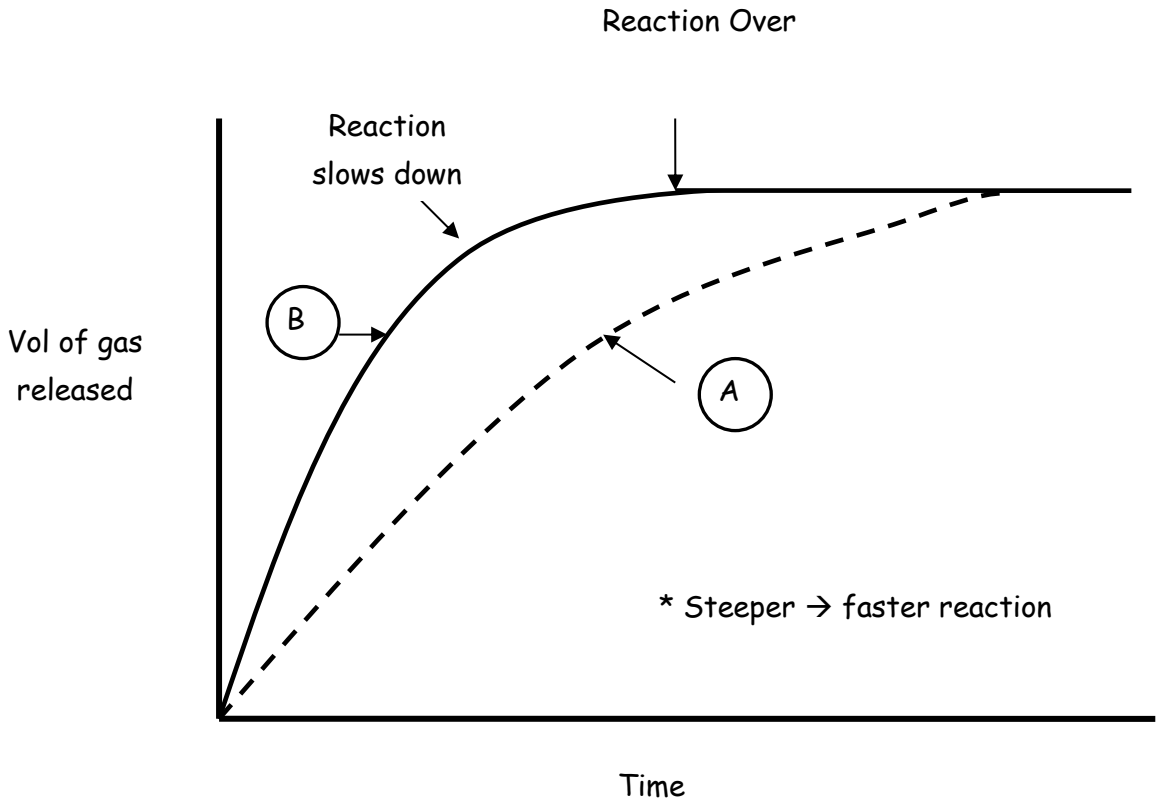
- **PARTICLE SIZE** (SMALLER PARTICLES → FASTER)
- **TEMPERATURE** (HIGHER TEMP → FASTER)
- **CONCENTRATION** (MORE CONCENTRATED → FASTER)

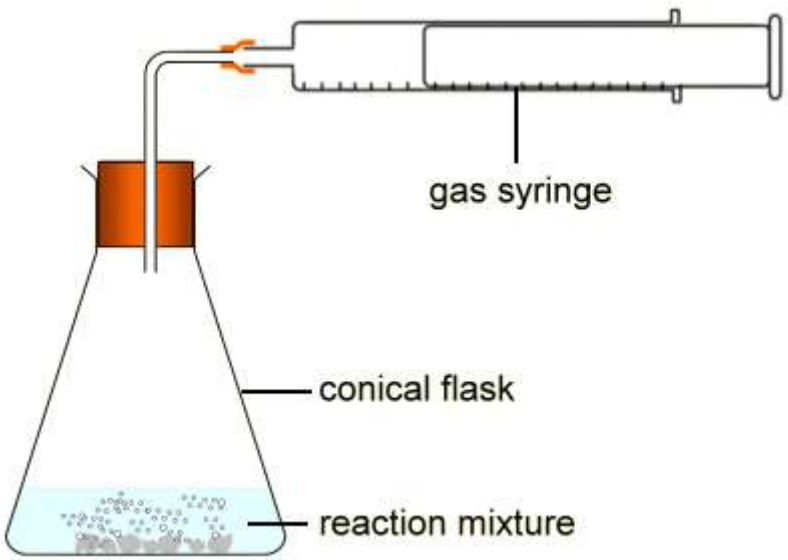
A **CATALYST** is a substance which **speeds up a reaction but remains unchanged at the end** (not used up!).

Presenting results on RATES of reactions:

e.g. Lump of chalk + acid A

Powdered chalk + acid B



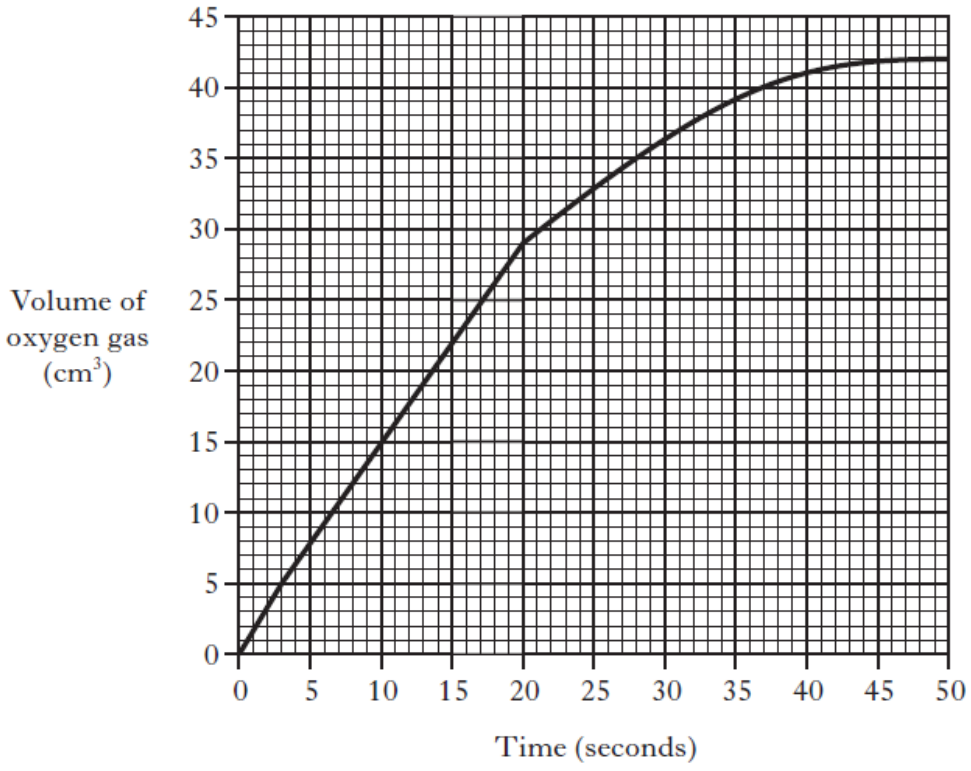


Average Rate of Reaction

$$\text{Average rate} = \frac{\text{CHANGE IN MASS/VOLUME/CONCENTRATION}}{\text{TIME INTERVAL}}$$

Eg.

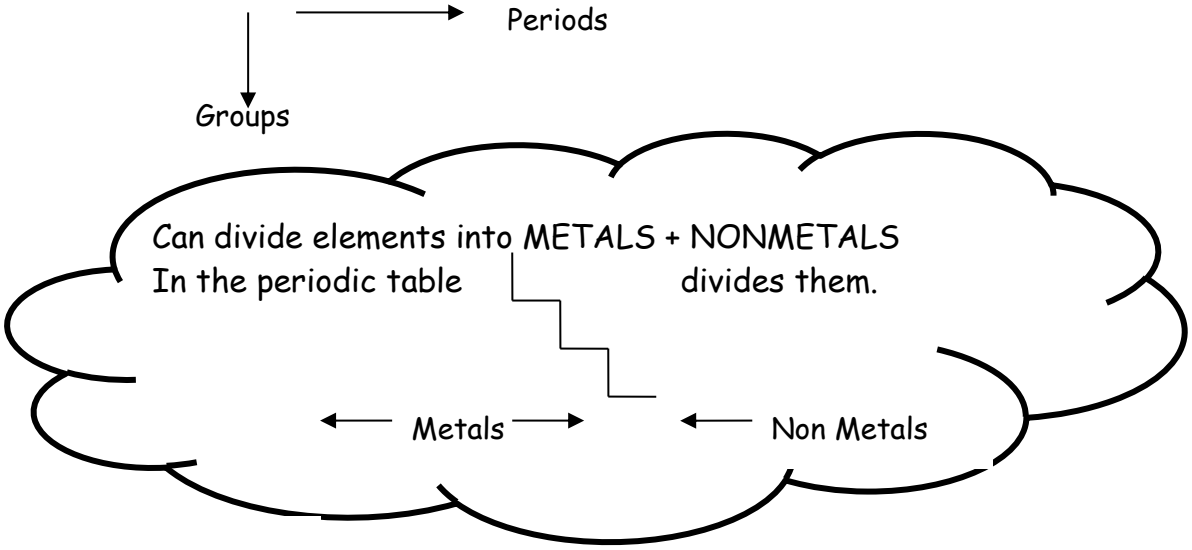
(*a*) The graph shows the results of an experiment carried out to measure the volume of oxygen gas released.



Calculate the average rate of reaction between 0 and 20 seconds.

_____ $cm^3 s^{-1}$

7.**Elements are listed in the Periodic Table**



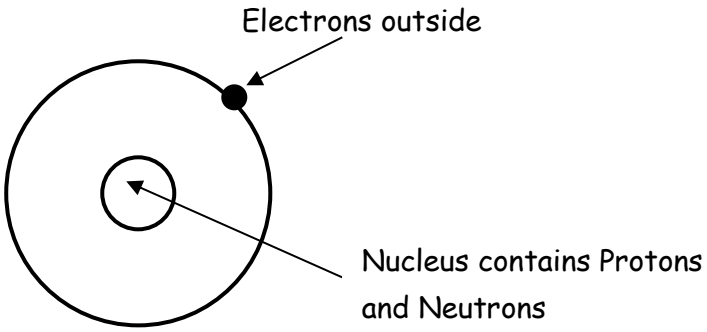
Electrical conductivity distinguishes between metals and non metals.

Group 1	Group 7	Group 8
Alkali Metals e.g. K, Na, Li	Halogens e.g. Br, Cl, I	Noble Gases e.g. He, Ne
*stored under oil → Very Reactive	* Very Reactive	*Very Unreactive

8. **Atomic structure**

Elements are made up of tiny identical particles called ATOMS.

Structure of an atom



Particle	Charge	Mass
Electron	1-	0
Proton	1+	1
Neutron	0	1

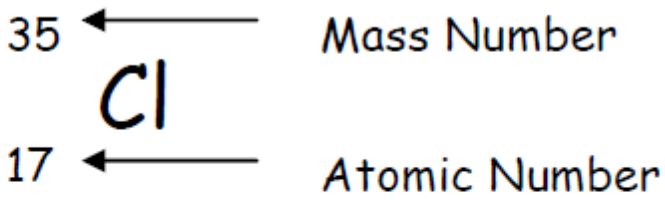
Atomic Number = number of protons

Mass Number = number of protons + number of neutrons

In a NEUTRAL atom,

NUMBER OF PROTONS = NUMBER OF ELECTRONS

Nuclide Notation

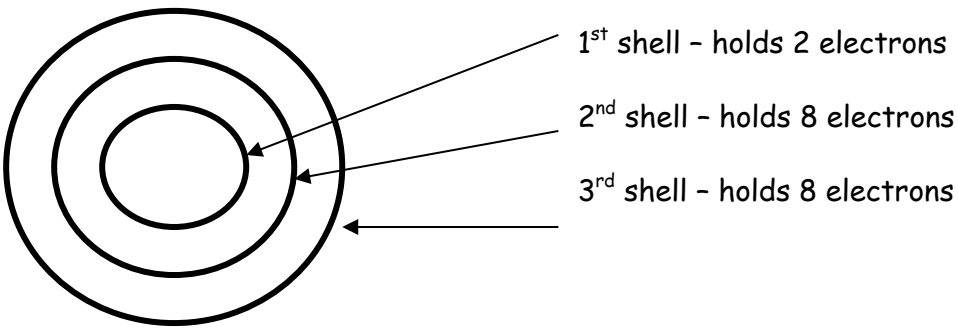


No Protons = 17

No Electrons = 17

No Neutrons = 35 -17 = 18

Outside the nucleus, the electrons fill shells, (or energy levels)



e.g. sodium, Na → 11 electrons, arranged 2, 8, 1

In a group, each element has the same number of outer electrons → fixes the chemical properties of the group.

<u>ISOTOPES</u> – are atoms of the same element but have different mass numbers.

e.g. ^{35}Cl ^{37}Cl Isotopes of Chlorine

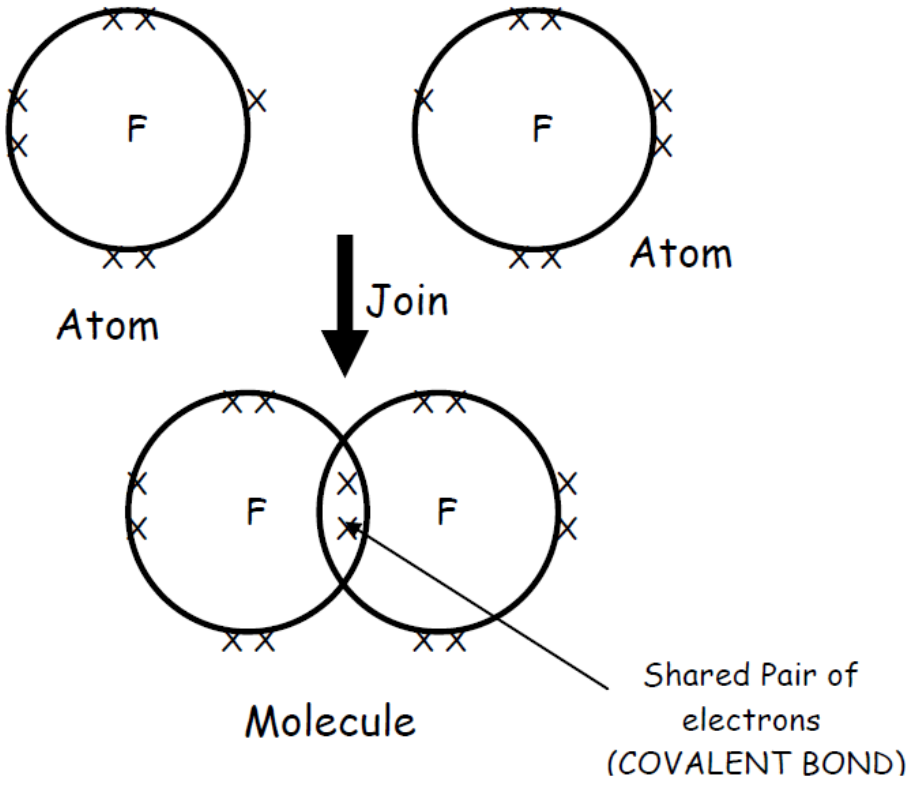
<u>Relative Atomic Mass</u> – is the average mass taking into account the isotopes present and the proportions of each.

9. Chemical Bonding (Part 1)

Atoms join together by forming BONDS.

When NONMETAL atoms join together, they form COVALENT bonds between the atoms by sharing electrons to obtain a full outer shell of electrons.

e.g. Fluorine
electron arrangement 2, 7



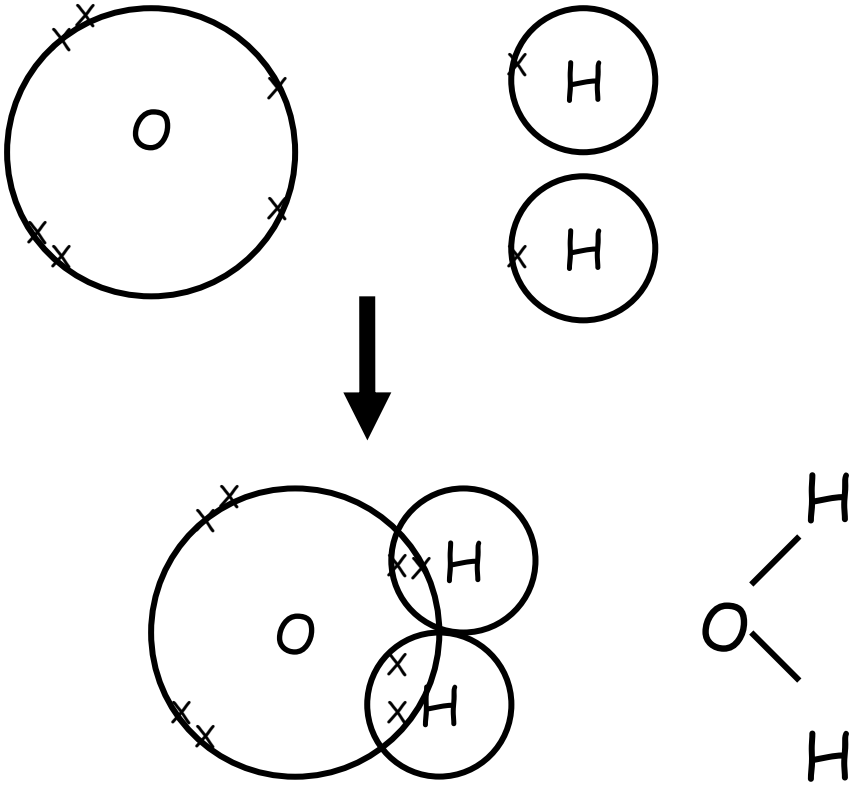
Written as F-F or F_2 , fluorine is a DIATOMIC MOLECULE

The 7 elements which exist as DIATOMIC MOLECULES are:

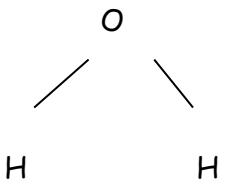
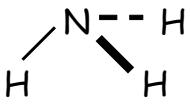
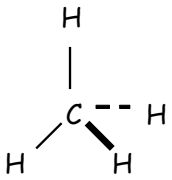
H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2

4. Compounds with covalent bonding

e.g. hydrogen oxide (water)



Shapes of Molecules

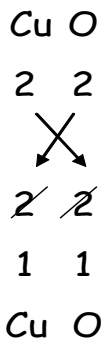
Molecule	Hydrogen Fluoride	Water	Ammonia	Methane
	HF	H_2O	NH_3	CH_4
Shape	H – F			
	Linear	Bent	Pyramidal	Tetrahedral

10. **Chemical Formulae**

(a) Valency Rules (to work out formula)

e.g. Copper(II) oxide

a. symbols
b. valency
c. cross-over
d. divide
e. formula



***RULE BREAKERS

Names contain a **PREFIX**

Eg. nitrogen dioxide NO_2

(b) Writing formula for compounds with COMPLEX IONS

eg. magnesium **nitrate**

USE PG.8 DATABOOK

	Mg	(NO_3)	***GET VALENCY FROM NUMBER OF CHARGE***
VALENCY	2	1	
BRACKETS around complex ion			
SWAP	1	2	
FORMULA	$Mg(NO_3)_2$		

11. Formulae Equations

magnesium + oxygen → magnesium oxide **WORD EQUATION**

$Mg + O_2 \rightarrow MgO$ **FORMULAE EQUATION**

(a) formula of an **element is its SYMBOL**
(b) formula of a **diatomic element is X_2**
(c) **USE RULES to write formula of a COMPOUND**

STATE SYMBOLS: (s) solid

(l) liquid

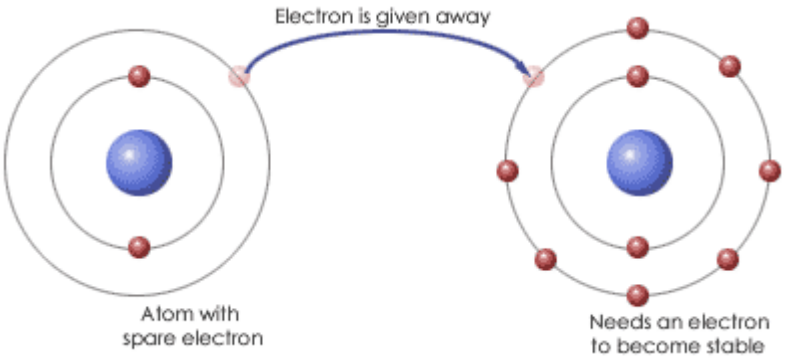
(g) gas

(aq) aqueous

12. **Chemical Bonding (Part 2)**

IONIC BONDING is formed between **METALS** and **NONMETALS**.

Metal atom transfers outer electrons to the non-metal atom.



IONS are formed. The oppositely charged ions attract each other strongly. This attraction is an **IONIC BOND**.

In an ionic compound the ions arrange themselves in a regular pattern.

IONIC LATTICE STRUCTURE

13. Differences between Ionic/Covalent Compounds

	Covalent Compounds	Ionic Compounds
How to Recognise e.g.	Non-Metal + Non-Metal(s) ↓ ↓ hydrogen oxide	Metal + Non-Metal(s) ↓ ↓ Sodium chloride
Particles	Molecules (which are NEUTRAL)	Ions (charged particles + or -)
Forces of attraction between particles	Weak forces between molecules	Ions attract strongly (held in a rigid IONIC LATTICE)
Melting + Boiling Points	*Low LOVALENT	*High HIONIC
Solubility	Dissolve in NON-AQUEOUS SOLVENTS e.g. ethanol	Dissolve in WATER
Conductivity	NEVER	Only when dissolved in WATER or MOLTEN → Ions Are Free To Move

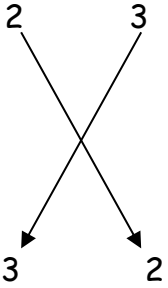
*** EXCEPTION: COVALENT NETWORK SUBSTANCES

e.g. silicon dioxide (sand)

14. Writing IONIC FORMULA

SHOWS CHARGES OF BOTH IONS PRESENT!

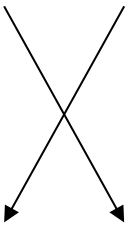
eg. magnesium nitride

	$(Mg^{2+})\ (N^{3-})$
VALENCY	2 3
CHARGES	
BRACKETS	
SWAP	
FORMULA	$(Mg^{2+})_3\ (N^{3-})_2$

METALS +
NONMETALS –
NUMBER OF CHARGE IS VALENCY

eg. calcium nitrate

USE pg.8 DATABOOK

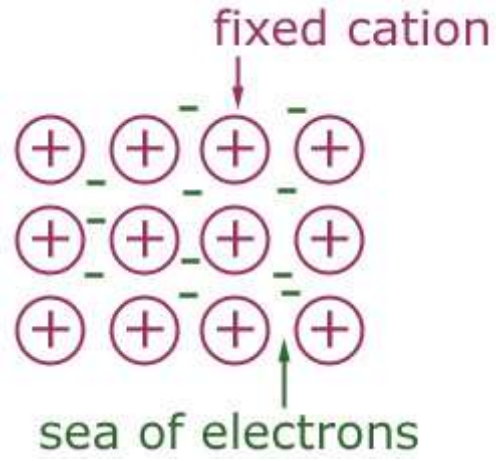
	$(Ca^{2+})\ (NO_3^-)$
VALENCY	2 1
CHARGE	
BRACKETS	
SWAP	
FORMULA	$(Ca^{2+})\ (NO_3^-)_2$

VALENCY OF COMPLEX ION IS NUMBER OF CHARGE

15. Metallic Bonding

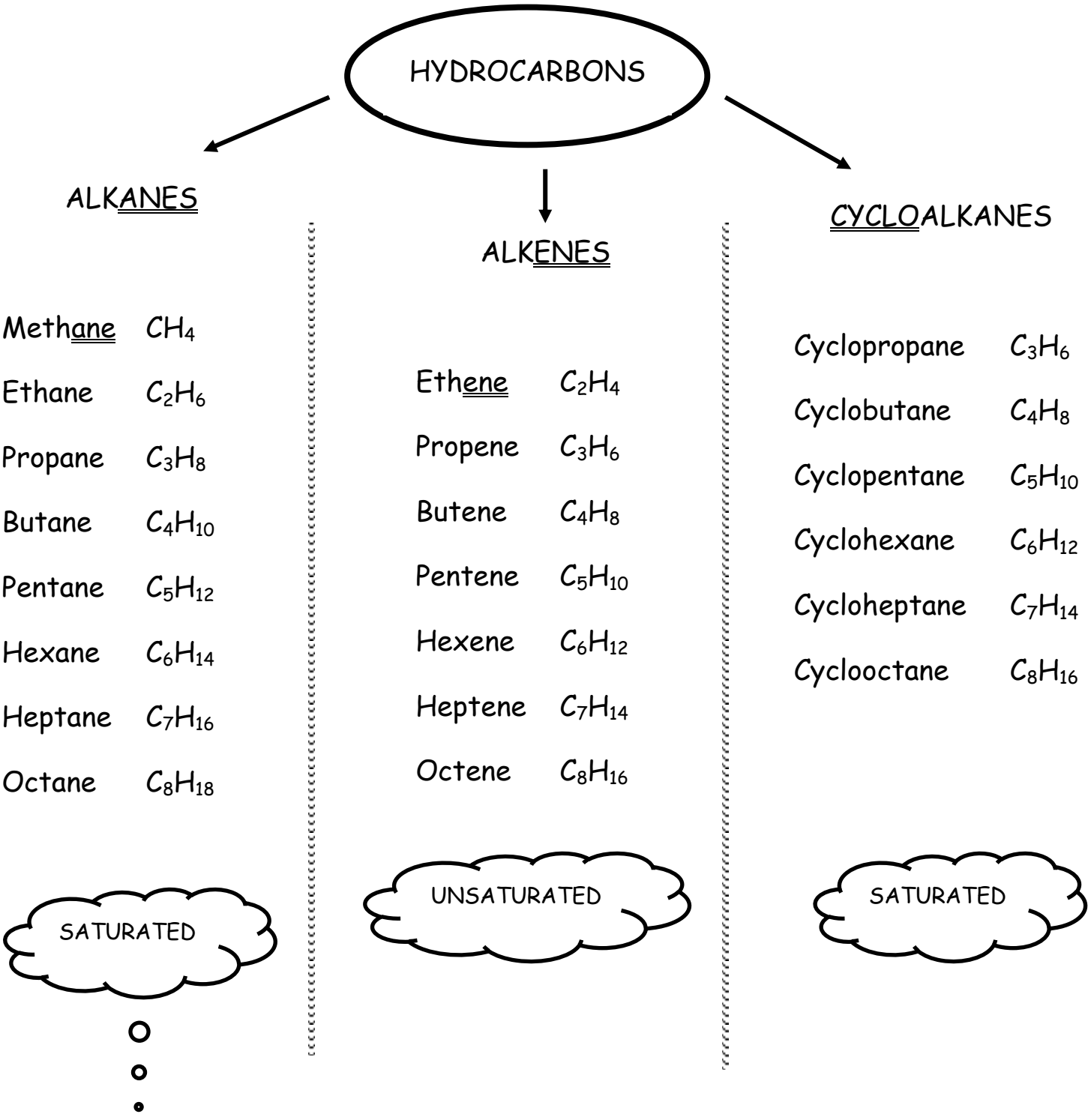
As the name suggests, this type of bonding is between metals. In this type of bonding many positive metal ions occupy a fixed position in a lattice (a bit like ionic). Its outer electron energy level become **delocalised**, creating what is known as a **sea of electrons** since they are not fixed and are free to move throughout the lattice.

The presence of these delocalised electrons explains why metals are very good conductors of electricity.



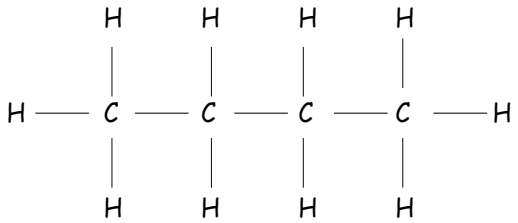
16. **Hydrocarbons**

Hydrocarbons are compounds formed between HYDROGEN and CARBON.



Full → Shortened Structural Formula

e.g.



$CH_3CH_2CH_2CH_3$

FULL STRUCTURAL FORMULA SHORTENED STRUCTURAL FORMULA

C_4H_{10} MOLECULAR FORMULA

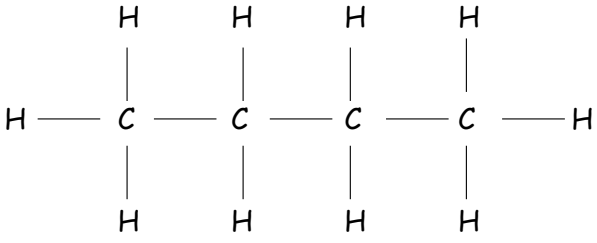
Homologous Series

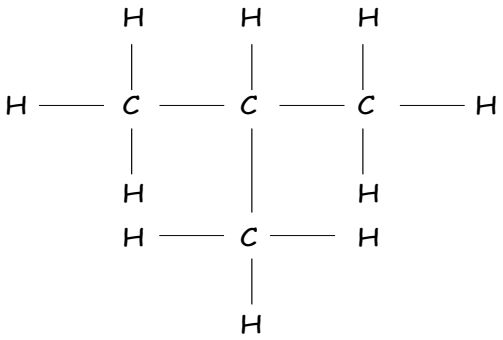
Alkanes, alkenes, and cycloalkanes are examples of HOMOLOGOUS SERIES.
In a homologous series:

(a) members represented by GENERAL FORMULA
(b) as the molecules get bigger, the melting and boiling points increase
(c) members have **similar** chemical properties

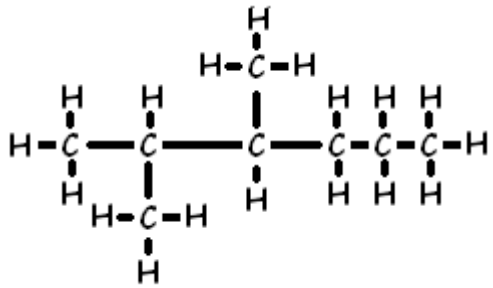
Isomers – compounds which have same molecular formula but different structural formula

e.g.



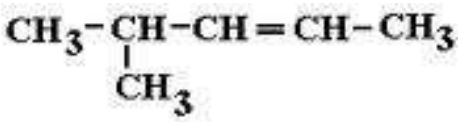


Naming Branched Alkanes



- name longest carbon chain -> hexane
- number longest carbon chain to give lowest numbers to carbons with branches attached
- name branches
  -CH_3 methyl
  -CH_2CH_3 ethyl
-if more than one of same branch use prefix
  di (if two)
  tri (if three)
- name branched alkane
  2,3-dimethylhexane

Naming Branched Alkenes



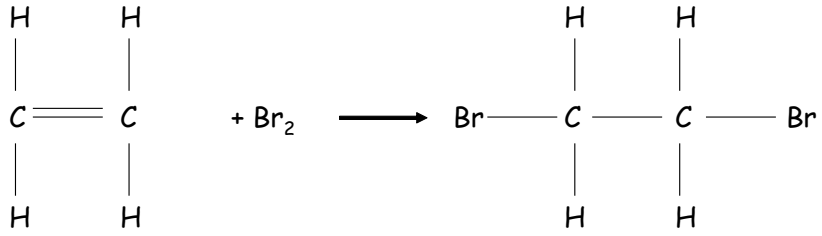
- find longest carbon chain containing double bond
- number this carbon chain to give lowest number to where double bond starts -> pent-2-ene
- indentify branches and indicate position with number in front of branch name

  4-methylpent-2-ene

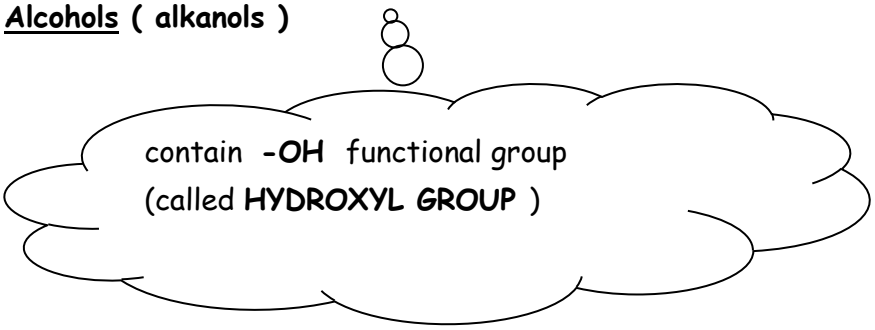
Addition Reactions

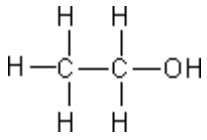
Alkenes undergo ADDITION REACTIONS with hydrogen, halogens, and water

e.g.

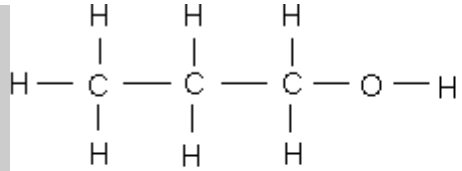


17. **Alcohols (alkanols)**

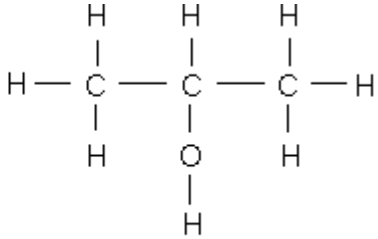




ethanol



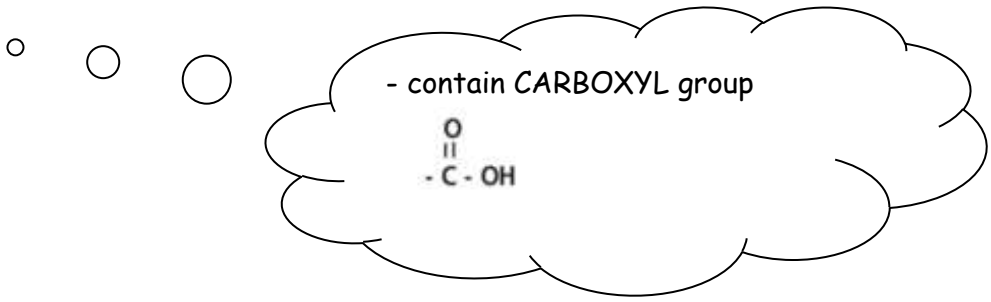
propan-1-ol



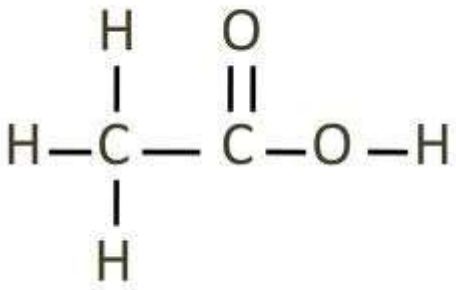
propan-2-ol

Alcohols are used as SOLVENTS and FUELS.

18. **Carboxylic Acids (alkanoic acids)**



eg.



Vinegar is a solution of ethanoic acid. It is used as a food preservative and in household cleaning products.

19. **Plastics**

Plastics are SYNTHETIC materials and are made from chemicals obtained from OIL.

2 Types of Plastics

Thermoplastic	Thermosetting Plastics
Can be heated and reshaped again and again	Do not melt on reheating
e.g. polythene	e.g. formica

Monomers and Polymers

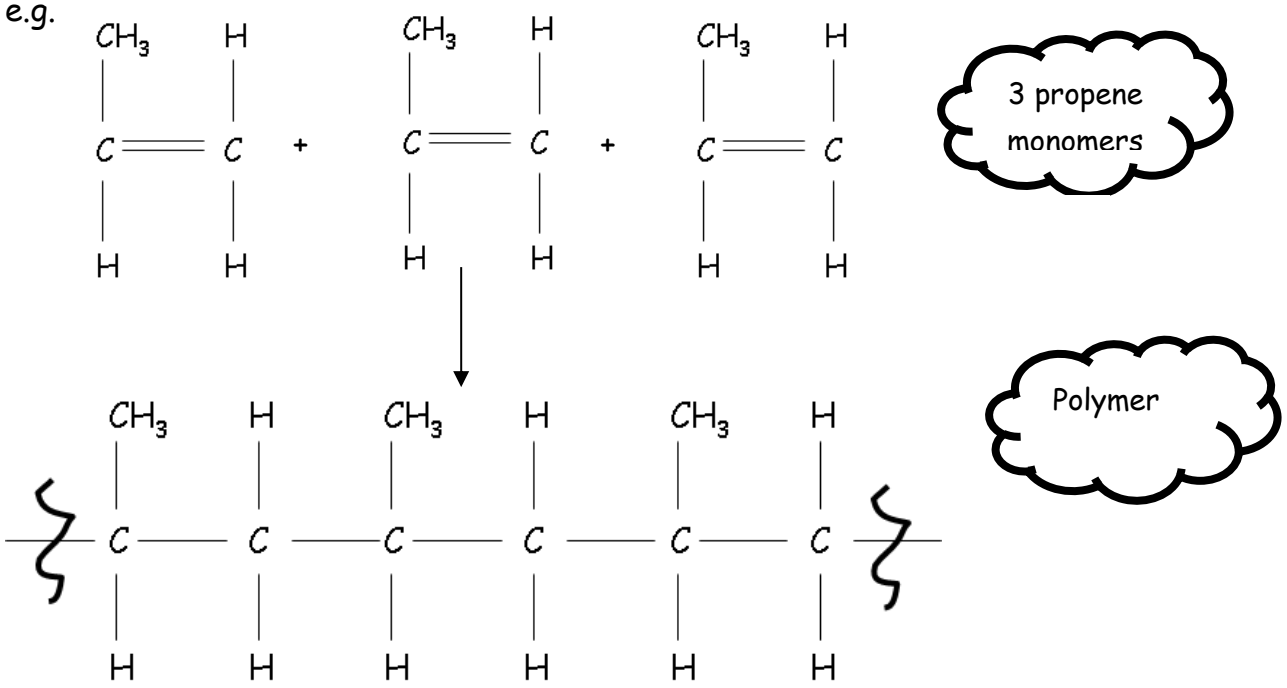
Plastics are made of large molecules called POLYMERS.

Polymers are made from small molecules called MONOMERS (need to be UNSATURATED)

Making Polymers by ADDITION POLYMERISATION

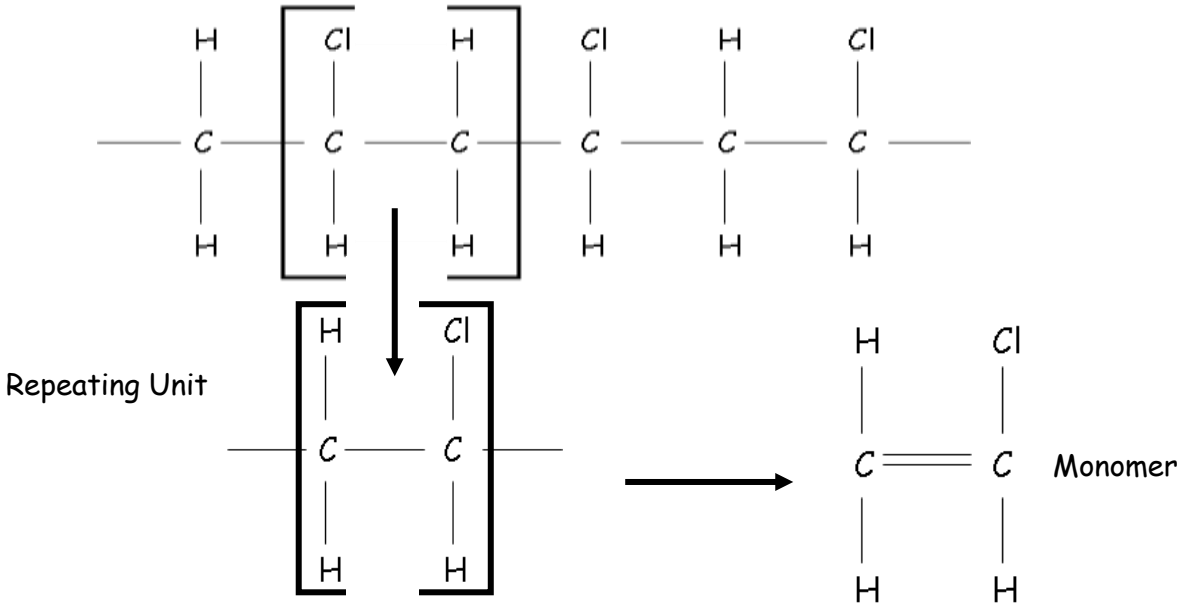
In ADDITION POLYMERISATION, the monomers ADD to each other by the opening of the double bond in the monomer.

e.g.



Naming Plastics: place 'Poly' in front of monomer it is made from.

Identifying the Monomer



20. **FUELS**

A Fuel is a substance which burns well giving out energy.

Combustion is another name for burning.

Oxygen is needed for anything to burn.

Alkanes and alcohols can be used as fuels since they burn well.

Combustion is an EXOTHERMIC reaction.

In an exothermic reaction the products have less energy than the reactants.

HYDROCARBON + OXYGEN → CARBON DIOXIDE + WATER

ALCOHOL + OXYGEN → CARBON DIOXIDE + WATER

The amount of energy released by a fuel when it burns can be worked out using:

$$E_h = cm\Delta T$$

c = 4.18 (specific heat capacity of water)

m = mass of water (in kg) ****1cm^3=0.001kg**

ΔT= change in temperature (°C)