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COMBINED SCIENCE:TRILOGY

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

8464
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General Introduction to the November Series

This has been an unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

More than 200,000 students sit this paper every summer. This session attracted a very small entry of just under 190 students.

Comments on Individual Questions

Question 1 (low and standard demand)

01.1 Most students knew that magnesium reacting with chlorine is an example of a metal reacting with a non-metal.

01.2 Approximately two thirds of students were able to construct a word equation from the information supplied in the question.

01.3 Approximately two thirds of students knew that a balance is used to measure 1.0 g of magnesium.

01.4 Nearly half of students deduced that more than 1.0 g of magnesium chloride is formed when 1.0 g of magnesium reacts with chlorine.

01.5 Just under one third of students gained two marks for correctly calculating the percentage of magnesium in magnesium oxide.

01.6 More than half of students deduced that the anomalous result is explained when the student heated the magnesium carbonate for less than ten minutes. ‘The student used a higher temperature’ was a strong distractor.

01.7 Approximately one quarter of students gained three marks for correctly calculating the mean and just under one third of students incorrectly included the anomalous result in their mean. A few did not give their answer to two significant figures.

Question 2 (low demand)

02.1 Just over one third of students correctly chose 'molten' to complete the sentence.

02.2 Just over one third of students knew that negative ions are attracted to the positive electrode during electrolysis.

02.3 Copper chloride proved to be a more commonly seen response than the correct answer, water. This question was only correctly answered by just over one third of the students.

02.4 More than two thirds of students knew that Cu^{2+} ions produce a metal during electrolysis.

02.5 Investigating what happens when aqueous solutions are electrolysed using inert electrodes is one of the required practical activities. When carrying out these investigations students should observe what happens at the electrodes. The figure was provided to help students answer this question. More than three quarters of students gained one mark for stating that fizzing is observed at the positive electrode. Most students were unable to state the correct observation at the negative electrode.

02.6 Just under one third of students were able to determine the correct mass of copper chloride in 40 cm^3 of solution. Students should be encouraged to think about the magnitude of the numbers and whether their answer is reasonable.

Question 3 (low demand)

03.1 Nearly two thirds of students were able to give the approximate radius of a carbon atom.

03.2 Students were good at describing the atomic structure of the carbon atom. More than half of students scored at least three marks. A few did not use the given diagram of the carbon atom to determine the number of neutrons located in this atom's nucleus.

03.3 Nearly half of students were able to use the diagram of graphite's structure to determine the number of covalent bonds each carbon atom has in graphite. Four proved to be a popular incorrect response, which is the number of covalent bonds each carbon atom forms in substances such as diamond or methane.

03.4 Nearly two thirds of students knew that covalent bonds hold carbon atoms together in graphite.

03.5 Few students stated that layers (of carbon atoms) can slide over each other in graphite or were able to use the diagram of graphite's structure to explain why graphite can be used as a lubricant.

03.6 Nearly two thirds of students gained one mark and approximately one sixth of students gained two marks for linking the structures with the correct form of carbon.

Question 4 (low and standard demand)

04.1 More than two thirds of students knew that the name of the Group 1 elements is the alkali metals.

04.2 More than two thirds of students were able to determine the melting point of sodium from the bar chart recognising the *y*-axis scale of 1 small square being equal to 4 °C.

04.3 Nearly two thirds of students were able to balance the chemical equation.

04.4 More than half of students successfully calculated the relative formula mass of sodium hydroxide.

04.5 This extended response question required students to compare the observations when sodium and potassium are reacted with water. Approximately half of students either recalled or used the figure to state that with sodium fizzing occurs. Other observations seen included sodium melting, forming a ball and moving. A comparison of the similarities and differences between these metals and also the magnitude of these was required to achieve level two.

Question 5 (low and standard demand)

05.1 This question was based on the required practical activity of investigating the variables that affect temperature changes. Students had difficulty in identifying improvements from the given method or from the diagram of the apparatus; just over two fifths of students gained one or more marks.

05.2 More than four fifths of students were able to determine the volume of solution in the measuring cylinder.

05.3 Nearly three fifths of students either used the fact that the temperature increased or the reaction profile to identify this as an exothermic reaction.

05.4 This calculation was very well answered by most students; nearly four fifths of students gained all four marks. They were able to use the graph to read an increase in mass with the corresponding increase in temperature and then use these values to evaluate the gradient.

05.5 A small number of students did not follow the rubric of the question to extend the line. A few students did not use a ruler or did not extrapolate the line correctly. Approximately one third of students correctly extended the line and recognised that if 10 g of zinc was used a temperature change of 84 °C would occur or that the temperature of the solution would be approximately 100 °C.

Question 6 (standard demand)

06.1 Just under half of students knew that Group 0, the noble gases, had not been discovered when Mendeleev's version of the periodic table was published.

06.2 The plum pudding model was identified by nearly three fifths of students.

06.3 Chadwick discovered the neutron. Students found difficulty in making the link between this discovery and the figure which represented an atom containing neutrons. Approximately one third of students gained the mark.

06.4 The question required students to answer in terms of 'subatomic particles'; the answer was that isotopes are atoms with the same number of protons but different numbers of neutrons. Less than one fifth of students gained a mark.

06.5 Just over one fifth of students gained the first mark by showing that the weighted average had to be divided by 100. The evaluation of this gained the second mark which then needed to be correctly rounded to one decimal place.

Question 7 (standard demand)

07.1 Approximately one quarter of students were able to give the colour change, 'green to red', as the observed change when nitric acid is added to a mixture of universal indicator and water.

07.2 Many students appeared to confuse the increase in acidity when nitric acid is added to water with an increase in pH, which proved to be a strong distractor.

07.3 Very few students were able to give (aq) as the state for a substance dissolved in water.

07.4 The required practical activity of making a soluble salt starts by reacting either an insoluble metal oxide or metal carbonate with an acid. The word equation was provided to help students with this question although many students found difficulty in making links between this and the resulting observations. Since carbon dioxide is produced, initial observations would be fizzing and white solid disappearing. Excess zinc carbonate would result in all the nitric acid reacting; fizzing would stop and excess solid would collect at the bottom. Just under one fifth of students gained a mark.

07.5 Zn_2NO_3 proved a more commonly seen response than $Zn(NO_3)_2$, the correct answer. Just under one quarter of students answered this correctly.

07.6 Students had difficulty in describing the essential steps of the method of making a soluble salt from an insoluble metal oxide and an acid. Most failed to select the correct chemicals, copper oxide and hydrochloric acid, without these the method would not lead to a valid outcome. Just under one third of students gave a level one answer and very few got into level two.

Concluding Remarks

The demand of this paper was similar to those previously set for this specification. Students should note that two-mark questions require two answer points and so on.

15% of marks are based upon the required practical activities; students should question 'what and why' is happening in each step of these procedures. Answers should be chemically accurate, e.g. crystals are produced from salt solutions when the solution is heated (partially evaporated to produce a more concentrated solution) and then left to crystallise, rather than implying that 'all the water was evaporated'.

In chemistry 20% are marks are for questions assessing mathematical skills. In these questions, students should show their working for each step. If an error is made, such as an incorrect evaluation of values in the question, credit can be awarded for each correct step shown. Students should be encouraged to think about their answers; in **01.5** a small number gave percentages in excess of 100. In **01.7** students did not always disregard the anomalous result but were able to get a mark for the correct division of all four values. A few were unable to give the answer to two significant figures. In **02.6** students needed to use all the data provided and to use the ratio of volumes to evaluate the mass. In **04.4** a minority of students multiplied, rather than adding, the relative atomic masses. In **06.5** not all students used all the data provided to evaluate the relative atomic mass, a weighted mean of the mass numbers.

Mark Ranges and Award of Grades

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