AQA Trilogy Science

SAMUEL WARD ACADEMY TRUST

Paper 1 Chemistry topics

- Atoms, molecules and moles
  - Atomic structure
  - The periodic table
  - Structure and bonding
  - Chemical calculations
- Chemical changes and energy changes
  - Chemical changes
  - Electrolysis
  - Energy changes

Paper 2 Chemistry topics

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
  - The Earth's resources

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Key points to learn

1. Chemical reaction	Reactants → Products *'turn into'*
2. Reactants	Ingredients in a chemical reaction
3. Products	The chemicals that are produced
Conservation of mass	In a chemical reaction the total mass of reactants = total mass of products
4	
5. Rate	How quickly something happens. Usually measured per second
6. Rate of reaction	How fast reactants turn into products
7. Measuring rate of reaction	1. Measure decrease in mass of a reaction if a gas is given off
	2. Increase in volume of gas given off. Catch gas given off
	3. Decrease in light passing through a solution
8. Calculating rate of reaction	The steepness of the line at any point on a reaction vs time graph.
	The steeper the line on the reaction vs time graph, the faster the reaction
9. Increasing temperature	Increases speed and energy of particles
10. Concentration	Amount of a substance per defined volume units of mol/dm^3
11. Pressure	Force applied per unit area [N/m^2]
12 Endothermic	Reaction that absorbs in energy
13 Exothermic	Reaction that releases heat energy
14 Equilibrium	Concentrations remain constant

Key points to learn

15. Collision theory	Reactions occur when particles collide with enough energy
16. Activation energy	Minimum energy needed in a collision for a reaction to occur
17. Increasing rate of reaction	1. Either need more particle collisions or more energetic collisions
	2. Increase surface area to volume ratio: greater rate of collisions
	3. Increase concentration: more particles, greater rate of collisions
	4. Increase pressure: particles closer, greater rate of collisions
	5. Increase temperature: greater rate of collisions each with more energy
	6. Use of a catalyst: reduce activation energy required for a reaction to happen
18. Catalyst	A substance that helps a reaction take place but is not used up itself
	In industry the increase rates of reaction and reduce energy cost
19. Reversible reactions	A reaction where the products will turn back into the products
	Reactants ⇌ Products
	eg hydrated copper sulfate ⇌ Anhydrous copper sulfate + water

Trilogy C8: Rates and equilibrium

Part of: The rate and extent of chemical change

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - Crude oil and fuels
- Analysis and the Earth's resources
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  - The Earth's atmosphere
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Background

In your body there are lots of reactions taking place all the time. Reactions are also important in industry to make products to sell for money. How do we measure or accelerate these reactions up? This topic finds out.

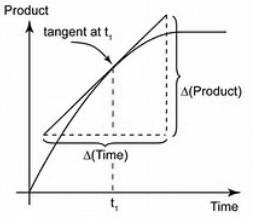
Additional

Look back at Trilogy C7: Energy Changes for more on endothermic, exothermic and activation energy.

Maths skills

Finding the steepness (gradient) of a curved line at a point using a tangent.

Gradient = rise ÷ run



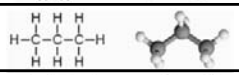
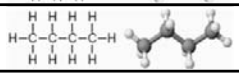
Rate of reaction = Δ(Product) ÷ Δ(time)

Trilogy C9: Crude Oil and Fuels

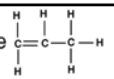
Part of: Organic Chemistry

Knowledge Organiser

Key points to learn

1. Mixture	Not pure. Different compounds / elements not chemically bonded
2. Hydrocarbon	Compound containing only hydrogen and carbon eg CH_4
3. Crude oil	Fossil fuel mixture of hydrocarbons
4. Distillation	Separating liquid from a mixture by evaporation and condensation
5. Compound	Two or more different elements chemically bonded
6. Molecule	Two or more atoms chemically bonded
7. Fractions	Hydrocarbons with similar boiling points separated from crude oil
8. Alk**ane**s	Hydrocarbon with only single covalent bonds eg C–C
	Known as saturated hydrocarbons
	Methane (CH_4) 
	Ethane (C_2H_6) 
	Propane (C_3H_8) 
	Butane (C_4H_{10}) 
9. Boiling point	Temperature liquid turns to gas. (Long hydrocarbons have higher)
10. Volatility	How easily it evaporates (Long hydrocarbons have lower)
11. Flammability	How easily it lights and burns (Long hydrocarbons have lower)

Key points to learn

12. Viscosity	The resistance of a liquid to flowing or pouring. (Long hydrocarbons have higher)
13. Fractional distillation	Separating liquids from a mixture by boiling then condensing at different temperatures
14. Burning hydrocarbons	Hydrocarbon + Oxygen → Water + Carbon Dioxide
	eg $CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$
15. Oxidised	Oxygen added or electrons lost
16.Test for CO_2	Turns limewater colourless → cloudy
17. Incomplete combustion	When a fuel burns with insufficient oxygen. Produces toxic Carbon Monoxide (CO)
18. Cracking	Breaking large alkanes into smaller, more useful ones
19. Thermal decomposition	Breaking down a compound by heating it
20. Catalyst	Chemical which speeds up a reaction without being used itself
21. Alk**ene**s	Hydrocarbon with a double covalent bond eg C=C
	Known as unsaturated hydrocarbons
	Has twice as many H as C atoms
	eg Ethene  Propene 
22. Testing for alkenes	Unsaturated hydrocarbons turn bromine water colourless

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
  - Rates and equilibrium
  - **Crude oil and fuels**
- Analysis and the Earth's resources
  - Chemical analysis
  - The Earth's atmosphere
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Background

Fossil fuels are non-renewable which means they are running out. But why is oil so useful? This topic explores that very question.

Additional

Remember that non-metals bond by covalent bonding (sharing electrons) and that Carbon is in group 4 so needs 4 electrons to fill its outer shell.

Maths skills

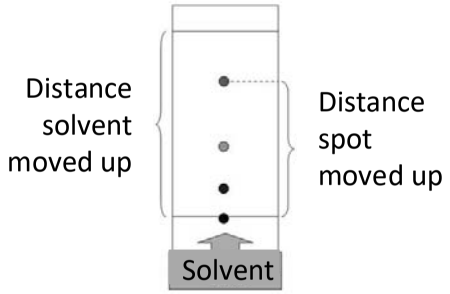
Balancing equations:

Number of atoms on reactant side = Number of atoms on product side

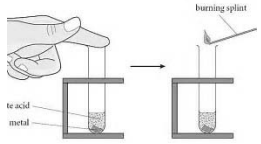
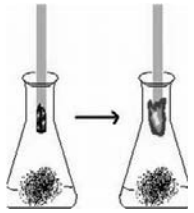
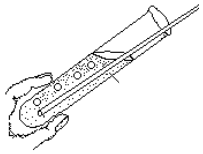
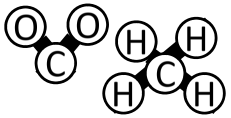
Alkane general formula: C_nH_{2n+2}

Alkene general formula: C_nH_{2n}

Key points to learn

1. Melting point	The temperature at which substances melt or freeze
2. Boiling point	The temperature at which substances boil or condense
3. Pure	Made of one substance. Can be an element or compound
4. Impure	Made of a mixture of substances
5. Fixed points	Melting and boiling pints of a pure substance Eg. Water 0°C and 100°C
6. Formulation	A mixture designed to produce a useful product
	Examples: paints, washing liquids, fuels, alloys, fertilisers, cosmetics
7. Paper Chroma-tography	A separation techniques where a solvent moves up a material and carries different substances up different heights with it
	
	Each substances has a unique Retention factor (R_f) at the same temperature in the same solvent
	$R_f = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$

Key points to learn

8. Test for hydrogen	Hydrogen makes a squeaky 'pop' when lit with a splint 
9. Test for oxygen	Oxygen will relight a glowing splint. 
10. Test for carbon dioxide	If you bubble carbon dioxide through limewater it will turn milky (cloudy white)  *Colourless → milky*
11. Test for chlorine gas	Chlorine gas will turn blue litmus paper white
	Need to be very careful as chlorine gas is toxic(poisonous)
12. Element	Only one type or atom present. Can be single atoms or molecules
	Both examples of the (N_2)  Nitrogen element (N) 
13. Compound	Molecule containing more than one type of atom
	Carbon dioxide (CO_2)  Methane (CH_4)
14. Mixture	Two or more chemicals not chemically combined

Trilogy C10: Chemical analysis

Part of: Chemical analysis

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
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- Analysis and the Earth's resources
  - **Chemical analysis**
  - The Earth's atmosphere
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Background

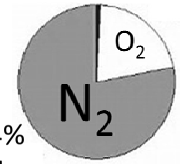
Somethings are useful, some are harmful. It's important that we can test to see what is in a substance or what is made in a reaction. Here are some of the methods we use in Science. You will have come across most of them earlier in school.

Maths skills

Rearrange and use the R_f chromatography equation

$$R_f = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$$

Key points to learn

1 Atmosphere	Layer of gas around Earth
2. Earth's early atmosphere theory	Volcanos released carbon dioxide (CO_2), water vapour (H_2O) and nitrogen (N_2)
	Similar to Mars and Venus
3. Photosynthesis	We think it was responsible for changing early atmosphere
	Removes carbon dioxide and makes oxygen
	Carbon + Water → Oxygen + Glucose Dioxide
4. Fossil fuels	Coal, crude oil and natural gas. Formed from fossilised remains of plants and animals
5. Carbon 'locked into' rock	Carbon stored in shells and skeletons turned into limestone
	Carbon in living things was also locked away as fossil fuels
6. Ammonia and methane	Removed from atmosphere by reactions with oxygen
7. Earth's atmosphere today	Nitrogen: 78% Oxygen: 21% Argon: 0.9% Carbon dioxide: 0.04% Trace amounts of other gases 
8. Ozone layer	Nothing to do with Global warming or the Greenhouse Effect. A layer of O_3 protecting us from UV rays
9. Incomplete combustion	If not enough oxygen is available then poisonous carbon monoxide and soot are produced

Key points to learn

10. Greenhouse effect	Greenhouse gases stop heat escaping from the Earth into space. This results in Earth getting hotter
11. Greenhouse gases	1. Carbon dioxide: released from burning fossil fuels 2. Methane: released from swamps, rice fields 3. Water vapour (eg steam and clouds)
12. Risks of global climate change	1. Rising sea levels as a result of melting ice caps 2. Extreme weather eg storms 3. Changes to temperature and rainfall patterns 4. Ecosystems under threat
13 Issues with reducing greenhouse gas emission	1. It will cost money 2. There is still disagreement that it is a problem 3. It is difficult to implement
14. Carbon footprint	The CO_2 released as a result of a persons activities over a year
15. Ideas for reducing our carbon footprint	1. Burn less fossil fuels 2. Carbon capture 3. Reduce demand for beef 4. Planting more trees
16. Carbon capture	Pumping and storing CO_2 underground in rocks
17. Nitrogen oxide	Released by burning fossil fuels. Causes acid rain and breathing issues
18 . Sulfur dioxide	Released by burning fossil fuels. Causes acid rain

Trilogy C11: The Earth's atmosphere

Part of: Chemistry of the atmosphere

Knowledge Organiser

Big picture (Chemistry Paper 2)

- Rates, equilibrium and organic chemistry
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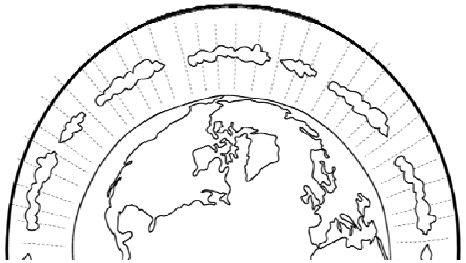
Background

The bubble of gas around our planet that we call Earth's atmosphere does far more than provide the oxygen we need for respiration. In Europe, winters are almost two weeks shorter than they were 40 years ago. Extreme weather seems more common than ever. Cases of asthma and respiratory difficulties increase year-on-year and we are always looking at ways of making our air cleaner .



Key points to learn

1. Natural resources	Can be found in their natural form. Some are finite and will run out
2. Fossil fuels	Coal, crude oil and natural gas. Formed from fossilised remains of plants and animals
3. Non-renewable	Finite. Are used quicker than they are made. So will run out
4. Renewable	Made quicker than they are used. Will not run out
5. Sustainable development	Meets current demands without affecting future generations.
6. Potable water	Water that is safe to drink. Not pure as it contains dissolved substances
7. Pure water	No dissolved substances. Only H_2O
8. Normal way of making potable water	1. Choose source of water 2. Filter the water in filter beds 3. Sterilise the water with chlorine, ozone or ultraviolet light
9. Desalination	Method for treating salty water. Two methods both energy intensive 1. Distillation – evaporate water then condense steam 2. Reverse osmosis. Uses membranes
10. Life cycle assessments (LCAs)	Product environmental impact in: 1. Extracting raw materials 2. Manufacturing and packing 3. Use during life 4. Disposal at end of life
11. Recycling	Saves energy and finite resources. Less pollution from making new

Key points to learn

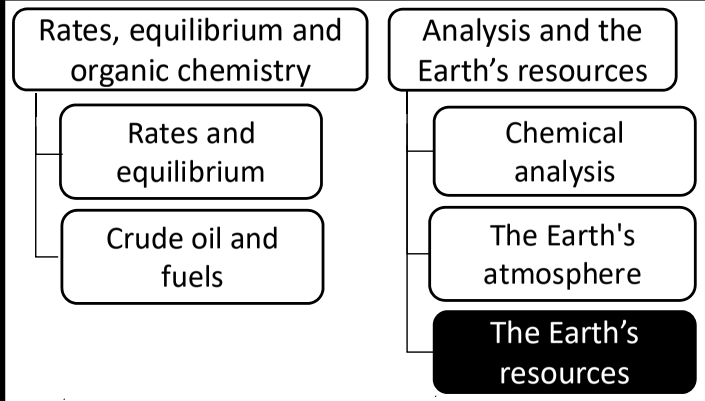
12. Aerobic	With oxygen (exposed to air)
13. Anaerobic	Without oxygen
14. Treating waste water	1. Remove lumps – screening 2. Let sludge sink – sedimentation 3. Bacteria added to clean - Aerobic treatment
15. Treating sludge	Anaerobic digestion by bacteria Can be used as fertiliser or as biofuel
16. Ore	*Rock containing enough metal compounds to be worth extracting*
17. Copper Ores	*Contain copper compounds. Becoming scarce so much harder to find large quantities. Main ways of extracting copper:* *1. Mining – dig up rocks* *2. Phytomining* *3. Bioleaching* *4. Electrolysis* *5. Displacement with iron*
18. Phytomining	*Plants absorb coppers compounds. Plants then burned and copper obtained from ash*
19. Bioleaching	*Bacteria pumped underground absorb copper. Produce leachate solutions containing copper compounds*
20. Electrolysis	*Breaking down a substance in a liquid using electricity*
21. Displacement	*A more reactive metal will displace a less reactive metal*
22. Economic issues	The cost of doing something

Trilogy C12: The Earth's resources

Part of: Using resources

Knowledge Organiser

Big picture (Chemistry Paper 2)



Background

Up to 60% of the rubbish in the average dustbin could be recycled. This wasteful approach has big environmental and economic impact for us all.

What are natural resources and why are they important? This topic looks at some of the issues that affect all of humankind.

Additional information

Content in *italics* is Higher Tier only.

Look back at Topic C5 and C6 for more on displacement reactions and electrolysis.