# PLANNING SUPPORT BOOKLET

**J248, J250**

**For first teaching in 2016**

This support material booklet is designed to accompany the OCR GCSE (9–1) in Chemistry A and Combined Science A (Gateway Science).

***DISCLAIMER***

This resource was designed using the most up to date information from the specification at the time it was published. Specifications are updated over time, which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)

# Introduction

This support material is designed to accompany the new OCR GCSE (9-1) specification for first teaching from September 2016 for:

* [Chemistry A (Gateway Science – J248)](http://www.ocr.org.uk/Images/234598-specification-accredited-gcse-gateway-science-suite-chemistry-a-j248.pdf)
* [Combined Science A (Gateway Science – J250)](http://www.ocr.org.uk/Images/234596-specification-accredited-gcse-gateway-science-suite-combined-science-a-j250.pdf)

We recognise that the number of hours available in timetable can vary considerably from school to school, and year to year. As such, these suggested teaching hours have been developed on the basis of the experience of the Science Subject Specialist team in delivering GCSE sciences in school. The hours are what we consider ideal for providing the best opportunity for high quality teaching and engagement of the learners in all aspects of learning science.

While Combined Science is a double award GCSE formed from the three separate science GCSEs, the DfE required subject content is greater than a strict two-thirds of the separate science qualifications, hence the suggested hours here are greater than a strict two-thirds of the separate science hours.

The suggested hours take into account all aspects of teaching, including pre- and post-assessment. As a linear course, we would recommend on-going revision of key concepts throughout the course to support learner’s learning. This can help to minimise the amount of re-teaching necessary at the end of the course, and allow for focused preparation for exams on higher level skills (e.g. making conceptual links between the topics) and exam technique.

Actual teaching hours will also depend on the amount of practical work done within each topic and the emphasis placed on development of practical skills in various areas, as well as use of contexts, case studies and other work to support depth of understanding and application of knowledge and understanding. It will also depend on the level of prior knowledge and understanding that learners bring to the course.

The table follows the order of the topics in the specification. It is not implied that centres teach the specification topics in the order shown. Centres are free to teach the specification in the order that suits them.

Should you wish to speak to a member of the Science Subject Team regarding teaching hours and scheme of work planning, we are available at [scienceGCSE@ocr.org.uk](mailto:scienceGCSE@ocr.org.uk) or 01223 553998.

## Delivery guides

Delivery guides are individual teacher guides available from the qualification pages:

* <http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/>
* <http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-combined-science-a-j250-from-2016/>

These Delivery guides provide further guidance and suggestions for teaching of individual topics, including links to a range of activities that may be used and guidance on resolving common misconceptions.

## Practical work

Specification Topic C7 (Practical skills) is not included explicitly in the Planning Guidance table. The expectation is that the practical skills are developed throughout the course and in support of conceptual understanding.

Suggestions where the PAG activities can be included are given in the table below. This is by no means an exhaustive list of potential practical activities that can be used in teaching and learning of Chemistry.

Suggested activities are available under “Teaching and Learning Resources / Practical Activities” on the qualification page: <http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-chemistry-a-j248-from-2016/#resources>.

An optional activity tracker is available at <http://www.ocr.org.uk/Images/323481-gcse-chemistry-practical-tracker.zip>.

An optional learner record sheet is available at <https://www.ocr.org.uk/Images/295630-gcse-chemistry-student-record-sheet.doc>.

A sample set of activities that gives learners the opportunity to cover all apparatus and techniques is available at <https://www.ocr.org.uk/news/example-set-of-chemistry-practicals/>.

| Topics | Suggested teaching hoursSeparate / Combined | Comments and PAG opportunities |
| --- | --- | --- |
| **Topic C1: Particles** | | |
| C1.1 The particle model | 4 / 4 |  |
| C1.2 Atomic structure |  |
|  | **Total 4 / 4** |  |
| **Topic C2: Elements, compounds and mixtures** | | |
| C2.1 – Purity and separating mixtures | 10 / 10 | PAG C3: Using chromatography to identify mixtures of dyes in an unknown ink.  PAG C3: Thin layer chromatography.  PAG C4: Distillation of mixtures.  PAG C4, C7: Separation of mixtures and purification of compounds. |
| C2.2 – Bonding | 8 / 8 |  |
| C2.3 – Properties of materials | 10 / 6 | PAG C8: Dissolving tablets. |
|  | **Total 28 / 24** |  |
| **Topic C3: Chemical reactions** | | |
| C3.1 – Introducing chemical reactions | 11 / 11 |  |
| C3.2 – Energetics | 6 / 6 | PAG C8: Measuring the temperature change in reactions. |
| C3.3 – Types of chemical reactions | 10 / 10 | PAG C6: Neutralisation reactions.  PAG C6: Determining pH of unknown solutions.  PAG C6: Use of pH probes.  PAG C7: Production of pure dry sample of salt. |
| C3.4 – Electrolysis | 4 / 4 | PAG C2: Electrolysis of sodium chloride solution.  PAG C2: Electrolysis of copper sulfate solution. |
|  | **Total 31 / 31** |  |
| **Topic C4: Predicting and identifying reactions and products** | | |
| C4.1 – Predicting chemical reactions | 8 / 6 | PAG C1: Displacement reactions of halogens with halides.  PAG C1, C5, C8: Investigation of transition metals.  PAG C1, C7, C8: Reaction of metals with water, dilute hydrochloric acid.  PAG C1, C7, C8: Displacement reactions involving metals and metal salts. |
| C4.2 – Identifying the products of chemical reactions | 8 / 1 | PAG C5: Flame tests.  PAG C5: Testing unknown solutions for cations and anions.  PAG C5: Tests for anions using silver nitrate and barium sulfate.  PAG C5: Tests for cations using sodium hydroxide. |
|  | **Total 16 / 7** |  |

| Topics | Suggested teaching hoursSeparate / Combined | Comments and PAG opportunities |
| --- | --- | --- |
| **Topic C5: Monitoring and controlling chemical reactions** | | |
| C5.1 – Monitoring chemical reactions | 12 / 1 | PAG C6: Acid/alkali titrations.  PAG C8: Measurement of gas volumes and calculating amount in moles. |
| C5.2 – Controlling reactions | 10 / 10 | PAG C1, C7, C8: Marble chip and acid or magnesium and acid experiments either measuring reaction time or the volume of gas over time.  PAG C1, C8: Catalysis of hydrogen peroxide with various black powders including MnO2.  PAG C1, C8: Catalysis of reaction of zinc with sulfuric acid using copper powder.  PAG C1, C8: Magnesium and acid, marble chip and acid.  PAG C1, C8: Rate of reaction experiments.  PAG C1, C8: Reaction of magnesium and acid with different temperatures of acid – measure reaction times.  PAG C1, C8: Varying surface area with marble chips and hydrochloric acid.  PAG C8: Disappearing cross experiment. |
| C5.3 – Equilibria | 3 / 3 |  |
|  | **Total 25 / 14** |  |
| **Topic C6: Global challenges** | | |
| C6.1 – Improving processes and products | 16 / 7 | PAG C1: Extraction of copper by heating copper oxide with carbon.  PAG C2: Electrolysis of aqueous copper sulfate solution.  PAG C2: Electrolysis of aqueous sodium chloride solution.  PAG C6: Preparation of potassium sulfate or ammonium sulfate using a titration method. |
| C6.2 – Organic chemistry | 12 / 4 |  |
| C6.3 – Interpreting and interacting with earth systems | 8 / 7 |  |
|  | **Total 36 / 18** |  |
| **GRAND TOTAL SUGGESTED HOURS – 140 / 98 hours** | | |

þ This symbol indicates content that is found only in the chemistry separate science qualification.

Statements shown in **bold** type will only be tested in the Higher Tier papers. All other statements will be assessed in both Foundation and Higher Tier papers.

# Outline Scheme of Work: C3 – Chemical reactions

## Total suggested teaching time – 31 hours (separate and combined)

### C3.1 – Introducing chemical reactions (11 hours – separate and combined)

|  |  |
| --- | --- |
| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * chemical symbols and formulae for elements and compounds * conservation of mass changes of state and chemical reactions. * energy changes on changes of state (qualitative) * representing chemical reactions using formulae and using equations * the Periodic Table: periods and groups; metals and non-metals * thermal decomposition | Links to Practical Activity Groups (PAGs)  * N/A |
| Links to Mathematical Skills  * M1a * M1b * M1c * M2a | Links to Working Scientifically  * WS1.1b * WS1.3c * WS1.4a * WS1.4b * WS1.4c * WS1.4d * WS1.4f |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C3  Topic 1  11 hours  (separate and combined) | CM3.1i – arithmetic computation and ratio when determining empirical formulae, balancing equations [M1a, M1c ]  **CM3.1ii – calculations with numbers written in standard form when using the Avogadro constant [M1b]**  CM3.1iii – provide answers to an appropriate number of significant figures [M2a]  CM3.1iv – convert units where appropriate **particularly from mass to moles [M1c]**  C3.1a – use chemical symbols to write the formulae of elements and simple covalent and ionic compounds  C3.1b – use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations **and half equations**  C3.1c – use the names and symbols of common elements from a supplied periodic table to write formulae and balanced chemical equations where appropriate [the first 20 elements, Groups 1, 7, and 0 and other common elements included within the specification]  C3.1d – use the formula of common ions to deduce the formula of a compound  **C3.1e – construct balanced ionic equations**  C3.1f – describe the physical states of products and reactants using state symbols (s, l, g and aq)  **C3.1g – recall and use the definitions of the Avogadro constant (in standard form) and of the mole [the calculation of the mass of one atom/molecule]**  **C3.1h – explain how the mass of a given substance is related to the amount of that substance in moles and vice versa**  C3.1i – recall and use the law of conservation of mass  C3.1j – explain any observed changes in mass in non-enclosed systems during a chemical reaction and explain them using the particle model  **C3.1k – deduce the stoichiometry of an equation from the masses of reactants and products and explain the effect of a limiting quantity of a reactant**  **C3.1l – use a balanced equation to calculate masses of reactants or products** | Change in mass in non-closed systems is well demonstrated with calcium carbonate in acid on a top-pan balance. By either leaving the flask open to the atmosphere, or covering the mouth of the flask with a balloon, the ‘loss’ or conservation of mass can be readily seen and discussed.  Conservation of mass is the cause of many difficulties and misconceptions as it can seem to run counter to intuition – e.g. wood ‘disappears’ when it burns. This can be investigated practically by weighing a splint, burning it, and then weighing the remains. An opposite, apparent ‘appearance’ of mass, can be practically investigated using the [oxidation of magnesium](http://www.rsc.org/learn-chemistry/resource/res00000718/the-change-in-mass-when-magnesium-burns)  These reactions lead into balancing equations and link back to empirical formulae. OCR resources are available [here](http://www.ocr.org.uk/Images/179563-balancing-equations-activity.doc), [here](http://www.ocr.org.uk/Images/179630-balancing-equations-activity-powerpoint.ppt) and [here](http://www.ocr.org.uk/Images/179564-balancing-equations-teacher-instructions.pdf). Conversion between mass and moles is equally covered by many on-line [worksheets](http://www.rsc.org/learn-chemistry/resource/download/res00000954/cmp00001406/pdf).  [Decomposition of metal carbonates](http://www.rsc.org/learn-chemistry/resource/res00000450/thermal-decomposition-of-metal-carbonates?cmpid=CMP00005971) helps bring together various aspects of this topic including balancing equations, stoichiometry of equations and calculating masses from equations.  Limiting reagents can be investigating using the [reaction of magnesium with hydrochloric acid](http://www.rsc.org/learn-chemistry/resource/res00001916/the-rate-of-reaction-of-magnesium-with-hydrochloric-acid?cmpid=CMP00006119) and varying the mass of magnesium and/or concentration of hydrochloric acid used. | This topic contains many generic chemical skills that are used in topics throughout the specification, including amounts of substance and balancing equations. The skills may be taught in isolation, but will be best consolidated throughout the course in a variety of different contexts. The indicated 11 hours are therefore throughout the course, rather than necessarily in one block.  A chemical equation represents, in symbolic terms, the overall change in a chemical reaction. New materials are formed through chemical reactions but mass will be conserved. This can be explained by a model involving the rearrangement of atoms. Avogadro gave us a system of measuring the amount of a substance in moles.  Learners should be familiar with chemical symbols and formulae for elements and compounds. They should also be familiar with representing chemical reactions using formulae. Learners will have knowledge of conservation of mass, changes of state and chemical reactions.  Although learners may have met the conservation of mass they still tend to refer to chemical reactions as losing mass. They understand that mass is conserved but not the number or species of atoms. They may think that the original substance vanishes ‘completely and forever’ in a chemical reaction.  Some graph interpretation skills and simple introduction to rates could be developed here by considering the progress of reaction, and the effect of limiting reagents on the shape of graphs related to amount of product and time. |

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| Additional remote learning opportunities ***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** | | |
| **Topic** | **Statement** | **Teaching activities** |
| 1 | C3.1b | An [interactive game](https://phet.colorado.edu/sims/html/balancing-chemical-equations/latest/balancing-chemical-equations_en.html) to practise balancing equations. |
|  |  | A free [online learning platform](https://app.senecalearning.com/classroom/course/96e31cd0-163e-11e8-8f0b-c709585e9621/section/fd1126e0-164e-11e8-b52e-dd62726b4526/session). Consists of revision questions. Covers the whole specification. You can choose which topics to answer questions on. |

# Outline Scheme of Work: C3 – Chemical reactions

## Total suggested teaching time – 31 hours (separate and combined)

### C3.2 – Energetics (6 hours – separate and combined)

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| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * combustion, thermal decomposition, oxidation and displacement reactions * exothermic and endothermic chemical reactions (qualitative). * representing chemical reactions using formulae and using equations | Links to Practical Activity Groups (PAGs)  * PAG C8: Measuring the temperature change in reactions. |
| Links to Mathematical Skills  * M1a * M4a | Links to Working Scientifically  * WS1.3b * WS1.3c * WS1.3d * WS1.3e * WS1.3g * WS1.3h * WS1.4c |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C3 Topic 2  6 hours  (separate and combined) | CM3.2i – interpretation of charts and graphs when dealing with reaction profiles [M4a]  CM3.2ii – arithmetic computation when calculating energy changes [M1a]  C3.2a – distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings  C3.2b – draw and label a reaction profile for an exothermic and an endothermic reaction [activation energy, energy change, reactants and products]  C3.2c – explain activation energy as the energy needed for a reaction to occur  **C3.2d – calculate energy changes in a chemical reaction by considering bond making and bond breaking energies** | The energetics topics has the advantage of having spectacular demonstrations such as the [Whoosh Bottle](https://science.cleapss.org.uk/login.aspx/?returnto=/resource/sra006-the-whoosh-bottle-demonstration.pdf), [thermite reaction and chip-pan fire](http://science.cleapss.org.uk/Resource/L195-Safer-chemicals-safer-reactions.pdf), that allow direct observation of chemical energetics and open up the discussions.  Good practical skills can be developed by [comparing exothermic and endothermic reaction](https://edu.rsc.org/resources/exothermic-or-endothermic/406.article). If available, data-loggers can be used.  If extending the learners to ideas around calorimetry, this [practical](http://www.rsc.org/learn-chemistry/resource/res00000397/energy-values-of-food?cmpid=CMP00005022) is a useful place to start.  Calculation of energies of reactions from bond energies requires careful dissection of the different processes (bond breaking then bond making) and plenty of practice, with many worksheets available [online](http://www.chalkbored.com/lessons/chemistry-11/bond-energies-worksheet.pdf).  Discussion of activation energies allows for use of interesting demonstrations around catalysis including the [oxidation of acetone with copper](http://www.instructables.com/id/How-to-Make-Copper-Glow-Red-Hot-with-Acetone/), and [elephant’s toothpaste](https://ncsu.edu/project/chemistrydemos/Kinetics/Elephants%20Toothpaste.pdf). | Chemical reactions are accompanied by an energy change. A simple model involving the breaking and making of chemical bonds can be used to interpret and calculate the energy change. Learners should be familiar with exothermic and endothermic chemical reactions. Learners commonly have the idea that energy is lost or used up, not grasping the idea that energy is transferred (conservation of energy). Learners also wrongly think that energy is released when bonds break and do not link this release of energy with the formation of bonds. They also may think for example that a candle burning is endothermic because heat is needed to initiate the reaction.  Learners should be able to recognise endothermic and exothermic reactions from temperature changes, and link this to bond breaking and making in the reactants and products. At Higher tier, learners will need to calculate these energy changes using bond energies.  While calorimetry is not included in the subject criteria, this remains an important experimental technique in science, and extension work in this area may be appropriate, allowing scientific concepts, experimental design and evaluation, and comparison of primary and secondary data. |

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| Additional remote learning opportunities ***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** | | |
| **Topic** | **Statement** | **Teaching activities** |
| 2 | C3.2d | Free online [video](https://www.youtube.com/watch?v=eExCBkp4jB4) explaining how to perform bond energy calculations. |

# Outline Scheme of Work: C3 – Chemical reactions

## Total suggested teaching time – 31 hours (separate and combined)

### C3.3 – Types of chemical reactions (10 hours – separate and combined)

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| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * defining acids and alkalis in terms of neutralisation reactions * mixtures, including dissolving * oxidation reactions * reactions of acids with alkalis to produce a salt plus water * representing chemical reactions using formulae and using equations * the chemical properties of metal and non-metal oxides with respect to acidity. * the pH scale for measuring acidity/alkalinity; and indicators | Links to Practical Activity Groups (PAGs)  * PAG C7: Production of pure dry sample of salt * PAG C6: Neutralisation reactions * PAG C6: Determining pH of unknown solutions * PAG C6: Using pH probes |
| Links to Mathematical Skills  * M1a * M1c * M1d | Links to Working Scientifically  * WS1.4a |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C3 Topic 3  10 hours  (separate and combined) | CM3.3i – arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry [M1a, M1c, M1d]  C3.3a – explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced [the concept of oxidising agent and reducing agent]  **C3.3b – explain reduction and oxidation in terms of gain or loss of electrons, identifying which species are oxidised and which are reduced**  C3.3c – recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions  C3.3d – describe neutralisation as acid reacting with alkali or a base to form a salt plus water  C3.3e – recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water  C3.3f – recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants  **C3.3g – use and explain the terms dilute and concentrated (amount of substance) and weak and strong (degree of ionisation) in relation to acids [ratio of amount of acid to volume of solution]**  C3.3h – recall that relative acidity and alkalinity are measured by pH  **C3.3i – describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH (whole numbers only) [pH of titration curves]**  **C3.3j – recall that as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by a factor of one**  C3.3k – describe techniques and apparatus used to measure pH | Preparing [ammonium sulfate by neutralisation](http://www.rsc.org/learn-chemistry/resource/res00001760/preparing-a-soluble-salt-by-neutralisation?cmpid=CMP00005270) covers several practical techniques and chemical concepts. Equally, [reactions of acids with oxides and carbonates](http://www.rsc.org/learn-chemistry/resource/res00001762/preparing-salts-by-neutralisation-of-oxides-and-carbonates?cmpid=CMP00005272) can be carried out.  OCR have an activity on [making salts](http://www.ocr.org.uk/Images/179599-making-salts-activity-teacher-instructions.pdf) (all materials on the [qualification page](https://ocr.org.uk/qualifications/gcse/gateway-science-suite-chemistry-a-j248-from-2016/) under Teaching and Learning Resources / Support Materials).  The difference between concentration and acid strength is simply demonstrated by reaction of magnesium with hydrochloric acid and ethanoic acid of the same concentration (e.g. 0.5 mol dm–3). Such a demonstration can also be used to introduce the idea of equilibrium if the acids are used in excess, and writing of ionic equations. A basic introduction to rates is also possible if the mass of the reaction mixture is monitored over time, and a time/mass graph plotted (data loggers would be particularly useful here).  Ethanoic acid can be [investigated in greater depth](http://www.rsc.org/learn-chemistry/resource/res00000462/the-acidic-reactions-of-ethanoic-acid?cmpid=CMP00005925), by using a range of other reagents.  An interesting [practical investigation](http://www.rsc.org/learn-chemistry/resource/res00000621/universal-indicators?cmpid=CMP00000643) is available on making universal indicator.  Activities from Keith Taber’s Chemical Misconceptions book cover relevant theory, including [types of chemical reactions](http://www.rsc.org/learn-chemistry/resource/res00001089/types-of-chemical-reaction), [revising acids](http://www.rsc.org/learn-chemistry/resource/res00001086/revising-acids) and [acid strength](http://www.rsc.org/learn-chemistry/resource/res00001105/acid-strength). Kristy Turner and Catherine Smith’s Starters for Ten publication also includes useful [activities](http://www.rsc.org/learn-chemistry/resource/res00001358/advanced-starters-for-ten?cmpid=CMP00002956).  Titration is developed in greater detail in later sections (Topic 5 and 6), but could be introduced simply here. A [microscale vinegar titration](http://science.cleapss.org.uk/Resource-Info/PP019-Analysis-of-vinegar-small-scale.aspx) is available from CLEAPSS (login required). | As with C3 Topic 1, this section contains some generic skills that can be taught in isolation, but best consolidated throughout the course in different contexts. The indicated 10 hours are therefore throughout the course, rather than necessarily in one block.  Chemical reactions can be classified according to changes at the atomic and molecular level. Examples of these include reduction, oxidation and neutralisation reactions.  Learners should be familiar with combustion, thermal decomposition, oxidation and displacement reactions. They will be familiar with defining acids and alkalis in terms of neutralisation reactions. Learners will have met reactions of acids with alkalis to produce a salt and water and reactions of acids with metals to produce a salt and hydrogen.  Redox reactions can be discussed in a wide range of contexts throughout the course, and should be understood in terms of oxygen and electrons. Acid-base reactions also commonly occur throughout the course, and can allow for discussion of concepts such as rate of reaction, equilibria and practical techniques.  Learners commonly intuitively adhere to the idea that hydrogen ions in an acid are still part of the molecule, not free in the solution. They tend to have little understanding of pH..For example, they tend to think that alkalis are less corrosive than acids. Learners also may think that the strength of acids and bases and concentration mean the same thing. |

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| Additional remote learning opportunities ***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** | | |
| **Topic** | **Statement** | **Teaching activities** |
| 3 | C3.3c – C.3.3e | A short [video](https://www.youtube.com/watch?v=vt8fB3MFzLk) going over the basics of acids, alkalis, indicators and neutralisation. |
|  | C3.3c– C3.3i | Set of [RSC activities](https://edu.rsc.org/download?ac=12427) on acids and alkalis aimed at higher ability students. Most of the activities are practicals, but Activity 5 ‘Explaining Acid Strength’ is more of a comprehension type exercise. |
|  | C3.3h – C3.3k | RSC [titration screen experiment](https://edu.rsc.org/download?ac=15369). Differentiated into 4 levels. Each takes around 30 minutes to complete. |

# Outline Scheme of Work: C3 – Chemical reactions

## Total suggested teaching time – 31 hours (separate and combined)

### C3.4 – Electrolysis (4 hours – separate and combined)

|  |  |
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| Links to KS3 Subject content  * chemical reactions as the rearrangement of atoms * representing chemical reactions using formulae and using equations * the varying physical and chemical properties of different elements | Links to Practical Activity Groups (PAGs)  * PAG C2: Electrolysis of sodium chloride solution * PAG C2: Electrolysis of copper sulfate solution |
| Links to Mathematical Skills  * M1a * M1c | Links to Working Scientifically  * WS1.2a * WS1.2b * WS1.2c * WS1.4a * WS2a * WS2b |

| Suggested timings | Statements | Teaching activities | Notes |
| --- | --- | --- | --- |
| C3 Topic 4  4 hours  (separate and combined) | CM3.4i - arithmetic computation and ratio when determining empirical formulae, balancing equations [M1a, M1c]  C3.4a - recall that metals (or hydrogen) are formed at the cathode and non-metals are formed at the anode in electrolysis using inert electrodes [the terms cations and anions]  C3.4b - predict the products of electrolysis of binary ionic compounds in the molten state [compounds such as NaC*l*]  C3.4c - describe competing reactions in the electrolysis of aqueous solutions of ionic compounds in terms of the different species present [the electrolysis of aqueous NaC*l* and CuSO4 using inert electrodes]  C3.4d - describe electrolysis in terms of the ions present and reactions at the electrodes  C3.4e - describe the technique of electrolysis using inert and non-inert electrodes | Electrolysis is traditionally demonstrated with [lead bromide](http://www.rsc.org/learn-chemistry/resource/res00001725/electrolysing-molten-lead-ii-bromide?cmpid=CMP00005239), although [zinc chloride](http://www.rsc.org/learn-chemistry/resource/res00000826/electrolysis-of-molten-zinc-chloride?cmpid=CMP00005020) is a safer alternative.  OCR have Topic Exploration pack on [electrolysis](https://www.ocr.org.uk/Images/363951-electrolysis-topic-exploration-pack.docx) containing guidance on teaching and other suggested activities. The [Particles and Elements transition guide](http://www.ocr.org.uk/Images/223681-particles-atoms-and-elements-transition-guide.pdf) can also be of use.  [Electrolysis of copper sulfate](http://www.rsc.org/learn-chemistry/resource/res00000476/electrolysis-of-copper-ii-sulfate-solution?cmpid=CMP00005019) can be carried out qualitatively, or extended to a quantitative investigation, looking at the link between current and mass of copper sulfate deposited on the cathode. While making accurate measurements can be challenging, this would provide an opportunity to develop/refine pupils’ manipulative skills.  Competing reactions under electrolysis can be challenging for learners – [practical work](http://www.rsc.org/learn-chemistry/resource/res00000737/identifying-the-products-of-electrolysis?cmpid=CMP00005149) may help, along with making the conceptual link between electrolysis as ‘normal’ chemical reaction in reverse, linking with reactivity series (e.g. reactivity series of metals, reactivity trends in Group 7).  Spending time on ensuring a firm understanding of the terminology is useful – mind/concept [maps](http://mind42.com/public/bce9f084-0f78-4835-bf11-dbdc3035b643) can be useful as a learning tool as well as for revision.  Demonstration of the electrolysis of dilute sulfuric acid to produce oxygen and hydrogen with a Hoffman [Voltameter](http://www.docbrown.info/page01/ExIndChem/electrochemistry02.htm), links to research on the uses of products of electrolysis (online and offline) and makes a good project/homework. | Decomposition of a liquid during the conduction of electricity is a chemical reaction called electrolysis. This section explores the electrolysis of various molten ionic liquids and aqueous ionic solutions.  Learners should be familiar with ionic solutions and solids.  A common misconception is that ionic solutions conduct because of the movement of electrons. Another common misconception is that ionic solids do not conduct electricity because electrons cannot move. |

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| Additional remote learning opportunities ***As a response to the Covid-19 outbreak, additional online learning opportunities were identified for each topic in June 2020.*** | | |
| **Topic** | **Statement** | **Teaching activities** |
| 4 | C3.4a – C3.4d | [Electrolysis storyboard challenge](https://www.teachitscience.co.uk/resources/ks4/electrolysis/chemistry/electrolysis-storyboard-challenge/30918). A consolidation activity for students who have already studied electrolysis. The website does have a subscription option, but there is a free option also, where resources can be downloaded as a pdf. |
|  | C3.4a – C3.4b, C3.4d | [Video and teaching pack](https://ocr.org.uk/rpgchem2) for Electrolysis of molten zinc chloride practical. Can be used for actual or virtual practical (although the practical must be carried out in a fume cupboard, so in most classes it would have to be a virtual practical). In addition to the resources for carrying out the practical, it also includes preparation worksheets and a summary quiz. |



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