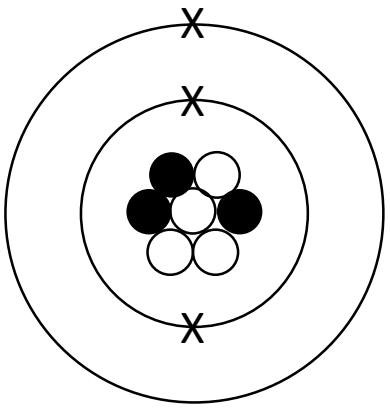
Atoms

- All substances are made of **atoms**.
- **Elements** are made of only one type of atom.
- **Compounds** contain more than one type of atom.
- Compounds are held together by **bonds**.
- **Mixtures** contain elements and compounds.



Protons and Neutrons are found in the **nucleus**.

Electrons orbit the nucleus in **shells**.

	Proton	Neutron	Electron
Mass	1	1	negligible
Charge	+	0	-
Location	nucleus	nucleus	shells

Any atom contains **equal** numbers of protons and electrons.

All atoms of a particular element have the same number of protons. Atoms of different elements have different numbers of protons.

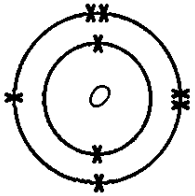
Mass number = Number of protons and neutrons

Atomic number = Number of protons

$^{7}_{3}Li$

Number of neutrons = Mass Number – Atomic Number

Electrons occupy particular energy levels. Each electron in an atom is at a particular energy level (in a particular shell). The electrons in an atom occupy the lowest available energy levels (innermost available shells).

8	O	1st shell: X X 2nd shell: X X X X X X 3rd shell: Config: 2, 6	

10 Questions

1. In the nucleus of an atom there are protons and _____.
2. Around the nucleus there are electrons in _____.
3. What is the charge on a proton?
4. Atoms are always neutral, explain why?
5. How many protons, neutrons and electrons does Lithium have?
6. What is the atomic number and mass number of Oxygen?
7. What is the electron configuration of Oxygen?
8. Draw the electronic structure of Magnesium.
9. How many different types of atom are in an element?
10. How are compounds and elements different?

Periodic Table and Bonding

- Each element has its own **symbol**.
- Columns are called **groups**.
- Elements in a group have similar properties.
- Rows are called **periods**.
- The staircase splits metals from non-metals.

1	2											3	4	5	6	7	8
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	?	?	?						

Elements in the same group in the periodic table have the same number of electrons in their highest energy level (outer electrons) and this gives them similar chemical properties.

Li
Na
K
Rb
Cs

Reactivity Increases

Reactions involve the loss of the outermost electron. Losing this electron seems to get easier as we go down the group.

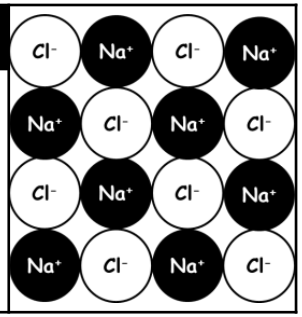
Atoms of the last group (noble gases) have stable arrangements and are unreactive

2 types of bonding:

- Transferring electrons → **IONIC BONDING**
- Sharing electrons → **COVALENT BONDING**

Ionic Bonding

- Metal and non-metal react
- Metals form positive ions,
- Non-metals negative ions
- Opposite charges attract
- A giant lattice is formed



Covalent Bonding

- When 2 non-metals bond
- Outermost electrons are shared
- A pair of shared electrons forms a bond

10 Questions

1. Lithium and potassium are in which group of the periodic table?
2. Does the reactivity of this group increase or decrease as you go down the group?
3. Do periods go across or down?
4. Are non-metals on the left or right side of the periodic table?
5. What are the group of elements called that site between group 2 and 3 in the periodic table?
6. Which element is in period 2, group 6?
7. Which element is in period 4 group 3?
8. Why are noble gases unreactive?
9. Ionic bonds exist between 2 non-metals, true or false?
10. Explain your answer to question 9.

Chemical Equations

- Chemical equations show the **reactants** (what we start with) and the **products** (what we end with).
- No atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants.
- We often use symbol equations to make life easier

calcium carbonate → calcium oxide + carbon dioxide

$CaCO_3$ → $CaO + CO_2$

100g 56g 44g

HT Only

- Equations **MUST** balance
- We can **ONLY** add **BIG** numbers to the front of a substance
- We can tell elements within a compound by **BIG** letters
- We can check an equation is balanced by counting the number of each type on either side

H = 2 O = 2	$H_2 + O_2 \rightarrow H_2O$ **Unbalanced**	H = 2 O = 1
H = 2 O = 2	$H_2 + O_2 \rightarrow 2H_2O$ **Unbalanced**	H = 4 O = 2
H = 4 O = 2	$2H_2 + O_2 \rightarrow 2H_2O$ **Balanced**	H = 4 O = 2

10 Questions

Assuming the thermal decomposition of copper carbonate

1. What are the reactants?
2. How many products?
3. What is the name of the solid product?
4. What is the name of the gaseous product
5. If I heated 5 tonnes of copper carbonate and got 3.5 tonnes of solid how much CO_2 will be given off?

Assuming the reaction: $Mg\ (s) + 2HCl\ (aq) \rightarrow MgCl_2\ (aq) + H_2\ (g)$

6. What are the names of the reactants?
7. What is the name of the gaseous product?
8. What does (aq) stand for?
9. Explain why the equation is balanced.
10. Describe a positive test for the gaseous product.

Limestone and Carbonates – 1

- Limestone is made mainly of Calcium Carbonate
- Calcium carbonate has the chemical formulae $CaCO_3$
- Some types of limestone (e.g. chalk) were formed from the remains of animals and plants that live millions of years ago

Use in Building

We use limestone in many buildings by cutting it into blocks.

Other ways limestone is used:

- **Cement** = powdered limestone + clay
- **Concrete** = Cement + Sand + Water

- Buildings made from limestone suffer from damage by acid rain
- This is because carbonates react with acid to form a salt, water and carbon dioxide

Calcium Carbonate + Hydrochloric Acid → Calcium Chloride + Water + Carbon Dioxide

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

Heating limestone and carbonates

Breaking down a chemical by heating is called **thermal decomposition.**

Calcium Carbonate → Calcium Oxide + Carbon Dioxide

$$CaCO_3 \rightarrow CaO + CO_2$$

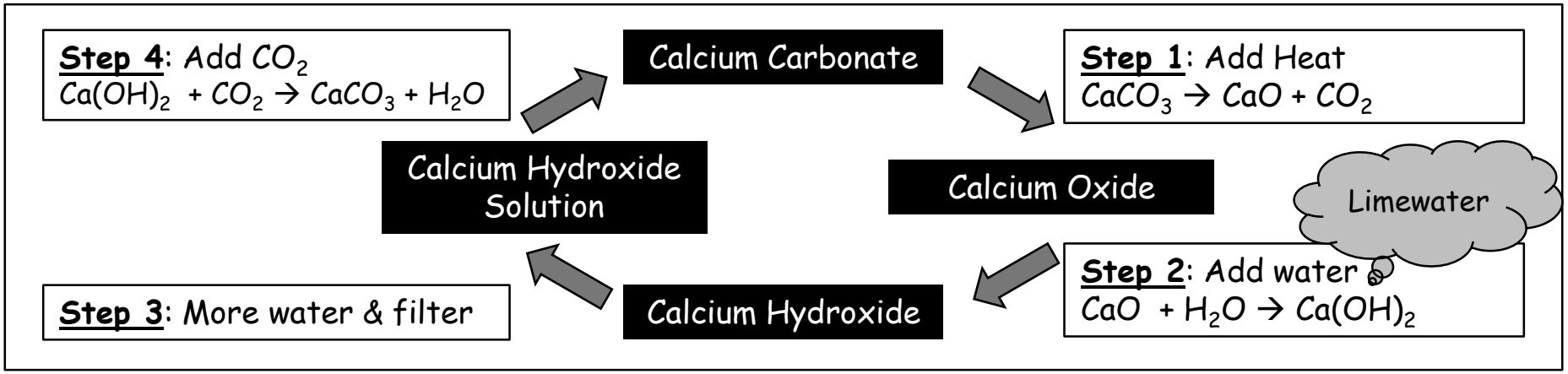
Testing for CO_2

- We use limewater to test for CO2
- Limewater turns cloudy
- A precipitate (tiny solid particles) of calcium carbonate forms causing the cloudiness!

10 Questions

1. Give 3 alternative names for $CaCO_3$
2. How many different types of atoms are there in $CaCO_3$
3. How many atoms in total are there in $CaCO_3$
4. Name 3 of the 4 substances found in concrete.
5. Which chemical do we use to test for the presence of CO_2?
6. What is considered a positive result for this test?
7. What is the chemical name for limewater?
8. Cement is made by heating powered limestone and _____ in a kiln?
9. Why do buildings made from limestone in built-up industrial areas erode?
10. Breaking down a chemical by heating is called _____ _____ ?

Limestone and Carbonates – 2



- Limestone is used widely as a building material
- We can also use it to make other materials for the construction industry

1. calcium carbonate + *heat* → calcium oxide + carbon dioxide
2. calcium oxide + water → calcium hydroxide

Cement
Made by heating limestone with clay in a kiln

Mortar
Made by mixing cement and sand with water

Concrete
Made by mixing crushed rocks or stones (called aggregate), cement and sand with water

Benefits	Drawbacks
• Provide jobs • Lead to improved roads • Filled in to make fishing lakes or for planting trees • Can be used as landfill sites when finished with	• Destroys habitats • Increased emissions • Noisy & Dusty • Dangerous areas for children • Busier roads

10 Questions

1. What gas is released when carbonates are heated strongly?
2. What solid product is formed when zinc carbonate is heated?
3. What is the name of the product formed when calcium oxide (CaO) is reacted with water (H_2O)?
4. What is the chemical formula of the solid formed when carbon dioxide (CO_2) is bubbled through calcium hydroxide ($Ca(OH)_2$)?
5. List 2 benefits of limestone quarrying.
6. List 2 drawbacks of limestone quarrying.
7. How can we separate calcium carbonate from water?
8. Why is the following reaction balanced: $CaCO_3 \rightarrow CaO + CO_2$?
9. What is the alternative name for calcium hydroxide?
10. List 1 social, environmental and economic consequence of busier roads caused by quarrying

Extracting Metals

Increasing reactivity

The Reactivity Series

Potassium
sodium
calcium
magnesium
aluminium

Carbon

zinc
iron
lead
copper
silver
gold

The reactivity of a metal determines the method of extraction.

Metals above carbon must be extracted using **electrolysis**.

Metals below carbon can be extracted by **reduction** using carbon, coke, or charcoal.

Gold and silver do not need to be extracted. They occur **native**.

- A metal compound within a rock is an **ore.**
- The metal is often combined with oxygen.
- Ores are mined and then purified.

- Iron Ore contains iron combined with oxygen
- A blast furnace and carbon to extract it.
- Carbon **REDUCES** the iron oxide:

Iron Oxide + Carbon → Iron + Carbon Dioxide

Copper-rich Ores

Large amounts of copper. There are 2 ways:

1. Smelting
- 80% of copper is produced this way.
- Heat copper ore in a furnace with air.

Copper Sulphide + Oxygen → Copper + Sulphur Dioxide
- Then use electrolysis to purify the copper .
- Expensive as needs lots of heat and power.

2. Copper Sulphate
- Add sulphuric acid to a copper ore
- Produces copper sulphate
- Extract copper using electrolysis or displacement

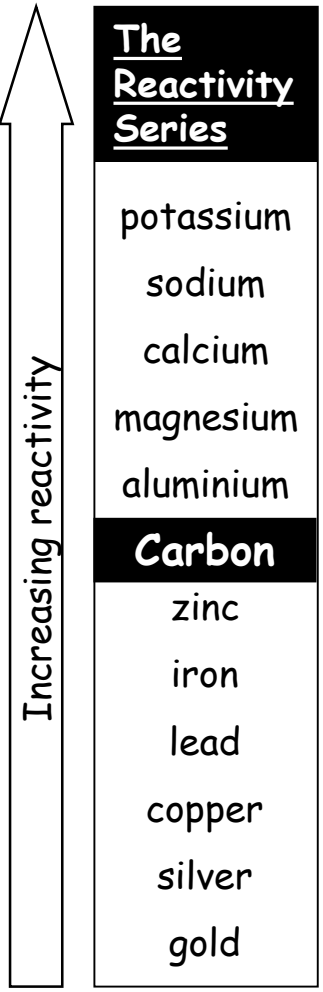
Low Grade Copper Ores

Small amount of copper. There are 2 main ways:

1. Phytomining
- Plants absorb copper ions from low-grade ore
- Plants are burned
- Copper ions dissolved by adding H_2SO_4
- Use displacement or electrolysis to extract pure Cu

2. Bioleaching
- Bacteria feed on low-grade ore
- Produce a waste product that contains copper ions
- Use displacement or electrolysis to extract pure Cu

10 Questions



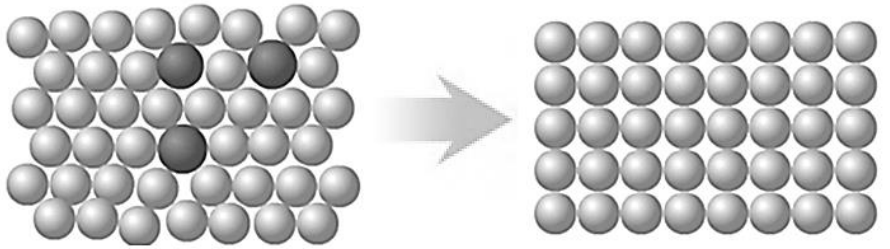
1. A metal compound within a rock is an _____.
2. How do we extract metals above carbon?
3. Why does gold not need to be extracted?
4. Why do we use carbon to extract lead from lead sulphide as opposed to a more reactive metal such as sodium?
5. Complete the following reaction used in extraction:

   copper oxide + carbon → _____ + _____ _____

6. Name one method of extracting low-grade copper ores.
7. Name one method of extracting copper-rich ores.
8. Inside what device is the smelting process performed?
9. Why electrolysis is expensive (2 reasons)?
10. Name the process for taking ores out of the ground.

Aluminium, Titanium and Alloys

	Aluminium	Titanium
Property	Shiny, Light, Low density, Conducts electricity and energy, Oxide layer on the surface prevents **corrosion**, Malleable – easily shaped, Ductile – made into cables or wires, Improve hardness by forming **alloys**. These alloys are **stronger** and **rigid** than pure Al.	Strong, Oxide layer on the surface prevents **corrosion**, High melting point – so can be used at high temperatures, Less dense than most metals
Use	Uses: Drinks cans, cooking oil, saucepans, overhead cables, aeroplanes and bicycles.	Uses: Hip replacements, racing bikes, jet engines, parts of nuclear reactors.
Extraction	• Aluminium ore is mined and extracted. • Aluminium oxide (the ore) is melted • Electric current passed through a high temperature ***Expensive process – need lots of heat and electricity***	• Use sodium or potassium to displace titanium from its ore • Get sodium and magnesium from electrolysis ***Expensive – lots of steps involved, & needs lots of heat and electricity***



A metal mixed with other elements is called an **ALLOY**. Alloys are harder than pure metals.

IRON ALLOYS

Steel → Iron with carbon and/or other elements. Impurities make it brittle.

There are a number of types of steel alloys:
- Carbon steels
- Low/High-alloy steels
- Stainless steels

COPPER ALLOYS

Bronze (Copper + Tin)
- Tough
- Resistant to corrosion

Brass (Copper + Zinc)
- Harder but workable

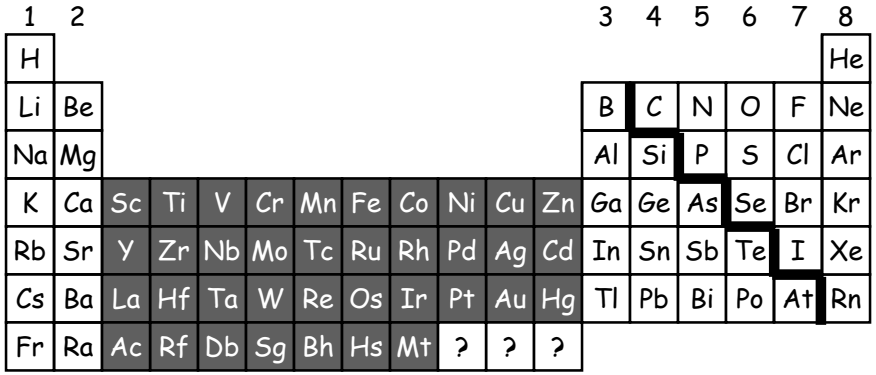
ALUMINIUM ALLOYS
- Alloyed with a wide range of other elements
- All have very different properties
- E.g. in aircraft or armour plating!

GOLD ALLOYS
- Usually add Copper to make jewellery last longer

10 Questions

1. What prevents aluminium and titanium from corroding?
2. State 2 uses of aluminium.
3. State 2 uses of titanium.
4. Give 2 reasons why we choose to recycle aluminium
5. Why do we alloy aluminium with other metals?
6. What do we react with iron to produce steel
7. State 1 benefit of stainless steel over iron.
8. Why are alloys harder than pure metals?
9. Is brass a pure metal or an alloy?
10. Explain your answer to question 9.

Transition Metals + Issues



1	2											3	4	5	6	7	8
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	?	?	?						

Transition Metals

Found in the central block of the periodic table

Properties:

- Good conductors of electricity and energy
- Strong
- Malleable – easily bent into shape

Uses:

- Buildings
- Transport (cars, trains etc)
- Heating systems
- Electrical wiring

Example (Copper):

- Water pipes – easily bent into shape, strong, doesn't react with water
- Wires – ductile and conduct electricity

Exploiting Ores

- Mining has many environmental consequences:
- Scar the landscape
- Noisy & Dusty
- Destroy animal habitats
- Large heaps of waste rock
- Make groundwater acidic
- Release gases that cause acid rain

Recycling Metals

- Recycling aluminium saves 95% of the energy normally used to extract it!
- This saves money!
- Iron and steel are easily recycled. As they are magnetic they are easily separated
- Copper can be recycled too – but it's trickier as it's often alloyed with other elements

Benefits	Drawbacks
• Steel is strong for girders. • Aluminium is corrosion resistant. • Many are malleable. • Copper is a good conductor and not reactive.	• Iron & steel can rust. • Extraction causes pollution. • Metals are more expensive than other materials like concrete.

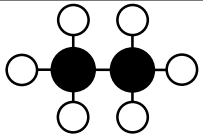
10 Questions

1. Is the majority of the periodic table metals or non-metals?
2. Name a transition metal which would be found **native**.
3. Which 2 groups of the periodic table are the transition metals found between?
4. Give 2 reasons why we use copper to make water pipes.
5. Give 2 drawbacks of mining transition metal ores.
6. Give 2 properties of transition metals
7. Is potassium a transition metal?
8. Explain your answer to question 7
9. Give 2 reasons why we recycle metals.
10. Which transition metal is a liquid at room temperature (*not on exam*)?

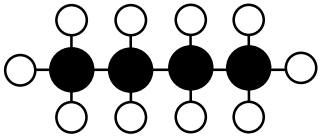
Hydrocarbons and crude oil

Crude Oil

- A **mixture** of lots of different compounds.
- We separate it into substances with similar **boiling points**. These are called **fractions**.
- This is done in a process called **fractional distillation**.

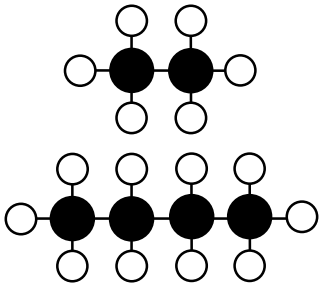


Fractions with low boiling points condense at the top.



Fractional Distillation

- **Refinery Gas** (fuel)
- **Petrol** (cars)
- **Naphtha** (industry)
- **Kerosene** (jet fuel)
- **Diesel** (engines)
- **Residue** (road surface)

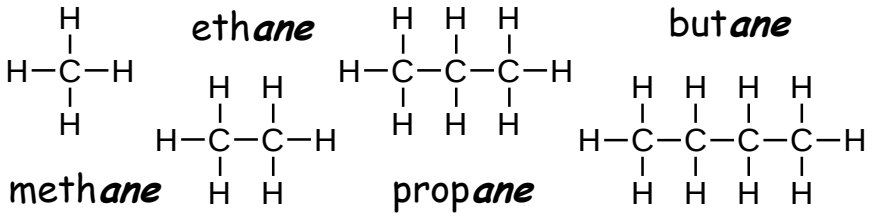


Increasing length

Longer chains mean…

1. Less ability to flow
2. Less flammable
3. Less volatile
4. Higher boiling point

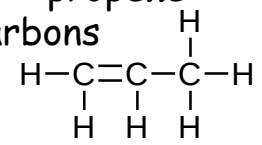
Nearly all the compounds in crude oil are **hydrocarbons** (hydrogen and carbon only).



- Most of these are **saturated** hydrocarbons called **alkanes**.
- General formula for an alkane is $C_nH_{(2n+2)}$.

Alkenes

- These are unsaturated hydrocarbons
- They contain a double bond
- General formula is C_nH_{2n}



Combustion of hydrocarbons

- When burnt in an adequate supply of air alkanes react to form **carbon dioxide**, e.g.

propane + oxygen → carbon dioxide + water

- When burnt in not enough oxygen **carbon monoxide** is formed instead

propane + oxygen → carbon monoxide + water

10 Questions

1. Which 2 elements do hydrocarbons contain?
2. The process of separating out hydrocarbons by their boiling points is called _____ _____ ?
3. Short chain hydrocarbons have the _____ (lowest / highest) boiling points.
4. How many bonds does carbon always form?
5. What is the name of the alkane with the formula C_2H_6?
6. How many carbon atoms does propane have?
7. The general formula for an alkane is: C_nH_{2n}, C_nH_{2n+2} or $C_{n+2}H_{2n}$
8. A hydrocarbon has 14 hydrogen atoms, how many carbon atoms will it have if it is (a) and alkane (b) and alkene?
9. What is the formula of the saturated hydrocarbon from question 8?
10. Which 2 products are formed when cyclohexane is burned in a plentiful supply of oxygen?

Pollution and Fuels

Fossil fuels also produce a number of impurities when they are burnt, main pollutants are summarised below

Sulphur Dioxide	Nitrogen Oxide	Particulates
• Poisonous gas • It's acidic • Causes **acid rain** • Causes engine corrosion	• Poisonous • Trigger asthma attacks • Can cause **acid rain**	• Tiny solid particles • Contain carbon and unburnt hydrocarbon • Carried in the air • Damage cells in our lungs • Cause cancer

Global Warming

- Caused by carbon dioxide
- Causing the average global temperature to increase

Global Dimming

- Caused by particulates
- Reflect sunlight back into space
- Not as much light gets through to the Earth

Biodiesel

Advantages	Disadvantages
• Less harmful to animals • Breaks down 5 × quicker • Reduces particulates • Making it produces other useful products • 'CO_2 neutral' – plants grown to create it absorb the same amount of CO_2 generated when it's burnt	• Large areas of farmland required • Less food produced → Famine • Destruction of habitats • Freezes at low temps

Ethanol

Advantages	Disadvantages
• Easily made by fermenting sugar cane • Gives off CO_2 but the sugar cane it comes from absorbs CO_2 when growing	• Large areas of farmland required • Less food produced as people use it for fuel instead!

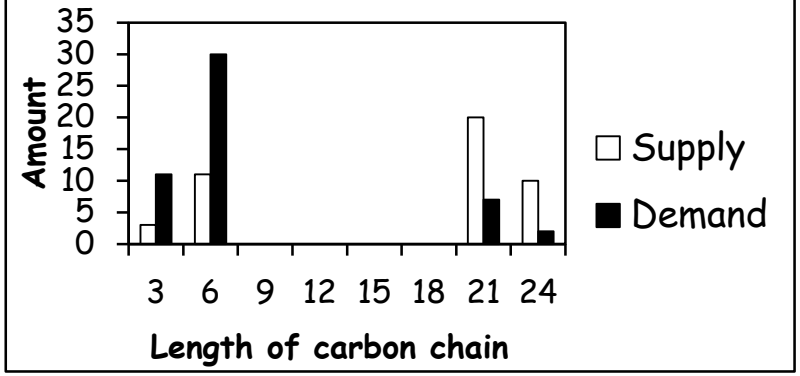
Hydrogen

Advantages	Disadvantages
• Very clean – no CO_2 • Water is the only product	• Hydrogen is explosive • Takes up a large volume → storage becomes an issue

10 Questions

1. What pollutant causes acid rain?
2. What pollutant causes global dimming?
3. What pollutant causes global warming?
4. State a consequence of global warming.
5. State 1 advantage and 1 disadvantage of biodiesel.
6. Yeast cells respire during the fermentation process, what gas is given off?
7. Why is hydrogen considered a clean fuel?
8. State 1 disadvantage of hydrogen as a fuel.
9. What is the chemical formula of ethanol?
10. Explain the term carbon neutral.

Cracking and Polymerisation



Short chain preferred so longer chain 'cracked' to make shorter ones

Cracking

By heating a long chain fraction from crude oil to produce a vapour and then passing the vapour over a **catalyst** you can 'crack' it into smaller, more useful hydrocarbons

Decane	→	pentane	+	propene	+	ethene
$C_{10}H_{22}$	→	C_5H_{12}	+	C_3H_6	+	C_2H_4

Saturated or unsaturated?

We can react products with bromine water to test for saturation:

Unsaturated hydrocarbon + Bromine Water → COLOURLESS

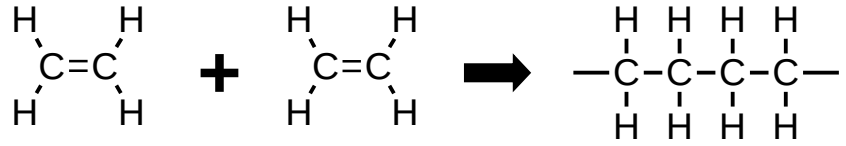
= ALKENES (alkanes will not react!)

Polymerisation

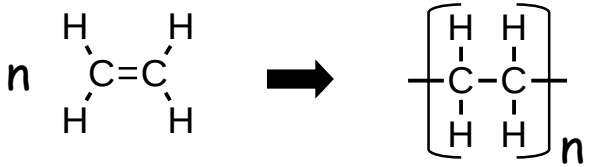
Polymers (plastics) re made from lots of **monomers** joined together to make a **polymer**

Process

- Double bond between carbons 'opens up'
- Replaced by single bonds as thousands of monomers join up

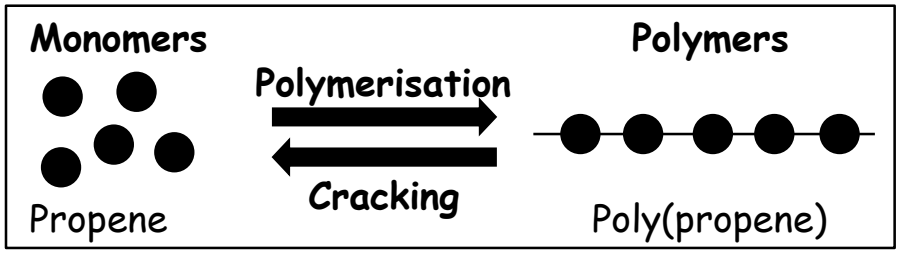


Ethene Ethene Poly(ethene)



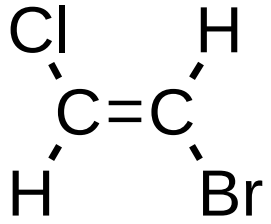
Simplified way of writing it

'n' represent a large repeating number



10 Questions

1. How do we turn long chain hydrocarbons into short chain ones?
2. What type of substance speeds up a chemical reaction without being used up?
3. What chemical is used to test for unsaturated hydrocarbons?
4. What would you expect to see during this test?
5. Name the monomer used to make: Polytetrafluoroethylene
6. Why do alkanes not react with bromine water?
7. Name the polymer formed by using the monomer: vinylchloride.
8. Draw the polymer formed by reacting 'n' monomers of:



9. What is the first step of the polymerisation process?
10. What is the second step?

New Polymers, waste and ethanol

Smart Polymers
Their properties changed by light, temperature or other changes in their surroundings.

Light-Sensitive Plasters	Hydrogels	Shape memory polymers
• Top layer of plaster peeled back • Lower layer now exposed to light • Adhesive loses stickiness • Peels easily off the skin	• Have cross-linking chains • Makes a matrix that traps water • Act as wound dressings • Let body heal in moist, sterile conditions • Good for burns	• Wound is stitched loosely • Temperature of the body makes the thread tighten • Closes the wound up with the right amount of force

Issues with polymers

Biodegradable	Non-biodegradable
• Farmers sell crops like corn to make plastics • Demand for food goes up • Food prices go up • Habitats destroyed to make farmland	• Don't break down • Litter the streets and shores (unsightly) • Harm wildlife • Last 100's of years • Fill up landfill sites

Biodegradable Plastics
- Plastics that break down easily
- Corn-starch are built into the plastic
- Microorganisms in soil feed on corn-starch
- This breaks the plastic down

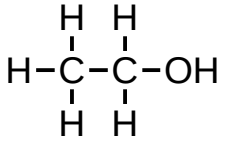
Ethanol - 2 main ways to make ethanol

Fermentation	Hydration
Uses corn, sugar cane, rice etc,(renewable resources).	Uses crude oil, which is a non-renewable resource.
Is a batch process, which needs a lot of workers	Is a continuous process so is less labour intensive
Produces impure ethanol, and is purified by distillation	Produces pure ethanol
Needs a temperature of 30-40 °C	Needs a temperature of 300 °C and high pressure
Is a slow reaction	Is a fast reaction

Fermentation
Sugar + Yeast → Ethanol + Carbon Dioxide

Hydration
Ethene + Steam → Ethanol

$C_2H_4 + H_2O \rightarrow C_2H_5OH$



Ethanol

10 Questions

1. Which smart polymer would you use in nappies to absorb moisture?
2. Which smart polymer would you use to make light sensitive plasters?
3. Which smart polymer would you use to make dental bracers?
4. State 2 issues associated with biodegradable plastics.
5. State 2 issues associated with non-biodegradable plastics.
6. What is put into polymers to make biodegradable plastics?
7. What is the chemical formula of steam?

Answers to the following are **fermentation** or **hydration**:

8. Which process is cheaper?
9. Which process requires a high temperature?
10. Which process uses non-renewable sources?

Oils

2 ways to extract vegetable oils from plants:

Pressing	Distillation
1. Farmers collect seeds from plants 2. Seeds are crushed and pressed, then the oil extracted 3. Impurities are removed 4. Oil is processed to make it into a useful product	1. Plants are put into water and boiled 2. Oil and water evaporate together 3. Oil is collected as the liquids separate e.g. lavender oil

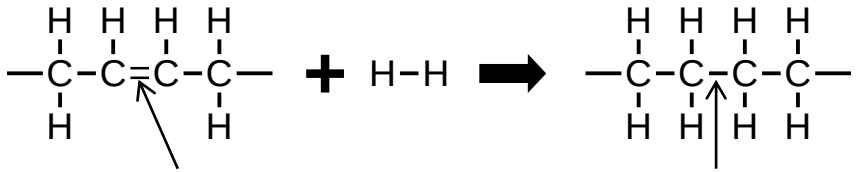
Vegetable oils are important foods:

- Provide important nutrients (e.g. vitamin E)
- Contain lots of energy → can be used as fuels
- Unsaturated oils contain double bonds (C=C) → they decolourise Bromine water

Benefits of cooking with oil:

- Food cooks quicker
- Outside becomes crispier
- Inside becomes softer
- Food absorbs some of the oil
- Higher energy content
- Too much is unhealthy

HT Only



- Reacting vegetable oils with **hydrogen** hardens them → increases melting points
- Makes them solid at room temperature → makes them into spreads!
- Double bonds converted to single bonds C=C → C-C
- Now called a **hydrogenated oils**
- Reaction occurs at 60°C with a nickel catalyst

10 Questions

1. Vegetable oil has a boiling point of 300°C, why is cooking with a fryer faster than cooking with water?
2. Which cooks faster under the same conditions, 1kg baking potato or 1kg of chips?
3. Explain your answer to question 2.
4. Which are worse for your health; saturated or unsaturated oils?
5. Why are vegetable oils important in your diet?

Answers to the following are **Pressing** or **Distillation**:

6. In which process is oil and water evaporated together?
7. In which process is groundnut oil made?
8. In which process would you need to separate oil from a pulp?

HT Only

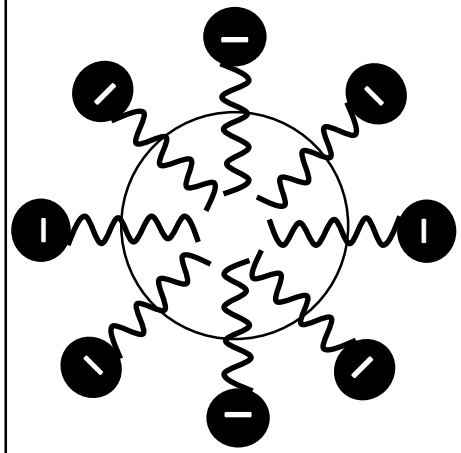
9. What catalyst is used in the hydrogenation of unsaturated vegetable fats?
10. How does a catalyst work?

Emulsions and Food Issues

Oils do not dissolve in water, they are immiscible

Emulsions
Where oil and water are dispersed (spread out) in each other. They have special properties.

HT Only
Emulsifiers have 2 parts that make them work



- **Hydrophobic tail** – is attracted to oil
- **Hydrophilic head** – is attracted to water. Has a negative charge.

Emulsifiers
- Stop water and oil separating out into layers
- Improve texture and taste of foods containing fats and oils.
- Makes them more palatable (tasty) and tempting to eat!

Vegetable Oils	**Animal Fats**
Unsaturated Fats: • Source of nutrients like vitamin E • Keep arteries clear • Reduce heart disease • Lower cholesterol levels	**Saturated Fats:** • Are not good for us • Increase risk of heart disease • Increase cholesterol

E Numbers
Additives approved for use in Europe

10 Questions

1. What type of reagent stops water and oil separating out into layers?
2. What is formed when oil and water are dispersed in each other?
3. Why do we use emulsifiers in cooking?
4. Which are better for us, vegetable oils or animal fats?
5. What type of numbers are put onto food labels in Europe and include information about the additives present?

Answers to the following are **Unsaturated Fats** or **Saturated Fats**:

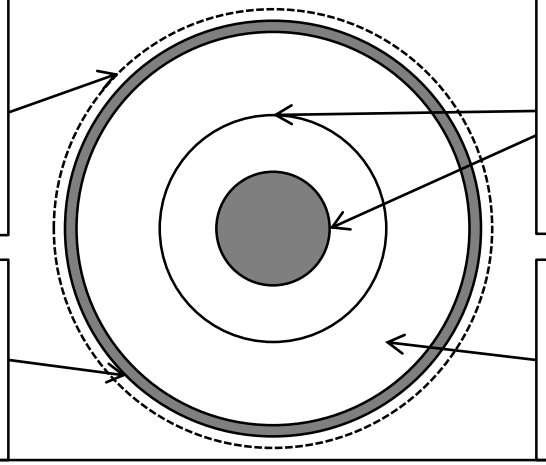
6. What type of fat lowers cholesterol?
7. What type of fat causes heart disease

HT Only

8. What part of an emulsifier is attracted to the oil?
9. What part of an emulsifier is attracted to the water?
10. What type of charge does the Hydrophilic head have?

The Earth's Structure

Atmosphere:
- Most lies within 10km of the surface
- Rest is within 100km but it's hard to judge!



Core:
- Made of nickel and iron
- Outer core is liquid
- Inner core is solid
- Radius is 3500km

Crust:
- Solid
- 6km beneath oceans
- 35km beneath land

Mantle
- Behaves like a solid
- Can flow very slowly
- Is about 3000km deep!

Moving Continents
- The Earth's crust and upper mantle are cracked into a number of pieces → **tectonic plates**
- These are constantly moving - just very slowly
- Motion is caused by **convection currents** in the mantle, due to radioactive decay

Pangea

If you look at the continents they roughly fit together. Scientists think they were once one large land mass called Pangea, which then broke off into smaller chunks

Wegener's evidence for continental drift:
- The same types of fossilised animals and plants are found in South America and Africa
- The shape of the east coast of South America fits the west coast of Africa, like pieces in a jigsaw puzzle.
- Matching rock formations and mountain chains are found in South America and Africa

Plate Boundaries
- Earthquakes and volcanoes happen when tectonic plates meet
- These are very difficult to predict

10 Questions

1. Put the layers of the Earth in order from outside inwards: outer core, mantle, crust, inner core, mantle, atmosphere
2. Which layer of the Earth is the hottest?
3. Which layers of the Earth are solid (there are 2)?
4. In which layer of the Earth do convection currents occur?
5. What type of plates is the Earth's crust cracked into?
6. State 2 pieces of evidence to support Wegener's idea of continental drift
7. Why did no one believe Wegener's theory
8. What was the name given to the Earth when it was just one super continent?
9. State 3 natural events which occur at plate boundaries.
10. Why are Earthquakes difficult to predict?

The Earth's Atmosphere

Evolution of the Earth's Atmosphere

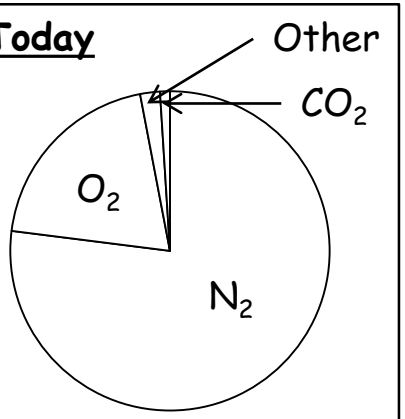
Phase 1	Phase 2	Phase 3
Volcanoes = Steam & CO_2	**Green Plants, Bacteria & Algae = Oxygen**	**Ozone Layer = Animals & Us**
• Volcanoes kept erupting giving out Steam and CO_2 • The early atmosphere was nearly all CO_2 • The earth cooled and water vapour condensed to form the oceans	• Green plants, bacteria and algae ran riot in the oceans! • Green plants steadily converted CO_2 into O_2 by the process of photosynthesis • Nitrogen released by denitrifying bacteria • Plants colonise the land. Oxygen levels steadily increase	• The build up of O_2 killed off early organisms - allowing evolution of complex organisms • The O_2 created the Ozone layer (O_3) which blocks harmful UV rays from the sun • Virtually no CO_2 left

Carbon Dioxide Levels

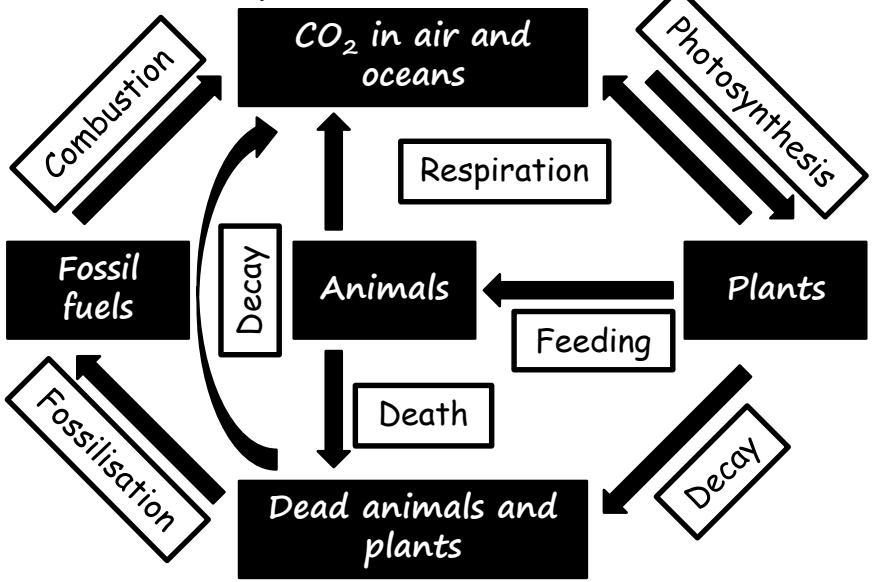
Have increased in the atmosphere recently largely due to the amount of fossil fuels we now burn

The Earth's Atmosphere Today

Gas	Formula	%
Nitrogen	N_2	71
Oxygen	O_2	28
Other		0.94
Carbon dioxide	CO_2	0.06



The Carbon Cycle



10 Questions

1. Name a gas in the Earth's early atmosphere (other than CO_2)
2. What are the origins of CO_2 in the Earth's early atmosphere?
3. What process undergone by plants removed CO_2 from the Earth's early atmosphere?
4. How did the oceans form from the early atmosphere?
5. Which is the most abundant gas in the atmosphere today?
6. State 3 sinks of CO_2 on the planet (i.e. where it is stored).
7. What is the main cause of the rising levels of CO_2 in the atmosphere today?
8. Why could the levels of CO_2 in todays atmosphere be considered insignificant?
9. The level of CO_2 in the atmosphere is maintained by this cycle.
10. In the atmosphere what blocks harmful UV radiation from the sun?

Life on Earth

HT Only

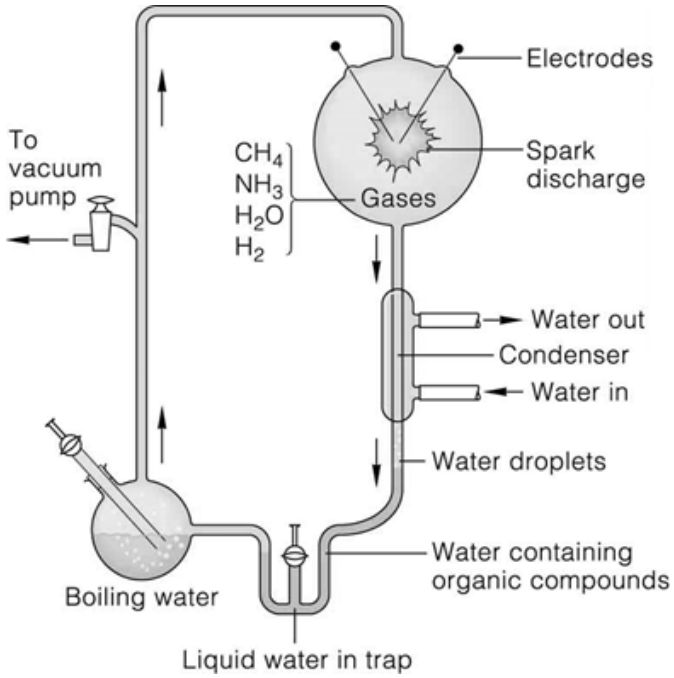
No one can be sure how life on Earth first started. There are many different theories:

Miller-Urey Experiment

- Compounds for life on Earth came from reactions involving hydrocarbons (e.g. methane) and ammonia
- The energy for this could have been provided by lightning

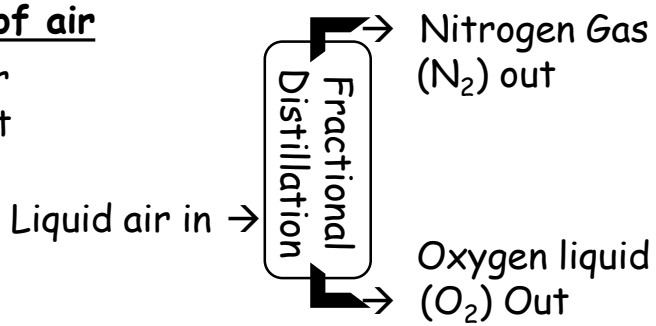
Other Theories

1. Molecules for life (amino acids) came on meteorites from out of space
2. Actual living organisms themselves arrived on meteorites
3. Biological molecules were released from deep ocean vents



Fractional Distillation of air

- The main gases in air can be separated out by fractional distillation.
- These gases are useful in industry



Carbon Dioxide

- Taken in by plants during photosynthesis.
- When plants and animals die carbon is transferred to rocks.
- Form fossil fuels, the CO_2 is released into the atmosphere when burnt.

10 Questions

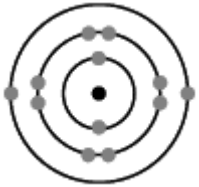
1. State 3 ways in which CO_2 is removed from the atmosphere.
2. Other than water what other product is formed when fossil fuels are burnt?
3. Name 2 gases thought to be in the Earth's early atmosphere.

HT Only

4. What process can be used to separate gases in the air?
5. Which chemical has the lowest boiling point; CO_2 or Nitrogen?
6. What was the Miller-Urey experiment trying to prove?
7. What natural event is required for gases in the atmosphere to react?
8. Considering this event, what is a flaw in the design of the experiment?
9. What type of simple molecules fundamental to life were found as a product during the experiment?
10. Why could the evidence provided be considered weak?

Mark Scheme

Atoms

1. Neutrons
2. Shells (*accept: Orbitals*)
3. +1 (*accept: positive, plus, +*)
4. Atoms are neutral because they contain equal numbers of protons and electrons.
5. Protons = 3, Electrons = 3, Neutrons = 3.
6. Atomic number = 8, Mass Number = 16
7. 2,6
8. Magnesium atom, Mg = 
9. One type of atm
10. Elements contain only one tpye of atom, compounds more than one. (*accept: elements are on the periodic table*)

Periodic Table and Bonding

1. Group 1 (*accept Alkali Metals*)
2. Increase
3. Across
4. Right
5. Transition metals/elements
6. Oxygen
7. Gallium
8. Full outer shell of electrons (*accept: all electrons are paired, or, no electrons can be added or taken away, or, forms a stable configuration*)
9. False
10. Ionic bonds exist between metals and non-metals.

Chemical Equations

1. Copper carbonate.
2. 2 products
3. Copper oxide
4. Carbon dioxide
5. 1.5 tonnes
6. Magnesium and Hydrochloric acid
7. Hydrogen
8. Aqueous, dissolved in water.
9. Equal number of atoms on both sides of the equation.
10. Squeaky pop is heard with a lit splint

Mark Scheme

Limestone and Carbonates – 1

1. Calcium carbonate, limestone, chalk, marble, travertine.
2. 3
3. 5
4. Sand, water, gravel cement.
5. Limewater (*accept: calcium hydroxide, or, $Ca(OH)_2$*).
6. Limewater turns cloudy/milky.
7. Calcium hydroxide, $Ca(OH)_2$
8. Clay.
9. Acid rain.
10. Thermal decomposition.

Limestone and Carbonates – 2

1. Carbon dioxide, CO_2
2. Zinc oxide.
3. Calcium hydroxide, $Ca(OH)_2$
4. $CaCO_3$
5. Provide jobs, Lead to improved roads, Filled in to make fishing lakes or for planting trees, Can be used as landfill sites when finished with. (*accept: any other sensible answer*).
6. Destroys habitats, Increased emissions, Noisy & Dusty, Dangerous areas for children, Busier roads. (*accept: any other sensible answer*).
7. Filtering (*accept: Filter paper, or, decanting*)
8. Equal number of atoms on both sides of the equation.
9. Limewater.
10. Social: noise and dust leading to health problems. Environmental: habitats destroyed to make way for roads. Economic: People late for work costs the economy money. (*accept: any other sensible answer*).

Extracting Metals

1. Ore.
2. Electrolysis (*accept: use a more reactive metal*).
3. It is found native.
4. Carbon is cheap.
5. Copper + carbon dioxide.
6. Bioleaching or Phytomining.
7. Smelting (*accept: electrolysis of copper sulphate*).

Mark Scheme

8. A kiln.
9. Money is needed to pay workers, required a lot of energy, lots of trucks needed to move the copper (*accept: any other sensible answer*).
10. Mining.

Aluminium, Titanium and Alloys

1. Oxide layer on the surface.
2. Drinks cans, cooking oil, saucepans, overhead cables, aeroplanes and bicycles, cooking foil.
3. Hip replacements, racing bikes, jet engines, parts of nuclear reactors.
4. Mining has many environmental, Large heaps of waste rock, requires less energy, (*accept: any other sensible answer*).
5. Requires energy, need to employ peopl – costing money. (*accept: any other sensible answer*).
6. Good conductors of electricity and energy, Strong, Malleable – easily bent into shape, High melting points.
7. Does not rust, shiny (more attractive).

8. The different sized atoms of the metals distort the layers in the structure, making it more difficult for them to slide over each other and so make alloys harder than pure metals.
9. Alloy.
10. Cannot be found on the periodic table.

Transition Metals + Issues

1. Metals.
2. Gold, silver, platinum.
3. Group 2 and group 3.
4. Good conductor of heat, can easily be bent into shape (malleable).
6. Destroys habitats, Increased emissions, Noisy & Dusty, Dangerous areas for children, Busier roads. (*accept: any other sensible answer*).
7. No.
8. It is in group 1.
9. Saves money, saves energy, we will run out eventually. (*accept: any other sensible answer*).
10. Mercury, Hg.

Mark Scheme

Hydrocarbons and crude oil

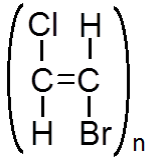
1. Hydrogen and carbon.
2. Fractional distillation.
3. Lowest.
4. 4
5. Ethane.
6. 3
7. C_nH_{2n+2}
8. Alkane = 6, Alkene = 7
9. C_6H_{14}
10. Carbon dioxide (CO_2) and water (H_2O)

Pollution and Fuels

1. Sulphur dioxide, SO_2
2. Carbon particulates
3. Carbon dioxide CO_2
4. The Earth gets hotter
5. **Advantages**: Less harmful to animals, Breaks down quicker. Reduces particulates, Making it produces other useful products, 'CO_2 neutral'. **Disadvantages**: Large areas of farmland required, Less food produced → Famine, Destruction of habitats, Freezes at low temps
6. Carbon dioxide CO_2
7. Only product is water (no CO_2) when burnt.
8. Hydrogen is explosive, Takes up a large volume, therefore storage becomes an issue.
9. C_2H_5OH
10. CO_2 neutral' – plants grown to create it absorb the same amount of CO_2 generated when it's burnt

Cracking and Polymerisation

1. Cracking.
2. Catalyst.
3. Bromine water.
4. Colour change from orange to colourless.
5. Tetrafluoroethylene.
6. The do not contain double bonds.
7. Polyvinylchloride (PVC)
8. The polymer formed is:



9. Double bond between carbons 'opens up'
10. Replaced by single bonds as thousands of monomers join up.

Mark Scheme

New Polymers, waste and ethanol

1. Hydrogel
2. light sensitive plasters
3. Shape memory polymers
4. Farmers sell crops like corn to make plastics, Demand for food goes up, Food prices go up, Habitats destroyed to make farmland. (*accept: any other sensible answer*).
5. Don't break down, Litter the streets and shores (unsightly), Harm wildlife, Last 100's of years, Fill up landfill sites. (*accept: any other sensible answer*).
6. Corn-starch.
7. H_2O.
8. Fermentation.
9. Hydration.
10. Hydration.

Oils

1. Temperature is higher in the fryer.
2. 1kg o chips.
3. Larger surface area.
4. Saturated fats
5. Provide important nutrients (e.g. vitamin E)
6. Distillation.
7. Pressing.
8. Pressing.
9. Nickel
10. Speeds up a chemical reaction without being used up. (*accept: lowers the activation energy for successful collisions to occur*).

Emulsions and Food Issues

1. Emulsifier.
2. Emulsion.
3. Improve texture and taste of foods containing fats and oils, or, makes them more palatable (tasty) and tempting to eat.
4. Vegetable oils
5. E-numbers
6. Unsaturated
7. Saturated
8. Hydrophobic tail
9. Hydrophilic head
10. Negative

Mark Scheme

The Earth's Structure

1. Atmosphere, crust, mantle, outer core, inner core.
2. Inner core.
3. Crust, inner core.
4. Mantle.
5. Tectonic plates.
6. The same types of fossilised animals and plants are found in South America and Africa, or, The shape of the east coast of South America fits the west coast of Africa, like pieces in a jigsaw puzzle, or, Matching rock formations and mountain chains are found in South America and Africa.
7. Very little evidence, cannot see under the Earth's surface i.e. convection currents.
8. Pangea.
9. Volcanoes, Earthquakes, mountains.
10. Unsure of the direction of convection currents, cannot see under the curst (*accept: any other sensible answer*).

The Earth's Atmosphere

1. Ammonia (NH_3), or, Methane (CH_4), or, Water (H_2O), or, Hydrogen (H_2)
2. Volcanoes.
3. Photosynthesis.
4. The earth cooled and water vapour condensed to form the oceans
5. Nitrogen
6. Oceans, Fossil fuels, Rocks, Plants
7. Burning of fossil fuels.
8. There is only a very low percentage compared to other gases.
9. Carbon cycle.
10. The ozone layer (O_3)

Life on Earth

1. Taken in by plants during photosynthesis, When plants and animals die carbon is transferred to rocks, Form fossil fuels, the CO_2 is released into the atmosphere when burnt.
2. Carbon dioxide, CO_2 (*accept: sulphur dioxide, SO_2*).

Mark Scheme

Life on Earth (continued)

3. Carbon dioxide (CO_2), Ammonia (NH_3), or, Methane (CH_4), or, Water (H_2O), or, Hydrogen (H_2).
4. Fractional distillation.
5. Nitrogen.
6. How life o Earth first started.
7. Thunderstorm (*accept: lightning*).
8. Constant lightning for a week or more does not happen.
9. Amino acids.
10. There is a large gap between amino acids and living organisms, or, no-one can be sure what the gases were when the Earth began