GCSE
CHEMISTRY

8462/1H Paper 1 Higher Tier
Report on the Examination

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General Introduction to the November Series

This has been another 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

Just over 200 students sat this component, of which a greater proportion than usual were private students. In a normal summer series, the entry size typically exceeds 100 000 students, so the range of responses seen was inevitably much more limited.

Comments on Individual Questions

Question 1 (standard demand)

01.1 There were many good answers but some focused on the hexagonal arrangement of bonds rather than the molecule as a whole. Others did not appear to realise the shape is three dimensional and described the molecule as a circle.

01.2 Many students knew the uses as catalysts, for drug delivery round the body, as lubricants' and for strengthening other materials. There were, however, some vague answers such as 'in medicine'.

01.3 This was well done. A few students drew double bonds between all the atoms. Some students did not appear to realise that all they had to do was copy the positions of the atoms and replace each shared pair of electrons with a line.

01.4 This was answered well, although a number of students had two oxygen atoms in their formula. A few appeared to misunderstand the question and gave the relative formula mass.

01.6 Some students gave full, detailed accounts of both properties. The reasons for the slipperiness of graphite were better understood than its electrical conductivity, though many did not refer to the weakness of the forces between the layers. There was some poor use of language in the description of the structure, with atoms, molecules and ions being used interchangeably. A fairly common misconception is that there are gaps between the layers, allowing 'electricity' to somehow slip through. Many students did not seem to appreciate that the electric current is delocalised electrons themselves flowing through the structure.

Question 2 (standard demand)

02.1 The usual definition (atoms with the same number of protons but a different number of neutrons), was not well known. Some students contradicted themselves by referring to elements in plural, rather than atoms of the same element. This was largely caused by the incorrect use of the word 'element' instead of 'atom'. Others said that the relative atomic mass (rather than the mass number) is different. One misconception is that an isotope is a single atom whose numbers of protons and electrons are the same, but whose number of neutrons differs from the number of protons. Electrons are not part of the definition of an isotope; their inclusion can lead to this type of confusion and ambiguous answers.

02.2 This was well answered by over half of the students, although a few ignored the instruction to give their answer to one decimal place. Some students did not appear to recognise that providing an answer that was not in between the mass numbers of the two isotopes was mathematically incorrect.

02.3 This was very well answered.

02.5 Many students had difficulty in articulating their answers. Many gave generic answers about Mendeleev having left gaps, rather than pointing out specifically that gallium fitted one of those gaps. There were also vague statements about gallium's properties fitting the adjacent elements, rather than matching the rest of the group. Some mentioned Mendeleev having predicted properties, without saying that those predictions were correct.

Question 3 (standard demand)

03.1 This was well answered by many students. A common error was to not multiply the relative formula mass of hydrogen by three, leading to an answer of 100.

03.2 This was well answered. Credit was given to those who applied an incorrect response to question **03.1** correctly. Some students gave an answer which corresponded to their answer to question **03.1** used as atomic number rather than relative atomic mass.

03.3 This was well answered, although a common error was to omit the carbon in calculating the total M_r of the reactants.

03.4 The best answers gave the pros and cons of each method and then gave a judgement. One misconception was that the iron oxide in method 3 could be sold. Many concentrated only on cost, and the number of by-products, rather than what those products were and how difficult or costly further separation would be. Few students used the information provided, that solid products have to be separated. A few very good students commented on the low atom economy that method 1 would give because of some tungsten being lost as tungsten carbide.

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

04.1 Many students remembered that effervescence would be seen, but there were many vague descriptions such as 'vigorous reaction' which did not gain credit. Students often gave the same observation twice, eg, 'effervescence' and 'bubbles'. Many students incorrectly mentioned a colour change, perhaps remembering a demonstration where an indicator had been added. Very few mentioned the potassium melting.

04.2 Very few students could write the formulae for the correct products. Those who could were usually able to balance the equation. Many students approached the question from the wrong direction, trying to balance the equation by inventing fictitious products.

04.3 This was not well answered, with only a small number of students scoring full marks. Many incorrectly tried to link reactivity to melting and boiling point. Many referred to the distance and / or attraction between the nucleus and electrons in general, rather than the outer electrons. Others failed to mention the nucleus at all.

04.4 The electron arrangements of both atoms and ions were required for full marks, as well as the ratio of sodium ions to oxide ions and the correct charges on the ions. Few students scored all the marks as they did not draw the atoms of sodium and oxygen before reaction. Many tried to draw covalent structures. The ratio of 2 atoms of sodium to one of oxygen was well known. Students should be aware that electrons cannot be in two places at the same time and should not be drawn as if they are. Some students drew both ionic and covalent structures, thereby contradicting themselves and losing the marks for a correct ionic structure. A great deal of time and effort would be saved by drawing the outer electrons only, as in the specification.

04.6 Students found this question very difficult, with many referring incorrectly to intermolecular forces, even when mentioning ions. Many also referred to covalent bonds or forces between atoms. Of those who did refer correctly to the large amounts of energy required to break the strong attractions between ions, very few referred to the giant structure of the compound.

Question 5 (standard, standard / high and high demand)

05.2 This equation, which is given in the specification, was not well known.

05.4 Students found this question difficult. Most students do not know why the acid is heated, and many incorrectly referred to helping the magnesium oxide dissolve. Very few appeared to understand that excess magnesium oxide is needed to ensure that all of the acid reacts. Most students knew that filtration separates solids from liquids or solutions, but many did not refer specifically to removing the excess magnesium oxide.

05.5 Very few students knew that a water bath or an electric heater should be used, despite this being stated in the specification.

05.6 Those who followed the method provided in the question were often successful in scoring at least one mark. It was common to see the number of moles of iron calculated by dividing the mass by 112 instead of 56. Those who calculated the number of moles of chlorine often insisted on converting this to a mass and then back again to calculate the volume of chlorine.

Question 6 (standard and standard / high demand)

06.2 This was poorly answered, with many instances of incorrect use of scientific terms. Some referred to molecules instead of atoms, different shapes instead of different sizes, and rows instead of layers. Many did not refer to the layers in a metal at all, merely referring to atoms, or a vague 'they' not being able to slide. Even those who did refer to layers rarely said those layers were distorted. There were many incorrect answers in terms of an incorrect type of bonding, and many thought that alloys are compounds.

06.3 Students were expected to do a simple comparison of the temperature change when each metal was added separately to silver nitrate solution. A control variable was needed for full marks to be awarded, as well as how the results would show which metal was the more reactive. Some students did not appear to know how to progress, with some trying to measure a temperature change while heating with a Bunsen burner, and some appearing to confuse reactivity with melting or boiling point. Of those students who did realise what was required, many spoiled their control variable by referring to the same 'amount' of a substance instead of volume, or concentration, or mass, as appropriate to the substance. Many students referred to temperature rather than temperature change. A few students tried to get round the fact that no other chemicals were available by making zinc nitrate and then seeing if Q would react with it. This approach could have worked but only if they had taken steps to ensure that all the silver nitrate had reacted before adding Q.

Question 7 (standard, standard / high and high demand)

07.1 Very few students picked up on the link between chemical reactions and electricity given in the question. The idea that electrolysis uses electricity to produce a chemical reaction was poorly understood. Many students believe electrolysis is a method of 'separating' compounds, rather than decomposing a compound. Very few realised that a chemical cell uses a reaction to produce electricity, with many making statements about a cell using electricity.

07.2 Many students were unable to write the formula of bromine. Those who could, often scored at least one mark, although the half-equation was not always balanced.

07.3 Students found difficulty in naming all 3 products. Many students did score the mark for iodine, though iodide was a common response. Very few could work out that in the absence of a halide ion, oxygen must be produced at the positive electrode, with many suggesting nitrogen as the product.

07.4 Of the students who recognised that the copper needed to be filtered from the solution, very few then washed and dried the copper, despite that step having been provided in the method for dealing with the electrode itself. Some said the filtered copper would be measured, rather than specifically that the mass would be measured. Some then said incorrectly that the mass would be added to the mass of the electrode, rather than the mass gain of the electrode. Many wasted time describing steps that had already been done, particularly weighing the electrode before and after the experiment.

07.5 The concept of proportionality is poorly understood. Even those who referred to the lines being straight rarely referred to their passing through the origin. Most simply described how the results showed a positive correlation, or a linear relationship.

07.6 The idea of one variable doubling (or trebling) as did the other variable was known by very few students.

07.7 Very few recognised that the blue colour was due to copper ions, which were being removed from the solution. Copper does not dissolve, and is not blue, so the phrase 'copper is removed from the solution' has no merit. Many think that the ions are being separated, rather than discharged.

07.8 Many students could make no progress as they had not calculated the number of moles of copper. Some tried to include the current, the time or both in their calculation, instead of using those values to establish the mass of copper formed from the graph.

Question 8 (standard, standard / high and high demand)

08.3 Whilst there were many excellent answers, many were very carelessly drawn, with arrows for activation energy and overall energy change being placed so that their start and end were only vaguely near the correct levels. Dotted lines should be drawn to clarify the energy gaps. Some drew the profile for an endothermic change, rather than exothermic, and some did not complete the profile, leaving out the energy level of the products. Some appeared to think that the activation energy is the energy at the peak, rather than the difference between the energy of the reactants and the peak.

08.4 A good number of students were successful with this calculation, although some failed to count all of the bonds correctly. Where students made a slip of this nature, or an arithmetic error, it was sometimes impossible to award marks for following through with the method, since there was often a jumble of numbers scattered over the page with no words to explain what was going on. 'Bonds broken' and 'bonds made' should be stated in calculations of this type. Many students did not use the value of 1034 kJ/mol provided.

Question 9 (standard, standard / high and high demand)

09.3 Many students included reading the bottom of the meniscus at eye level; this is just normal technique rather than an improvement to the method given. Many suggested repeating the titration, but this is pointless unless a mean of the accurate results is taken.

09.4 As with other calculations, students often failed to explain what they were doing, which made it difficult for the examiners to award partial credit. Numbers were scattered around without helpful words such as ‘moles =’ or ‘mass =’. Although most students convert the volume of a solution to dm^3 for a titration calculation, far fewer did in this calculation, so their calculated number of moles was 1000 times the correct value.

09.5 Many students were successful at this straightforward titration calculation. Most used the mole ratio, although some tried to apply this to concentrations or volumes rather than moles. Some students tried to bring relative formula mass into their calculation.

Concluding Remarks

The paper was broadly comparable with previous papers. Students did poorly on the questions on ionic bonding and electrolysis but performed well on the question on extraction of metals. There continues to be a lack of precision when recalling definitions and other statements from the specification.

Mark Ranges and Award of Grades

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