GCSE

COMBINED SCIENCE: TRILOGY

8464/C/1F Paper 1 Chemistry (Foundation Tier)
Report on the Examination

8464/C/1F
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General Comments

Around 218,000 students sat this component, so a wide and varied range of responses was seen.

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. Students who used the information provided in the stem of a question to greater effect often demonstrated a better level of understanding.

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.

There were seven questions on this paper. Questions **06** and **07** were common to questions **01** to **02** on the Higher Tier paper. The demand levels of the questions are designed to increase from low demand to standard demand through the paper. For questions **01** to **05** the demand of each question also increases through the question.

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

Comments on Individual Questions

Question 1 (low demand)

01.1 Three-quarters of the students correctly deduced the number of protons and the number of neutrons in the beryllium atom. Some students gave the numbers the opposite way around.

01.2 The relative charge on a beryllium ion was given by just over 50% of the students. A charge of 1+ proved to be a good distractor.

01.3 More than 95% of the students were able to identify the arrangement of atoms as a representation of the gas state.

01.4 More than 80% of the students were able to identify the states from the diagram and to link them to freezing, as the process when a liquid changes into a solid.

01.5 About two-thirds of the students were able to identify the states and knew that heating was required to change the states. Condensing was a very common incorrect response which is the reverse process of the direction being asked about.

01.6 Just over three-quarters of students knew the correct order for the development of the model of the atom was tiny sphere, plum pudding and then nuclear model. The most common incorrect distractor also started with the tiny sphere model.

01.7 Just under half of the students knew that the existence of neutrons was discovered by Chadwick. Mendeleev was the most common incorrect answer.

Question 2 (low demand)

02.1 The piece of equipment was correctly identified as a thermometer by nearly all the students.

02.2 More than 85% of students knew that a measuring cylinder is the best piece of equipment to measure volumes of solution.

02.3 This calculation was well answered with more than three-quarters of students correctly evaluating the mean temperature increase. A number of students believed that the value at 7.3 was anomalous; those who showed that they calculated the mean of the other two values were credited provided they showed their working.

02.4 Just under a third of students obtained full marks on this calculation. Some students successfully used their data from Question 02.3.

02.5 Just under half of the students knew that an exothermic reaction is one when the temperature increases. Endothermic proved to be a very popular distractor.

02.6 This question was a good discriminator. Just over a third of students answered this correctly. The temperature did not increase because copper is less reactive than zinc. Note that ‘copper is not very reactive’ is not a comparative.

Question 3 (low/standard demand)

03.1 More than half the students identified the noble gases as the group of elements that do not form ions.

03.2 This question was a good discriminator. Many gained the first three marks although MP4 was less common. Many incorrect terms such as ‘atoms sharing electrons to form ionic bonds’, ‘metal ions losing electrons’ and ‘non-metal ions gaining electrons’ were seen.

03.3 More than two thirds of students identified the structure that represents the arrangement of ions in solid potassium chloride. The first option was the best distractor.

03.4 More than a quarter of students correctly drew a dot and cross diagram for water. When only one mark was gained this was usually for the shared electrons in the overlap between oxygen and one of the hydrogen atoms. Some failed to show that there are four unshared electrons on the oxygen atom and others added more electrons into the circle around one or both of the hydrogen atoms.

03.5 More than three-quarters of students deduced the ratio of silicon atoms to oxygen atoms from the structure of silica.

03.6 Only 20% of students knew that weak intermolecular forces hold polymer molecules together in a polymer. Covalent bonds and electrostatic attraction between ions were perhaps terms more familiar to the students and both proved more popular options than the correct answer.

03.7 Students found difficulty in recognising the link between the two variables from the *x*-axis and the *y*-axis. Many stated that as the melting point increases the length of the polymer molecule increases. Students should appreciate that the independent variable is on the *x*-axis and that as this is changed, the effect on the dependent variable (*y*-axis) can be observed ie as the length of the polymer molecule increases (independent, *x*-axis) then the melting point increases (dependent, *y*-axis).

Question 4 (low/standard demand)

04.1 More than two-third of students knew that electrons carry the electrical charge through a metal wire. Protons proved to be the most popular distractor.

04.2 Students were given a symbol equation for the breakdown of a water molecule into hydrogen ions and hydroxide ions and were asked to complete the word equation for the breakdown. Just under 20% of students gained two marks and 60% of students gained one mark, usually for recognising that H^+ is a hydrogen ion. More students thought that OH^- was an oxide rather than a hydroxide ion.

04.3 Just under 20% of students deduced that the formula of copper bromide is $CuBr_2$
The formula Cu_2Br proved to be a good distractor selected by the majority of students.

04.4 Students were asked to explain why the copper ions moved to the negative electrode. A quarter of students gained two marks for stating that the copper ions are positively charged so are attracted to the negative electrode and nearly another 20% of students gained one mark, usually for stating that opposites attract.

04.5 More than 50% of students knew that at the negative electrode copper metal is produced when the copper ions are discharged.

04.6 More than 40% of students knew that mass of the negative electrode increases during the electrolysis of copper bromide solution. Decreases and no change were distractors selected by approximately 30% and 25% of students respectively.

04.7 More than 40% of students knew that bromine is produced at the positive electrode during the electrolysis of copper bromide solution. Hydrogen proved to be a good distractor selected by a large number of students.

Question 5 (low/standard demand)

05.1 More than a third of students knew that the extraction of aluminium is expensive because the process uses large amounts of energy. Heat was a very common response that was insufficient to gain credit.

05.2 More than 50% of students knew that carbon dioxide is produced when oxygen reacts with the positive carbon electrodes when aluminium is extracted by electrolysis from a molten mixture of aluminium oxide and cryolite.

05.3 Only a very small number of students were able to suggest that when titanium was extracted from a mixture of titanium chloride and sodium an inert atmosphere was essential to prevent the sodium reacting with air.

05.4 A third of students knew that argon is used for the inert atmosphere when titanium is extracted from a mixture of titanium chloride and sodium.

05.5 Just over half of the students correctly balanced the equation for the reaction of sodium with titanium chloride. Students should be aware that they should not change the formula of the compounds in the equation.

05.6 Students should know that the law of conservation of mass states that the mass of reactants equals to the mass of products. In this experiment the mass of carbon dioxide produced equals the difference between the sum of the mass of copper oxide and carbon (reactants) minus the mass of copper produced (other product). Only 20% of students calculated this correctly.

05.7 Students were asked to explain why the mass of a mixture of copper oxide and carbon in a crucible changed when the mixture was heated. Few students recognised that the mass would decrease because the carbon dioxide produced is a gas that escapes into the atmosphere. The term evaporation was incorrectly used by a large number of students. Only a small number of students gained two marks.

05.8 This question asked what happens to copper oxide in the reaction between copper oxide and carbon. Students should be careful with their use of technical terms as many incorrectly stated that ‘copper’ loses oxygen. Approximately 30% of students knew that copper oxide was reduced but very few students were then able to give a reason why.

Question 6 (standard demand)

06.1 Students found identifying the ion which makes a solution acidic very difficult. Carbon was a very common incorrect response.

06.2 Just over 25% of the students named an indicator (usually universal indicator) that could be used to test if a solution is acidic. About half of these then gave the correct colour in the acid solution. Common incorrect responses were pH paper, strips, solution or meter.

06.3 More than three-quarters of students deduced that the solubility of carbon dioxide decreases as the temperature of water increases. The solubility increases proved to be the most popular distractor.

06.4 Just over a third of students deduced that the pH of the solution increases as the temperature of water increases. The pH of the solution decreases was selected by nearly as many students.

06.5 More than 40% of students knew that the state symbol of water is (l). The other three distractors were selected in similar numbers.

06.6 The majority of students made an attempt at this question which discriminated well with nearly a third of students achieving level two, though few were able to access level 3. Students appreciated the need to mix together quantities of hydrochloric acid and calcium carbonate, then collect the gas evolved. Better answers gave an indication of how this was done. The sticking point was the method of collection of the gas which prevented students from achieving level 3. Many did not specify that the gas syringe needed to be connected to the conical flask. Many students used a beaker for the reaction which prevented successful gas collection. A tiny minority chose to filter and heat the solution with a Bunsen burner.

Question 7 (standard demand)

07.1 This question was answered with a wide variation of responses. Just under 20% of students knew that the reaction was either neutralisation or exothermic. Displacement was a common incorrect response as was endothermic which was given more frequently than exothermic.

07.2 Nearly a third of students correctly calculated the relative formula mass of sulfuric acid from the given formula and showed clear steps in their calculation. Students should be aware that when data is provided it is usually all required to be used to get to the correct answer. The most common responses seen that were not creditworthy were $M_r = 49$ from (1+32+16), $M_r = 512$ from (1×16×32) and $M_r = 146$ from (2+16+(4×32)).

07.3 Students found this question demanding but it proved to be a good discriminator. Just over a third of students gained at least 1 mark. Some students were not credited with MP1 as they had used the mass of O = 16, rather than O = 16 × 4. Some students successfully worked through the calculation logically but either forgot to follow the question instruction to give their answer to 2 significant figures or left their answer correct to 2 decimal places. Other responses showed little or no understanding of what was required in the calculation with figures added, subtracted or simply multiplied together.

07.4 Students found this question demanding but it proved to be a good discriminator. A small number of students gained all 3 marks. Many just multiplied the mass (0.30 g) by the volume (25 cm^3). Many answers calculated the concentration of the solution successfully (0.30 ÷ 25) but omitted to convert the volume of cm^3 into dm^3. Other students showed the correct conversion of the volume (0.025 dm^3) but then took the calculation no further.

Mark Ranges and Award of Grades

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