



GCSE

Chemistry

8462/1F Paper 1 Foundation Tier

Report on the Examination

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General comments

Over 22 000 students sat this component, so a wide and varied range of responses was seen.

Some students gave responses which showed excellent and comprehensive understanding of chemistry at this Foundation Tier GCSE level, while others had difficulty even with core chemical concepts.

The majority of students appeared to have sufficient time to complete the paper. The vast majority of students attempted all the questions with the exception of **07.3**, which was not attempted by nearly a quarter of the students.

In general, the number of writing lines provided is an indication of the length of response expected, though students are of course free to use the blank pages at the back of the booklet if required.

When answering multiple choice questions, students need to indicate clearly which is their correct response if they change their mind. They should also be careful to read the instructions regarding the number of boxes to be ticked; many ticked only one box when two were required. Some ticked more than one box when only one was required – this automatically loses the mark even if one response is correct, on the ‘list principle.’

Knowledge and understanding of how science works in everyday situations, including in the laboratory, were tested throughout this paper. This means that it was essential that students read and analysed the information provided, then read and understood the question before writing their response.

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** More than two thirds of students identified the pure compound, with the three distractors being approximately equally popular.
- 01.2** Just over one third of students identified the correct mixture. Distractor **A**, which is a mixture of two compounds, proved more popular than the correct answer.
- 01.3** More than four fifths of students identified the position of metals in the periodic table. Sections **B**, **C** and **D** was the most popular distractor.

- 01.4** Fewer than one third of students scored both marks, with nearly one in ten scoring neither. Low melting point was a popular distractor.
- 01.5** Over half of students scored both marks. Some students placed the electron from the potassium atom on the chlorine atom, rather than completing the structure of the chloride ion. Some added to the potassium ion diagram unnecessarily. A few showed an electron moving from chlorine to potassium. There were some blank answers, perhaps because the students did not realise there was something to do; students need to read the whole paper, not just the parts above an answer line.
- 01.6** More than four fifths of students identified the distillation apparatus.
- 01.7** Nearly all students identified the filtration apparatus. The most popular distractor was diagram **B**.

Question 2 (low and standard demand)

- 02.1** Over half of students named all three pieces of equipment correctly, with three quarters scoring at least two marks. The burette was often called a measuring cylinder, and the conical flask a beaker. The burette and pipette were sometimes reversed.
- 02.2** Students found this difficult – many gave names of acids or alkalis, or substances totally unrelated such as iodine. Of those who did give an indicator, many gave universal indicator, which is not suitable for a titration. The most common correctly named indicator was phenolphthalein; any reasonable attempt at the spelling was accepted.
- 02.3** This was answered well, with nearly two thirds of students giving ‘colour change’ or a description of one. ‘Clear’ is not a description of a colour so was insufficient for a mark.
- 02.4** A third of students scored one mark, but far fewer scored both. Many students did not realise that they had been given the correct apparatus, and merely had to say what they would do to use that apparatus accurately. Instead, most suggested using other, less accurate, equipment such as a measuring cylinder or a beaker. The most common correct answer was to add the acid drop by drop. A few suggested repeating the experiment, without also saying to take a mean of the results. Some students suggested using a measuring cylinder to measure acid into the burette, not understanding what a burette does.
- 02.5** Two thirds of students gave the correct reading. The most common distractor was 17.4 cm^3 .
- 02.6** Three quarters of students identified the closest pair of results.
- 02.7** Students found this standard demand question difficult. Just over a third of students identified the formula of barium chloride, but the distractor Ba_2Cl was even more popular.

Question 3 (low and standard demand)

- 03.1** Two thirds of students recognised this as a displacement reaction. Combustion proved surprisingly popular.
- 03.2** Nearly a half of students scored 2 or 3 marks on this calculation. A common error was to give the answer to three decimal places instead of three significant figures. A few students thought that 39.81 should be rounded up to 39.9, and some left a recurring dot on the 8 of 39.8̇ (so an infinite number of significant figures). Many students operated on the data provided seemingly at random, with addition, subtraction and multiplication seen as well as the division the wrong way round. It was common to leave the '× 100' out of the expression, so that marking point 1 could not be awarded if the answer was incorrect.
- 03.3** Two thirds of students identified the volume of copper sulfate solution as the control variable.
- 03.4** Two thirds of students gave the correct answer. Some students gave the minimum or maximum temperature as their answer, rather than reading the mass at the turning point of the graph.
- 03.5** Most students realised that they needed to subtract the minimum temperature from the maximum, and three fifths of students scored at least one mark. Some, however, misread those values from the graph, with 45.4 – 20.4 being frequently seen. Although this gave the correct answer, it was as the result of incorrect working so did not score both marks. A minority of students were unable to start the calculation, and various multiplications of random values were seen.
- 03.6** Over a half of students gave a fully correct answer. Many students could not convert their volume to dm³ even given the conversion factor, with many trying to do a calculation involving the mass of copper sulfate. However, partial credit was then awarded for those who substituted their value of volume into the given equation and calculated the results correctly. Many students do not seem to understand the terms volume and concentration, and that they mean different things.
- 03.7** Just over a half of students were able to draw two sharp straight lines, with a ruler, which passed through all the points. Some did not use a ruler, and a few drew an extra line joining the first and last points, meaning that full marks could not be awarded.
- 03.8** Students struggled with this standard demand question, with only a quarter gaining a mark. More than a half of students selected the second distractor, in which both parts of the statement are the opposite of the correct version. When temperature decreases, heat energy is being taken in from the surroundings and converted to chemical energy, so the reaction is endothermic. It is this reduction in heat energy that causes the temperature decrease. A misconception for many students is thinking that when heat energy is taken in from the surroundings it remains as heat energy in the system, causing the confusion with the direction of temperature change.

Question 4 (low and standard demand)

- 04.1** Fewer than one in eight students knew that a nanoparticle is only a few hundred atoms, despite this being clearly stated in the specification. The correct answer was a less popular option than all three distractors. The most popular answer was a few million atoms.

- 04.2** Fewer than a third of students could apply their knowledge that transition metals make good catalysts and select iron as the most likely element. By far the most popular distractor was magnesium.
- 04.3** More than four fifths of students scored both marks. Nearly all students identified the use of titanium dioxide for sun creams, and most also identified silver for wound dressings. There was no apparent pattern to incorrect responses.
- 04.4** Two fifths of students scored all six marks, with well over four fifths scoring at least 1 mark. The most common error was in the surface area, where the answer was often given as 6 times the volume, ie 384 nm^3 . Most students were able to cancel down their numbers to give the simplest whole number ratio and gained credit for doing so.

Question 5 (low and standard demand)

- 05.1** Nearly four fifths of students identified the number of protons. 13 was the most common distractor.
- 05.1** Over a half of students identified the number of neutrons. 6 was the most common distractor.
- 05.1** Over a half of students identified the number of electrons. 13 was the most common distractor.
- 05.4** Nearly three fifths of students scored the mark. Although the vast majority counted 2 carbon and 6 fluorine atoms, many could not write the formula correctly, with numbers discernibly smaller than the letters.
- 05.5** Only about a third of students identified that only intermolecular forces are weak. The most popular response was that both covalent bonds and intermolecular forces are weak. The myth that covalent bonds are weak is a difficult one to dispel.
- 05.6** More than a half of students knew that Buckminsterfullerene is spherical. The most common distractor was cylindrical, with the students possibly thinking of nanotubes.
- 05.7** Just under three quarters of students identified the number of bonds formed by a carbon atom in graphite. The most common distractor was 4.
- 05.8** Students found this standard demand question difficult, with fewer than one in twenty scoring all three marks, although more than a half did score one mark. Many did not mention the giant structure, or did not state that each carbon atom forms 4 bonds (despite having counted the bonds per atom in graphite in the previous question). Many did mention covalent bonds but then contradicted themselves by referring to intermolecular forces; these are not present, so the type of bonding mark could not be awarded. Many students gave properties of diamond, which were not asked for and gained no credit.

Question 6 (low and standard demand)

- 06.1** Fewer than a half of students identified the reason why molten substances can be electrolysed. The incorrect distractor that electrons can move through the substance was almost as popular.

- 06.2** Nearly three quarters of students could name all three substances correctly. The most common errors were iodide instead of iodine and zinc bromine instead of zinc bromide.
- 06.3** Nearly a half of students gave a completely balanced equation. The oxygen was correctly balanced more often than the aluminium.
- 06.4** Nearly three fifths of students set out their work clearly and obtained the correct answer. The most common incorrect answers were $27 + 16 = 43$ and $27 \times 16 = 432$.
- 06.5** Fewer than two thirds of students scored one or two marks, with fewer than one third scoring both marks. It was expected that students would choose appropriate metals from the list provided, but other correct answers were accepted. Gold was not given credit, since students should know that gold is found in the Earth as the metal itself, so does not need chemical extraction. Carbon was often given as a response.

Question 7 (low and standard demand)

- 07.1** The great majority of students realised that the voltage would be 4 times that of a single cell.
- 07.2** Two thirds of students identified sodium chloride solution as the correct substance to be an electrolyte. The two distractors, pure water and solid lead bromide, were equally popular.
- 07.3** Very few students managed to reach Level 3, which required mention of a control variable to make the outcome valid. However, two fifths of students managed to reach level 2 by mentioning some key steps in the procedure. Nearly one quarter of students did not attempt the question even though a diagram of a cell had been provided as a prompt.

There was much confusion with electrolysis, and with ‘watching to see if there is a reaction.’ Many students thought that a voltmeter produces a voltage rather than measuring it. Many students did not understand what a chemical cell is, despite the diagram, and many used electrodes of the same metal, or even just one electrode. Some referred to a power pack, not realising that the cell itself is the source of the voltage.

Question 8 (standard demand)

- 08.1** Nearly a half of students gave one correct product, although only about one in seven could give both. Copper sulfate was the most common correct answer but the two words were sometimes split either side of the + sign as if they were two substances. Copper and sulfur was another popular combination.
- 08.2** About a half of students gave a correct observation that would show that the reaction was no longer proceeding. Many did not realise that they were looking for signs of the reaction having stopped, and gave observations they would make while it was still ongoing.
- 08.3** Nearly two fifths of students were able to state that filtering is used to remove the excess copper carbonate. However, there were many answers that were expressed vaguely in terms of removing impurities, separating solids from liquids, or even removing the wrong substance such as the acid.

- 08.4** Only one in six students could give one of the two methods in the specification, i.e. a water bath or an electric heater. The use of a water bath was by far the more popular correct response. Many, however, simply stated that a Bunsen burner would be used. This was an insufficient response unless a beaker of water was also present.
- 08.5** Nearly a half of students scored two or three marks. Many could not substitute the correct values into the expression. There were often attempts to bring 50 cm^3 into the calculation. Rearrangement of the equation also proved difficult for some students.
- 08.6** Students struggled with this question, with fewer than one in five scoring one mark and very few scoring two. Many focused on physical properties of the metals, such as boiling point or conductivity, rather than their reactivity. Of those who did consider reactivity, many had the relative reactivities the wrong way round. Responses were often vague; for example 'high reactivity' for sodium was insufficient for the mark, as high reactivity on its own does not explain what the problem is.

Question 9 (standard demand)

- 09.1** This question discriminated well, with one in six students scoring both marks and more than two fifths scoring at least one. Many students did not read the question fully and gave similarities and differences in properties rather than electronic structures. These responses gained no credit. Of those who did reference the electronic structure, most stated correctly that both have one electron on the outer shell, but were less successful in giving a correct difference. Sometimes the wrong number of shells was given for the two elements: usually 2 shells for sodium and 3 for potassium. Some stated that potassium has more outer shells than sodium. This is not correct as the phrase 'outer shell' is always taken to mean the single outermost shell.
- 09.2** More than a third of students could give two correct observations, and more than four fifths could give one, with bubbling, floating and a flame being the most popular. 'Gas produced' did not gain credit as it is not an observation but a deduction from the observation of bubbling. 'Fizzing' is taken to mean effervescence, so fizzing and bubbling are the same thing rather than two different observations. Credit was not given for any observation requiring extra equipment such as a thermometer or an indicator.
- 09.3** Only two fifths of students could give a correct colour and even fewer could express the reason in terms of the solution being alkaline; many thought it would be neutral. Some students gave purple as the colour, but gave potassium burning with a purple flame as their reason.
- 09.4** Nearly three fifths of students scored both marks for plotting the data, with the vast majority scoring at least one. The most commonly mis-plotted point was (86, 9.1) which was often plotted at (92, 9.1). There was no expectation that a line of best fit would be drawn.
- 09.5** Students were good at estimating the missing value, with nearly three quarters scoring the mark. Sometimes incorrect and inappropriate methods were seen which produced values in the allowed range, such as averaging all five values, or finding the difference between the points adjacent to the missing one. These were not given credit.
- 09.6** Over a third of students identified the reagents. There was an even distribution of incorrect responses.

- 09.7** Two fifths of students identified the correct pair of trends. The most popular error was to identify that the boiling point decreases down the group.

Question 10 (standard demand)

- 10.1** Over a quarter of students could name both models, with four fifths able to name at least one - usually the plum pudding model. Far fewer knew what to call the Bohr model (even though 'nuclear' was accepted). A significant minority called model B the modern model, which contradicts the information that both were early models of the atom.
- 10.2** More than two fifths of students reached Level 2 in this question. The most common correct comparisons were that the modern model has a nucleus whereas model A does not, and the relative positions of the electrons in each model. Sometimes the electrons in model A were only described as negative charges. A common misconception was that model A contained protons.
- 10.3** Whilst few students scored both marks, nearly a third scored at least one. Of those who knew what isotopes are, most knew that isotopes had different numbers of neutrons but did not say that isotopes were atoms with the same number of protons or of the same element. Some referred to 'elements' with the same number of protons, which did not gain the first marking point. Many students used the phrase 'subatomic particles' in their answer without realising that subatomic particles means protons, neutrons and electrons. Some students described ions rather than isotopes.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results Statistics](#) page of the AQA Website.