GCSE

COMBINED SCIENCE:TRILOGY

8464/C/1H (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 100,000 students usually sit this paper every summer. This session attracted a relatively small entry of just under 140 students.

Comments on Individual Questions

Question 1 (standard demand)

01.1 More than two thirds of students knew that Group 0, the noble gases, had not been discovered when Mendeleev's version of the periodic table was published.

01.2 The plum pudding model was identified by more than four fifths of students.

01.3 Chadwick discovered the neutron. Just under half of students were able to make the link between this discovery and the figure which represented an atom containing neutrons.

01.4 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. Just over one third of students gained two marks.

01.5 Many 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. Approximately one third of students gained all three marks.

Question 2 (standard demand)

02.1 Just under half of students correctly choose 'green to red' as the colour change observed when nitric acid is added to a mixture of universal indicator and water.

02.2 Just over one half of students knew that the pH of water decreases when nitric acid was added.

02.3 Few students were able to give (aq) as the state for a substance dissolved in water.

02.4 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. Very few students scored two marks.

02.5 Students found difficulty in determining the formula for zinc nitrate. Just over one third of students gained the mark.

02.6 Students had difficulty in describing the essential steps of the required practical activity of making a soluble salt from an insoluble metal oxide and an acid. Many failed to select the correct chemicals, copper oxide and hydrochloric acid; without these the method would not lead to a valid outcome. Very few students got into level three. Approximately four fifths of students produced a level one answer.

Question 3 (standard and standard / high demand)

03.1 In this investigation the temperature of the solution is measured (the independent variable is changed and the dependent variable measured). Just under two fifths of students gained the mark.

03.2 This question was based on the required practical activity of investigating the variables that affect temperature changes. Students had difficulty in identifying more than one improvement from the method or from the diagram of the apparatus.

03.3 Students were good at describing the trends in the graph, although a few misread the minimum point (1.5, 15.4); approximately half of students gained two marks. However, students struggled to explain the trends. The temperature of the solution decreased because the dissolving process is endothermic. Then when the energy change due to dissolving finishes, the temperature of the solution increases from the minimum back to room temperature as energy transfers to the solution from the surroundings.

03.4 More than two thirds of students scored at least one mark with approximately one sixth of students gaining all four marks. A small number incorrectly drew the reaction profile for an endothermic reaction and some labels were not clearly drawn.

Question 4 (standard, standard / high and high demand)

04.1 The formula of Buckminsterfullerene was known by just over half of students.

04.2 Approximately one quarter of students gained one mark for delocalised electrons. Few gained the second mark for stating that these delocalised electrons carry electrical charge through the structure.

04.3 A small number of students knew that layers cannot slide in an alloy and understood that the carbon atoms distort the layers of iron atoms. Very few students recognised that carbon and iron atoms have different sizes.

04.4 Just under one fifth of students successfully completed this calculation. In calculations students must show all their working.

Question 5 (standard / high and high demand)

05.1 A small number of students gained both marks for recognising that when hydrogen ions gain electrons a reduction reaction occurs.

05.2 Few students were able to correctly complete the half equation for the formation of chlorine from chloride ions. Many failed to correctly write chlorine as a diatomic molecule.

05.3 Students found this question challenging. The idea that water molecules break down to produce hydroxide ions was very rarely seen. Many students stated that oxygen gas was produced because there were no halide ions present; this was ignored.

Question 6 (standard, standard / high and high demand)

06.1 Just over one-tenth of students gained full marks in this calculation. Having correctly calculated the mass of oxygen the most common error was to incorrectly calculate the number of moles by dividing by the relative atomic mass of oxygen (16) rather than the relative formula mass of oxygen molecules (32).

06.2 Few students realised that without a lid the mass of products would decrease as magnesium oxide would escape during the reaction.

06.3 This calculation was answered correctly by approximately one fifth of students. A small number were not able to round their answer correctly to three significant figures.

06.4 Students found this question challenging. Very few students were able to make the link between the moles of reagents that reacted and the formula of the product. Just under one sixth of students were able to correctly write a balanced chemical equation using their iron oxide product from the earlier part of the question.

Question 7 (standard / high and high demand)

07.1 One mark was gained by approximately one fifth of students, usually for stating that particles collide. Very few appreciated that at room temperature the particles had insufficient energy to react.

07.2 Approximately two thirds of students gained this mark. They were able to deduce the trend in increase of energy released as the number of carbon atoms increased.

07.3 Approximately one third of students were able to score at least one mark but only a small number scored all five marks. Students had to calculate the energy required to break all bonds and also the energy released when all bonds are formed. However, many made mistakes in these calculations. Few then were able to subsequently evaluate the difference in bonds broken (including the two C-C bonds), bonds made, and the energy released (1640 kJ/mol).

Concluding Remarks

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

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 is awarded for each correct step shown. In **01.5** not all students used all the data provided to evaluate the relative atomic mass, a weighted mean of the mass numbers. In **04.4** most students calculated the percentage and mass of the other elements. Fewer were able to use the ratio of percentages to evaluate the mass of iron. In **06.4** students found difficulty in converting moles to a formula or to simple whole number ratios in equations. In **07.3** the displayed formula was provided to help students calculate the energy required to break all the bonds and the energy released when all the bonds are formed. Many failed to link the energy released as the difference in bonds broken (including the two C-C bonds) and bonds made.

Mark Ranges and Award of Grades

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