GCSE

Chemistry

8462/1F

Report on the examination

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General comments

A wide and varied range of responses was seen to this paper, which was sat by over 19 000 students. Some students gave responses which showed an excellent level of knowledge and understanding at this level, while others showed little understanding of even the most basic chemical concepts.

The majority of students appeared to have sufficient time to complete the paper, although many chose not to answer some of the more difficult questions common to the Higher Tier paper in questions 8, 9 and 10. Except for the multiple-choice questions, these common questions were unanswered by between 10% and 25% of students.

The accurate use of subscripts and superscripts is fundamental to chemistry, and is expected in word processed, as well as handwritten, answers. If the word processing package used does not allow for subscripts and superscripts, the student needs to indicate their use in some way, for example using ^ to indicate a superscript.

Several questions showed that students are unwilling to learn facts that are stated in the specification.

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 ten questions on this paper. Questions 8, 9 and 10 were common to the Higher Tier. The demand levels of the questions are designed to increase from low demand to standard demand through the paper. For questions 1 to 7 the demand of each question also increases through the question. A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Comments on individual questions

Question 1 (low demand)

01.1 Nearly all students chose the correct name.

01.2 Most students filled in the table correctly, with the vast majority scoring at least two marks and about five sixths scoring all three marks. The most common error was 1 for the number of hydrogen atoms in the molecule. Occasionally chlorine was given as the name for the symbol C.

01.3 More than three quarters of students gave a correct word equation. The most common errors were 'potassium sulfuride' and potassium sulphate for the name of the product. A few tried unsuccessfully to write a symbol equation despite the instruction to write a word equation.

01.4 About five sixths of students could balance the Al atoms but there were more errors with the F atoms, with under a half of students scoring both marks. 1 F_2 and 2 F_2 were commonly seen.

Question 2 (low and standard demand)

02.1 More than four fifths chose the correct name. Magnesium nitrate was a more popular distractor than magnesium sulfate.

02.2 Fewer than three fifths chose hydrogen as the correct gas. Chlorine was by far the most popular distractor, and oxygen the least.

02.3 Fewer than two fifths of students could identify both variables, but another third could identify one. More students could identify the independent variable correctly than the dependent variable, with the volume of hydrochloric acid being a popular wrong choice for the dependent variable. Some students identified the correct two variables but had them the wrong way round, and a few drew multiple lines from the same box, which automatically negated any marks.

02.4 More than three fifths gave the correct answer, with the two distractors being approximately equal in popularity.

02.5 Just over a third of students gave 2 °C as the resolution of the thermometer, with the majority incorrectly opting for 20 °C. Many appear to think that the resolution of an instrument is the gap between numbered values on the scale rather than the size of the smallest scale division.

02.6 Fewer than half of responses gave the correct answer, with more than half believing that temperature decreases in an exothermic reaction.

02.7 Nearly three quarters of students were able to identify **A** as the reactants. **C** was the most popular distractor, followed by **B** and **D**.

02.8 More than four fifths could identify **C** as the activation energy, with **A** being the most popular distractor.

02.9 Only a quarter of students were able to identify **B** as the overall energy change, with **E** being by far the most popular response.

Question 3 (low and standard demand)

03.1 Two thirds of students were able to identify sodium chloride solution as the only possible electrolyte. Water was the more popular distractor, but a surprising number chose solid potassium bromide.

03.2 This was answered less successfully, with only an eighth of students scoring both marks. Even those who identified **B** as copper were often unable to give a correct reason for their choice. Many students chose **D** on the grounds that it has the highest voltage, completely missing the point that the two metals must be different in order to produce a voltage. Others suggested **D** on the grounds that it is a good conductor. A surprising number thought that a voltage of zero meant that the metal was a non-conductor. Those who did give the correct answer usually gave the reason that it does not produce a voltage, which was an acceptable alternative to the voltage being 0.0 V.

03.3 This was very well answered, with 5 sixths of students giving the correct order. A few reversed the order and some swapped **A** and **C**.

03.4 This was answered correctly by the vast majority of students. There was a multitude of ways of establishing that 4 cells were needed, rather than simply dividing the total voltage required by the voltage produced by one cell.

03.5 Fewer than a half of students knew that the product is water, with all three options being chosen many times.

03.6 Fewer than one in six students knew that the reaction would be reversed. 'Reversible' was also accepted. Most tried to answer in terms of endothermic or exothermic, without anything to base that choice on, and many gave the name of a substance, often ammonia, perhaps referring back to the previous question.

Question 4 (low and standard demand)

04.1 Nearly three quarters chose the correct answer. Distillation was a very popular distractor.

04.2 Fewer than a third of students realised that the substance should be an indicator or were able to name one. Universal indicator was the most popular named indicator; this was accepted although it is not really appropriate for a titration. Acid and alkali were popular incorrect responses, as was liquid.

04.3 About five sixths of students chose burette as the correct answer.

04.4 Only two fifths of students realised that the acid should be added dropwise and / or that the solution should be swirled. One popular misconception was that the addition should be timed. Stirring was not accepted as an alternative to swirling, but adding the acid slowly was accepted as an alternative to dropwise or drop by drop.

04.5 Most students knew how to calculate a mean, and the majority could round to 3 significant figures. However, some thought that 9.00, rather than 8.45, was the anomalous result; students need to look beyond the first digit. Quite a few placed a dot over the 3 in 8.93 of their final answer, indicating a recurring decimal, which was therefore an infinite number of significant figures not 3. Over two thirds of students scored at least 3 marks, with two fifths scoring full marks.

04.6 Only a quarter of students could identify both ions correctly. The ion present in an acid was known more often than the ion in an alkali. Many knew the correct two ions but had them the wrong way round. A significant number identified the ions in sodium chloride rather than in an acid and an alkali.

Question 5 (low and standard demand)

05.1 This was very well answered, although a few said bromide rather than bromine. Four fifths of students scored both marks.

05.2 Three quarters of students chose the correct formula. The most popular distractor was O^2.

05.3 Students found this question difficult and one in ten did not attempt it. Many stated that aluminium, rather than aluminium ions, is positive. The attraction between the positive ions and the negative electrode was better expressed.

05.4 Again, students found this difficult despite the data provided as a prompt, and again one in ten made no attempt. Few students stated clearly that the mixture has a lower melting point, and even fewer that less energy is therefore required. Some stated that the melting point is lowered by cryolite, which was not accepted; the melting point of aluminium oxide is a fixed value. Some did not make a clear reference to energy, referring to fuel or heat instead. Many referred to boiling points instead of melting points, despite also quoting the given values of melting point. Just over a quarter of students scored 1 mark but only one in 20 scored both.

05.5 About half of students gave the correct answer, with the two distractors both being very popular.

05.6 Three quarters of students gave the correct value, with 2.7 cm^3 being the more popular distractor.

05.7 Three fifths of students gave the correct reason, though a surprising number thought that hydrogen is more reactive than magnesium.

05.8 Only a half of students gave the correct answer, with nearly as many thinking that the volume did not depend on the time.

05.9 There were very many fully correct answers, with a half of students scoring full marks. A few measured the change in volume as 1.8 cm^3 instead of 1.9 cm^3, and some inverted

the expression for gradient even though it was provided. Any matching pairs of change in volume and change in time were accepted. Even those who read incorrectly from the graph were able to gain partial credit for showing how to manipulate their values correctly.

Question 6 (low and standard demand)

06.1 Nearly three fifths gave the correct answer, with the two distractors being almost equally popular despite the diagram looking nothing like a tube.

06.2 About half chose the correct reason, with the more popular distractor being that the nanoparticles are made of carbon atoms.

06.3 The vast majority could select the correct answer. 10^3 was the most popular distractor.

06.4 This was well done, with more than half of students scoring full marks. Many could calculate the volume, but some tried to calculate the surface area, ignoring the value provided. Some did not cancel their ratio down to the simplest whole number ratio, eg leaving the answer as 12:8. Partial credit was awarded for attempts to cancel down incorrect values of volume and / or surface area.

06.5 Over half of students scored both marks; most applied what they knew about nanoparticles to the context of the question.

Question 7 (low and standard demand)

07.1 Many could identify one mixture but not the other; two thirds of students scored one mark but fewer than a third scored both. Many chose the second box (a pure compound) for one of their answers.

07.2 Unlike some 6-mark questions in previous years, most students attempted this question with about 1 in 10 making no attempt. Three fifths of students were able to reach at least level 2 and a third scored full marks. The question provided lots of useful information to prompt and assist with creating a suitable method. Most students could state that the mixture needed to be dissolved in water. Where this happened varied, with many stating a beaker, but a number suggested doing this in a filter funnel. When this happened, some lost credit as they did not mention using a filter paper. Most could suggest evaporating the solution in an evaporating dish. Other common alternatives included leaving the solution to evaporate slowly or with a water bath.

Some students mixed up the correct order in which steps should be undertaken. Those who scored zero marks often described the set up of a water bath without providing any further indicative content. Some thought the glass rod was to measure temperature. Others used it to push the mixture through the filter paper. Those who did not add water to the mixture as their first step had difficulty in producing a method that would work. Many only used the water for a water bath, not as a solvent for the salt.

07.3 Four fifths of students scored both marks. A few inverted the expression provided.

Question 8 (standard demand)

08.1 Only one student in six could give a correct description of where the non-metals are found, despite there being a clear statement in the specification. Many referred to the right of the table, but few referred to the top. Those who referred to specific groups were often correct but some omitted Group 0. Some referred to a 'staircase' but did not specify what it means; it should be noted that the periodic table provided does not show a staircase.

08.2 About half correctly chose the low melting point, with the three distractors all being popular. Several ticked more than one box, which automatically scores zero when the instruction is to tick **one** box.

08.3 Three fifths of students drew the structure correctly. A few tried to put in 23 electrons and a few 12. One in seven students did not attempt to answer; this is a common occurrence when a question is not accompanied by answer lines. Students do need to read all the words, so they are aware there is a task to do.

08.4 This was answered less successfully. Many stated that Mendeleev left spaces for other elements to be discovered which, while true, does not answer the question. Others answered in terms of atomic number, which was not known in Mendeleev's time. Even those who tried to answer in terms of placing elements in the 'correct' group rarely mentioned properties.

08.5 Whilst about two fifths knew that argon has a full outer shell, not many were able to go on to say that this is a stable electronic structure, or that electrons are not transferred or shared. Many simply repeated information in the question with different words, such as 'argon is a noble gas' or 'argon is stable'.

08.6 Whilst about a quarter of students knew that a different number of neutrons was involved, few stated that isotopes are atoms with the same number of protons or atoms of the same element. Some referred to 'elements' implying more than one element, which contradicts the idea of atoms of the same element. Some students implied incorrectly that an isotope is a single atom in which the number of neutrons is different to the number of protons and electrons.

08.7 Fewer than half of students could correctly estimate that the A_r must be closest to 115 as there was such a high proportion of the 115 isotopes. The most popular answer was ~114, taking a simple mean rather than a weighted mean of the mass numbers.

Question 9 (standard demand)

09.1 Students found this very difficult, with only one in ten scoring the mark. Of those who knew they needed to count the ions of each element, few could then appreciate that the ratio was 1:1 so the formula was therefore CaS. Many just wrote the number of Ca atoms and of S atoms from the diagram.

09.2 Two fifths of students were able to score at least one mark, and one in eight scored all four. Many described electrons transferring from calcium to sulfur, and of those, most realised that 2 electrons would be transferred. Students were less able to gain the final marking point for a correct description of the ions formed. Some students contradicted an answer in terms of electron transfer by also referring to sharing electrons.

09.3 Students were unable to recall many details about the structure and bonding of graphite, even with the diagram as a prompt. Many did describe layers of carbon atoms, but few mentioned the giant structure or covalent bonding. Many focussed on the use of graphite in pencils, which was not relevant in the context of the question. Most responses did not mention the number of bonds per atom, or the delocalised electrons, or the lack of bonds between layers. The hexagonal rings, if mentioned at all, were not described well, with whole layers or even individual atoms being described as hexagonal. Fewer than a quarter of students scored a single mark and very few scored all four.

09.4 Only one in six students scored the mark, despite the clear statement in the specification that the molecules do not have an overall electrical charge. Those who did gain credit usually mentioned there being no delocalised electrons. 'Free' is not the same as delocalised in this context and did not gain credit. Popular incorrect responses were that the molecules are too small or that the molecules cannot move.

09.5 Only a third of students gave the correct reason, with stronger or more covalent bonds to break both being almost as popular.

Question 10 (standard demand)

10.1 Students found this question difficult and fewer than one in ten could give the correct substance. Many gave tin (the result of the reduction) as the answer instead of tin oxide, and many did not appreciate that reduction is loss of oxygen.

10.2 One in six students could give an acceptable answer in terms of reactivity. Students were expected to compare the reactivities of carbon and tin, so both needed to be named. There was some ambiguous use of the word 'it'.

10.3 Whilst a third of students scored one mark, only about one in ten scored all three. Many could not recall the expression for percentage atom economy and therefore did not attempt to find the total M_r of the reactants. A significant minority added the two relative atomic masses provided to give 124 and then divided by 128.

10.4 Nearly a half of students scored at least one mark. Many answers were not comparative so could not gain credit. Some gave two halves of the same comparison as two different differences in properties, e.g. tungsten is hard for one answer and potassium is soft for the other. Answers in terms of atomic structure, rather than properties of the element, did not gain credit.

10.5 Nearly a half of students scored both marks by producing working to show that the total M_r on each side was 238.

10.6 One in five students scored the mark. Common correct responses included minimising waste or making more profit. Common incorrect answers included references to yield, rate or safety.

Mark Ranges and Award of Grades

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