# Scheme of work

## Chemistry – Chemical analysis

This resource provides guidance for teaching the Chemical analysis topic from our new GCSE Chemistry (8462). It has been updated from the draft version to reflect the changes made in the accredited specification. Changes have been made to 4.8.1.3 and a few amendments to each of the other sections including the learning outcomes and opportunities to develop and apply practical and enquiry skills of most sections.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 4.8 Chemical analysis

#### 4.8.1 Purity, formulations and chromatography

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.8.1.1 | In chemistry, a pure substance is a single element or compound, not mixed with any other substance.  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.  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. | Be able to use melting point data to distinguish pure from impure substances.  WS 2.2, 4.1 | 1 | Define the terms:   * pure substance * compound.   Explain, in terms of intermolecular forces, the terms:   * melting point * boiling point.   Use data to identify pure and impure substances.  Identify the contents of mineral waters sold as ‘pure’. Discuss the meaning of ‘pure’. | Research the melting and boiling points of common pure substances and compounds. Suggest reasons for differences in data available on the internet. |  |
| 4.8.1.2 | 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. | Identify formulations given appropriate information.  Students do **not** need to know the names of components in proprietary products.  WS 1.4, 2.2 | 0.5 | Define the terms:   * mixture * formulation. | Research the composition of the following formulations:   * fuel * cleaning agents * paints * medicines * alloys * fertilisers * foods.   Identify the purpose of each chemical in the formulation. |  |
| 4.8.1.3 | 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.  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:  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. | Explain how paper chromatography separates mixtures.  Suggest how chromatographic methods can be used for distinguishing pure substances from impure substances.  Interpret chromatograms and determine Rf values from chromatograms.  Provide answers to an appropriate number of significant figures.  WS 2.4, 2.6  MS 1a, 1c, 1d, 2a | 2 | Describe a method for paper chromatography.  Explain what happens to substances during the process of chromatography.  Describe to another student what the Rf value is and instructions on how to calculate the Rf value.  Devise a method for distinguishing between pure and impure substances using chromatography. | **Required practical 6:**  Investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values.  AT skills covered by this practical activity: 1 and 4. | Video clips  YouTube:  [Basics of chromatography](https://www.youtube.com/watch?v=SnbXQTTHGs4&list=PLf9x1YPYxxybEystKXSdzqMnw-7wlJ8PY)  YouTube:  [Paper and thin layer chromatography](https://www.youtube.com/watch?v=ByJ6lzD2Vbg)  [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |

#### 4.8.2 Identification of common gases

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.8.2.1 | 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. |  | 0.5 | Describe the test for hydrogen to another student. | Carry out a simple test for hydrogen. | Video clip  YouTube: [Testing for hydrogen, oxygen, carbon dioxide, (ammonia) and chlorine](https://www.youtube.com/watch?v=_GqBl83Koig) |
| 4.8.2.2 | The test for oxygen uses a glowing splint inserted into a test tube of the gas. The splint relights in oxygen. |  | 0.5 | Describe the test for oxygen to another student. | Carry out a simple test for oxygen. |  |
| 4.8.2.3 | 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). |  | 0.5 | Describe the test for carbon dioxide to another student. | Carry out a simple test for carbon dioxide. |  |
| 4.8.2.4 | The test for chlorine uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white. |  | 0.5 | Describe the test for chlorine to another student. | Small amounts of chlorine can be generated from the electrolysis of brine (either as a demonstration or during a class practical). |  |

#### 4.8.3 Identification of ions by chemical and spectroscopic means

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.8.3.1 | Flame tests can be used to identify some metal ions (cations). Lithium, sodium, potassium, calcium and copper compounds produce distinctive colours in flame tests:   * lithium compounds result in a crimson flame * sodium compounds result in a yellow flame * potassium compounds result in a lilac flame * calcium compounds result in an orange-red flame * copper compounds result in a green flame.   If a sample containing a mixture of ions is used, some flame colours can be masked. | Identify species from the results of the tests in 8.3a to 8.3e.  *Flame colours of other metal ions are* ***not*** *required knowledge.*  WS 2.2 | 1 | Describe the flame tests for identifying cations to another student.  Research how firework manufacturers produce the different colours in fireworks. | Carry out flame tests on the following cations:   * lithium * sodium * potassium * calcium * copper.   AT 8 | Video clip  YouTube:  [Testing for positive ions – Part 1](https://www.youtube.com/watch?v=MqW6kktNA4E) |
| 4.8.3.2 | Sodium hydroxide solution can be used to identify some metal ions (cations).  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.  Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added. Copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate. | Be able to write balanced equations for the reactions to produce the insoluble hydroxides.  *Students are* ***not*** *expected to write equations for the production of sodium aluminate.*  WS 2.2 | 2 | Describe how sodium hydroxide can be used to identify some cations to another student. | Use sodium hydroxide to test for the following cations:   * aluminium * calcium * magnesium * copper(ll) * iron(ll) * iron(lll).   AT8 |  |
| 4.8.3.3 | Carbonates react with dilute acids to form carbon dioxide gas. Carbon dioxide can be identified with limewater. |  | 1 | Describe how dilute acids can be used to identify carbonates to another student. | Use dilute acid to test for the following carbonates:   * sodium carbonate * potassium carbonate.   Analyse the composition of an egg shell, testing for the presence of various ions using acids and other test tube reactions and flame tests. | Video clip:  YouTube: [Sulfate and Carbonate Tests](https://www.youtube.com/watch?v=1bCi_-gL2CE) |
| 4.8.3.4 | 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. |  | 1 | Describe how silver nitrate can be used to identify halides to another student. | Use silver nitrate to test the following halides:   * chloride * bromide * iodide. | Video clip:  YouTube:  [Halide ion tests](https://www.youtube.com/watch?v=7F4JhrBWdY4) |
| 4.8.3.5 | Sulfate ions in solution produce a white precipitate with barium chloride solution in the presence of dilute hydrochloric acid. | WS 2.4, 2.6 | 2 | Describe how barium chloride in the presence of dilute hydrochloric acid can be used to identify sulfate ions to another student.  Plan an analysis programme to identify an unknown substance using just test tube reactions. | Use barium chloride in the presence of dilute hydrochloric acid to test for sulfate ions.  **Required practical 7:**  Use of chemical tests to identify the ions in unknown single ionic compounds covering the ions from sections 4.8.3.1 to 4.8.3.5.  AT skills covered by this practical activity: 1 and 8. | Video clip:  [Sulfate and Carbonate Tests](https://www.youtube.com/watch?v=1bCi_-gL2CE) |
| 4.8.3.6 | Elements and compounds can be detected and identified using instrumental methods. Instrumental methods are accurate, sensitive and rapid. | State advantages of instrumental methods compared with the chemical tests in this specification.  WS 1.4 | 0.5 |  | Research instrumental methods for detecting elements and compounds.  Compare these to chemical tests carried out in this specification.  Suggest advantages of the instrumental methods compared with the chemical tests. |  |
| 4.8.3.7 | 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. | Interpret an instrumental result given appropriate data in chart or tabular form, when accompanied by a reference set in the same form, limited to flame emission spectroscopy.  WS 3.6  MS 4a | 1 | Describe the process of flame emission spectroscopy.  Explain what happens to a sample throughout the process of flame emission spectroscopy.  Interpret instrumental results for flame emission spectroscopy.  Research how chemical analysis has been used to detect and solve crimes especially in forgery and murder by poisoning.  Research how robotic spacecraft sent to investigate other planets analyse their atmospheres and surface materials using instrumentation.  Discuss the advantages and disadvantages of instrumental analysis versus test tube analysis. | Research how flame emission spectroscopy takes place.  An opportunity to observe flame spectra using a hand-held spectroscope.  AT 8 | Video clip  YouTube:  [Atomic Emission Spectroscopy](https://www.youtube.com/watch?v=L5jEePYQfCM) |