GCSE
CHEMISTRY – UNIT C3
Example 2
4421

Scheme of Work

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Introduction

This Outline Scheme of Work is one of a number of schemes prepared by practising teachers for the new AQA GCSE Sciences suite. It is hoped that other teachers will find them helpful as the basis for the fully detailed schemes prepared for teaching from September 2006. Each outline scheme covers one unit (B1, B2, B3, C1, C2, C3, P1, P2, P3) and for some units more than one outline scheme is available. This is because there are different, equally valid ways of approaching the teaching of the specifications and a single scheme would not show the range of possible approaches.

The AQA specifications are designed to be used with a wide range of resources, so this scheme does not assume the availability of any particular printed or electronic publications, or any special equipment. Teachers are enabled to use existing resources, including their own, together with resources specially purchased for the new specifications.

The outline scheme is arranged under the section headings of the relevant specification, for example, *13.1 How was the periodic table developed and how can it help us understand the reactions of elements?* The content in the section is further subdivided with a brief statement given of the coverage of each subdivision, together with activities that relate to that content and an indication of the number of hours it is suggested are needed to deliver that part of the content.

Opportunities to deliver 'How Science Works' and to use ICT are highlighted using the same icons as used in the specifications.

This identifies parts of the content which lend themselves to extended investigative work of the type needed to explore Sections 10.3–10.7 of the specifications. These sections are about obtaining valid and reliable scientific evidence.

This identifies parts of the content which lend themselves to activities which allow Sections 10.2 and 10.8–10.9 to be considered. These sections are about using scientific evidence, for example, how scientific evidence can contribute to decision making and how scientific evidence is limited.

This identifies where there are opportunities to use ICT sources and tools in teaching the specifications.

Author Note:
The scheme that follows is designed for groups of middle range candidates, not with guaranteed access to IT facilities at home, who will be covering the course in a good allocation of time. (Maybe they studied 'core science' in the first two terms of year 10 and are now studying two sciences out of the three in a 'double time slot'.) The scheme assumes that candidates will be covering all the 'Higher' content and that there is availability of text books written for this specification.

Please note that this is an outline scheme of work, with some suggestions for a possible approach and some opportunities for AfL (Assessment for Learning) identified. To convert the document into a more detailed scheme, objectives and outcomes of each lesson would need to be clearly identified, as well as how the achievement of those outcomes is to be assessed.

UNIT C3			
Total hours: 7	**13.1 How was the periodic table developed and how can it help us understand the reactions of elements?**		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Early Periodic Table: Describe how periodic table first constructed Explain why periodic table important Explain significance of the method used by Mendeleev	 	• Brief discussion re the ideas of the Greeks about elements – earth, fire, water etc, to modern ideas. Then an interactive PPT sequence – ideally carried out by individual students in computer room, with worksheet prompts 1 early ideas 2 Dalton 3 Newlands 4 Mendeleev + the importance of the 'gaps' • Write up carefully	Plan lesson carefully to ensure that it is interesting. For each development, discuss what was improved by the idea. Strengths? Flaws? Good 'How Science Works' material.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Modern Periodic Table: Label main groups Identify which group an element belongs to, and explain similarity of properties within a group Recall and explain the trend in reactivity in Groups 1 and 7	?	• Revisit work done in Chemistry 2 on periodic table – groups/periods/electronic structure of first 20 elements – could label a blank periodic table as a starter. Ensure students understand the pattern that group number equates to the number of outer electrons • Give diagrams of full electronic structure of Li/Na/K and F/Cl and recall ionic bonding. In pairs, think which will be most reactive and why. Discuss ease of gain/loss of electrons related to size and nuclear attraction and shielding • Volunteer to explain back to class at the end	Excellent high level thinking exercise and very good for fundamental understanding of Chemistry Reinforce with homework questions.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
The Alkali Metals Examples/names/ properties/trends in physical and chemical properties Balance symbol equations and explain trend of reactivity		• Starter – what do we know about Group 1 (from KS3)? What could the products be in a reaction between Na and water? • Demonstration – Li plus water – plus careful list of all observations – density/hydrogen produced/alkaline/melts into ball easily etc. Develop equations, then do Na and K and discuss results and equations • Discuss reasons for activity trend • Full careful write up of lesson with all explanation and details	Good thinking skills A good deal to observe and explain

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
The Halogens - 1 Group 7 elements – list, plus name of group Physical properties Diatomic Molecules	?	• Names of halogens • Show sealed samples – chlorine bromine and iodine • Discuss bonding – diatomic molecules with weak forces between them. Discuss why sealed – heavy toxic vapours • Video clip of chlorine in WW1 – heavy green poisonous vapour • Demonstration in fume cupboard – heat iodine and can 'pour' the heavy vapour • Table of boiling point – plot against atomic number	Introduce this additional lesson for middle ability, hopefully relaxed and interesting. This can be extended into a 'How Science Works' discussion on misuse of science – could possibly include the famous Wilfred Owen poem.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
The Halogens – 2 Trends in chemical properties Explanation of trends and balanced equations		• Recall last lesson and extend into a discussion of what is expected with chemical properties (refer back to ease of gaining electrons). Discuss what is meant by 'displacement' and what the students would predict and how they would expect to conduct an experiment • Displacement reactions – aqueous solutions of halogens with potassium halide solutions • Discuss – what does this show about the order of reactivity/word and symbol equations?	Homework: make a list of ionic and molecular compounds of Cl, Br, I. Task: to identify whether ionic or molecular – if ionic, give charges on ions.
Transition Metals: Position in Periodic Table Examples, and properties Formulae of ions and compounds		• Discuss position in periodic table between Groups 2 and 3. What is happening to the electrons as we go along the row? Leads to idea of 'infilling', which gives rise to particular properties • Demonstration or Practical: **Contrast** with alkali metals. Leads to comparison table – hardness, colour of compounds as solids and in solutions, melting point etc. Fe(II) and Fe (III) different colours – leads to discussion of formulae of ions and compounds	High level thinking – take care to make sure it is not too high. Homework: practise with formulae of ions and compounds.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Consolidation	 	• Computer room – exercise such as web research (with prompts) into a topic such as identifying the elements present in stars – presenting data from results in a suitable chart form ('How Science Works'). Could then do an on-line assessment exercise	

Total hours: 5	13.2 What are strong and weak acids and alkalis? How can we find the amounts of acid and alkali in solution?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Strong and Weak Acids and Alkalis: Define acids/alkalis in terms of ions produced and as proton acceptors/donors Define strength of acids/alkalis and explain the difference List common examples of strong/weak acids/alkalis Explain neutralisation in terms of ions		• Revisit pH scale/examples to fit on it/H^+ and OH^- ions/neutralisation. Then develop general equation to word equation to symbol equation to ionic equation, to show neutralisation as reaction of these ions to form water (maybe do one and students repeat with another). From this, comes the idea of proton donor/acceptor • Quick practical – maybe 3 acids and 3 alkalis of different strengths (but same concentration) – measure pH. Discussion – how can acids of the same concentration be of different strengths? Leads to idea of degree of ionisation • Volunteer to explain ideas back to class	There are some high level concepts here.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Titration 1 Define titration, end point, indicator Carry out titration and explain qualitatively what is happening Suitable choice of indicator		• Discuss – how to measure completion of neutralisation – need something more precise than indicator paper and measuring cylinders. Leads to demonstration of titration technique. Leads to: - NaOH/HCl titration - tabulate results - show calculation • Homework: write up, plus a few more of these straightforward calculations	
Titration 2 Choice of indicator Straightforward and more complex calculations (using simple ratio)		• Discuss and demonstrate the use of different indicators – summary table • Another titration to improve technique. This time use sodium hydroxide and sulfuric acid (to use ratio) • Work through calculation plus worksheet with many more examples as homework	‘

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Development of Ideas and Assessment		• Use of computers to generate timeline of development of ideas of acids and bases from information in school IT package • On-line assessment	

Total hours: 7	13.3 What is in the water we drink?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Water and Solubility: Explain water cycle Give examples of substances that dissolve in water and explain which types of substance are usually soluble Units of solubility and define saturation		• Diagram of water cycle – blank boxes for names of processes – quick exercise, add in pencil then correct • Quick practical – 2 ionic and 2 covalent substances – try solubility in water and propanone (care!). Discuss and tabulate pattern • Discuss – is there a limit to solubility? Idea of saturation and units • Some questions as homework	This topic should be familiar.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Solubility Curves: Construct solubility graph and read data from curves Examples of gases that dissolve in water and uses of this Explain how solubility changes with temperature and pressure		• Plot solubility graph from given data – potassium nitrate, sodium nitrate and sodium chloride all on one graph – use to read data off graph and answer questions • Demonstrate – shake coke bottle and release top! Explain what has happened • Give table of solubility of carbon dioxide, oxygen and nitrogen with temperature and pressure. Then discuss why this is important, eg: - aquatic life - 'fizz' in drinks' - carbon dioxide in oceans (significance of global warming)	Alternatively, give plotted data if short of time. Beware of chaos!

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Hard Water: Definition Advantages and disadvantages of hard water Explanation of what makes water hard what happens to soap	 	• Discussion – what is hard water? • Quick experiment – adding pipette measures of soap solutions to corked conical flasks with a) distilled water, b) tap water, c) saturated calcium chloride solution, d) saturated magnesium sulfate solution. Leads to a measurement of hardness • Interactive PPT leads to notes: - where does hardness come from? (plus diagram) - pros and cons of hard water - what happens to soap? (diagram) • Homework: questions to consolidate	Most students usually have a good idea about this topic. Exposure to adverts on TV helps, though take care about the idea of water 'filters', as advertised, that remove hardness. This leads to a common examination error.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Removing Hardness: List methods for removing hardness and explain how they work		• Discussion – what do we know about removing hardness? • Test with pipette measures needed to obtain 'permanent lather' samples of: 1 distilled water as a control 2 'boiled temporary hard water' 3 'boiled permanent hard water' 4 hard water to which students can add sodium carbonate 5 hard water which students pour through ion exchange resin • Discuss results in terms of ionic equations – careful write up needed	Look at ideas from TV adverts etc. To have solutions 1, 2 and 3 pre-prepared would save time.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Water Treatment: Where water is obtained and stages of treatment Explain processes of water treatment Difference between pure water and drinking water		• What do we know now? 'Water comes out of a tap – where does it come from and what has happened to it on the way?' Discuss • PPT presentation. Leads to diagram with blanks to add labels and explanation – distinguish between physical and chemical properties • Discussion – why pay for bottled water? Is it pure? • Homework: Prepare an advert for bottled water – convince the consumer that it is worth paying 25p for what is 'free' out of a tap	Distinguish between 'filters' and ion exchange.
Water Issues Environmental social and economic aspects of water quality and hardness		• Group work from information sheets. Each group to prepare short presentation. All students to write up as notes for homework, eg: 1 daily water use in my home. How much is wasted? 2 water and health 3 water and crops in the desert 4 water and developing countries 5 water – is it worth going to war?	

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Consolidation and Assessment		• Mind map of recent topics – half lesson • On-line assessment – half lesson	

Total hours: 5	13.4 How much energy is involved in chemical reactions?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Comparing Energy Produced by Fuels: Describe method for measuring energy in fuels and how to calculate energy content		• Recall work covered previously on energy. Leads to a discussion of measurement of energy released by burning alcohols • Calorimetry experiment with alcohol burners. Different groups to have different alcohols and to enter data on board. Worksheet leads through the calculations • Careful write up after discussion. Homework: to include more questions to practise	Link with Chemistry 2 – bonus if developed the topic then. **Good experiment to extend into ISA** – an additional lesson collecting data – lots to discuss in terms of accuracy etc. Could extend into an investigation into the pattern of heats of combustion of the alcohols, relating to bond energies.
Energy in Foods Food energy and relation to obesity		• Revisit calculations of last lesson and spend a little more time to ensure understanding • Extend into foods as fuels – supply students with calorie charts to add up average daily intake and compare with the norm that depends on lifestyle • PPT: Problems of obesity • Discussion about whether schools should ban junk food – or should it be a matter of choice?	This is largely a consolidation lesson, but also very topical for many teenagers, so it should be possible to generate interest.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Energy Changes in Reactions: Bonds breaking and forming as enothermic and exothermic processes Energy diagram and interpretation Calculations		• Recall activation energy and energy diagram. Discuss in terms of energy to break and form bonds • Simple calculations – energy to break v energy from formation leads to overall exo or endo and by how much • Short lesson – maybe generating time for an on-line assessment	It helps if this has been introduced in Chemistry 2 – usually an easy concept for most students.
Calculations using Bond Energies: Definition of bond energy Calculate energy transferred in a reaction using supplied bond energies		• Recall work of last lesson, define bond energy, then show how energy values can be calculated from the sum of bond energies of reactants and products • Worked example, then several to practise • Homework: start in lesson as shorter lesson – worksheet of all calculation type problems	The key here is to careful and very logical layout of working. Then it is much easier for students to understand and much more difficult to make mistakes.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Environmental Consequences of Using Fuels Consider social, economic and environmental consequences of using fuels	?	• One possible approach is a debate between two halves of the class: 'We believe that all students within 3 miles of the school should have to walk or cycle. It should be illegal for them to be brought by car.'	Careful organisation is needed so that all students are involved. The students may need some prompts to start off, depending on the nature of the group. Ensure learning is 'captured' at the end.

Total hours: 7	13.5 How do we identify and analyse substances?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Tests for Positive Ions: Explain how to complete flame tests, plus results for Li, Na, K, Ca and Ba Explain how to use aqueous sodium hydroxide to test for different cations and state result for Al, Ca, Cu(II), Fe (II), Fe(III), Mg and ammonium Explain how to test for ammonia gas and give result		• Demonstrate how to do flame tests (interesting ideas from CLEAPPS) and how to do tests on solutions • Give an analysis key. Then students can work through a list of unknowns and identify • Homework: write up, plus some extra questions – identifying 'unknowns' from supplied information	Seems a lot to cover in a lesson, but if it is well organised, can work with pace and do it comfortably. Given more time, it would be interesting and valuable for students to develop their own key from 'known' observations, although very often their results with the 'knowns' may differ from the textbook. This can lead to confusion, so care is needed if you decide to do this.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Tests for Negative Ions: Explain how to complete tests, and state results, for carbonate/halides/sulfate/nitrate Interpret results		• Suggest 'Interactive Demonstration' • Assemble all students around the front with pen and paper. Have a grid on PPT – ion/formula/test/result – one student is tasked with its completion as the lesson progresses • Pair by pair, under instruction, students to carry out a test and describe what is seen to the rest of the class. All complete an **accurate** table • Problems – to complete for homework – unknowns (anions and cations for complete compound)	Can be fun as other students watch and offer comments about technique! It is important to ensure that the final table is accurate.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Whodunnit? Consolidation lesson		• Describe the scene. Professor Plum has been foully done to death and the suspects are …….. (members of senior staff!), but our intrepid forensic scientist has a sample of dust found at the scene and samples taken from the shoes of the suspects. Using the techniques of the last two lessons, a) confirm the match and b) prepare an 'expert witness' statement for court proceedings. Complete as homework	This lesson can be good fun and provide some good learning. This may be developed, if time, into some posters.
Testing for Organic Substances: State and explain positive result for organic compounds State positive result for unsaturated compounds		• Organic compounds – what are they? • Demonstrate and explain the effect of heat on methane, oil, sugar • Discuss – where have students heard the term saturated/unsaturated? Show the test with bromine water • Practical: food tests. Can run a series of tests with olive oil, sunflower oil etc. Comment and explain. • Homework: write up, plus some research into food labelling	This experiment works well and may be better than introducing alkenes.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Organic Substances 2 Instrumental Analysis 1 Calculations of empirical formula from combustion analysis Names of modern analysis techniques Advantages and disadvantages of modern analysis techniques		• Remind students about the formula, then carefully work through a worked example. Volunteer does one on the board to check understanding. All practise more as homework, eg atomic absorption spectroscopy, mass spectrometry • Provide material to read through and make notes in a table of pros and cons. Then discuss what each item really means	As always, the key is to laying out the work with clarity and logic – otherwise a recipe for confusion. It is very easy to become totally confused with these names, so care is needed to avoid muddle. Could make into an AfL exercise with peer marking and comment.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Instrumental Analysis 2: Recognise the information a given technique will provide and how it can be used		• Discussion – how can we make sense of long technical names? • Provide A4 information sheet on each of: - infra red spectroscopy - ultraviolet spectroscopy - NMR spectroscopy - gas-liquid chromatography - mass spectrometry - atomic absorption spectroscopy Task: abstract key facts and colour code onto A6 size cards – make a silly 'memory sentence' about each • Plenary: review sentences, maybe a prize for the funniest!	

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Analysis **'How Science Works'** To interpret and evaluate the results of instrumental analysis to identify elements and compounds for forensic, health or environmental purposes		• Pick an issue with internet information printed off for student use, eg: 'Doping in the Tour de France' or 'Banned Substances in Sport' (what the drug does to enhance performance, its side effects and how it is detected) • end with some presentations	Now prepare a **revision sequence**, though it is much better to have done little and often on the way through.