Questions matter

GCSE
Chemistry

8462/2F Paper 2 Foundation Tier

Report on the Examination

8462
June 2024

Version: 1.0

Further copies of this Report are available from aqa.org.uk

General

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

Many students gave responses which showed thorough and comprehensive understanding of chemistry at this Foundation Tier GCSE level. Others had difficulty with basic chemical concepts.

The majority of students appeared to have sufficient time to complete the paper.

Knowledge and understanding of how science works in the laboratory, in industry and in the wider world were tested throughout this paper. This meant 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.

Question 1 (low and standard demand)

01.1 The vast majority of students scored both marks and correctly identified the elements present in a hydrocarbon.

01.2 Over 80% of students correctly identified the number of atoms in the formula provided. The most common distractor was to identify the number of elements present.

01.3 About 70% of students correctly identified the general formula of the alkanes.

01.4 Just over half the students correctly identified the compound as being an alkane.

01.5 Less than 40% of students correctly completed the displayed structural formula of the alkane. The most common incorrect response was to omit the bonds between the carbon atoms. A small percentage of students went on to include additional bonds attached to the ends of the molecule or to include one or more double bonds between carbon atoms. Over a third of students did not attempt this question.

01.6 This question was not well answered with fewer than one third of students correctly identifying petrol as being a fuel. Over 60% of students incorrectly identified alternative general names to describe the reaction of petrol when burned including combustion (complete and incomplete), burning and exothermic.

01.7 This question was a good discriminator with roughly one third of students correctly identifying both of the atmospheric pollutants. Just over one third of students correctly identified one pollutant most commonly the gaseous pollutant carbon monoxide. The most commonly seen incorrect responses included to identify coal as the solid pollutant and sulfur dioxide as the gaseous pollutant.

01.8 Just over 60% of students correctly completed the equation. Many failed to gain credit because the numbers were not subscripts but the same size as the letters. The most commonly seen incorrect formula was C_3H_7.

01.9 More than 80% of students were able to complete and label the bar chart correctly with a further 10% obtaining one mark. Students should use a ruler when drawing bars to ensure their line stays within the tolerance stated in the mark scheme.

Question 2 (low demand)

02.1 This was well answered with nearly all students identifying the effect on the rate of global warming.

02.2 Over 70% of students gained both marks for this calculation with less than 3% obtaining just one mark. The most common incorrect response was to invert the expression or to include additional steps in their calculation neither of which allowed access to either marking point.

02.3 Over 75% of students correctly identified acid rain. A frequently seen incorrect response was acid reflux.

02.4 This was well answered with more than 80% of students obtaining two or three marks. The most common reason for gaining two marks was having omitted to plot the point at (0,0). The majority of students drew a correct line of best fit, but a few had doubled or feathered lines, or had clearly not used a ruler.

02.5 Over 90% of students correctly identified that the mass of sulfur dioxide increases.

02.6 This question assessed a little-known part of the specification with fewer than one in ten students correctly identifying that particulates cause global dimming. By far the most common incorrect response was global warming.

Question 3 (low and standard demand)

03.1 Over 55% of students obtained two marks by correctly identifying the mistake and providing a correct reason. Almost 30% of students obtained one mark usually by correctly identifying the mistake as using ink but providing an insufficient reason for the mistake such as mix, ruin, or affect the result. In this question there was evidence of students not understanding the meaning of the terms solute and solvent and using them incorrectly.

03.2 Nearly 80% of students correctly identified the number of different dyes in substance **Y**. The most common incorrect response was five, where students had mistakenly counted the spots on the chromatogram.

03.3 Over 70% of students correctly identified dye **A** as being present in substance **Y** but only 17% of students provided a correct reason. The most frequently seen incorrect reason was to state that both travelled the same distance failing to take account of the second dye in **Y**. Other vague insufficient reasons that were frequently seen included that the dyes were in line or in the same place.

03.4 Less than 15% of students identified that dye **D** must be insoluble. The most frequently seen incorrect responses included that the dye did not react with the water, was permanent, waterproof, or suggested that the dye was not soluble enough. Other incorrect responses included the idea that substance **D** was pure or contained no other dyes and so could not separate.

03.5 Nearly 90% of students were able to correctly substitute into the equation provided and calculate the R_f from the values given. The most common incorrect response was the values being substituted incorrectly.

03.6 Just over 50% of students correctly identified water as being a solvent. The most common incorrect distractor was solute.

Question 4 (low and standard demand)

04.1 One in four students obtained all three marks in this question with two out of five obtaining two marks. The most frequently seen reason for not obtaining full marks was to incorrectly determine the date in billions of years at which the percentage of nitrogen in the atmosphere became constant. Students need to be exposed to as many examples as possible of explaining trends as some struggled to express the percentage of nitrogen becoming constant, describing the line as becoming, steady, calm, stable, stopping or going at a constant speed or using vague statements about 'it.'

04.2 Almost 80% of students correctly identified that the percentage of carbon dioxide decreased.

04.3 Well over 80% of students correctly identified light as being the energy source for photosynthesis.

04.4 Nearly 80% of students identified the two organisms that produce oxygen. A further 15% correctly identified one organism, usually plants.

04.5 Less than 30% of students could correctly identify the two natural polymers produced from glucose. It is important that students read the question carefully as there was a significant number of students who ticked only one box rather than the two requested.

04.6 Well over 75% of students correctly expressed the relative formula mass of DNA in standard form.

04.7 Only one in two students were able to correctly calculate the relative formula mass of each polymer chain in DNA. The most popular incorrect distractor was 140 000 000 000 where the student had failed to realise that the DNA molecule was comprised of two chains.

04.8 Just under 75% of students correctly described the shape of a DNA molecule as a double helix. The most common incorrect response was double bond.

04.9 Less than 35% of students were able to correctly identify the number of different nucleotides present in a molecule of DNA.

Question 5 (low and standard demand)

05.1 One in two students were able to correctly explain why a 50 cm^3 flask is unsuitable for use in the method provided and obtain both marks. A further one in four achieved one mark for recognising that the flask was too small but did not provide a reason as to why this would be a problem.

05.2 More than 65% of students were able to correctly name a suitable piece of apparatus for measuring volume. The vast majority of students answered measuring cylinder with burette being a popular second choice. Care should be taken over the spelling of burette to avoid the incorrect response biuret.

05.3 Just over one third of students achieved both marks in this question and a further third achieved one mark. Students appeared to struggle to recognise and correctly identify both the independent and dependent variables. A sizeable number of students identified the independent and dependent variables the wrong way around achieving the compensation mark. It is important that students read the question carefully as there was a significant number of students who drew multiple lines from each box.

05.4 Over 4 in 5 students correctly identified that the time taken for the cross to disappear would increase.

05.5 Over 75% of students correctly identified the concentration of sodium thiosulfate that had the highest rate of reaction.

05.6 This question was well answered with over 90% of students being able to identify at least one correct statement to explain the effect of increasing the concentration. Almost 50% of students correctly identified both statements.

05.7 Just over 60% of students correctly identified what would happen to the time taken for the cross to disappear for both of the changes made to the investigation with a further 10% of students correctly identifying the effect of just one change. The most common incorrect response was to reverse the order.

Question 6 (low and standard demand)

06.1 The test for unsaturation is not well known by students. The question includes that bromine water is orange but only one in five students were able to correctly identify the colour change

when bromine water is added to ethene. The most common incorrect responses were brown, black, and clear.

06.2 Just over 60% of students correctly identified the test for chlorine.

06.3 Around half of the students were able to correctly identify the displayed structural formula of the compound produced when chlorine reacts with ethene.

06.4 Around two thirds of students were able to correctly identify the structure of poly(chloroethene).

06.5 Over half the students successfully processed the density values and correctly evaluated them for two marks. Only two out of five of these students then went on to determine the simplest whole number ratio and achieve all three marks. Incorrect responses included the use of temperature values rather than density or simply rounding the density values to the nearest whole number.

06.6 Three out of five students were able to correctly identify why neither polymer was suitable to carry steam at 300 °C. Incorrect responses included those that just quoted values from the table or stated low melting temperatures without including any consequence of the high temperature to either the pipe or the polymer. An incorrect unit for temperature was frequently seen in responses.

06.7 'Sustainable' is a poorly understood term with only one third of students correctly answering this question. Incorrect responses included reference to different stages in a life cycle assessment including comparisons in terms of the environmental consequences of different disposal methods for each material. Some students struggled to express that paper was made from a renewable resource, suggesting that paper is renewable or that paper can be regrown.

Question 7 (low and standard demand)

07.1 Approximately two out of five students gained both marks with a one in two gaining one mark. It is important that students read the question carefully as there was a significant number of students who ticked one box instead of two.

07.2 This question asked for two ways in which a greenhouse gas is released in the process described. Less than 25% of students gained both marks with just over 35% more gaining one mark. Incorrect or insufficient responses included 'heating the limestone' and general references to the equation, or that methane might escape during its combustion.

07.3 The carbonate test is poorly understood with less than 15% of students correctly identifying the substance added to the limestone and the test for carbon dioxide. Two in five students gained one mark. The most frequent incorrect response was to mistakenly identify the test as universal indicator.

07.4 Less than 35% of students gained one mark in this question, with less than 15% gaining two marks. Responses which did not gain credit included those referring to carrying heavy weights in general rather than the weight being from lorries or vehicles, responses in terms of the incorrect property from the table or failing to make a valid comparison.

07.5 This question proved to be easier than that for the concrete bridge with over 50% of students gaining one mark and over 35% gaining both marks. Responses which did not gain credit again included those that failed to make a valid comparison or those that simply quoted data from the table.

Question 8 (standard demand)

08.1 The test for sodium ions and the correct result were not well known with only 10% of students achieving both marks and a further 10% achieving one mark. Some students attempted to describe a flame test but failed to include the flame or how to introduce the sample into the flame in some way. Incorrect flame colours were often seen, particularly orange or crimson. Other incorrect tests that were commonly seen was the use of limewater or universal indicator.

08.2 The specific test for chloride ions is poorly understood with fewer than 1.5% of students achieving any marks. Many students misread the question and correctly described the test for chlorine gas. The mark for the result of the test was dependent upon a mark being awarded for a correct test.

08.3 The majority of students (more than 96%) were not awarded this mark. The use of words such as solution or liquid were common incorrect responses. The removal of **all** of the water was also not included by many students.

08.4 Less than 50% of students correctly identified how the mass of solid sodium chloride was calculated.

08.5 More than one in two students correctly calculated the mean concentration of sodium chloride and gained two marks. Fewer than one in five students correctly calculated the percentage. The remaining students either failed to progress in the calculation or attempted to calculate a percentage, frequently missing multiplying by one hundred, or getting the expression upside down. Many students incorrectly identified one of the concentrations as being anomalous despite this not being asked for in the q uestion. The only possible anomaly would be 36.4g/dm^3 and omitting only this value allowed students access to one of the two marks for the calculation of the mean concentration.

Question 9 (standard demand)

09.1 The role of the condenser and the importance of recycling unreacted gases in the Haber process is poorly understood with just over 5% of students gaining credit in this question. A large number of students stated that the ammonia or excess gases or gases alone were returned to the reactor. In addition, a number of students focused their answer on the condenser part of the flow chart and responded with the idea that uncondensed gases needed to be recycled.

09.2 Less than 25% of students correctly identified the catalyst used in the Haber process as iron, with copper, ammonia and hydrogen being frequently seen incorrect responses.

09.3 The test for oxygen gas is poorly understood with less than 25% of students being able to recall the correct test and its result. Many students referred to the splint being lit and then blown out or

attempted to describe a glowing splint as a small or dying flame. A correct test was needed to allow award of a mark for the test result. The correct test and result for hydrogen gas was frequently seen.

09.4 Over 25% of students either correctly labelled the products and reactants or correctly drew an arrow, labelled the activation energy, and gained one mark. A further 10% of students gained two marks by doing both correctly.

There were many variations of drawing and labelling the arrow for the activation energy. Some students mistakenly labelled the peak as being the activation energy or despite the dotted line drew the arrow too short or at an angle.

Many students incorrectly identified the reactants and products from the equation or used nitrogen, hydrogen, and ammonia from the previous question. Other students were unsure where the reactants and products would be located on a reaction profile diagram.

09.5 One in five students correctly identified that if there was no catalyst used in the reaction the peak would be higher. Many students misread the question and incorrectly answered that the peak would be lower.

09.6 One in six students were able to identify the use of ammonium nitrate in a fertiliser or NPK fertiliser. A small minority stated that it was used in farming or agriculture unqualified. Only a handful of students identified its use in explosives or sports injury packs. Many students misread the question and took salt from the stem of the question and answered in terms or flavouring or preserving food or using salt to de-ice roads.

Question 10 (standard demand)

10.1 More than 15% of students correctly identified the words that are used to describe the reaction between hydrogen and oxygen with a further 70% being able to correctly identify one of the words. It is important that students read the question carefully as there was a significant number of students who ticked one box instead of two.

10.2 Over 65% of students were able to correctly identify the sentence that described the reversible reaction in the question.

10.3 Few students demonstrated a good overall understanding of the sequence of steps involved in potable water production and wastewater treatment. Weaker responses tended to focus on wastewater treatment, for which the diagram in the stem provided more scaffolding.

Most students recognised that ground water needed to be filtered initially. A few responses referred to screening before the use of filter beds, although only referring to screening in potable water production was considered insufficient. Sometimes the descriptions of things removed by filter beds did not make it clear that they were solid. The process of sterilisation was generally well described, although removal of microbes rather than their destruction was not creditworthy.

In waste water treatment removal of solids using a metal grid was included by most students, making use of the diagram where a metal grid was featured. Fewer students referred to this step

as screening and again things removed by screening were not always clearly identified as solid. Organic matter in sewage is not removed by screening as this is treated subsequently. The final steps were poorly addressed overall. Most students referred to sludge and effluent (again these featured in the diagram) but many failed to recognise that these were separated by sedimentation. Some responses confused the separation of sludge and effluent with their biological treatment afterwards. Some students recognised that sludge is treated anaerobically and effluent aerobically but did not refer to digestion or biological treatment or an equivalent description of microbial action.

References to flocculation, desalination, fluoridation or pH adjustment were considered irrelevant and ignored in the marking of this item.

Over 30% of students simply described what they could see in the picture and gained no marks. A further 40% achieved Level 1 by describing the diagram but also making a link between the use of the metal grid and the removal of solids like toilet paper or stones rather than organic waste. Most students appeared not to understand the use of the word process and failed to add any detail about how ground water is treated to produce potable water. Many students describing potable water treatment failed to identify ground water as fresh water and described desalination.

Only 10% of students achieved Level 2, usually by successfully linking the removal of solids using the metal grid and including some detail of either filtering ground water to remove solids or adding chlorine to sterilise the water or to kill microbes.

Mark Ranges and Award of Grades

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