AQA

GCSE

COMBINED SCIENCE: TRILOGY

8464/C/1F: Paper 1 - Chemistry (Foundation tier)
Report on the Examination

8464
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General

Questions five, six and seven were common to both Foundation and Higher tiers and were targeted at standard demand.

The paper is designed to assess knowledge, understanding and application of skills up to and including grade 5. Students generally scored well on the initial low demand questions but found the greater demands of application of knowledge and logical reasoning more challenging. Similarly, the some of the questions assessing mathematical skills proved to be a barrier for many.

For the extended response question students should be advised to always take note of the command word. In this paper, question 07 asked the students to plan an investigation. To achieve level 3 the description must lead to a valid outcome where all variables are controlled. This can be achieved in a clear, concise answer.

This report should be read in conjunction with the published mark scheme.

Levels of demand

Questions are set at two levels of demand for this paper:

- **low demand** questions are designed to broadly target grades 1–3.
- **standard demand** questions are designed to broadly target grades 4–5.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Low demand)

01.1 Almost three-quarters of the students could correctly identify Group 1 metals as the alkali metals.

01.2 Just over 60% of students correctly deduced the number of electrons and the number of neutrons from the structure of a lithium atom.

01.3 The relative charge on a lithium atom was given by more than 55% of the students.

01.4 The physical changes occurring when a solid changes into a liquid and when the liquid changes back into a solid were known by 60% of the students.

01.5 More than 80% of the students were able to read the melting point of caesium from a bar chart.

01.6 More than 80% of the students were able to draw a bar at 63 °C for the melting point of potassium on a bar chart. The most common mistake was for students to misinterpret the scale on the graph. Others did not use a ruler so did not draw a straight horizontal line.

01.7 Almost half of the students gained two marks, for describing the trend as the melting point decreases going down Group 1. Many students recognised that the melting points decrease but had difficulty in articulating that this is as you go down or descend the group. Very few accessed the third marking point which was that the differences got smaller going down the group or that the initial drop was greatest.

01.8 Just under half of the students deduced that sodium is a liquid at 150 °C. Solid proved to be a popular distractor.

01.9 More than a third of students knew that potassium is more reactive than sodium because potassium more easily loses an electron.

Question 2 (Low demand)

02.1 More than a third of students correctly drew a dot and cross diagram for hydrogen chloride. The most commonly awarded mark was for the two shared electrons in the overlap between the atoms. Many failed to show that there are six unshared electrons.

02.2 Only 20% of students gained this mark for correctly identifying sodium chloride as one of the products of the reaction between hydrochloric acid and sodium hydroxide. The most common error was identifying the product as sodium chlorine. Some students also attempted to add other products to the equation.

02.3 Only 20% of students gained the mark for calculating the correct mass. Many students added the three masses together rather than recognising that in a reaction the mass of reactants equals the mass of products.

02.4 More than three-quarters of the students correctly read the temperature reading on the thermometer scale.

02.5 Just under a quarter of students knew that when the temperature of a reaction increases an exothermic reaction is taking place. The most common error described the reaction as endothermic.

02.6 30% of students correctly identified that Na^+ and OH^- ions are present in sodium hydroxide.

Question 3 (Low and standard demand)

03.1 More than half of the students knew that silicon dioxide has a giant covalent structure.

03.2 Approximately 30% of students were able to use the diagram of the structure of silicon dioxide to correctly deduce the number of bonds formed by each silicon atom as four.

03.3 Approximately 90% of students recognised that the structure of fullerenes is based upon hexagons.

03.4 More than two thirds of students recognised that the fullerene molecules are made from atoms of carbon.

03.5 Just over 40% of students knew that fullerenes are used in electronics.

03.6 Over 40% of students recognised that covalent bonds hold atoms together in a polymer chain.

03.7 Approximately 70% of students recognised that polymer chains are held together by intermolecular forces.

03.8 Just over 40% of students achieved the first marking point for deducing the number of magnesium atoms shown in an alloy. A similar number were then able to use the number of magnesium atoms to calculate the percentage of copper atoms in the alloy. This question was a good discriminator.

03.9 This explanation of why a magnesium alloy is harder than magnesium metal was not well answered. The diagram of the magnesium alloy showed that the copper atoms were larger than the magnesium atoms and that these distort the layers that are evident in the pure metal.

Question 4 (Low and standard demand)

04.1 More than 70% of students correctly balanced the equation. Some students changed the formula, usually from MgO to MgO_2

04.2 Almost three-quarters of students stated a safety precaution that should be taken when heating magnesium and oxygen. The most common correct responses were to wear eye protection and to use tongs.

04.3 Almost one-quarter of students gave the correct answer for the relative formula mass of magnesium fluoride. These students recognised that the subscript 2 means the relative atomic mass of fluorine needed to be doubled before being added to the relative atomic mass of magnesium. Many showed clear steps in their calculation. The most common errors were to either add or multiply 24 and 19.

04.4 Magnesium does not react when heated with argon - argon is unreactive because argon atoms have eight electrons in the outer shell. Common responses referred to magnesium (and argon) both being unreactive, that metals (or solids) do not react with gases or that both elements had full outer shells. This question discriminated well.

04.5 Almost 60% of students gained at least one of the two marks for correctly deducing the method used to extract a metal. The students were given a reactivity series showing the position of these two metals compared to other known metals, carbon and hydrogen.

04.6 Students found difficulty in explaning why sodium chloride conducts electricity when molten but not when a solid. Many indicated that this was due to something being able to move but failed to link this to ions or charged particles. Most referred to moving particles, atoms or electrons.

04.7 Students also found difficulty in explaning why sodium conducts electricity when solid. Delocalised electrons were rarely seen as was the concept of these delocalised electrons carrying charge through the sodium.

Question 5 (Standard demand)

05.1 Students were asked to state observations made when copper carbonate is added to sulfuric acid. Many students appeared to misunderstand what an observation is and instead either wrote instructions on how to carry out the preparation of copper sulfate or stated what to look for such as ‘check the pH level’ or ‘did anything change’. Just over a quarter gave at least one correct observation. The most common responses were ‘colour changes’ or ‘fizzing’.

05.2 More than a third of students knew that filtration is used to separate unreacted copper carbonate after a reaction between sulfuric acid and excess copper carbonate.

05.3 Just over 20% of students knew the pH of the solution after a reaction between sulfuric acid and excess copper carbonate.

05.4 Just over 10% of students knew that the reaction between sulfuric acid and copper carbonate is neutralisation.

05.5 The question required students to read the masses of ammonium nitrate that dissolve at 80 °C and 20 °C from a graph and to then carry out a subtraction to determine the mass of solid that crystallises on cooling. Just over 15% of students were able to gain all 3 marks.

Question 6 (Standard demand)

06.1 Students were given the formula of the potassium and sulfate ions and asked to deduce the formula of potassium sulfate. Just under 40% of students correctly determined the formula as K_2SO_4. The formula $K(SO_4)_2$ proved to be a good distractor.

06.2 Just under 15% of students were able to correctly read the volumes of hydrogen and oxygen in the measuring cylinders. Most wrote the volumes of solution left in the measuring cylinder, rather than the gas, stating 20 cm^3 for hydrogen and 35 cm^3 for oxygen.

06.3 Students were given a hypothesis linking the ratio of the volumes of gases collected in an electrolysis experiment with the ratio of hydrogen to oxygen atoms in a water molecule. When students deduced that the volumes of hydrogen gas and oxygen gas collected were 30 cm^3 and 15 cm^3, they were able to simplify this ratio to 2:1 which they recognised as the ratio of hydrogen atoms to oxygen atoms in a water molecule and thus able to confirm the hypothesis. When the ratio of their volumes was not 2:1 many did not then go on to state that the hypothesis was incorrect.

06.4 Just over 30% of students identified that the measure of uncertainty in the 4 experiments was 9 ± 3 cm^3. The mean volume was 9 cm^3 and the range of reading was from 6 to 11 cm^3. The option of 9 ± 2 cm^3 proved a good distractor.

06.5 Just over 10% of students gained 2 of the 3 marks, usually following method 3 for dividing the mass of 0.86 g by the volume of 25 cm^3. Few students then went onto carry out the unit conversion of cm^3 into dm^3 which required multiplying their answer (in g/cm^3) by 1000.

Question 7 (Standard demand)

07 This question discriminated well with around 20% of students achieving level two or above. It was based upon Required Practical Activity 10. Students were asked to plan an investigation to find the order of reactivity of three metals using the temperature change recorded when each metal reacts with hydrochloric acid.

To access level 3, the method would need to lead to a valid outcome. This required students controlling variables such as the mass of metal and the volume of acid reacting, determining a temperature change having recorded the initial and final temperatures and repeating the method for each metal.

To access level 2 the method would not necessarily lead to a valid outcome. Common omissions were to add the metal to the acid before taking the initial temperature or failing to take the initial temperature altogether or not to control variables which would not ensure a fair test. Weaker responses could gain credit for either correctly identifying apparatus or for explaining the link between the expected results and the reactivity of the metal.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.