Version 1.0

GCSE
ADDITIONAL SCIENCE, CHEMISTRY
UNIT C2 – Example 1
4463, 4421

Scheme of Work

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Registered address AQA, Devas Street, Manchester M15 6EX. *Dr Michael Cresswell Director General.*

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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, *12.1 How do sub-atomic particles help us to understand the structure of substances?* 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.

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Author Note:
The scheme that follows is designed for groups of able candidates, with access to IT facilities at home, who will be covering the course in the minimum amount of time. (Maybe they are studying all three sciences in a 'double time slot'.) To make this possible, there is an appreciable degree of independent learning and an assumption that they all have their own textbooks suitable for the new 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 C2			
Total hours: 6	12.1 How do sub-atomic particles help us to understand the structure of substances?		
Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Atomic Structure: Atom consists of smaller particles – names and charges. Protons = Electrons Atomic Number and relation to Periodic Table		• Discussion – most of atom must be empty space (how do we know this?). Leads to idea of most of mass in centre plus orbiting electrons (what stops them 'flying off'?) • Build up of structure/diagrams and relative charges • Define atomic number plus idea that periodic table arranged in order of atomic number • Idea that this gives repeating patterns of properties – maybe use a technique such as a blank periodic table and fill in with colour codes for different types of element – information on worksheet or cards	**Independent Learning: project work on "History of the Atom"** – use of textbook and internet resources to research a timeline "From Democrites to Quarks via Dalton". All student to do the work, but two to do as PPT presentations – over the course opportunities for all students to use IT and presentation skills in this way.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Electron Arrangement: Representation for first 20 elements Relationship of number of 'outer' electrons to Group Number and thus chemical properties		• Careful progression of ideas – Starter: recall last lesson then discuss how electrons avoid colliding all the time – must be in specific 'pathways' then - 3D picture of an atom (PPT) - simple depiction as shells (PPT) - 2.8.8.depiction as well - exercise to ensure complete understanding – adding electrons to blank shells for 20 elements (together with 2.8.1 depiction) • Exercise to add 1, 2, 2.1, 2.2, 2.3 etc to elements in a periodic table – plenary – what does this show?	Homework task: make as visual as possible by colour coding. Last exercise – clear relation of group number to number of outer electrons
Elements Make Compounds: Metals, eg Na, react with non-metals, eg Cl, to form compounds by electron transfer. Noble gas structure is gained by forming charged **ions**		• Recall ideas of elements and compounds • Demonstrate reaction of Na and Cl – then discuss what must be happening – idea of electron transfer and particles now charged • A great deal of practice now needed – exercises involving going from atomic to ionic structure and numbers of electrons gained or lost	It is essential that these are very clearly taught lessons – good opportunity for developing thinking skills rather than just telling students. There is a danger of making this too simplistic (Na 'wants' to lose electron etc). Important that really understand reason for charge on ions and the fact that bonding = electrostatic attraction. Homework: lots of practice to really embed

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Ionic Bonding: Ions in giant structures Structures of NaCl MgO and $CaCl_2$		• Recall forming ions from atoms • Demonstrate Mg reacting with Oxygen – then discuss in detail (2 electrons transferred, from metal to non metal, achieve noble gas structure, form oppositely charged ions, giant structure, electrostatic forces) • Diagrams (to stick into books) of giant structures of NaCl, MgO, $CaCl_2$ - predict properties • Lots of practice showing ionic bonding process – atoms into ions. Complete as homework	This could be made into a useful AfL exercise. Homework: questions to complete
Covalent Bonding: Definition and formation Dot cross diagrams H_2 Cl_2 HCl H_2 O_2 CH_4 NH_3 Giant covalent structures		• How can 2 atoms of chlorine combine to make a molecule? (PPT) Idea of **shared pair** • Careful use of PPT – build up diagrams – pupils have blank worksheet to complete • Models useful as can emphasise the difference between bonds within and forces between molecules • Then discuss – what must happen in substances such as diamond and silicon oxide? – develop idea of giant structures – diagrams	Often errors in understanding, so it is worth spending time emphasising key points, eg shared pair – one electron from each atom covalent bonding is **strong but** there are **weak forces** (**not** bonds) between molecules.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Metallic Bonding: How atoms are arranged What holds atoms/ions together?	?	• Discuss what students know about metals (brainstorm) – hard/conductor (thus moving electrons)/high m pt etc, plus extra clue from growing silver crystals as this is going on (copper wire in silver nitrate solution in Petri dish on OHP). Leads to individual then group work on ideas of what must be happening • Ensure clear understanding and carefully drawn diagrams • Work on questions to ensure understanding, then discuss a mind map about this topic	Some key ideas to ensure understood, eg **outer** electrons are able to move through the metal. A very good diagram helps, as students can visualise this. Homework: mind map plus some exam/assessment questions

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Total hours: 4	12.2 How do structures influence the properties and uses of substances?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Ionic Compounds: Ionic compounds are solid at room temperature and have high melting points Ionic compounds conduct electricity when molten or when dissolved in water		• Discussion – know ionic compounds consist of charged ions held together by powerful electrostatic forces – what do you think properties might be? How could we find out? • Practical: two ionic compounds, say sodium and magnesium chloride - effect of heat - solubility in water - conductivity of solution • Sum up in detail so can produce a high quality write up	Good for thinking skills – best students come up with ideas rather than being told Practical write up needs to include comparison of: a) ionic solid with b) molten ionic compound with c) ionic compound in solution and also discussion of conduction by movement of ions – useful when talk about electrolysis later. Homework: prepare a good write up.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Simple Molecules: Properties of substances made of simple molecules Reasons for low melting and boiling points Reasons why do not conduct electricity		• Discussion – know covalent compounds consist of uncharged molecules – what do you think properties might be? How could we find out? • Practical: melting point of water and wax. Demonstrate melting point of sulfur – useful to have S_8 models for subsequent discussion. Also quickly demonstrate lack of conductivity of water, ethanol etc. Discuss results in detail so can produce a good write up with key points	Some key concepts here – need to ensure the learning is captured. Eg: **strong covalent bonds within molecules** **weak forces between molecules** and no charged particles to conduct electricity.
Giant Covalent Structures: Egs of substances with giant covalent structures Associated physical properties Physical properties of diamond and graphite related to structure Electrical conductivity of graphite		• Discuss/list uses of diamond. Show graphite, allow to touch and demonstrate conducts. List properties of both, then ask students to think and try to explain • Leads to PPTs – pictures of diamond and graphite and copies to 'cut and paste' in to books. Talk about 2D and 3D strong covalent bonds • Questions to practise to ensure understanding • Volunteers at end to explain back to rest of class	This could be made into a good AfL exercise.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Metallic Structures: Metals conduct heat and electricity and can be bent and shaped Uses of metals can be matched to their specific properties		• Recall bonding in metals/delocalised electrons and conduction of electricity. Then brainstorm other properties of metals • Build up a table relating metals, properties and uses. Discuss reasons for metals being malleable and ductile – what must be happening? • Use model of soap bubbles in a Petri dish to show effect of stretching plus use whatever models and PPT available to make as visual as possible • Need good diagrams of metal planes and slipping for books	Can discuss use of models in science. **Independent Learning - exercise on 'Nanotechnology'**. Guide sheet of essential points and references, limit to 3 or 4 sheets of A4 – two students to produce PPT presentation.

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Total hours: 7	12.3 How much can we make and how much do we need to use?		
Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Mass Numbers: Relative masses of subatomic particles Mass Numbers (plus use of Periodic table) Isotopes and relative atomic mass		• Recall protons, neutrons and electrons and atomic number. Table of masses and charges. Define mass number, then practise interpretation of information from periodic table (whole numbers only at first) • Pose the question – why are there some numbers like Chlorine at 35.5 – if protons are the same, there must be a mixture of atoms with different neutron numbers. Leads to idea, and definition, of isotopes • Discuss and make a table – isotopes of H, Cl and C • Define relative atomic mass • More practice for homework	**Independent Learning:** use ICT to find information on use of isotopes for tracers, for medical purposes and for radiocarbon dating. All students to do work, two students to prepare a PPT presentation.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Masses of Atoms and Moles: Masses of atoms compared by relative atomic masses Calculation of relative formula mass Concept of moles		• Very careful progression of ideas needed • PPT, or samples of molar amounts of elements such as C, Mg, S, together with their relative mass numbers. **Thinking exercise** to develop concept of mole then define • Extend to compounds – discussion leads to definition of relative formula mass and its calculation. Lots of practice on a worksheet to ensure understanding • Plenary volunteer to explain what learnt in class	The key here is very careful explanation and lots of practice and good Q and A technique, that ensures **understanding** rather than just following number patterns. Homework: more practice

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Percentages and Formulae: Percentage mass of an element in a compound Empirical formulae from percentage composition		• Idea of percentage – eg percentage of girls in room = number/total $\times$ 100 • Transfer idea to a chemical formula – simple examples, with extension for more able of more complex ones. Lots of practice • Formulae – 'easy if follow the rules' 1 list the elements 2 underneath put mass or % 3 divide by RAM to get mole ratio 4 simplest ratio of moles 5 Formula • Lots of practice to complete for homework	May be useful to check with Maths dept when last covered % ratio and proportion. Rarely tackled well. If train into this method, the chemistry (and hopefully the understanding) is correct and the student can gain credit for the method even if they do not make it the whole way to the right answer.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Equations and calculations: Interpret the number of moles of reactants and products in a balanced equation Balance symbol equation Use balanced equation to calculate mass of reactants or products		• Revisit simple equations (5 mins practice), then emphasise what they are telling us in terms of moles, then in terms of masses (the chemistry is not just making the numbers fit) • Again 'follow the rules and get the answer' 1 write the equation 2 write the numbers of moles 3 write the reacting masses and check that total LHS = total RHS 4 then the proportion exercise – 'what is done to one side must be done to the other' – show working suggest calcium carbonate – lots of practice with simple numbers, then some others to ensure understanding	Again emphasise the importance of setting out working clearly – both for clarity of thought and also to gain examination marks. Could make into useful AfL exercise – correct each other and point out where going wrong and explain to peer partner if having difficulties.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Making as Much as we Want: Yield Factors affecting yield. Atom economy and importance. Calculations		• Demonstration – heat 31 g of copper carbonate (0.25 mole). While this is happening, work out equation and then expected mass of copper oxide (20 g). Measure actual mass and then discuss reasons why it is different from 20 g • Leads to concept of yield, a definition and calculation of percentage yield • Define atom economy and discuss importance. Lots of calculation practice	Once again, students need the discipline of setting out working clearly – less likely to make errors and more likely to gain credit.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Reversible reactions: Explain reversible reactions, giving examples Recognise from word and symbol equations		• Demonstration as starter – 'water to wine' (and back again!): 2 litre beaker of water with trace of phenol phthalein goes red when poured into 'empty' beaker with trace of alkali and so on. Discuss – is this magic or is it science? Leads to ideas … reversible reaction/reactants/products/equilibrium (try to get an 'endpoint' and talk about what is happening)/closed system • Ammonium chloride quick practical. Then good PPT – with really good diagrams that can be printed off for books – build up ideas carefully showing graphically what is going on at equilibrium • Test understanding with volunteer explaining back to class	This is not an easy lesson to do well – needs careful planning, lesson tailored to group and total clarity of teaching. Need to be very careful that do not confuse with physical processes like evaporate and condense. Could make the explanation like a 4 mark exam question –for total precision.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Making Ammonia: Uses of ammonia Making ammonia – equations, reaction conditions, minimising waste Relate reaction conditions to rate and yield (effect on amount of product)	?	• Discussion re plants needing nitrates, we eat plants, N removed, has to be replaced but N unreactive so we need to make N into a soluble compound that bacteria can convert into nitrates. Haber process – maybe provide page of text with blank flow diagram for exercise to abstract all the necessary details. Discuss the reasons for the conditions and summarise in a table – pressure/temp/catalyst/recycling – effect on yield and rate • Need to ensure understanding – eg plenary could be PPT of process, filling in blanks again	Emphasis on thinking rather than just telling The Haber process is met again in Section 12.5, where energy has been covered, so can discuss the reasons for the conditions in more detail then. Homework: detailed revision of this section prior to on line assessment

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Total hours: 5	12.4 How can we control the rates of chemical reactions?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
How fast? Definition of rate of reaction Methods for measuring rates, related to specified types of reaction		• PPT – pictures of fast/slow reactions. Discussion re how to come up with a definition of RATE. How can we measure the rates of these reactions? – discuss/demo/results into a worksheet with diagrams 1 marble and acid – change of mass 2 marble and acid – volume of gas thio and acid both with cross and with colorimeter attached to datalogger	Thinking skills May seem quick, but each method is to be revisited over next few lessons. Very useful homework – plot the graphs – as starter next lesson = interpretation which is a good lead into collision theory.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Collision Theory: Explain collision theory Factors affecting the rate of reaction Explain, in terms of collision theory, how surface area affects rate of reaction		• Discuss graphs from last lesson – reaction fastest at start. Why? Leads to idea of higher concentration and faster rate. Why? Idea of collisions • What could affect rate? Surface area/temperature/concentration/catalyst • Surface Area – marble chip practical – large/medium/small chips – readings of mass against time • Plot graphs, careful write up as homework	Thinking skills Temperature/concentration and catalysis in next lessons 'How science works' input as much as possible **Good place to plan PSA/ISA over this sequence of lessons – could observe student skills this lesson and next**.
Effect of Temperature: Activation energy Describe and explain how and why increasing temperature increases rate of reaction		• Discuss – what evidence is there from everyday life that increasing temperature increases rate of reactions – bake cake in oven not freezer etc. Discuss why this is so – interactive PPT. Idea of increased rate of collisions, increased energy and more particles with activation energy • Thiosulphate/Acid – 5 water baths with reagents set at different temperatures. Each working group does one at high temp and one at low temp. Results averaged and plotted. Discussion and good write up	Thinking skills Use as chance for **PSA observation** and revision of ideas of 'How Science Works' prior to **ISA**. Homework: write up plus some additional questions

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Effect of Concentration: Define concentration Explain effect of changing concentration on rate in terms of collision theory For gases, equal volumes at same temperature and pressure contain equal number of particles – effect of pressure on rate		• Beaker of 1M potassium permanganate – dilute 10 times, then another 10 times etc. What is the concentration each time? Define concentration. What do the students think will be the effect of changing concentration and why? • Excess marble chips reacting with HCl of different concentrations – measure change in volume of gas. Plot and interpret graphs • Discussion – then write up as homework • Discuss gases – leads to a good homework question – predicting/explaining the effect of pressure	Thinking skills More PSA/ISA/'How Science Works' opportunities

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Effect of Catalysts: Definition of a catalyst Explanation of how a catalyst works		• Starter – student has to leave room to go into corridor, but door locked so has to go out of fire door and round the whole school to reach the corridor. Now unlock the door – which route is easier? Discuss ideas of catalysis • Decomposition of hydrogen peroxide with small amount of manganese (IV) oxide, collect gas in syringes, plot graph and discuss results. Come to a definition of a catalyst and explain in terms of activation energy. Discuss why catalysts used in industry (eg processes operate at lower temperature, reducing cost)	Thinking skills **Independent learning –** all to do research and hand in. Two to do PPT presentations **–** three headings: a) catalysts in car exhausts b) catalysts reducing costs in industry c) enzymes in the home Revision for on-line assessment.

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Total hours: 4	12.5 Do chemical reactions always release energy?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Exothermic and Endothermic Reactions: Define exothermic and endothermic reactions, and explain the difference Give examples and recognise from data		• Discuss photosynthesis v respiration – with equation in words and symbols – as good example of energy taken in one direction and released in the other. A good diagram would be useful. This should lead to definitions • Discuss what is happening in terms of bonds breaking and forming – useful if have already done activation energy diagram when discussing activation energy. This gives rise to a higher level definition in terms of bonds • Alcohol burners – heat used to increase temperature in a copper calorimeter. Discuss in terms of equation and bond energies	Thinking skills Bond energies are met in Section 13.4, so no harm in discussing here as can reinforce later. Homework: write up in detail and list other exothermic/endothermic reactions.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Energy and Reversible Reactions: If reaction exothermic in one direction, then endothermic by same amount in reverse direction (and vice versa) Effect of temperature change in equilibrium mixture		• Revisit equilibria (eg by 'active demo' with students transferring balls in two directions simultaneously – reaction going on in both directions at same rate so no apparent change in concentration – good for understanding) • Copper sulfate experiment (hydrated to anhydrous and reverse) and include test for water. Careful explanation in terms of energies with volunteer explaining back to class to test understanding	Homework: write up plus practice questions
Haber Process 2: State and justify the operating conditions of the Haber process Explain effect of changing temperature in exothermic and endothermic reactions and pressure in a gaseous reaction		• Recall conditions of Haber process –why go to the expense of generating this temperature and pressure? Leads to data analysis exercise – plot yield against pressure for three different temperatures all on one graph. Discuss and make notes in a table to compare yield and rate effect of temperature and why effect of pressure and why effect of catalyst and why Last 20 mins – do a past paper question – then peer marking against actual mark scheme	Very careful planning is needed for this lesson as very easy to generate confusion. Yield and rate are very frequently mixed up in exam answers, so good to emphasise again the difference. AfL opportunity and a good use of AfL

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Sustainable Development: Importance of minimising use of raw materials and energy requirements	?	• Structured discussion. Each group to use material to prepare a short presentation on a different topic, eg over-exploitation of raw materials, resources from the ocean, energy getting scare. What will be left of the Earth when we are 60? etc. Presentations and discussions	Technique to be used will depend on how good the group is at this sort of activity. All students to produce notes of discussion for homework

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Total hours: 7	12.6 How can we use ions in solutions?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Electrolysis 1: Define electrolysis Know which compounds undergo electrolysis Add state symbols to equations		• Interactive PowerPoint to recall work done on ionic compounds and conduction by melts and solutions – develop a definition of electrolysis • Demonstrate electrolysis of molten lead bromide, with **overall** equation and symbols • Quick practical – electrolysis of aqueous copper chloride leading to overall equation and symbols	Clarity of teaching essential or students may become very confused. Throughout this topic, it is very important to keep checking on understanding and progress – Q and A technique. AfL work, answering students to explain back to you and marking work which asks for explanations
Electrolysis 2: Explain electron transfer at anode and cathode Construct half equations and recognise oxidation and reduction Predict products and explain effect of water		• Revisit the key points of last lesson to reinforce learning and then think about what is really happening at the electrodes. Leads to half equations for previous lesson and extension into redox • Now another example: Practical – electrolysis of aqueous potassium chloride – use cells with carbon electrodes so that can isolate and test products – hydrogen and chloride • Write up with more half equations	Thinking skills More reinforcements and consolidation of topic students find difficult

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Electrolysis of Brine: Explain electrolysis of brine and recall products Half equations Uses of products		• Discuss ions in brine – what are the possible products? • Electrolysis cells – produce hydrogen and chlorine and write half equations • Really good demonstration – use a Hoffman voltameter with some indicator in the solution – shows alkali at one electrode and bleached at the other – can prompt a very good high level discussion • PPT – build up spider diagram of uses of products and schematic for industrial process – hard copies for notes	It is useful to add tests for these gases. Works very well! Homework: prepare a write up.
Purifying Copper: Reasons for purification and what happens at electrodes Half equations		• Discuss why copper needed is pure • Group thinking problem – given pure and impure copper (show), copper sulfate solution and electricity, how could we make use of electrolysis? • Discuss then experiment: copper sulfate and copper electrodes – use balance to show increase/decrease in mass. Write up with half equations	High level thinking skills – able students who really understand the work done so far should be able to work it out. **Independent Learning:** a salt mine near a small Cheshire town is to be extended as is the associated brine works. All students to produce work examining the pros and cons of this, and two students to prepare a PPT presentation.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Acids and Alkalis: List properties Give examples and recognise acid/alkali from pH Neutralisation Acids and alkalis in terms of ions		• Starter – revision exercise – should be familiar with material from KS3 – in pairs maybe, large pH charts and lots of common substances on small cards to place in the right position • Discussion and some brief notes – properties/examples/pH/neutralisation/alkalis and bases • Demonstration – Hoffman voltameter with sodium chloride solution again – indicator added. Discuss ions present and the fact that water must be partly ionised (how do we know this?) in a reversible reaction. Then can explain what happens – why does the solution at cathode turn alkali? – because hydrogen ions discharged, leaving hydroxide • Write up carefully. Volunteer to explain back to ensure all listening	Alkalis and bases very commonly confused, so worth a little time. High level thinking (and also some good revisiting of previous ideas). If really understand this, then the point has been made very effectively.

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Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Making salts from metals or bases: Neutralisation Names of salts Equations for salt formation General word equations		• Discussion – what is a salt? Table of acids and corresponding salts – formulae and names – highlight the H in the acid and where it has been replaced by a metal in the salt. Leads simply to definitions and names • Heated dilute sulfuric acid with copper oxide – all used, then filter, evaporate and leave to make crystals. Can discuss experiment while heating to evaporate – word equation, symbol equation and general equations	Making crystals lends itself to useful reinforcement of ionic properties.
Salts from Solutions: Methods for making soluble and insoluble salts Precipitation – what it is/examples/explanation		• Demonstrate – acid ammonia solution and sulfuric acid – no apparent change, but a reaction has happened – equation/ionic equation. How do we know it has reacted? How can we recover products? Then show barium chloride and copper sulfate solutions and discuss • Making ammonium sulfate and barium sulfate – two quick experiments to write up with sequential diagrams to remember methods	**Independent Learning:** Ammonium compounds as fertilisers – all students to do the work. Two students to prepare PPT presentations. After this lesson, will be into a revision sequence for Chemistry 2 examination.

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