# Year 11 AQA GCSE Chemistry Revision Booklet

*Use this booklet to help you with your revision in preparation for your year 11 Chemistry examination.*
*There are lots of tips and hints to make sure that the time you spend revising is effective.*


## Exam Technique Pointers……

- Do not overwrite numbers – they become unreadable when scanned. Make sure if you make a mistake you cross out and re-write.
- Avoid repeating the questions and make sure that you add value to the information that the question provides.
- Show your working and make sure it is set out correctly
- Look carefully at the stem word – does it say ‘explain, state, describe’
- Where you are asked to explain – state the pattern, then write because/therefore/so that and then carry on…..
- Words to avoid – if.. they..
- Be precise – don’t say I would use an ‘amount’ – are you talking about mass (g), volume ($cm^3$), concentration ($mol/dm^{-3}$) force (N)
- If you are asked to ‘suggest’ then you are likely to need to use knowledge which you are unfamiliar with
- Where asked to plan – remember to write logically – maybe write bullet points in a draft plan – important for questions of 6 marks or more
- If asked to ‘evaluate’ you often need to write an opinion
- Practise writing paragraphs to describe processes/conclusions
- Get formulae correct carbon dioxide is **$CO_2$** – not Co2, $Co_2$, $Co^2$, $CO^2$ or CO2.

Revision Schedule**: Use the table below to help you plan your revision. (* = large topics)**

| **Topic Area** | **Pages of the textbook (second edition** | **Studied specification checklist** | **Read through revision guide or textbook or exercise book** | **Made notes or index cards or mind map or spider diagram** | **Revisit of topic area** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Atomic Structure and Periodic Table * | 30-44<br>166-180 | | | | | | | | | |
| Particles | 6-14 | | | | | | | | | |
| Formulae and Equations | 66-68 | | | | | | | | | |
| Bonding and Structure | 46-64 | | | | | | | | | |
| Organic Chemistry | 244-255<br>262-264 | | | | | | | | | |
| Metals | 182-208 | | | | | | | | | |
| Rates of Reaction | 130-146 | | | | | | | | | |
| Energetics | 114-128 | | | | | | | | | |
| Experimental Techniques | 16-28 | | | | | | | | | |
| Acids, Bases, Salts | 148-161 | | | | | | | | | |
| Moles | 76-79<br>84-91 | | | | | | | | | |
| Air and Water | 210-223 | | | | | | | | | |

# Revision Top Tips

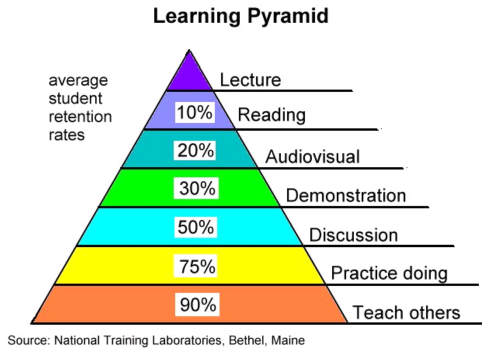
**Use your textbook**

This book is excellent and covers all the work that you have done this year. It also contains questions to test knowledge and also past paper questions – use these resources rather than spending time browsing the web.

**Use your exercise book**

**Go through the work that you have done in lessons – use your exercise book to remind yourself what you have studied.**

Remember the learning Pyramid when you do your revision.




Use the text book and revision book.

Read and write notes or draw a mind map

Condense work or notes

**Write, write, write** – at least then you have to engage with thinking

Test yourself

Look at the checklist

**Use the checklist to guide writing some revision notes**

You have been given a checklist which tells you exactly what needs to be learnt. For each topic make some notes, produce a spider diagram? or index cards.

| **Year 9 Atomic Structure and the Periodic Table** | | | |
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| **Models of the atom – know the:**<br>• plum pudding model of the atom and Rutherford and Marsden's alpha experiments<br>• Niels Bohr adaptation of the plum pudding model<br>• Chadwick's experiments and what they showed | | | |
| **Atoms, elements and compounds - know**<br>• about elements (first 20) and what compounds are<br>• names of compounds given formulae or symbol equations<br>• how to write word equations and how to write formulae / balanced chemical equations<br>• the electrical charges and masses of protons, neutrons and electrons.<br>• how to calculate the number of protons, electrons and neutrons in an atom or ion given the atomic number and mass number<br>• the size of atoms as very small, having a radius of about 0.1 nm ($1 \times 10^{-10}$ m).<br>• the radius of a nucleus is less than 1/10 000 of the atom (about $1 \times 10^{-14}$ m).<br>• what an isotope is | | | |
| **Electronic structure - know**<br>• how to draw electron configuration diagrams | | | |

| **Year 9 Particles** | | | |
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| **The three states of matter - know**<br>• The states of matter are solid, liquid and gas and how they are shown in equations<br>• The names of the changes of state<br>• The arrangement of particles in each of the states of matter<br>• How to use particle theory to explain changes of state such as steric acid cooling<br>• What affects the amount of energy needed for a substance to change state<br>• How to use melting and boiling point data to decide the state of a substance | | | |

| **Formulae and Equations - Stoichiometry** | | | |
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| **Conservation of mass and balanced chemical equations – know that**<br>• no atoms are lost or made during a chemical reaction,  mass of the products equals the mass of the reactants.<br>• mass changes when a reactant or product is a gas<br>• what happens to the mass of reactants and products during reactions such as when a metal reacts with oxygen or during the thermal decompositions of metal carbonates.<br>• how to use the balanced symbol equation and calculations involving the masses of atoms and molecules to make predictions about the changes of mass during a reaction. | | | |
| **Formulae and valencies – know**<br>• the valencies of elements and common ions<br>• how to write the formulae for compounds and how to balance equations. | | | |

| **Reactions of Acids** | | | |
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| **Reactions of acids with metals – know the following reactions and be able to apply them to different metals, acid etc**<br>• Metal and acid produce salts and hydrogen.<br>• Acid and base (alkali) produce salt and water = neutralisation<br>• Metal carbonates and acids produce salt and water and carbon dioxide<br>**Be able to**<br>Predict the salt formed during a reaction between any particular acid and a base or alkali. | | | |

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| **Soluble salts - know**<br>• how to make soluble salts by reacting acids with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates.<br>• how to describe in detail the steps to make a pure, dry sample of a soluble salt from an insoluble oxide or carbonate (base). | | | |
| **The pH scale and neutralisation – know**<br>• how to use the pH scale, 0 to 14, to measure of the acidity or alkalinity of a solution.<br>• how to describe what a base and alkali are<br>• how to describe what an acid is<br>• how to use universal indicator or a wide range indicator to measure the approximate pH of a solution and then identify acidic or alkaline solutions. | | | |
| **Strong and weak acids - know**<br>• what a strong acid is along with examples<br>• what a weak acid is along with examples<br>• why a particular acid is either strong or weak in terms of dissociation/ionisation<br>• how the hydrogen ion concentration is related to the pH<br>• how to describe the terms dilute and concentrated and understand that these are different to strong and weak | | | |

| **Year 9 - Structures and Bonding** | ☺ | 😐 | ☹ |
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| **Ionic bonding – know**<br>• in ionic bonding the particles are oppositely charged ions when a metal atom reacts with a non-metal atom electrons in the outer shell of the metal atom are transferred.<br>• how metal atoms become ions either +, 2+ etc<br>• how non metal atoms become ions either -, 2- etc<br>• how to draw dot and cross diagrams to show ionic bonding with the metal atoms losing electrons forming +ve ions and the non-metal gaining electrons forming –ve ions. | | | |
| **Ionic compounds - know**<br>• The structure of an ionic compound such as sodium chloride is a giant structure of ions which are held together by strong electrostatic forces of attraction between oppositely charged ions.<br>• How to deduce that a compound is ionic from a diagram of its structure<br>• The limitations of using dot and cross, ball and stick, two and three dimensional diagrams to represent a giant ionic structure<br>• How to work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure. | | | |
| **Properties of ionic compounds - know**<br>• How the strong electrostatic forces of attraction in all directions in an ionic compound result in compounds with high melting points and high boiling points<br>• Why ionic compound when melted or dissolved in water, conduct electricity | | | |
| **Covalent bonding - know**<br>• that particles are atoms which share pairs of electrons and that bonds are strong<br>• that covalent bonding occurs in non-metallic elements or compounds of non-metals.<br>• that covalent bonding can be found in different structures – covalent molecular structures such $H_2$, $Cl_2$, $O_2$, $N_2$, HCl, $H_2O$, $NH_3$ and $CH_4$ and giant covalent structures such as diamond, graphite and silicon dioxide | | | |
| **Properties of small molecules - know**<br>• The properties of covalent small molecules and be able to explain why they are gases using ideas relating to energy and the strength of intermolecular forces.<br>• How the strength of intermolecular forces varies as molecules get bigger and how this affects boiling and melting points. | | | |

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| **Giant covalent structures – know**<br>• That diamond and graphite (forms of carbon) and silicon dioxide (silica) are examples of giant covalent structures<br>• The properties of each of these giant covalent structures<br>• How to relate the properties of each of these substanes to their structures eg; melting point, electrical conductivity, hard or soft, shiny? | | | |
| **Graphene and fullerenes – know**<br>• the structure of graphene and fullerenes including a Buckminsterfullerene (C60) and carbon nanotubes<br>• how their properties in terms of strength, electrical and thermal conductivity.<br>• how fullerenes can be used for drug delivery into the body, as lubricants, as catalysts and carbon nanotubes can be used for reinforcing materials, eg in tennis rackets. | | | |
| **Nanoscience and Nanoparticles – know**<br>• That nanoscience refers to structures that are 1–100 nm in size, of the order of a few hundred atoms. Nanoparticles, are smaller than fine particles, which have diameters between 100 and 2500 nm ($1 \times 10^{-7}$ m and $2.5 \times 10^{-6}$ m).<br>• That coarse particles (PM10) have diameters between $1 \times 10^{-5}$ m and $2.5 \times 10^{-6}$ m. Coarse particles are often referred to as dust.<br>• Nanoparticles have different properties due to their high surface area to volume ratio.<br>• some of the applications in medicine of nanoparticles including controlled drug delivery; in electronics; in cosmetics and sun creams; in the development of new catalysts for fuel cells materials; in deodorants and in fabrics to prevent the growth of bacteria.<br>• some of the advantages and disadvantages of using nanoparticles. | | | |
| **Metallic bonding and metallic properties - know**<br>• How to draw and explain the structure of a metal and an alloy<br>• How to explain the properties of metals and relate these properties (high melting point, shiny, malleability and electrical conductivity) to their structures<br>• Why most metals in everyday use are alloys | | | |

| **Year 9 and Year 10 – Further Atomic Structure** | ☺ | 😐 | ☹ |
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| **The Periodic Table - know**<br>• How elements in the periodic table in terms of atomic number groups and periods<br>• How to use the periodic table to draw electronic configuration diagrams and to predict the reactivities and properties of a given element.<br>• how to describe the steps in the development of the Periodic Table including the work of Mendeleev and why the discovery of isotopes enabled us to explain why the order based on atomic weights was not always correct. | | | |
| **Metals and non-metals – be able to explain..**<br>• the differences in the physical and chemical properties of metals and non-metals.<br>• how the electron configuration affects the reactivity of elements. | | | |
| **Group 1 – The Alkali Metals know**<br>• the physical properties of alkali metals<br>• the chemical properties of alkali metals – how they react, what they react with etc.<br>• how to explain and predict the change in reactivity down the group using ideas about electron shield and size of atom | | | |
| **Group 7 – The Halogens know**<br>• The physical and chemical properties of the halogens<br>• How to explain the change in melting and boiling points down the group<br>• How to explain and predict the change in reactivity of the halogens<br>• How to write equations for halogen displacement reactions and be able to relate this to the colour changes and reactivity of the halogens | | | |

| Year 10 Metals | 🙂 | 😐 | 🙁 |
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| **Metallic bonding – know**<br>The structure of metals and non metals – recap from year 9 | | | |
| **Properties of transition metals - know**<br>• the properties of transition elements such as Cr, Mn, Fe, Co, Ni, Cu – be able to compare their boiling points, densities, strength, reactivity with water and oxygen compared to group 1 metals<br>• that many transition elements have ions with different charges, form coloured compounds and are useful as catalysts. | | | |
| **Metal oxides - know**<br>• that metals react with oxygen to produce metal oxides via oxidation reactions.<br>• how to explain these reactions in terms of reduction and oxidation in terms of loss or gain of oxygen. | | | |
| **The reactivity series – know**<br>• the reactivity series eg potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper and how it can be established by looking at the reactivity with acid and water and is linked to the tendency to form positive ions<br>• where hydrogen and carbon are in the reactivity series.<br>• how to explain and write metal displacement reactions<br>• the reactions, if any, of the metals in series with water (not steam) at room temperature or dilute acids<br>• how to use experimental data to deduce an order of reactivity | | | |
| **Extraction of metals and reduction – know**<br>• how to relate the metal extraction process to the reactivity of the metal<br>• that unreactive metals such as gold are found in the Earth as the metal itself<br>• that metals less reactive than carbon can be extracted from their oxide by reduction/ removal of oxygen with carbon and be able to identify the substances which are oxidised or reduced in terms of gain or loss of oxygen. | | | |
| **Oxidation and reduction in terms of electrons – know**<br>• that oxidation is the loss of electrons and reduction is the gain of electrons.<br>• how to write ionic equations for displacement reactions and to idenfify what has been oxidised or reduced | | | |
| **Alternative methods of extracting metals - know**<br>• how we use phytomining and bioleaching to extract copper from low-grade ores<br>• know the advantages and disadvantages of phytomining and bioleaching and be able to evaluate data on these alternative extraction methods. | | | |
| **Properties and use of alloys - know**<br>• why we used alloys rather than pure metals – know how their structures differ<br>• know what alloys such as bronze, gold alloys, steel alloys and aluminium alloys are, what they are made of and their properties. | | | |

| Year 10 Moles I – Quantitative Chemistry | 🙂 | 😐 | 🙁 |
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| **Relative formula mass – know**<br>• How to calculate the relative formula mass of a compound<br>• What a mole is and Avagadro's number<br>• How to use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa. | | | |
| **Amounts of substances in equations- be able to:**<br>• calculate the masses of substances shown in a balanced symbol equation<br>• calculate the masses of reactants and products from the balanced symbol equation and | | | |

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| the mass of a given reactant or product<br>• balance an equation given the masses of reactants and products. | | | |
| **Limiting reactants – know**<br>• Often in a reaction one of the reactants is not used up totally as it is excess<br>• That the reactant that is completely used up is called the limiting reactant because it limits the amount of products.<br>• How to explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams. | | | |
| **Percentage yield – know**<br>• That a reaction may not go to completion because it is reversible<br>• some of the product may be lost when it is separated from the reaction mixture<br>• some of the reactants may react in ways different to the expected reaction.<br>• how to calculate the theoretical amount of a product from a given amount of reactant and the balanced equation for the reaction<br>• how to calculate the percentage yield of a product from the actual yield of a reaction. | | | |
| **Atom economy - know**<br>• the atom economy is a measure of the amount of starting materials that end up as useful products and it is important when considering sustainable development/economics.<br>• how to calculate the percentage atom economy<br>• how to calculate the atom economy of a reaction from the balanced equation<br>• how to explain why a particular reaction is chosen to produce a product given appropriate data such as atom economy, yield, rate, equilibrium position and usefulness of by-products. | | | |

| **Year 10 - Rates of Reaction** | ☺ | 😐 | ☹ |
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| **Calculating rates of reactions - know**<br>• calculate the mean rate of a reaction from given information about the quantity of a reactant used or the quantity of a product formed and the time taken<br>• the units of rate<br>• how to draw, and interpret, graphs showing the quantity of product formed or quantity of reactant used up against time<br>• how to draw tangents to the curves and use gradient of the tangent to calculate rate. | | | |
| **Factors which affect the rates of chemical reactions - know**<br>• the how different factors affect the rates of chemical reactions include: the concentrations of reactants in solution, the pressure of reacting gases, the surface area of solid reactants, the temperature and the presence of catalysts.<br>• how to investigate factors which affect the rate of chemical reactions by measuring the loss in mass of reactants, the volume of gas produced or the time for a solution to become opaque or coloured.<br>• How to predict and explain the effects of changing conditions on the rate of a reaction using collision theory to explain the effect of a factor on the rate of a reaction | | | |
| **Collision theory and activation energy - know**<br>• how to use Collision theory to explain how various factors affect rates of reactions using ideas of reacting particles colliding with each other and with sufficient energy.<br>• Know what that the minimum amount of energy that particles must have to react is called the activation energy. | | | |
| **Catalysts – know**<br>• that catalysts speed up the rate of chemical reactions, are not used up and provide a different pathway for the reaction that has a lower activation energy<br>• that different reactions need different catalysts and that enzymes act as catalysts in biological systems.<br>• how to show the effect of a catalyst on a reaction profile diagram. | | | |

| Year 10 – Organic Chemistry | ☺ | 😐 | ☹ |
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| **Crude oil, hydrocarbons and alkanes - know**<br>• crude oil is a mixture of a large number of compounds, mainly hydrocarbons ( alkanes)<br>• alkanes are a homologous series with a general formula of $C_nH_{2n+2}$<br>• the names of the first four members of the alkanes | | | |
| **Fractional distillation and petrochemicals - know**<br>• what a fraction is and how fractional distillation is used to separate fractions<br>• that fractions are processed to produce fuels +feedstock for the petrochemical industry.<br>• that fuels on which we depend for our modern lifestyle, such as petrol, diesel oil, kerosene, heavy fuel oil and liquefied petroleum gases, are produced from crude oil.<br>• that many useful materials on which modern life depends are produced by the petrochemical industry, such as solvents, lubricants, polymers, detergents. | | | |
| **Properties of hydrocarbons - know**<br>• how boiling point, flammability and viscosity of hydrocarbons is affected by the molecular size of a hydrocarbon molecule which affects its use as a fuel<br>• and write equations for the complete combustion of a hydrocarbon fuel | | | |
| **Cracking and alkenes - know**<br>• what cracking is, how it happens and why it is used<br>• how to balance cracking equations and know the products of a cracking reaction<br>• the test for alkenes<br>• Cracking produces small molecules which have high demand for use in fuels and as a starting material for polymerisation | | | |
| **Structure, formulae and reactions of alkenes - know**<br>• what an alkene is and the first 4 members of the homologous series<br>• how to describe and write equations to show an alkene reacting with oxygen hydrogen, water and the halogens by the addition of atoms across the carbon-carbon double bond | | | |
| **Polymers - know**<br>• what a polymer is, its bonding and how it is formed<br>• know that the intermolecular forces between polymer molecules are relatively strong and so these substances are solids at room temperature. | | | |
| **Addition polymerisation - know**<br>• that many small molecules (monomers) join to form large molecules (polymers).<br>• how poly(ethene) and poly(propene) are made by addition polymerisation.<br>• be able to recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group C=C in the monomers<br>• be able to draw diagrams to show a polymer formed from a given alkene monomer in addition to identifying the monomer from polymers | | | |
| **Ceramics, polymers and composites - know**<br>• how glass is made<br>• how clay ceramics (pottery and bricks) are made.<br>• how low density (LD) and high density (HD) poly(ethene) are produced from ethene using different catalysts and reaction conditions.<br>• what thermosoftening polymers and thermosetting polymers are and relate their properties to their structures<br>• what a composite is and be able to give examples<br>• be able to compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals<br>• be able to explain how the properties of materials relate to their uses | | | |

| Year 10 Energetics | | | |
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| **Energy transfer during exothermic and endothermic reactions - know**<br>• that an exothermic reaction transfers energy to the surroundings so the surrounding temperature increases eg: combustion, many oxidation reactions and neutralisation.<br>• Some everyday uses of exothermic reactions eg: self heating cans and hand warmers.<br>• that an endothermic reaction takes in energy from the surroundings so the temperature of the surroundings decreases eg: thermal decompositions and the reaction of citric acid and sodium hydrogencarbonate. Some sports injury packs are based on endothermic reactions.<br>• be able to distinguish between exothermic and endothermic reactions on the basis of the temperature change of the surroundings and to be able to evaluate uses and applications of exothermic and endothermic reactions given appropriate information. | | | |
| **Reaction profiles -know**<br>• that reaction profiles can be used to show the relative energies of reactants and products, the activation energy and the overall energy change of a reaction.<br>• be able to draw energy level diagrams for exothermic and endothermic | | | |
| **The energy change of reactions  know**<br>• that during a chemical reaction energy must be supplied to break bonds in the reactants and energy is released when bonds in the products are formed.<br>• be able to calculate the overall energy transferred during a reaction using bond energies supplied.<br>• in an exothermic reaction, the energy released from forming new bonds is greater than the energy needed to break existing bonds.<br>• in an endothermic reaction, the energy needed to break existing bonds is greater than the energy released from forming new bonds. | | | |
| **Cells and batteries - know**<br>• cells contain chemicals which react to produce electricity and that the voltage produced is dependent upon a number of factors including the type of electrode and electrolyte.<br>• how to make a simple cell and the a battery<br>• in non-rechargeable cells and batteries the chemical reactions stop when one of the reactants has been used up. Alkaline batteries are non-rechargeable. | | | |
| **Fuel cells - know**<br>• Fuel cells are supplied by an external source of fuel (eg hydrogen) and oxygen or air. The fuel is oxidised electrochemically within the fuel cell to produce a potential difference.<br>• 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.<br>• how to evaluate the use of hydrogen fuel cells in comparison with rechargeable cells/batteries and to be able to write the half equations for the electrode reactions in the hydrogen fuel cell. | | | |

| Year 10, Air, Water and Environmental Chemistry | | | |
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| **The Earth's early atmosphere - know**<br>• the composition of the earth's atmosphere  today<br>• the theories and evidence about what was in the Earth's early atmosphere and how the atmosphere formed have changed and developed over time.<br>• how to, given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere.<br>• what has caused the changes to the levels of oxygen and carbon dioxide | | | |

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| **Greenhouse gases - know**<br>• how a greenhouse gas maintains temperatures on Earth high enough to support life.<br>• how human activities contribute to an increase in greenhouse gases in the atmosphere including combustion of fossil fuels to release carbon dioxide, deforestation, methane release from cows and paddy fields, more animal farming (digestion, waste decomposition) and decomposition of rubbish in landfill sites.<br>• that the increase in the percentage of carbon dioxide in the atmosphere over the last 100 years correlates with the increased use of fossil fuels and what the predictions are for the future<br>• that it is difficult to model such complex systems as global climate change.<br>• be able to evaluate the quality of evidence about global climate change given information including describing uncertainties in the evidence base | | | |
| **Global climate change -know**<br>• that an increase in average global temperature is a major cause of climate change.<br>• the scale, risk and environmental implications of global climate change. | | | |
| **The carbon footprint and its reduction - know**<br>• that the carbon footprint is the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.<br>• the ways we can reduce the carbon footprint and the problems with trying to do this.<br>• be able to describe how emissions of carbon dioxide and methane can be reduced | | | |
| **Atmospheric pollutants from fuels - know**<br>• that combustion of fuels is a major source of atmospheric pollutants.<br>• all of the gases released into the atmosphere when a fuel is burned<br>• The problems/effects of releasing all of these pollutants into the atmosphere | | | |
| **Using the Earth's resources and sustainable development - know**<br>• that natural resources, supplemented by agriculture, provide food, timber, clothing and fuels. Finite resources from the Earth, oceans and atmosphere are processed to provide energy and materials.<br>• how to state examples of natural products that are supplemented or replaced by agricultural and synthetic products<br>• how to to distinguish between finite and renewable resources and evaluate the significance of data.<br>• That industries use the Earth's natural resources to manufacture useful products. In order to operate sustainably, chemists seek to minimise the use of limited resources, energy consumption, waste and environmental impact in the manufacture of these products.<br>• that chemists study the impact of human activity on the earth and aim to develop ways of disposing of products at the end of their useful life in a sustainable way by minimising material and energy usage whilst reducing pollution, waste disposal and environmental impact. | | | |
| **Corrosion and its prevention – know**<br>• that rusting is an example of corrosion. Both air + water are necessary for iron to rust.<br>• how to prevent corrosion<br>• why zinc is used to galvanise iron and when scratched provides sacrificial protection because zinc is more reactive than iron.<br>• why magnesium blocks can be attached to steel ships to provide sacrificial protection. | | | |
| **Potable water - know**<br>• the features and importance of potable water which is different to pure water<br>• the methods used to produce potable water depend on available supplies of water and local conditions.<br>• In the UK rain provides water with low levels of dissolved substances (fresh water) that collects in the ground, lakes and rivers, and this water is passed through filter beds to remove any solids, sterilising to kill microbes. | | | |

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| • that sterilising agents used for potable water include chlorine, ozone or ultraviolet light.<br>• that if supplies of fresh water are limited, desalination of salty water or sea water may be required.<br>• how desalination works<br>• be able to describe the differences in treatment of ground water and salty water. | | | |
| **Waste water treatment - know**<br>• how sewage and agricultural waste water is treated by screening and grit removal, sedimentation to produce sewage sludge and effluent, anaerobic digestion of sewage sludge, aerobic biological treatment of effluent.<br>• How to comment on the relative ease of obtaining potable water from waste, ground and salt water. | | | |
| **Life cycle assessment - know**<br>• That life cycle assessments (LCAs) are carried out to assess the environmental impact of products in each of these stages: extracting and processing raw materials, manufacturing and packaging, use and operation during its lifetime in addition to disposal at the end of its useful life, including transport and distribution at each stage.<br>• That a LCA needs to take the energy, water, resource consumption and production of some wastes into account, although assessing pollutant effects is difficult to base on evidence/data.<br>• That Life cycle assessments can be misused to reach pre-determined conclusions, eg in support of claims for advertising purposes.<br>• be able to carry out simple comparative LCAs for shopping bags made from plastic and paper. | | | |
| **Ways of reducing the use of resources - know**<br>• why it is good to reduce use, reuse or recycle – be able to give examples<br>• that metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials and use energy also in their manufacture<br>• quarrying and mining causes environmental impacts. | | | |

| **Year 10/Year 11, Acids, Bases, Salts and Ion Testing –recaps year 9 work on this topic** | ☺ | 😐 | ☹ |
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| **Reactions of acids – know how to**<br>• write and predict the products when given reactants for the following types of equations and use the formulae of common ions to write balanced equations<br>• Metal and acids produce salts and hydrogen and these are redox reactions which you can explain in terms of gain or loss of electrons.<br>• Metal carbonates and acids produce salt and water and carbon dioxide<br>• Hydrochloric acid produces chlorides, nitric acid produces nitrates, sulfuric acid produces sulfates<br>Students should be able to:<br>• predict products from given reactants<br>• use the formulae of common ions to deduce the formulae of salts. | | | |
| **Soluble salts**<br>• Soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates.<br>• Be able to describe how to make a pure, dry sample of a soluble salt from an insoluble oxide or carbonate (base). Key steps are the solid is added to the acid until no more reacts and the excess solid is filtered off to produce a solution of the salt. Salt solutions can be crystallised to produce solid salts. | | | |
| **The pH scale and neutralisation**<br>• The pH scale, from 0 to 14, is a measure of the acidity or alkalinity of a solution, measured using universal indicator or a pH probe. A solution with pH 7 is neutral. | | | |

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| • Aqueous solutions of alkalis contain hydroxide ions ($OH^-$).<br>• Acids produce hydrogen ions ($H^+$) in aqueous solutions.<br>• In neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water.<br>• How to describe the use of universal indicator to measure the approximate pH of a solution and use the pH scale to identify acidic or alkaline solutions. | | | |
| **Strong and weak acids**<br>• A strong acid is completely ionised in solution eg: hydrochloric, nitric and sulfuric acids.<br>• A weak acid is only partially ionised in solution eg ethanoic, citric and carbonic acids.<br>• For a given concentration of aqueous solutions, the stronger an acid, the lower the pH.<br>• As the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10.<br>• How to use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids<br>• describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH (whole numbers only). | | | |
| **Identification of common gases**<br>**Test for hydrogen** - The test for hydrogen uses a burning splint held at the open end of a test tube of the gas. Hydrogen burns rapidly with a pop sound.<br>**Test for oxygen** - The test for oxygen uses a glowing splint inserted into a test tube of the gas. The splint relights in oxygen.<br>**Test for carbon dioxide** - The test for carbon dioxide uses an aqueous solution of calcium hydroxide (lime water). When carbon dioxide is shaken with or bubbled through limewater the limewater turns milky (cloudy).<br>**Test for chlorine** - The test for chlorine uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white. | | | |
| **Flame tests – know that**<br>Flame tests can be used to identify some metal ions (cations). Lithium, sodium, potassium, calcium and copper compounds produce distinctive colours in flame tests:<br>• lithium compounds result in a crimson flame<br>• sodium compounds result in a yellow flame<br>• potassium compounds result in a lilac flame<br>• calcium compounds result in a red flame<br>• copper compounds result in a green flame.<br>If a sample containing a mixture of ions is used some flame colours can be masked. | | | |
| **Metal hydroxides**<br>Sodium hydroxide solution can be used to identify some metal ions (cations).<br>Solutions of aluminium, calcium and magnesium ions form white precipitates when sodium hydroxide solution is added but only the aluminium hydroxide precipitate dissolves in excess sodium hydroxide solution.<br>Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added.<br>Copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate –be able to write balanced equations for these reactions. | | | |
| **Carbonates**<br>Carbonates react with dilute acids to form carbon dioxide gas. Carbon dioxide can be identified with limewater. Most carbonates are insoluble, but some, including sodium carbonate and potassium carbonate, are soluble in water and produce solutions containing carbonate ions. | | | |
| **Halides**<br>Halide ions in solution produce precipitates with silver nitrate solution in the presence of dilute nitric acid. Silver chloride is white, silver bromide is cream and silver iodide is yellow. | | | |
| **Sulfates** | | | |

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| Sulfate ions in solution produce a white precipitate with barium chloride solution in the presence of dilute hydrochloric acid | | | |
| **Flame emission spectroscopy**<br>Flame emission spectroscopy is an example of an instrumental method used to analyse metal ions in solutions. The sample is put into a flame and the light given out is passed through a spectroscope. The output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations.<br>Be aware of the advantages of instrumental methods compared with the chemical tests | | | |

| **Year 11 Electrolysis** | ☺ | 😐 | ☹ |
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| **The process of electrolysis**<br>• When an ionic compound is melted or dissolved in water, the ions are free to move about within the liquid or solution (the electrolytes).<br>• Passing an electric current through electrolytes causes the ions to move to the electrodes.<br>• Positively charged ions move to the negative electrode (the cathode), and negatively charged ions move to the positive electrode (the anode). Ions are discharged at the electrodes producing elements.<br>• be able to write half equations for the reactions occurring at the electrodes during electrolysis, and may be required to complete and balance supplied half equations. | | | |
| **Electrolysis of molten ionic compounds**<br>• When a simple ionic compound (eg lead bromide) is electrolysed in the molten state using inert electrodes, the metal (lead) is produced at the cathode and the non-metal (bromine) is produced at the anode.<br>• be able to predict the products of the electrolysis of binary ionic compounds in the molten state. | | | |
| **Using electrolysis to extract metals**<br>• Metals can be extracted from molten compounds using electrolysis.<br>• Electrolysis is used if the metal is too reactive to be extracted by reduction with carbon or if the metal reacts with carbon. Large amounts of energy are used in the extraction process to melt the compounds and to produce the electrical current.<br>• Aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite. The mixture has a lower melting point than pure aluminium oxide. Aluminium forms at the negative electrode (cathode) and oxygen at the positive electrode (anode). The positive electrode (anode) is made of carbon, which reacts with the oxygen to produce carbon dioxide and so must be continually replaced. | | | |
| **Electrolysis of aqueous solutions – know that**<br>• the ions discharged when an aqueous solution is electrolysed using inert electrodes depend on the relative reactivity of the elements involved.<br>• at the negative electrode (cathode), hydrogen is produced if the metal is more reactive than hydrogen.<br>• at the positive electrode (anode), oxygen is produced unless the solution contains halide ions when the halogen is produced. This happens because in the aqueous solution water molecules break down producing hydrogen ions and hydroxide ions that are discharged.<br>• How to predict the products of the electrolysis of aqueous solutions containing a single ionic compound. | | | |
| **Representation of reactions at electrodes as half equations**<br>• During electrolysis, at the cathode (negative electrode), positively charged ions gain electrons and so the reactions are reductions.<br>• At the anode (positive electrode), negatively charged ions lose electrons and so the reactions are oxidations. | | | |

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| • Reactions at electrodes can be represented by half equations, for example:<br>$2H^+ + 2e^- \rightarrow H_2$ and $4OH^- \rightarrow O_2 + 2H_2O + 4e$ or $4OH^- - 4e^- \rightarrow O_2 + 2H_2O$ | | | |

| **Year 11 Moles** | ☺ | 😐 | ☹ |
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| **Concentration of solutions**<br>Many chemical reactions take place in solutions. The concentration of a solution can be measured in mass per given volume of solution, eg grams per $dm^3$ ($g/dm^3$).<br>Students should be able to:<br>• explain how the mass of a solute and the volume of a solution is related to the concentration of the solution<br>• calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution. | | | |
| **Using concentrations of solutions in mol/dm$^3$**<br>The concentration of a solution can be measured in $mol/dm^3$.<br>The amount in moles of solute or the mass in grams of solute in a given volume of solution can be calculated from its concentration in $mol/dm^3$.<br>If the volumes of two solutions that react completely are known and the concentration of one solution is known, the concentration of the other solution can be calculated.<br>The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator.<br>Students should be able to:<br>• describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only)<br>• calculate the chemical quantities in titrations involving concentrations in $mol/dm^3$ and in $g/dm^3$<br>• explain how the concentration of a solution in $mol/dm^3$ is related to the mass of the solute and the volume of the solution. | | | |
| **Use of amount of substance in relation to volumes of gases**<br>• Equal amounts in moles of gases occupy the same volume under the same conditions of temperature and pressure.<br>• The volume of one mole of any gas at room temperature and pressure ($20^oC$ and 1 atmosphere pressure) is 24 $dm^3$.<br>• The volumes of gaseous reactants and products can be calculated from the balanced equation for the reaction. | | | |

| **Year 11 Organic Chemistry** | ☺ | 😐 | ☹ |
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| **Alcohols**<br>Alcohols contain the functional group –OH. Methanol, ethanol, propanol and butanol are the first four members of a homologous series of alcohols.<br>Alcohols can be represented in the following forms: $CH_3CH_2OH$ or structural formulae<br>Methanol, ethanol, propanol and butanol:<br>• dissolve in water to form a neutral solution<br>• react with sodium to produce hydrogen<br>• burn in air to produce carbon dioxide and water<br>• are oxidised to produce carboxylic acids<br>• are used as fuels and solvents, and ethanol is the main alcohol in alcoholic drinks.<br><br>Aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast. Be able to:<br>• recognise alcohols from their names or from given formulae up to butanol<br>• know the conditions used for fermentation of sugar using yeast. | | | |

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| • write balanced chemical equations for the reactions of alcohols other than for combustion reactions. | | | |
| **Carboxylic acids**<br>Carboxylic acids have the functional group – COOH. The first four members of a homologous series of carboxylic acids are methanoic acid, ethanoic acid, propanoic acid and butanoic acid.<br>Carboxylic acids:<br>• dissolve in water to produce acidic solutions<br>• react with carbonates to produce carbon dioxide<br>• do not ionise completely when dissolved in water and so are weak acids<br>• react with alcohols in the presence of an acid catalyst to produce esters, for example ethanoic acid reacts with ethanol to produce ethyl ethanoate and water.<br>Be able to<br>• recognise carboxylic acids from their names or from given formulae up to butanoic acid.<br>• write balanced chemical equations for the reactions of carboxylic acids.<br>• know the name of esters ethyl ethanoate. | | | |
| **Condensation polymerisation**<br>• Condensation polymerisation involves monomers with two functional groups. When these types of monomers react they join together, usually losing small molecules such as water, and so the reactions are called condensation reactions.<br>• The simplest polymers are produced from two different monomers with two of the same functional groups on each monomer. For example: ethane diol and hexanedioic acid polymerise to produce a polyester:<br>• Be able to explain the principles of condensation polymerisation in relation to the functional groups in the monomers and the repeating units in the polymers. | | | |
| **Amino acids**<br>• Amino acids have two different functional groups in a molecule. Amino acids react by condensation polymerisation to produce polypeptides.<br>• For example: glycine is $H_2NCH_2COOH$ and polymerises to produce the polypeptide $(\text{-}NCH_2COO\text{-})_n$ and $_nH_2O$.<br>• Different amino acids can be combined in the same chain to produce proteins. | | | |
| **DNA (deoxyribonucleic acid) and other naturally occurring polymers**<br>• DNA (deoxyribonucleic acid) is a large molecule essential for life. DNA encodes genetic instructions for the development and functioning of living organisms and viruses.<br>• Most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix. Other naturally occurring polymers important for life include proteins, starch and cellulose. Proteins are polymers of amino acids. Starch and cellulose are polymers of sugars. Sugars, starch and cellulose are carbohydrates. | | | |

| **Year 11 Equilibria** | ☺ | 😐 | ☹ |
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| **Reversible reactions**<br>In some chemical reactions, the products of the reaction can react to produce the original reactants. Such reactions are called reversible reactions<br>The direction of reversible reactions can be changed by changing the conditions.<br>For example:<br>$\text{ammonium chloride} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{ammonia + hydrogen chloride}$ | | | |

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| **Energy changes and reversible reactions**<br>If a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction. The same amount of energy is transferred in each case. For example:<br>hydrated copper sulfate (blue) $\underset{\text{exothermic}}{\overset{\text{endothermic}}{\rightleftharpoons}}$ anhydrous copper sulfate (white) + water | | | |
| **Equilibrium**<br>When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate. | | | |
| **The effect of changing conditions on equilibrium**<br>• The relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. If a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change.<br>• The effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle.<br>• Be able to make predictions about the effect of changes on the systems at equilibrium when given appropriate information. | | | |
| **The effect of changing concentration**<br>• If the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again.<br>• If the concentration of a reactant is increased, more products will be formed until equilibrium is reached again.<br>• If the concentration of a product is decreased, more reactants will react until equilibrium is reached again.<br>• Be able to interpret data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium. | | | |
| **The effect of temperature changes on equilibrium**<br>If the temperature of a system at equilibrium is increased:<br>• the relative amount of products at equilibrium increases for an endothermic reaction<br>• the relative amount of products at equilibrium decreases for an exothermic reaction.<br>If the temperature of a system at equilibrium is decreased:<br>• the relative amount of products at equilibrium decreases for an endothermic reaction<br>• the relative amount of products at equilibrium increases for an exothermic reaction.<br>• Be able to interpret data to predict the effect of a change in temperature on given reactions at equilibrium. | | | |
| **The effect of pressure changes on equilibrium**<br>For gaseous reactions at equilibrium:<br>• an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction<br>• a decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction.<br>• Be able to interpret data to predict the effect of pressure changes on given reactions at equilibrium. | | | |
| **The Haber process**<br>• The Haber process is used to manufacture ammonia, which can be used to produce nitrogen based fertilisers.<br>• The raw materials for the Haber process are nitrogen and hydrogen. Nitrogen is | | | |

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| obtained from the air and hydrogen may be obtained from natural gas or other sources<br>• The purified gases are passed over a catalyst of iron at a high temperature (about 450°C) and a high pressure (about 200 atmospheres). Some of the hydrogen and nitrogen reacts to form ammonia. The reaction is reversible so some of the ammonia produced breaks down into nitrogen and hydrogen<br>• On cooling, the ammonia liquefies and is removed. The remaining hydrogen and nitrogen are recycled.<br>Students should be able to:<br>• apply the principles of dynamic equilibrium in relation to the Haber process<br>• explain the trade-off between rate of production and position of equilibrium<br>• explain how the commercially used conditions for the Haber process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate. | | | |
| **Production and uses of NPK fertilisers**<br>• Compounds of nitrogen, phosphorus and potassium are used as NPK fertilisers to improve agricultural productivity. Industrial production of NPK fertilisers can be achieved using a variety of raw materials in several integrated processes. NPK fertilisers are formulations of various salts containing appropriate percentages of the elements.<br>• Ammonia can be used to manufacture ammonium salts and nitric acid.<br>• Potassium chloride, potassium sulfate and phosphate rock are obtained by mining, but phosphate rock cannot be used directly as a fertiliser because it is insoluble.<br>• Phosphate rock is treated with nitric acid to produce phosphoric acid and calcium nitrate.<br>• Phosphoric acid is neutralised with ammonia to produce ammonium phosphate.<br>• Phosphate rock is treated with sulfuric acid to produce single superphosphate (a mixture of calcium phosphate and calcium sulfate) or with phosphoric acid to produce triple superphosphate (calcium phosphate).<br>• Students should be able to compare the industrial production of fertilisers with laboratory preparations of the same compounds, given appropriate information. | | | |

| Year 11 Practical Skills | ☺ | 😐 | ☹ |
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| • A mixture consists of two or more elements or compounds not chemically combined together. The chemical properties of each substance in the mixture are unchanged.<br>• Mixtures can be separated by physical processes such as filtration, crystallisation, simple distillation, fractional distillation and chromatography. These physical processes do not involve chemical reactions. Students should be able to:<br>• describe, explain and give examples of the specified processes of separation<br>• suggest suitable separation and purification techniques for given mixtures | | | |
| **Chemical analysis**<br>• Analysts have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate.<br>• Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods | | | |
| **Pure substances**<br>• In chemistry, a pure substance is a single element or compound, not mixed with any other substance.<br>• Pure elements and compounds melt and boil at specific temperatures. Melting point and boiling point data can be used to distinguish pure substances from mixtures.<br>• In everyday language, a pure substance can mean a substance that has had nothing added to it, so it is unadulterated and in its natural state, eg pure milk.<br>• Be able to use melting and boiling point data to distinguish pure from impure substances. | | | |
| **Formulations**<br>• A formulation is a mixture that has been designed as a useful product. Many products are complex mixtures in which each chemical has a particular purpose. Formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties. Formulations include fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods. Students should be able to identify formulations given appropriate information. | | | |
| **Chromatography**<br>• Chromatography can be used to separate mixtures and can give information to help identify substances. Chromatography involves a stationary phase and a mobile phase. Separation depends on the distribution of substances between the phases.<br>• In paper chromatography a solvent moves through the paper carrying different compounds different distances, depending on their attraction for the paper and the solvent. The ratio of the distance moved by a compound (centre of spot from origin) to the distance moved by the solvent can be expressed as its Rf value:<br>• $R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$<br>• Different compounds have different Rf values in different solvents, which can be used to help identify the compounds. The compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents. Students should be able to:<br>• suggest how chromatography can distinguish pure substances from impure substances<br>• interpret chromatograms and determine Rf values from chromatograms. | | | |
| **Instrumental methods**<br>Elements and compounds can be detected and identified using instrumental methods. Instrumental methods are accurate, sensitive and rapid and are particularly useful when the amount of a sample is very small. Be able to state advantages of instrumental methods compared with the chemical tests in this specification | | | |

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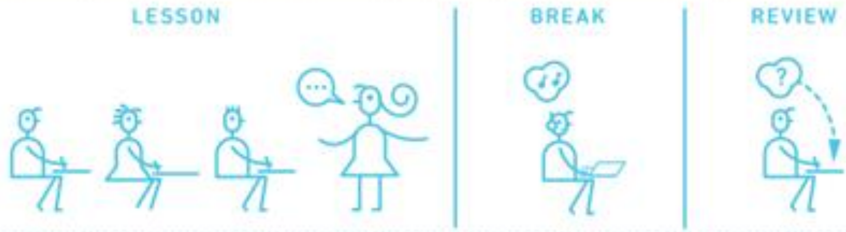
# Spaced Practice

SPACE OUT YOUR STUDYING OVER TIME

## HOW TO DO IT

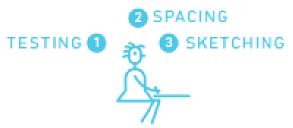
Start planning early for exams, and set aside a little bit of time every day. Five hours spread out over two weeks is better than the same five hours all at once.


Review information from each class, but not immediately after class.

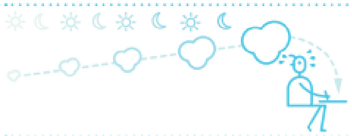



After you review information from the most recent class, make sure to go back and study important older information to keep it fresh.

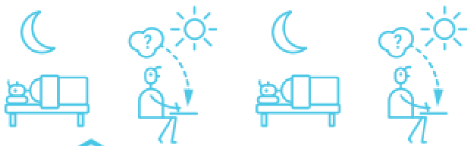

## HOLD ON!




When you sit down to study, make sure you are using effective study strategies rather than just re-reading your class notes.



This may seem difficult and you may forget some information from day to day, but this is actually a good thing! This forces you to retrieve information from memory (see Retrieval Practice poster).



Create small spaces (a few days) and do a little bit over time, so that it adds up!

## RESEARCH

Read more about spaced pratice as a study strategy


Benjamin, A. S., & Tullis, J. (2010). What makes distributed practice effective? *Cognitive Psychology*, *61*, 228-247.