A LEVEL
CHEMISTRY

7405/3
Report on the Examination

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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 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

A rather different cohort than usual gained a paper average of 53% compared with 57% in June 2019. Given that anyone awarded an A* (and most awarded an A) by the CAGs process in June will not have taken the exam in this session, this is not surprising.

The maximum mark achieved was 82/90 while at the other end of the scale two students scored only 5/90.

There were no 'dead' marks on the paper although only about 11% of students were able to access Level 3 on Question 06.2, the question marked using levels of response, and a similar percentage gained full marks on Question 05.3. Only 6% of students achieved full marks for 06.4.

Students are advised that:

- It is not good practice to start an answer by repeating the question.
- They should not include apparatus lists with practical descriptions. Each piece of apparatus will be mentioned in turn when it is used in the method so does not need a separate listing. If a labelled diagram is used then it is not necessary to repeat a full written description as well.
- They must not offer two alternative answers (even if one is on separate paper), as, if one answer is correct but the second is incorrect, the incorrect answer will negate the mark.
- When generating intermediate answers in a calculation, it should be clearly indicated what the number refers to; this was especially relevant in Questions 04.6 and 05.1.

It was surprising to see how many students in section B suggested two possible answers for some questions; students should be aware that there is only one answer to each question in section B.

Comments on Individual Questions

Question 1

01.1 proved trickier than expected with about one third of students failing to score any marks. There was confusion about the origin of the nitrogen and a frequent failure to mention the importance of high temperature.

In 01.2, the expected answers were acid rain or respiratory problems although ‘toxic’ was allowed. Many students referred incorrectly to global warming or a greenhouse gas.

01.3 was fairly well answered with some quirky variations on fractional balancing seen.

In 01.4, 85% of students scored only one or no marks out of a possible two. The commonest mistake was to attempt only a definition of ‘heterogeneous’ and not go on to define the meaning of the term ‘catalyst’.

In 01.5, most students recognised that production of carbon particulates is due to incomplete combustion.

Question 2

Some answers to 02.1 were too vague, with alkalinity being explained for example by the statement that Na and Mg are both alkali metals. About two-thirds of students scored the first mark by mentioning hydroxide ions but the second mark for a mention of the difference in solubility of the hydroxides was often missing. It was difficult to understand why a significant minority of students tried to explain the difference in terms of sodium hydroxide having ‘two hydroxide ions’ by comparison with magnesium hydroxide having only one.

02.2 was answered correctly by about 40% of students. A common mistake was to use the wrong formula for phosphorus(V) oxide. Students were expected to use P_4O_{10}.

In 02.3, the students who could give a correct answer for one of the equations could usually also give a second correct equation.

Question 3

In 03.1, a majority of students were able to score 2 or more marks but many answers were rather muddled. There was often a failure to appreciate that only certain wavelengths or frequencies of light are absorbed (to excite d sub-shell electrons) and that the colour seen is the result of the remaining unabsorbed wavelengths or frequencies of light being reflected or transmitted. Only 20% of students scored all three marks. The equation needed was often incorrect with $E = hc\lambda$ seen quite frequently. Many students failed to convert 490 nm to metres (or did so incorrectly).

03.2 proved to be a very discriminating question. Students should now be familiar with the fact that this paper contains a significant proportion of marks related to the description of practical scenarios. The key to success with such questions is to be familiar with a wide range of practical techniques and to be able to write concise, accurate descriptions. For example, in this case, a reference to plotting a graph of absorbance vs concentration needs to be preceded by a reference to taking a series of measurements of the absorbances for differing concentrations and it was not enough to simply repeat the question by saying ‘use the graph to find the unknown concentration’. The examiners wanted to see a description of **how** the graph should be used.

It was encouraging to see many correct answers to 03.4 which proved to be one of the easiest questions on the paper

Question 4

In 04.1, as is often the case when a piece of syllabus recall is tested for the first time, relatively few students were able to recall the name of the process prevented by cisplatin during cell division.

Students were expected to answer 04.2 by following the description in the question of a chloride ligand being replaced by a water molecule. In many cases students failed to appreciate that replacement of a negative chloride ion by a neutral water molecule would result in a net charge (of 1+) on the resulting complex.

04.3 proved to be very tricky for many students – perhaps due to the amount of reading needed to pick up on the clues in the question and to appreciate what was being asked. Students are clearly more familiar with questions asking them to show hydrogen bonding between base pairs because that is what many tried to do – and they ignored the need to include the complex in their diagram. Where the complex was included it was sometimes drawn as trans- rather than cis- and often without an indication that the bonds formed are co-ordinate bonds.

The experiment in 04.4 was another example of a situation where a description of a (hopefully familiar) practical scenario was needed. Students found this very taxing and over half scored no marks. The question described measurements of concentration being taken at one-minute intervals and then asked for a description of graphical methods. Although there were several alternative possibilities, they all needed to start with a description of the need to plot a graph of these measured concentrations against time. The next stage needed to be some reference to a determination of rate from the concentration-time graph. When referring to a subsequent rate-concentration graph it is not enough to refer to a 'straight line of constant gradient' as that could also be a zero order line – a sketch graph was useful to some students here. The idea of constant half-lives is not on the syllabus, so this type of answer was not expected but was credited if seen.

Most were able to complete the two simple calculator processes in 04.5 although some students seemed to try and arrive at the answers by using the successive differences between previous values in the table. However they failed to spot that the temperature differences were not all the same.

Answers to 04.6 showed an improvement in graph skills with 70% of students scoring at least 3 marks. The negative scale confused some students and some forgot the need for at least 50% of the available space to be taken up by the plotted points. Most students then recognised that the gradient = E_a/R but some tried to solve the whole equation by inventing values for the ln terms. In some cases gradient calculations were the wrong way up or involved a misreading of the scales, e.g. 0.00341 was often seen as the value for Δx instead of (0.00341 – 0.00310).

Question 5

In 05.1 most students were able, at the least, to calculate the amount of hexane but some then got confused and attempted to use the more familiar $q = mc\Delta T$ instead of the relevant equation given in the question. In some cases students erroneously converted the temperature change into Kelvin by adding 273. If temperature was incorrectly converted into Kelvin, in 05.2 it was marked as 'ecf' from 05.1 to avoid a double penalty for the same error. This enabled weaker students to score some marks.

Most students seemingly failed to appreciate that question 05.3 was about why the value was not an 'enthalpy change' and, instead, offered answers that tried to explain why it was not a 'standard' change. Only 11% gained the mark. Students failed to recognise that, by definition, an enthalpy change is measured at constant pressure but the sealed nature of a bomb calorimeter will not allow expansion so the pressure will not remain constant.

In 05.4, many students did not appreciate the need to double the thermometer uncertainty because two thermometer readings are taken.

Question 6

In 06.1, many students just listed standard conditions without identifying the gas, solution or electrode.

In 06.2, surprisingly, only about 9% of students were able to access Level 3, due mainly to a failure to address the indicative content in stage 1 (preparation of the solution) despite the prompts in the question. Many of those who did try to calculate the mass of solid needed seemed to base the calculation on the 0.5 mol dm^{-3} value for the sulfuric acid instead of the required standard concentration of 1.0 mol dm^{-3}. Students should also appreciate that weighing by difference is not the best approach when making up a solution of an exact concentration. The best method is to weigh the solid directly into the beaker before dissolving in a small volume of solvent and then transferring (with washings) to a volumetric flask. By contrast, many students covered all the items in stage 2 of the indicative content (how to set up the cell) where a diagram was often usefully employed.

In 06.3, balancing the equation proved trickier than expected.

The use of electrode potential data to explain the course of chemical reactions is always a challenge for students. 06.4 was not an exception and only 19% of students scored two or more marks. Many students failed to appreciate the need to discuss both comparisons and only focused on the interaction between copper and nitric acid. Many descriptions made confused references to the electrodes – often without referring to an electrode at all but using phrases such as ‘the E for nitric acid’. The best answers made clear references such as "$E^{\ominus}$ NO_3^-/NO > $E^{\ominus}$ Cu^{2+}/Cu, so Cu can reduce NO_3^-". It was also often unclear what the students were suggesting as being oxidised or reduced – specific species need mentioning.

Section B

The percentage scores in the multiple-choice questions were overall much higher than in the written questions; the mean score across the 30 questions in Section B was 18.75 (62.5%).
As always, there was a marked spread of difficulty across Section B. The vast majority of the questions yielded success rates of between 40 and 80%. The easiest questions were B17, B22 and B24 which had success rates in excess of 80%. Questions that students found particularly difficult, with a success rate of <40% were B7, B13 and B28.

Mark Ranges and Award of Grades

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