Name ……………………………………….…. Group ………………………….

**WHAT YOU NEED TO KNOW**

**AQA GCSE Chemistry - Unit 8 Chemical Analysis**

Analysts have developed a range of qualitative tests to detect specific chemicals. The tests are based on reactions that produce a gas with distinctive properties, or a colour change or an insoluble solid that appears as a precipitate.

Instrumental methods provide fast, sensitive and accurate means of analysing chemicals, and are particularly useful when the amount of chemical being analysed is small. Forensic scientists and drug control scientists rely on such instrumental methods in their work.

**8.1 – Purity, Formulations and Chromatography**

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| **Specification code** | **Expected knowledge and understanding** | **** |
| 4.8.1.1  **Pure Substances** | a) In chemistry, a pure substance is a single element or compound, not mixed with any other substance.  b) 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.  c) 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.  d) Students should be able to use melting point and boiling point data to distinguish pure from impure substances. |  |
| 4.8.1.2  **Formulations** | 1. 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. 2. Students should be able to identify formulations given appropriate information.   Students do not need to know the names of components in proprietary products |  |
| 4.8.1.3  **Chromatography** | a) 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.  b) 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:  Rf =    c) 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.  d) Students should be able to:   * explain how paper chromatography separates mixtures * suggest how chromatographic methods can be used for distinguishing pure substances from impure substances * interpret chromatograms and calculate Rf values from chromatograms * provide answers to an appropriate number of significant figures * recognise and use expressions in decimal form * use ratios, fractions and percentages * make estimates of the results of simple calculations |  |
| **Required Practical 6** | **Investigate how paper chromatography can be used to separate and tell the difference between coloured substances. Students should calculate Rf values.** |  |

### 4.8.2 Identification of Common Gases

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| Specification code | Expected knowledge and understanding | **** |
| 4.8.2.1  **Test for Hydrogen** | a) 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. |  |
| 4.8.2.2  **Test for Oxygen** | a) The test for oxygen uses a glowing splint inserted into a test tube of the gas. The splint relights in oxygen. |  |
| 4.8.2.3  **Test for Carbon Dioxide** | a) 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). |  |
| 4.8.2.4  **Test for Chlorine** | a) The test for chlorine uses litmus paper. When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white. |  |

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

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| Specification code | Expected knowledge and understanding | **** |
| 4.8.3.1  **Flame Tests** | a) 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 a **red** flame * **copper** compounds result in a **green** flame.   b) If a sample containing a mixture of ions is used some flame colours can be masked.  c) Students should be able to identify species from the results of the tests in 4.8.3.1 to 4.8.3.5  Flame colours of other metal ions are not required knowledge |  |
| 4.8.3.2  **Metal Hydroxides** | a) Sodium hydroxide solution can be used to identify some metal ions (cations).  b) 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.***  c) Solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added.  d) Copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate.  e) Students should 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 alumnate |  |
| 4.8.3.3  **Carbonates** | a) Carbonates react with dilute acids to form carbon dioxide gas. Carbon dioxide can be identified with limewater. |  |
| 4.8.3.4  **Halide ions** | a) 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. |  |
| 4.8.3.5  **Sulfate ions** | a) Sulfate ions in solution produce a white precipitate with barium chloride solution in the presence of dilute hydrochloric acid. |  |
| **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** |  |
| 4.8.3.6  **Instrumental methods** | a) Elements and compounds can be detected and identified using instrumental methods. Instrumental methods are accurate, sensitive and rapid.  b) Students should be able to state advantages of instrumental methods compared with the chemical tests in this specification. |  |
| 4.8.3.7  **Flame emission spectroscopy** | a) Flame emission spectroscopy is an example of an instrumental method used to analyse metal ions in solutions.  b) 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.  c) Students should be able to 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  d) Students should have the opportunity to observe flame spectra using a hand-held spectroscope. |  |