Bottisham Village College

KNOWLEDGE ORGANISER

CHEMISTRY

YEAR 10 ALL YEAR

KNOWLEDGE ORGANISERS

At Bottisham Village College, we are striving to create a five-year curriculum plan that builds effective revision strategies into homework and lessons, to ensure that students are able to place powerful knowledge into their long-term memories. Additionally, we hope that this will help build effective learning strategies from early in their time here at the college.

Based on evidence, we know that regular recall activities are the best way of achieving this goal and committing powerful knowledge into the students' memories.

At the start of each term, we shall publish all the knowledge organisers that students will require for their studies in each curriculum area. These will cover a range of aspects: facts, dates, characters, quotes, precise definitions and important vocabulary. We are clear: if this fundamental knowledge is secured, students can then develop their higher-level skills of analysis and critical understanding with greater depth.

They will be given an electronic A4 Knowledge Organiser (KO) booklet for each term containing all of the knowledge required. In lessons, Bottisham staff will be regularly testing this fundamental knowledge, using short -quizzes or even more formal "Faculty Knowledge Tests".

The best way to use these organisers at home, is to follow a simple mantra:

1. Look at a certain aspects of a particular knowledge organiser
2. Cover up part of their knowledge organiser
3. Write it out from memory
4. Check and correct any spelling mistakes, missing bits or mistakes

So simple but so effective.

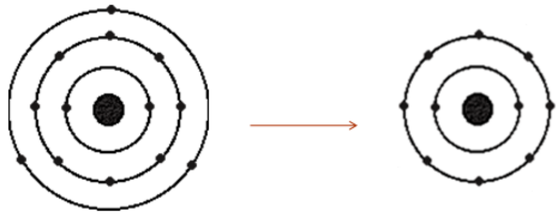
Atomic Structure and Periodic Table Year 10 Combined

A. Keywords.

Atom	Smallest part of an element that can exist
Molecule	Two or more atoms chemically bonded together
Element	A substance made up of only one type of atom.
Compound	A substance made up of two or more different elements chemically bonded together
Nucleus	The centre of the atom. Contains neutrons and protons
Proton	Charge of +1. Mass of 1. Found inside the nucleus
Neutron	Charge of 0. Mass of 1. Found inside the nucleus
Electron	Charge of -1. Mass of almost 0. Found in shells, orbiting around the nucleus
Ion	An atom that has lost or gained electrons. An ion has a positive or negative charge.

B. Positive Ions

Positive ions are formed when an atom loses electrons to obtain a full outer shell of electrons



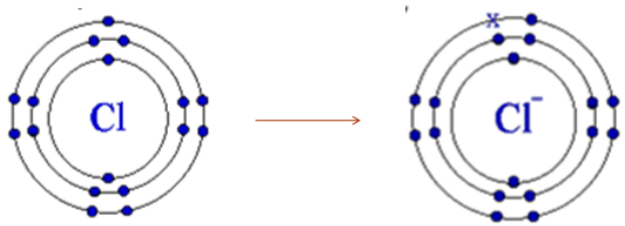
2.8.3
Aluminium atom, Al
Charge of protons = +13
Charge of electron = -13
Total Charge = 0

2.8
Aluminium ion, Al^{+3}
Charge of protons = +13
Charge of electron = -10
Total Charge = +3

Group 0: have full shells of outer electrons and are therefore unreactive. He, Ne, Ar, Xe, Rn

C. Negative Ions

Negative ions are formed when an atom gains electrons to obtain a full outer shell of electrons



2.8.7
Chlorine atom, Cl
Charge of protons = + 17
Charge of electron = - 17
Total Charge = 0

2.8.8
Chlorine ion, Cl-
Charge of protons = + 16
Charge of electron = - 17
Total Charge = - 1

D. Group 1 Alkali Metals

Li, Na, K, Rb, Cs, Fr
Very reactive: only one electron in their outer shell
Reactivity increases as you go down the group
React with oxygen to give metal oxides eg MgO
React with water to give metal hydroxide (alkali) and hydrogen eg MgOH
React with chlorine to give metal chloride eg MgCl

E. Group 7 The Halogens

F, Cl, Br, I
Melting and boiling point increase as you go down group
Reactivity decreases as you go down the group
A more reactive halogen will displace a less reactive one

Atomic Structure and Periodic Table Year 10 Separate

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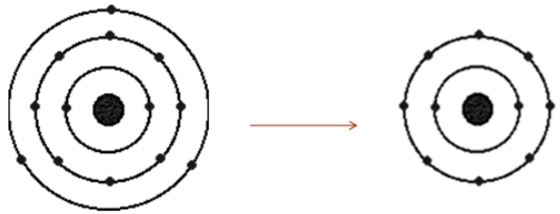

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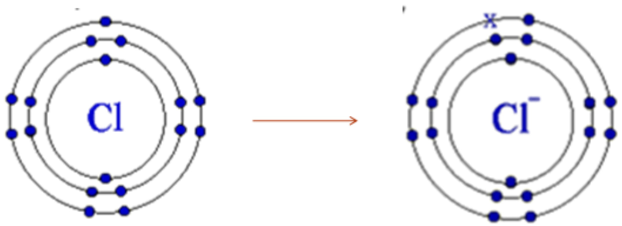

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E. Group 7 The Halogens

F, Cl, Br, I
Melting and boiling point increase as you go down group
Reactivity decreases as you go down the group
A more reactive halogen will displace a less reactive one

Transition Metals

Form coloured compounds. Often catalysts.

Form ions with multiple charges.

Bonding, Structure and Properties of Matter

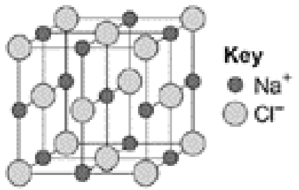
Year 10 Combined

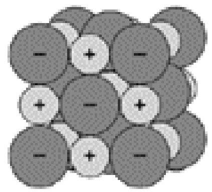
A. Keywords

Ion	An atom that has lost or gained electrons. An ion has a positive or negative charge.
Bonding	The changes atoms go through during a reaction to give them a stable arrangement
Chemical Properties	A description of how a substance acts in the presence of other chemicals. e.g. reactivity, the reactions that a substance can take part in.
Physical Properties	A description of the appearance of a substance or how it acts without involving chemical reactions. For example, state, melting point, conductivity, etc.
Ionic Bond	Electrostatic force of attraction between positively and negatively charged ions
Covalent Bond	The bond between two atoms that share one of more pairs of electrons
Electrostatic attraction	A strong force of attraction between oppositely charged objects.
Intermolecular force (of attraction)	Forces of attraction between separate molecules in a covalent compound

B. Giant Ionic Structures:

Salt:





High melting and boiling point.

Many strong electrostatic forces of attraction.

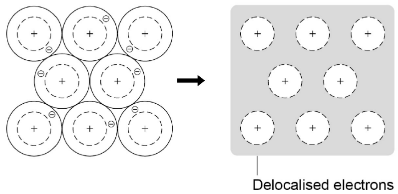
Conduct electricity when melted or dissolved in water.

D. Giant Metallic Structures:

High melting and boiling point.

Conduct heat. Conduct electricity.

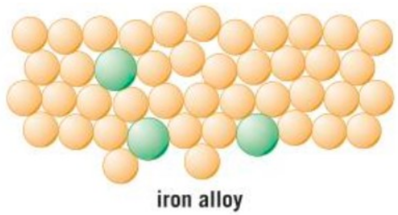
Malleable and ductile.



E. Alloys:

Mixture of metals or metal + carbon.

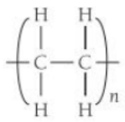
Stronger/harder



H. Polymers:

Long chains of covalent substances.

Strong with high boiling point.



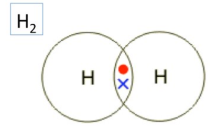
long chain of poly(ethene)

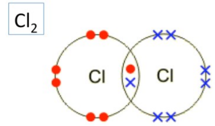
C. Simple Chemicals/Simple Covalent

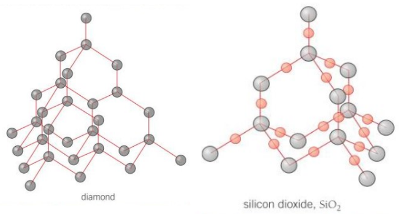
Small molecules, usually liquids or gases.

Weak intermolecular forces. Low boiling point.

Cannot conduct electricity.







Giant Covalent:

Diamond & Silicon dioxide

Many covalent bonds.

Strong. Cannot dissolve. Cannot conduct.

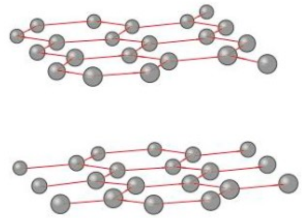
High boiling point

Graphite:

Carbon bonded to 3 others.

Arranged in layers, so can slide over each other and is soft.

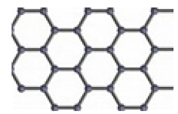
Conducts electricity.



G. Carbon Structures

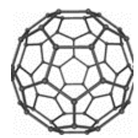
Graphene: A single layer of graphite.

Used in electronics.



Fullerene: Carbon or graphite arranged in a tube or ball-shape.

Used as lubricant, in nanotechnology and electronics.



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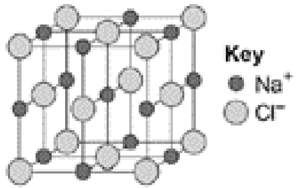

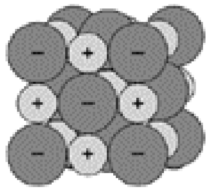

High melting and boiling point.

Many strong electrostatic forces of attraction.

Conduct electricity when melted or dissolved in water.

C. Simple Chemicals/Simple Covalent

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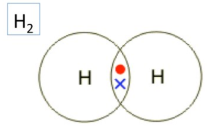

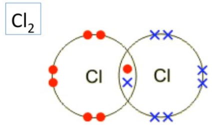

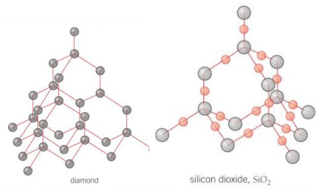

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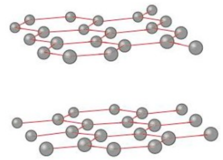

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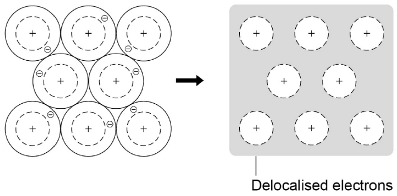
High melting and boiling point.

Conduct heat. Conduct electricity.

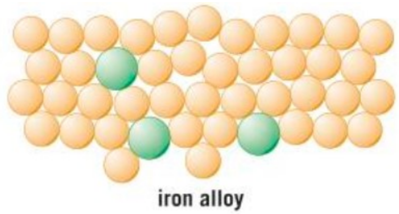
Malleable and ductile.



E. Alloys:

Mixture of metals or metal + carbon.

Stronger/harder



F. Nanotechnology:

Particles that are 1–100 nm in size. 1nm is 1×10^{-9} m.

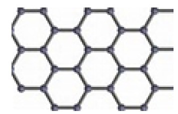
High surface area to volume ratio.

E.g. silver in socks and plasters. Carbon nanotubes.

G. Carbon Structures

Graphene: A single layer of graphite.

Used in electronics.



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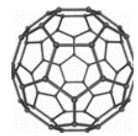

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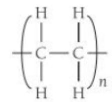


Quantitative Chemistry
Year 10
Combined Foundation

A. Keywords.

Mass number	Number of neutrons + protons (The large number)
Atomic number	Number of protons (the small number)
Relative atomic mass	A_r The mass number of an atom.
Relative formula mass	M_r The mass of all the atoms of a molecule added together.
Concentration	A measure of the number or mass of reactant particles in a given volume of liquid.
Balanced equation	The number of each type of atom in the reactants must be the same as the number of each type of atom in the products

B. Equation

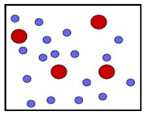
Concentration = Mass (g) / Volume (dm^3)

C. Concentration

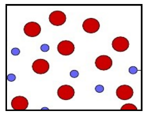
Concentration is a measure of the mass of reactant particles in a given volume of liquid.

The units for concentration are g/dm^3

The greater the mass of solute dissolved in a given volume the more concentrated the solution is.



Low concentration

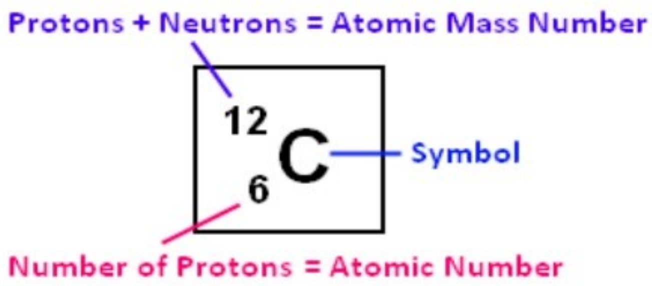


High Concentration

D. Mass Number and Atomic Number

The **mass number** is the sum of the protons and neutrons found in the nucleus of the atom

The **atomic number** is the number of protons found in the nucleus of the atom



E. Relative Formula Mass

The sum of the relative atomic masses of the atoms in a compound.

There are no units for relative atomic mass because it a way of measuring the mass of atoms compared to each other.

E.g. Relative atomic masses:

Carbon = 12 and Hydrogen = 1

This means carbon is 12 times heavier than hydrogen.

Calculate the relative formula mass of Carbon dioxide (CO_2)

Relative atomic masses:

Carbon = 12 and Oxygen = 16

CO_2 = (12 x 1) + (16 x 2) = 44

F. Uncertainty in Measurements.

Uncertainty in results can be judged in two ways:

- Using the resolution on the measuring instrument. This is plus or minus (±) half the smallest scale division.
- Using a set of repeat measurements. This is the mean ± half the range.

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Relative formula mass	M_r The mass of all the atoms of a molecule added together.
Limiting reactant	The reactant in a chemical reaction that when used up causes the reaction to stop
Concentration	A measure of the number or mass of reactant particles in a given volume of liquid.
Balanced equation	The number of each type of atom in the reactants must be the same as the number of each type of atom in the products
Mole	The amount of substance in the relative atomic or formula mass of a substance in grams.
Avogadro Constant	The number of atoms, molecules or ions in one mole of substance 6.02×10^{23}

B. Moles

The mass of one mole of a substance in grams is equal to its relative formula mass. E.g. one mole of Carbon has a mass of 12g because it's relative atomic mass is 12

One mole of a substance contains 6.02×10^{23} units of the substance.

E.g. One mole of Carbon atoms contains 6.02×10^{23} atoms of carbon.

Moles can be used to measure atoms, molecules, ions, electrons, formulae and equations. E.g. In one mole of carbon the number atoms is the same as the number of molecules in one mole of carbon dioxide.

The large numbers in a chemical equation can be used to show the ratio of moles of substances that react.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

Shows that one mole of magnesium reacts with 2 moles of hydrochloric acid to produce one mole of magnesium chloride and one mole of hydrogen.

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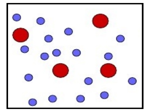
The greater the mass of solute dissolved in a given volume the more concentrated the solution is.



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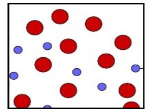

High Concentration

E. Limiting Reactants

In a chemical reaction it is common for one reactant to be in excess to ensure the other reactant is used up entirely.

The reactant that gets used up is the limiting reactant, this will be the reactant that dictates how much product is made.

F. Equations

Moles = Mass (g) / Relative Atomic Mass

Concentration = Mass (g) / Volume (dm^3)

G. Relative Formula Mass

The sum of the relative atomic masses of the atoms in a compound.

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Concentration	A measure of the number or mass of reactant particles in a given volume of liquid.
Balanced equation	The number of each type of atom in the reactants must be the same as the number of each type of atom in the products
Titrations	Titration is used to measure accurately what volumes of acid and alkali react together completely (neutralisation)
Atom Economy	A measure of the amount of starting materials that end up as useful products.
Percentage Yield	The proportion of the theoretical yield actually produced in the reaction.

B. Equations

Moles = Mass (g) / Relative Atomic Mass

Concentration = Mass (g) / Volume (dm^3)

Moles of gas = Volume of gas(dm^3) /24 dm^3

$$\text{Percentage Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$\text{Atom Economy} = \frac{\text{mass of atoms in desired product}}{\text{mass of atoms in reactants}} \times 100$$

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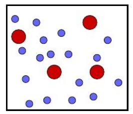

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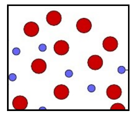

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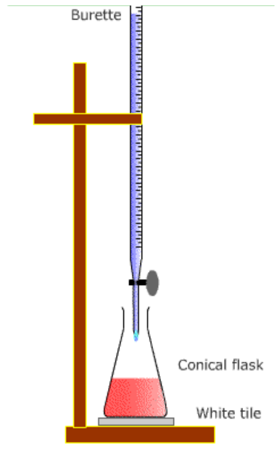
E. Required practical—Titration



Set up a burette containing the solution of an unknown concentration.

Measure 25cm^3 of the solution of a known concentration into the conical flask and add a few drops of indicator.

Slowly open the tap on burette and react the two solutions, swirl it to ensure it mixes thoroughly.

Record the amount of the solution in the burette required to neutralise the solution.

Use the balanced symbol equation, the two volume of the solutions and the one known concentration to find the unknown concentration.

F. Percentage Yield and Atom Economy

Percentage Yield: A reaction may not produce the maximum amount of product because:

- The reaction may be reversible and never reach completion.
- Some of the product may be lost when it is separated from the reaction mixture.
- Some reactants may react in ways that were not expected.

Atom Economy

Some reactions convert most of their reactants into useful products but others are very wasteful.

Atom economy measure the percentage of atoms converted into something useful which helps:

- Improve sustainable development.
- Ensure companies can make a profit.

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Relative formula mass	M_r The mass of all the atoms of a molecule added together.
Limiting reactant	The reactant in a chemical reaction that when used up causes the reaction to stop
Concentration	A measure of the number or mass of reactant particles in a given volume of liquid.
Balanced equation	The number of each type of atom in the reactants must be the same as the number of each type of atom in the products
Titrations	Titration is used to measure accurately what volumes of acid and alkali react together completely (neutralisation)
Mole	The amount of substance in the relative atomic or formula mass of a substance in grams.
Atom Economy	A measure of the amount of starting materials that end up as useful products.
Percentage Yield	The proportion of the theoretical yield actually produced in the reaction.
Avogadro Constant	The number of atoms, molecules or ions in one mole of substance 6.02×10^{23}

B. Gas Volumes

A mole of any gas at the same temperature and pressure will always occupy the same volume.

At room temperature (20°C) and pressure (1atm) the volume of any gas is $24 dm^3$.

C. Equations

Moles = Mass (g) / Relative Atomic Mass

Concentration = Mass (g) / Volume (dm^3)

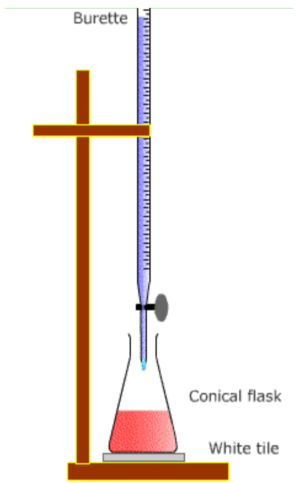
Concentration = Moles / Volume

Moles of gas = Volume of gas(dm^3) /24 dm^3

$$\text{Percentage Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$\text{Atom Economy} = \frac{\text{mass of atoms in desired product}}{\text{mass of atoms in reactants}} \times 100$$

D. Required practical—Titration



Set up a burette containing the solution of an unknown concentration.

Measure $25cm^3$ of the solution of a known concentration into the conical flask and add a few drops of indicator.

Slowly open the tap on burette and react the two solutions, swirl it to ensure it mixes thoroughly.

Record the amount of the solution in the burette required to neutralise the solution.

Use the balanced symbol equation, the two volume of the solutions and the one known concentration to find the unknown concentration.

E. Uncertainty in Measurements.

Uncertainty in results can be judged in two ways:

- Using the resolution on the measuring instrument. This is plus or minus (±) half the smallest scale division.
- Using a set of repeat measurements. This is the mean ± half the range.

F. Moles

The mass of one mole of a substance in grams is equal to its relative formula mass. E.g. one mole of Carbon has a mass of 12g because it's relative atomic mass is 12

One mole of a substance contains 6.02×10^{23} units of the substance.

E.g. One mole of Carbon atoms contains 6.02×10^{23} atoms of carbon.

Moles can be used to measure atoms, molecules, ions, electrons, formulae and equations. E.g. In one mole of carbon the number atoms is the same as the number of molecules in one mole of carbon dioxide.

The large numbers in a chemical equation can be used to show the ratio of moles of substances that react.

$$Mg + 2HCl \rightarrow MgCl_2 + H_2$$

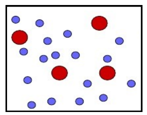
Shows that one mole of magnesium reacts with 2 moles of hydrochloric acid to produce one mole of magnesium chloride and one mole of hydrogen.

G. Concentration

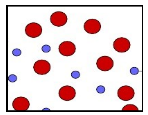
Concentration is a measure of the number or mass of reactant particles in a given volume of liquid.

The units for concentration are g/dm^3 or mol/dm^3

The greater the mass of solute dissolved in a given volume the more concentrated the solution is.



Low concentration



High Concentration

H. Limiting Reactants

In a chemical reaction it is common for one reactant to be in excess to ensure the other reactant is used up entirely.

The reactant that gets used up is the limiting reactant, this will be the reactant that dictates how much product is made.

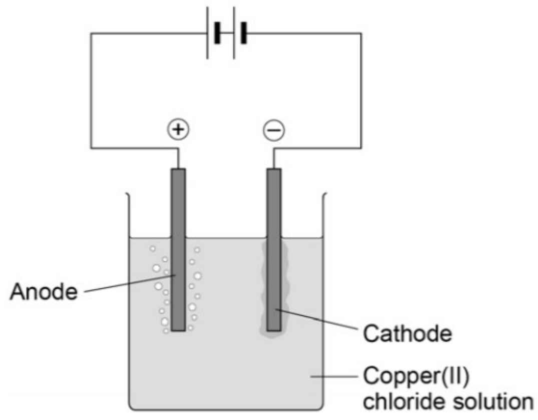
Chemical Changes

Year 10 Foundation

A. Keywords.

Aqueous	Dissolved in water
Molten	A substance that has melted
Neutral	Equal concentrations of H^+ and OH^- in the solution.
Electron	Charge of -1. Mass of almost 0. Found orbiting around the nucleus
Ion	An atom that has lost or gained electrons and therefore has a positive or negative charge.
Electrolysis	When an electric current is passed through a molten or aqueous ionic compound the positive and negative ions separate to opposite electrodes and are discharged to produce elements.
Electrode	Rod placed into the solution during electrolysis
Anode	The positively charged electrode
Cathode	The negatively charged electrode

B. Required Practical: Electrolysis



Set up the circuit as directed in the diagram, do not let the electrodes touch in the solution.

Damp blue litmus paper will bleach white if Chlorine gas is produced.

C. Electrolysis

Molten ionic compound:

- The metal is produced at the cathode.
- The non-metal is produced at the anode.

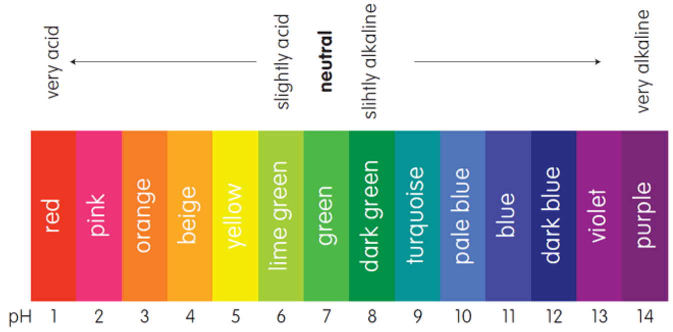
Aqueous solutions:

- The metal and hydrogen ions are attracted to the cathode. The **least reactive** of the two ions gains electrons and forms the element.
- The non-metal and hydroxide ions are attracted to the anode. If the non-metal is a halide then the halogen is formed, if not oxygen is produced.

D. Neutralisation

Acids produce hydrogen ions (H^+) in aqueous solutions. Aqueous solutions of alkalis contain hydroxide ions (OH^-)

pH scale measures from 1-14 (acid to alkali)



The general equation for neutralisation:

$$H^+ + OH^- \rightarrow H_2O$$

pH can be measure using litmus paper, universal indicator or a pH probe.

Litmus Paper	Universal Indicator	pH Meter
Simple and cheap to use	Semi-quantitative and cheap	Very accurate - can measure to decimal places
Only provides qualitative data.	The solution cannot be easily separate from the product tested.	Expensive. Must be stored safely and calibrated before use.

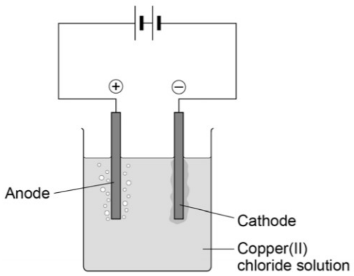
Chemical Changes

Year 10 Higher

A. Keywords.

Aqueous	Dissolved in water
Molten	A substance that has melted
Reduction	The gain of electrons
Oxidation	The loss of electrons.
Neutral	Equal concentrations of H^+ and OH^- in the solution.
Electron	Charge of -1. Mass of almost 0. Found orbiting around the nucleus
Completely ionised	All of the acid molecules have separated into H^+ and their other component. Strong acids. E.g. Hydrochloric acid, Sulfuric acid and Nitric acid.
Partially ionised	Some of the acid molecules have separated into H^+ and their other component. Weak acids. E.g. Citric acid, ethanoic acid and carbonic acid.
Ion	An atom that has lost or gained electrons and therefore has a positive or negative charge.
Electrolysis	When an electric current is passed through a molten or aqueous ionic compound the positive and negative ions separate to opposite electrodes and are discharged to produce elements.
Electrode	Rod placed into the solution during electrolysis
Anode	The positively charged electrode
Cathode	The negatively charged electrode

B. Required Practical: Electrolysis



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- The metal is produced at the cathode.
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Aqueous solutions:

- The metal and hydrogen ions are attracted to the cathode. The **least reactive** of the two ions gains electrons and forms the element.
- The non-metal and hydroxide ions are attracted to the anode. If the non-metal is a halide then the halogen is formed, if not oxygen is produced.

D. Electrolysis: Half Equations

At the Cathode:

The metal ion gains electrons (oxidised) to form the element

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

At the Anode:

The non-metal ion loses electrons (reduced) to form the element

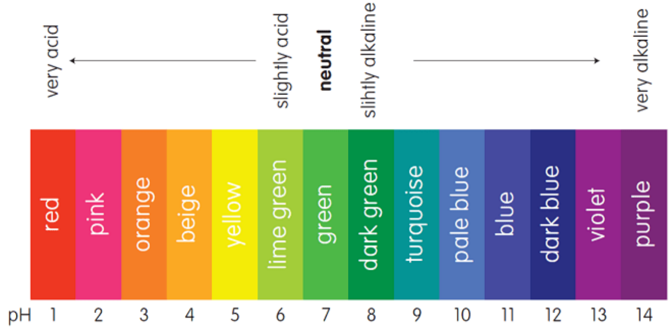
$$2Br^- \rightarrow Br_2 + 2e^-$$

E. Neutralisation

Acids produce hydrogen ions (H^+) in aqueous solutions.

Aqueous solutions of alkalis contain hydroxide ions (OH^-)

pH scale measures from 1-14 (acid to alkali)



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$$H^+ + OH^- \rightarrow H_2O$$

pH can be measure using litmus paper, universal indicator or a pH probe.

Litmus Paper	Universal Indicator	pH Meter
Simple and cheap to use	Semi-quantitative and cheap	Very accurate - can measure to decimal
Only provides qualitative data.	The solution cannot be easily separate from the product tested.	Expensive. Must be stored safely and calibrated before use.

F. Strengths of Acids

A strong acid is completely ionised in aqueous solution.

A weak acid is partially ionised in aqueous solution.

pH is a measure of the concentration of H^+ in the solution.

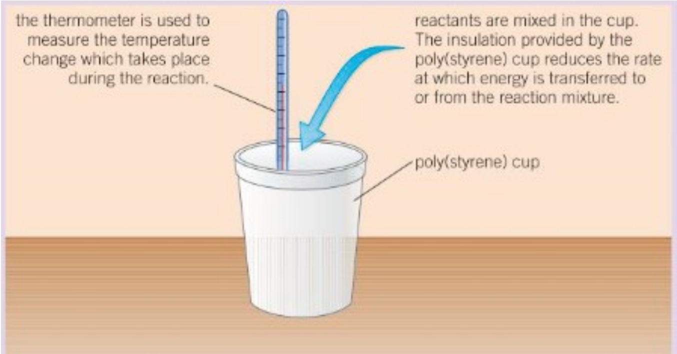
A decrease of 1 pH unit is a decrease in H^+ by a factor of 10.

Energy Changes
Year 10
Combined Foundation

A. Keywords.

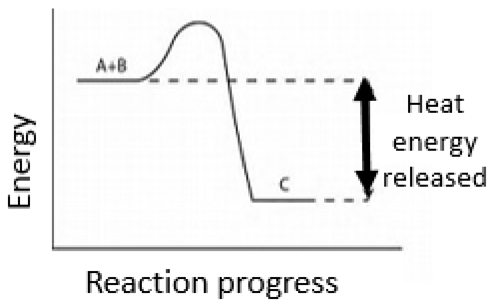
Exothermic Reaction	One that transfers energy to the surroundings so the temperature of the surroundings increases
Endothermic Reaction	One that absorbs energy from the surroundings so the temp. of the surroundings decreases
Energy Level Diagram	A diagram to show if a reaction is exo or endothermic
Activation Energy	Is the energy required to start a reaction
Reactants	A starting substance in a chemical reaction
Products	A substance made in a chemical reaction

B. Temperature Change Required Practical



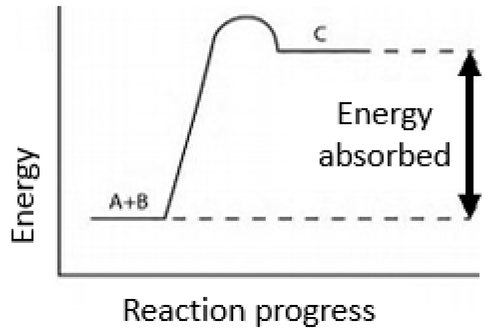
Monitor the temperature rise as small volumes of sodium hydroxide solution are added to dilute hydrochloric acid. The acid will be contained in an insulated cup.

C. Exothermic Reactions



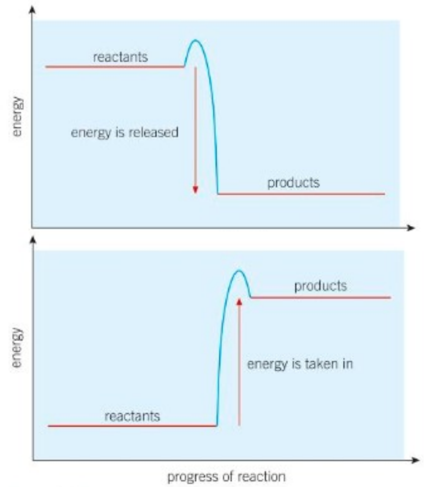
An exothermic reaction gives out energy, so products have less energy than reactants, but temperature of surroundings goes up.

D. Endothermic Reactions



An endothermic reaction takes inenergy, so products have more energy than reactants, but temperature of surroundings goes down

E. Reaction Profiles



Exothermic

Endothermic

Energy change = energy of reactants—energy of products

Energy Changes

Year 10 Combined Higher

A. Keywords.	
Exothermic Reaction	One that transfers energy to the surroundings so the temperature of the surroundings increases
Endothermic Reaction	One that absorbs energy from the surroundings so the temp. of the surroundings decreases
Ion	A charged particle. Either positive or negative
Energy Level Diagram	A diagram to show if a reaction is exo or endothermic
Activation Energy	Is the energy required to start a reaction
Reactants	A starting substance in a chemical reaction
Products	A substance made in a chemical reaction
Bond Energy	Energy required to break or make a bond

B. Using Bond Energies for Exothermic and Endothermic Reactions

Worked example

Ammonia is made from nitrogen and hydrogen in the Haber process. The balanced symbol equation for this reaction is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Calculate the overall energy change for the forward reaction using bond energies.

Solution

This equation tells you that the bonds in 1 mole of nitrogen molecules and 3 moles of hydrogen molecules need to break in this reaction (see Figure 2).

N≡N H—H H—H H—H

Figure 2 *These bonds are broken in the forward reaction*

Nitrogen molecules are held together by a triple bond (written like this: N≡N). This bond is very strong. Using data from the table, its bond energy is 945 kJ/mol.

Hydrogen molecules are held together by a single bond (written like this: H—H). From the table, the bond energy for this bond is 436 kJ/mol.

The energy needed to break 1 mole of N≡N and 3 moles of H—H bonds = 945 + (3 × 436) kJ = 2253 kJ taken in from the surroundings (an endothermic process).

When these atoms form ammonia (NH_3), six new N—H bonds are made since 2 moles of NH_3 are formed (see Figure 3). The bond energy of the N—H bond is 391 kJ/mol.

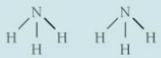


Figure 3 *These bonds are made in the forward reaction*

Energy transferred when 6 moles of N—H bonds are made = 6 × 391 kJ = 2346 kJ (the energy is transferred to the surroundings as this is an exothermic process).

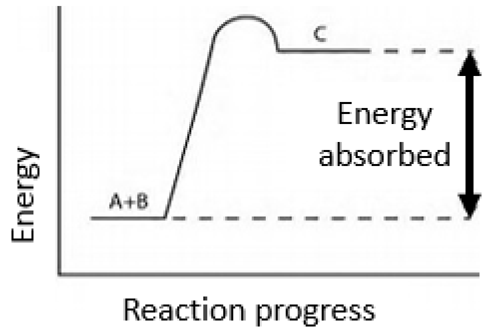
So the *overall* energy change = (2253 kJ – 2346 kJ) = –93 kJ

This is the energy *transferred to the surroundings* in the forward reaction as written above.

Table 1 *Common bond energies*

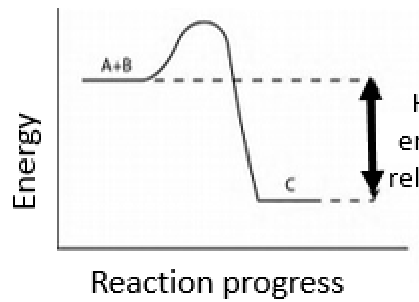
Bond	Bond energy in kJ/mol	Bond	Bond energy in kJ/mol
C—C	347	H—Cl	432
C—O	358	H—O	464
C—H	413	H—N	391
C—N	286	H—H	436
C—Cl	346	O=O	498
Cl—Cl	243	N≡N	945

C. Endothermic Reactions



An endothermic reaction takes in energy, so products have more energy than reactants, but temperature of surroundings goes down

D. Exothermic Reactions



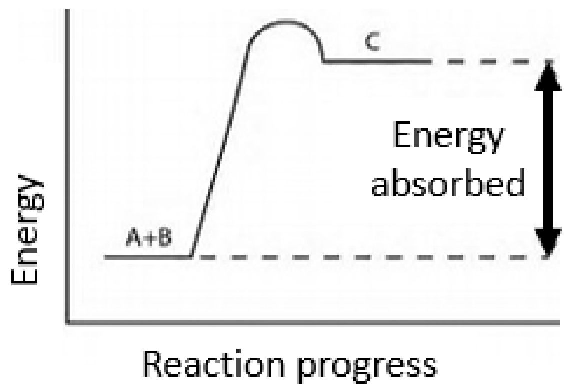
An exothermic reaction gives out energy, so products have less energy than reactants, but temperature of surroundings goes up.

Energy change = energy of reactants—energy change of products

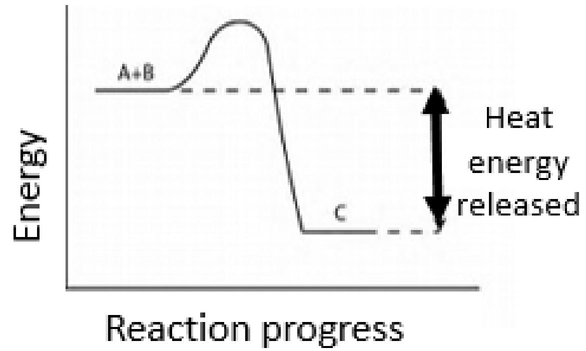
Energy Changes
Year 10
Separate Foundation

A. Keywords.	
Exothermic Reaction	One that transfers energy to the surroundings so the temperature of the surroundings increases
Endothermic Reaction	One that absorbs energy from the surroundings so the temp. of the surroundings decreases
Ion	A charged particle. Either positive or negative
Battery	Two or more cells joined together to increase voltage.
Fuel Cell	Sources of electricity that are supplied by an external source of fuel.
Electrolyte	A liquid containing free moving ions.
Electrode	a conductor through which electricity enters or leaves an object
Energy Level Diagram	A diagram to show if a reaction is exo or endothermic
Activation Energy	Is the energy required to start a reaction
Reactants	A starting substance in a chemical reaction
Products	A substance made in a chemical reaction

B. Energy Level Diagrams



Endothermic Reaction



Exothermic Reaction

Calculating Energy Change

The change in the amount of energy in the chemicals can be calculated by subtracting the energy at the end from the energy at the start of the reaction

Energy change=energy of reactants—energy of products

C. Chemical Cell and batteries

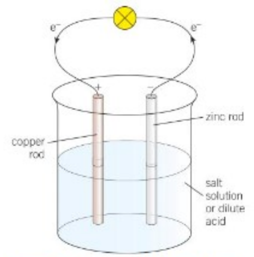


Figure 2 An electrical cell made from zinc and copper. The electrons flow from the more reactive metal (zinc) to the less reactive metal (copper). So zinc acts as the negative terminal of the cell, providing electrons to the external circuit

The greater the difference in reactivity between the metals used, the higher the potential difference produced.

Cells contain chemicals which react to produce electricity.

A simple cell can be made by connecting two different metals in contact with an electrolyte.

Cells stop working when reactants used up.

Rechargeable cells have a reversible reaction.

D. Fuel cells

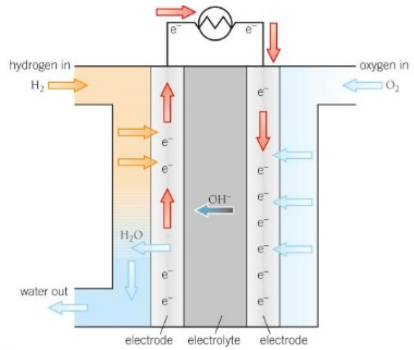


Figure 3 A hydrogen fuel cell which has an alkaline electrolyte, such as potassium hydroxide solution. Notice that the only waste product is water

Fuel cells are supplied by an external source of fuel (eg hydrogen) and oxygen or air.

The overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce water.

Hydrogen fuel cells offer a potential alternative to rechargeable cells and batteries.

Energy Changes
Year 10
Separate Higher

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Ion	A charged particle. Either positive or negative
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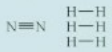

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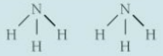

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So the *overall* energy change = (2253 kJ – 2346 kJ) = –93 kJ

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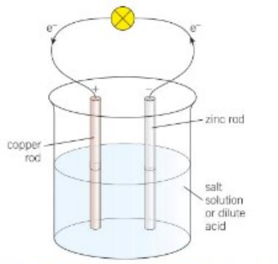
D. Chemical Cell and batteries



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The greater the difference in reactivity between the metals used, the higher the potential difference produced.

Cells contain chemicals which react to produce electricity.

A simple cell can be made by connecting two different metals in contact with an electrolyte.

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$$

C. Fuel cells

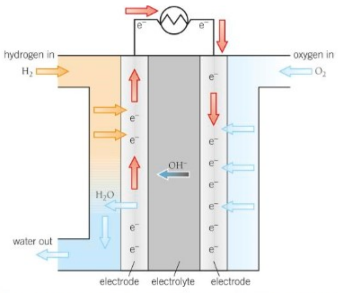


Figure 3 *A hydrogen fuel cell which has an alkaline electrolyte, such as potassium hydroxide solution. Notice that the only waste product is water*

Fuel cells are supplied by an external source of fuel (eg hydrogen) and oxygen or air.

The overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce water.

Negative Electrode	$2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$
Positive Electrode	$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

Rate & Extent of Chemical Change Year 10

A. Keywords

States of matter (states)	Whether a substance is a solid, liquid or gas at room temperature.
Collision Theory	An explanation of the way that chemicals combine in chemical reactions.
Rate	How quickly something happens.
Chemical Reaction	When atoms or molecules of chemicals combine to produce a different atom or molecule.
Reactant	A substance that combines in a chemical reaction to make a new product.
Product	The substance(s) created when a chemical reaction happens.
Atom	Smallest part of an element that can exist
Molecule	Two or more atoms chemically bonded.
Solution	A liquid made of a chemical (solute) dissolved in a solvent, usally water.

B. Collision Theory

A reaction only happens when reactants (atoms or molecules) collide or bump into each other.

The reactants have to collide with enough energy for the reaction to be successful. This energy is the Activation Energy.

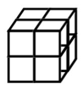
Rate of reaction can be measured by:

- Measuring change in mass over time.
- Measuring volume of gas produced over time.
- Timing how long it takes for a solid to form.

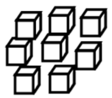
C. Surface Area (in solids)

Increased surface area to volume ratio increases rate of reaction.

Increased surface area increases the number of particles that are available to react.



1:3 Surface area to Volume



1:6 Surface area to Volume

D. Temperature (in liquids/solutions and gases)

Increased temperature increases the rate of reaction.

Increase in temperature increases the energy of the reactants so they move faster, colliding more often and with more energy.

E. Concentration (liquids/solutions)

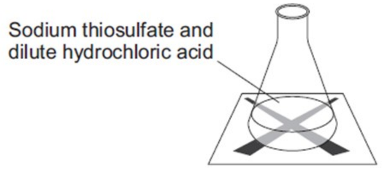
Increasing concentration increases rate of reaction. Increasing concentration reduces the space between reactants so collisions are more likely.

Required Practical: Rate and Concentration

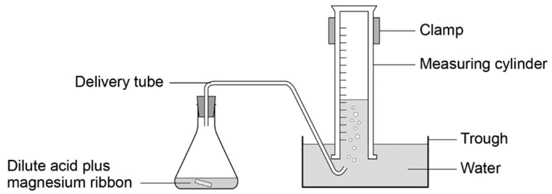
Make a range of concentrations using different amounts of reactant diluted with water.

Method 1: Measuring colour change or amount of light passing through as a solid forms.

Time how long it takes for a black 'X' on a piece of paper to disappear.



Method 2: Measuring volume of gas produced over time.



Collect gas in an upturned measuring cylinder in a trough of water. Time volume produced every 10 seconds. A gas syringe can also be used.

F. Pressure (gases)

Increasing pressure increases the rate of reaction.

Increasing concentration reduces the space between reactants so collisions are more likely.

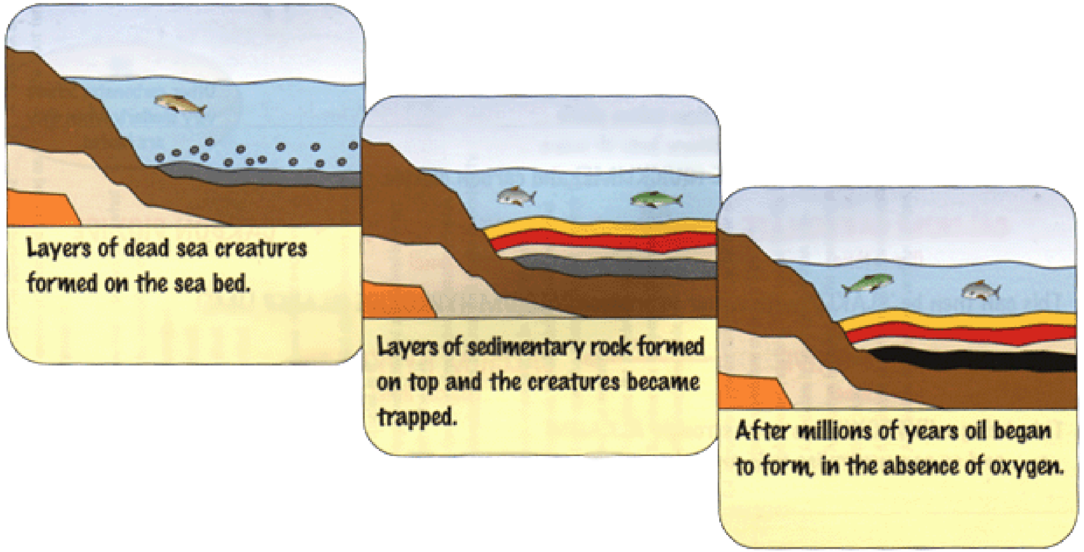
Organic Chemistry
Year 10

A. Keywords.

Crude Oil	Oil that has not been purified.
Fossil Fuels	Fuels that are made from the remains of dead plants and animals, eg coal and oil.
Hydrocarbons	Compounds only containing hydrogen and carbon
Alkane	A group of hydrocarbons with only single bonds.
Saturated	A hydrocarbon with only single bonds between its carbon atoms.
Covalent Bond	The bond between two atoms that share one or more pairs of electrons.
Intermolecular Force	The force between two or more molecules
Melting Point	The temperature required to make a substance melt. Changes from a solid to a liquid.

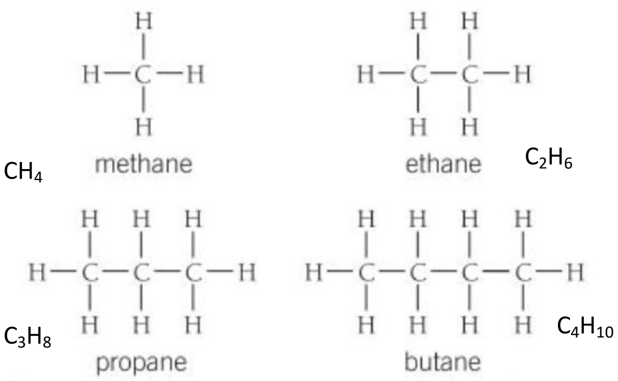
B. Formation of Crude Oil

Crude oil is a mixture of lots of hydrocarbons that need to be separated. Hydrocarbons are compounds that contain only carbon and hydrogen.

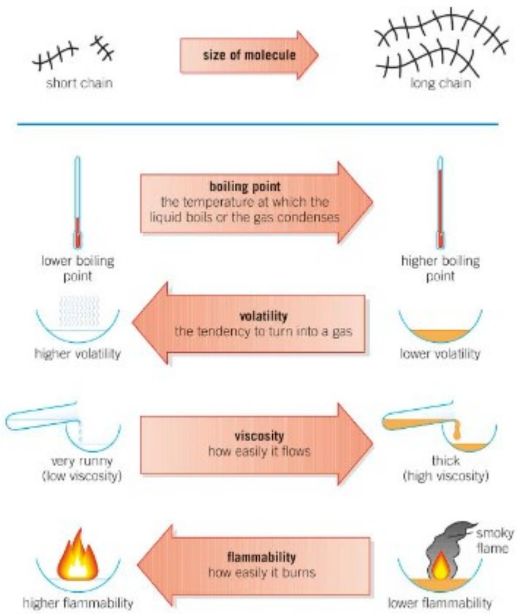


C. Hydrocarbons and Alkanes

Nearly all of the compounds in crude oil are hydrocarbons (contain only carbon and hydrogen). Most of the hydrocarbons are ALKANES. They are described as SATURATED because the carbon-carbon bonds are single covalent bonds. The first four alkanes are:



E. Properties of Hydrocarbons



Large molecule = large intermolecular forces

Small molecule = small intermolecular forces

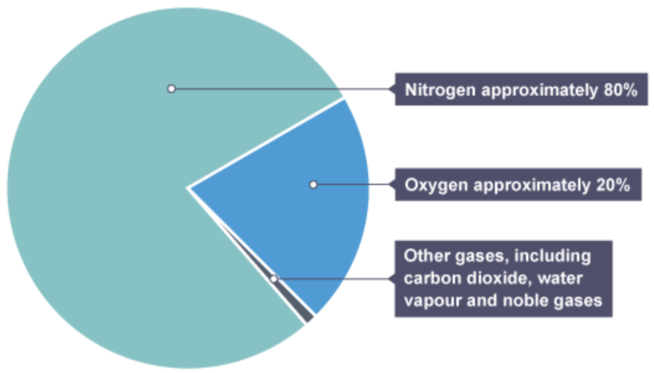
Chemistry of the Atmosphere Year 10

A. Keywords.

Atmosphere	The gas surrounding the Earth (or another planet)
Greenhouse effect	Trapping the energy absorbed and radiated by the Earth in the atmosphere, causing a temperature
Greenhouse gases	Gases in the atmosphere that maintain temperatures on Earth high enough to support life. Carbon dioxide, water vapour and methane are greenhouse gases.
Photosynthesis	A chemical reaction carried out by algae and plants to convert carbon dioxide and water into glucose and
Precipitate	An insoluble solid that forms in a solution.
Combustion	A chemical reaction where a substance reacts with oxygen and emits heat and light (e.g. burning)
Global dimming	The release of carbon particulates into the atmosphere which reflect sunlight back into space and prevent it from reaching the Earth.
Life Cycle	Starting with collecting the raw materials, processing them to make a product and then their recycling and eventual disposal.

B. Composition of the Atmosphere

The atmosphere on Earth today is approx. 80% Nitrogen, approx. 20% Oxygen and small proportions of other gases including carbon dioxide, water vapour and noble gases.



C. Evolution of the Atmosphere

4.6 billion years ago. Atmosphere was mainly carbon dioxide

↓

Volcanoes erupted releasing nitrogen, water vapour and small amounts of methane and ammonia

↓

The Earth started to cool and the water vapour condensed to form oceans

↓

Carbon dioxide dissolved in the water and carbonates were precipitated forming sediments. — Carbon dioxide levels decreased

↓

Small photosynthetic organisms (algae) evolved. — Carbon dioxide levels decreased and Oxygen levels increased

↓

Plants evolved and carried out photosynthesis — Carbon dioxide levels decreased and Oxygen levels increased

D. Energy in Fuels - Combustion

When fuels burn there are two types of combustion that can occur, complete combustion and incomplete combustion.

	Complete Combustion	**Incomplete Combustion**
When does it happen?	Plenty of oxygen	Not enough oxygen
Energy released	Maximum amount	Less than complete combustion
Products	Carbon dioxide and water	Carbon monoxide, carbon particulates, and water

Problems with incomplete combustion:

- Carbon monoxide is poisonous, it prevents red blood cells from carrying oxygen around your body.
- Carbon particulates can cause health problems by irritating the lining of the lungs. E.g. making asthma worse.
- Carbon particulates can also cause global dimming.

E. Carbon Footprint

The total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.

Ways of reducing the carbon footprint:

Using Resources
Year 10

A. Keywords

Resource	A substance or material that can be used for human benefit.
Sustainable	Meets current demand without affecting future generations.
Microorganisms	Bacteria, Fungi and Viruses.
Pure	Containing only one type of element or compound.
Fresh Water	Water containing low levels of dissolved salts.
Salt or Saline Water	Water containing high levels of dissolved salts.
Desalination	The process of separating salty water into salt and water.
Distillation	Process of evaporating and condensing a solution to separate the chemicals in it.
Aerobic Digestion	Digestion in the presence of oxygen (by bacteria).
Anaerobic Digestion	Digestion without oxygen (by bacteria).
Organic Matter	Material that once came from a living thing e.g. faeces, dead plants/animals, leaves

B. Resources

Natural resources are found on earth and can be used in their current form with little changes from humans.

Synthetic resources are man-made alternatives to natural resources.

E.g.

Cotton	Clothing/Fabrics	Polyester
Wood	Construction	PVC

Finite Resources are being used up faster than they can be replaced e.g. metal ores, fossil fuels, limestone.

Renewable resources can be replaced at the same rate they are used up so they are sustainable.

C. Drinking Water

Pure water contains just H_2O molecules and no other substances.

Potable water is drinking water. It is safe as levels of microorganisms and dissolved substances are very low.

Water is made safe to drink by water treatment:

1. Passing through filter beds of sand or gravel to remove solid particles.

2. Sterilisation by adding chlorine, ozone or passing through UV light, to kill microorganisms

Salty water, e.g. seawater, is not fresh water and needs to be treated by desalination:

1. Distillation. Using lots of energy to heat water

2. Reverse osmosis. Pushing water through a membrane at high pressure.

D. Waste Water

Waste water or sewage is generated from human homes, agriculture and industry. It contains organic matter, toxic chemicals (e.g. metal ions) and lots of microorganisms.

Stages of waste water treatment:

1. Screening to remove large solids

2. Sedimentation to separate into sludge and effluent.

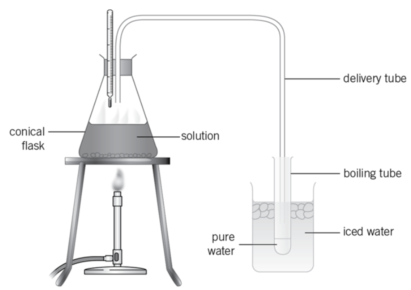
3. Sludge is digested anaerobically and burned or used for fertiliser.

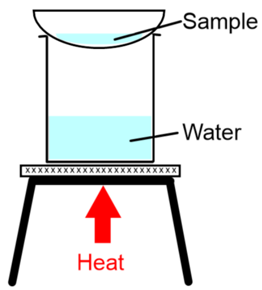
4. Effluent is digested aerobically and may also be sterilised by UV light or chlorine.

E. Required Practical: Analysis and purification of water samples.

Measure the boiling point. Pure water boils at 100 C.

Perform simple distillation of water. Test pH of water samples before and after using universal indicator or a pH meter. Pure water has pH of 7.





Test for dissolved solids: Weigh an evaporating basin. Add $10cm^3$ water sample. Heat over a Bunsen burner until the water evaporates. Weigh sample again and calculate the difference.