GCSE
CHEMISTRY

8462/2H: Paper 2 (Higher tier)
Report on the Examination

8462
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General

Questions 01, 02 and 03 were common to questions 08, 09 and 10 on the Foundation Tier paper.

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

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.

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 three levels of demand for this paper:

- **standard demand** questions are designed to broadly target grades 4–5
- **standard/high demand** questions are designed to broadly target grades 6–7
- **high demand** questions are designed to broadly target grades 8–9.

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 (Standard demand)

01.1 This was well answered by many students. The most common errors were to omit the double bond, or to add additional bonds to the carbon atoms. Brackets and/or the inclusion of the letter n were ignored. Around two-thirds of the students scored both marks.

01.2 The majority of responses correctly referred to the insulation being burned or melted or the lack of purity or 'contamination' of the copper produced. Around 60% of students scored this mark.

01.3 This was generally well answered as the copper melting and being reformed/moulded into new pipes were commonly seen. Responses referring to 'heating the wire' were insufficient to gain credit. Around 70% of the students scored both marks.

01.4 The most common correct responses referred to the conservation of copper and the use of less energy in this process. Relatively few answers identified specified environmental impacts.

Weaker responses referred to 'pollution' alone which was insufficient to gain credit. Only around 30% of the students were able to identify two advantages of recycling.

01.5 The specific correct reagent used and correct result, were not well known.

A variety of tests were chosen, with the most common incorrect response being the use of flame tests.

Acceptable results included shades of blue precipitate, e.g. pale/light blue, but answers giving two colours such as green/blue were not credited. Around a third of students scored both the marks.

01.6 The use of barium chloride or barium nitrate as the reagent for the test was generally followed by the correct result. Again, around a third of the students scored both the marks.

The most common incorrect responses were the use of a flame test or the use of an incorrect reagent.

The mark for the result of the test was dependent upon a mark being being awarded for a correct test.

Question 2 (Standard demand)

02.1 The majority of students correctly determined the mass of the empty test tube as 24.5g.

02.2 A number of inaccurate responses referred to the unspecified contents of the test tube evaporating when heated causing a decrease in the mass. Specific reference to water (vapour) or steam evolving was only given by a minority of students for the first marking point. Fewer students realised that the escape or loss of water from the test-tube completed the explanation. Around a third of the students scored both marks.

02.3 The indication that the reaction was complete or finished was needed. Similarly the idea that all of the water had been given off, or that only anhydrous cobalt chloride was left, gained credit. Mentioning that the reaction had stopped was insufficient. Around half of the students gained this mark.

02.4 The calculation discriminated well. Over half of the students scored all three marks by completing the calculation, usually showing full details of their working.

The final marking point was awarded for giving the answer to 3 significant figures. Some students gained this mark for an incorrect calculation (usually by inverting the fraction and only if they used data given in the question) expressed correctly to 3 significant figures.

02.5 Exothermic and chemical were common incorrect responses. Appproximately three-quarters of students scored this mark.

Question 3 (Standard demand)

03.1 In this extended response question, the command word was 'evaluate'. This command word demands a reasoned judgement to be given for a fully complete answer. The vast majority of students did not include a judgement and were therefore unable to access Level 3. Only about 10% of students gained 5 or 6 marks.

Even some students who did give a judgement gained a mark in Level 1 (1-2) often by only comparing the values given in the table or a mark in Level 2 (3-4), by introducing only one or two pieces of 'added value' information about the impacts of the data provided. Roughly 30% of students gained a Level 1 mark and nearly 60% were awarded a Level 2 mark

03.2 Well over 90% of the students gained all three marks on this calculation.

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

04.1 The vast majority of students wrote detailed answers to this question and the full range of marks was awarded although relatively few answers were awarded full marks. About 1 in 10 students scored all four marks, while a quarter scored three. Students often neglected to state the crude oil must be heated to begin the separation process. Some students failed to score the second marking point in the mark scheme because their description of a temperature gradient was not in the context of gases rising through a fractionating column or fractionating tower. A handful of students illustrated this idea by referring to a labelled diagram.

The idea of fractions collecting at different levels in the fractionating column was well understood but many described the collection of fractions without mentioning condensing and so could not access this mark. Some students incorrectly suggested that petroleum gases would condense at the top of the column. The idea that the separation of crude oil is based on differences in boiling points was an accessible mark but many failed to mention boiling points or simply quoted boiling point ranges from the table.

04.2 Just over a third of students were able to score both of the marks available in this multiple choice question. This suggests that the feedstock concept in the specification is not well known.

04.3 Nearly half of the students scored both marks by being able to write a correctly balanced equation for the combustion of nonane. Many were able to pick up one mark for writing the correct formulae for oxygen, carbon dioxide and water. Some students failed to score any marks because they included hydrocarbon molecules in their equation, perhaps confusing this combustion reaction with cracking. Students should be advised to take care when writing numbers in equations. A quickly written 14 sometimes looked like 19 and 19 H_2O was occasionally written by students who had double-counted the oxygen atoms in water. Similarly, excessively large subscript numbers and excessively small capital letters (especially O) are likely not to gain credit.

04.4 This question was generally well answered but some students stated that the combustion of sulfur would cause damage to the car engine while others appeared to confuse the effects of burning sulfur with a lack of oxygen and named the products of incomplete combustion. Some seemed to think that sulfur would be released into the air as a toxic gas but these students could still be credited for a description of the problems caused by sulfur dioxide. These problems were well known; acid rain or respiratory problems were common answers. Around 30% of the students gained both marks.

04.5 Most students scored at least one mark for this question, usually by giving a statement that heavy fuel oil has larger molecules. A relatively small proportion scored the first marking point in the mark scheme for stating the general relationship between molecular size and viscosity. A statement about heavy fuel oil being more viscous than kerosene was insufficient for credit because this repeated information given in the question. Nearly 30% of the students gained both of the marks.

04.6 The full range of marks was awarded. The name of the process was well known but a large proportion of students failed to mention either the high temperature or the use of steam or a catalyst and so gained only two of the three marks. Marks were awarded independently so even students who could not name the process could pick up two marks for correctly describing the conditions. Nearly half of the students gained all three marks here.

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

05.1 About a fifth of the students gained all the available marks. Many students answered the question in terms of treating water to make it potable, rather than treating sewage. Those who did answer in terms of treating sewage initially answered well though many answers broke down after mention of screening and sedimentation.

05.2 Half of the students were able to give the correct pair of concentrations in this multiple choice question.

05.3 The common error in this question was to concentrate on what Process 1 (filtering) did do, rather than the lack of effect on the ions. Of those who did correctly answer the question, more were awarded the first mark on the mark scheme. Around a quarter of the students gained both of the marks.

05.4 Students needed to state that the microbes were harmful and because of this some did not gain the first mark, although many were awarded the second. About 40% of the students scored both marks.

05.5 Less than a third of students answered this successfully with many responses stating the company meant the water was chemically pure, in spite of this being explicitly negated in the question.

05.6 Most students knew the test for chlorine gas; however a significant number did not refer to the need for the litmus paper to be damp and therefore did not gain the first mark. Over one-third of the students gained both marks.

Question 6 (Standard, standard/high and high demand)

06.1 Some answers were seen which invoked theories about the evolution of the atmosphere other than the single theory given in the specification. Responses therefore in terms of ammonia were insufficient. Weaker responses did not identify nitrogen from the provided key, but even so, there were many responses which mentioned volcanic activity. Over a third of the students gained both marks.

06.2 As in **06.1** the gas (carbon dioxide) was sometimes not explicitly identified. There were no algae or plants this early and many students negated correct responses about dissolving in oceans or carboniferous sediments with a further comment about photosynthesis. As a result, only around 20% of students scored both marks here.

06.3 Having mentioned carbon dioxide in **06.2**, some students only felt the need to refer to an increase in oxygen, and omitted any reference to a further fall in carbon dioxide. The idea that the rates of change were the same or similar was much less often seen. Therefore the majority gained the first mark, but only a minority gained the second.

06.4 More than 80% of students were able to identify the process causing the change as photosynthesis.

06.5 Some students were insufficiently precise about the size of the organisms involved in natural gas formation, and there was some confusion with the formation of coal. Similarly, the idea of coverage by sediments was sometimes inaccurately described as 'trapped under rocks', which is not part of the process, only of the outcome. The third mark was often not awarded as heat was stated instead of high temperature. Fewer than 1 in 20 gained all three marks available.

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

07.1 This was well answered with around half of the students scoring both marks. Incorrect responses included the atmosphere being a source of the hydrogen as well as the nitrogen. There were far fewer responses stating that biogas of any kind was suitable for the large-scale production of ammonia than in previous years.

07.2 About 25% of the students scored this mark. 'No by-products' was seen quite often and others stated there were the same number of atoms on both sides, which just means that the equation is balanced, not necessarily that there is only 1 product.

07.3 Roughly 1 in 10 students gained both marks. Many scored the second mark, but far fewer the first. This was often due to imprecise language rather than misunderstanding, but many stated that 'ammonia is cooled'. The distinction between **all** the gases being cooled but only ammonia condensing is important. A large proportion did not mention cooling at all. Some negated the second mark by stating that ammonia has a lower boiling point than the other two gases.

07.4 Labelling the scale and the plotting of the given points was nearly always correct. Some did not label on the major gridlines, while a few got the scale completely wrong by labelling the major gridlines in multiples of 60 atmospheres, which did not match the pre-plotted points and therefore denied access to the plotting marks. Most students drew good best-fit curves, although some inappropriately drew a straight line. Over half of the students gained all four marks.

07.5 Most students extrapolated their line correctly and read off the value of the percentage at 500 atmospheres. About two-thirds of the students scored both marks.

07.6 This high demand extended response question gave students the opportunity to demonstrate their knowledge of collision theory, Le Chatelier's Principle and catalytic action in the context of the Haber Process.

More able students seemed to understand that they needed to consider cost implications. Explaining that a compromise is made in the choice of the temperature and the pressure was important in accessing Level 3.

The compromises made for temperature and pressure that were related to cost were more commonly stated than the compromise for temperature in relation to rate and position of equilibrium.

There was a high proportion of responses with additional material producing comprehensive, high-scoring responses. There were also a good number of weaker responses containing isolated statements, most commonly relating the conditions to rate, or more rarely position of equilibrium, but without explaining these relationships. Such responses were usually confined to Level 1. The ratio of Level 1:2:3 marks was roughly 40:20:20 with the remainder failing to gain any marks on this question.

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

08.1 The majority of the students recognised that the solution became cloudy due to one of the products being a precipitate / solid.

08.2 The large majority of the students were able to draw a tangent at 30 seconds.
The construction lines used to determine the values of Δy and Δx were less well done. Some students appeared to have difficulty reading the scales on each of the axes.

Students should be aware that using very small portions of the graph for this type of calculation (and also in the ratio calculation in **08.9**) potentially limits the accuracy of their final answer.

Most students who determined the values of Δy and Δx went on to determine the correct ratio. The better responses then continued to use the ratio to determine the rate in mol/s. One-fifth of the students gained all five marks, whilst over half scored four, most often as a result of not using the factor 7.1×10^{-5} correctly.

08.3 Most students recognised that the rate of reaction decreased as the reaction proceeded but a significant proportion of these students did not gain the second mark because they referred to the concentration of unspecified substances rather than stating that the concentration of the reactants decreases. Nearly one-third of students gained both of these marks.

08.4 Some students made an insufficient general statement about reactants being used up. However a larger number mentioned the acid being used up. Few used the term limiting reactant. Over a third of students gained this mark.

08.5 Just over a third of students scored two marks on this question, understanding the meaning of a sketch graph. Others realised the gradient needed to be steeper for the sketch but did not level the line at 24%.

A sizeable minority had the sketch with a shallower gradient. Such a sketch seldom levelled out at 24%.

08.6 More than 80% of the students were able to identify the required improvement.

08.7 Just under half of the students gained the mark for this multiple choice question. Reproducible was a very common incorrect response.

08.8 Around 70% of the students were able to identify the expression representing the relationship between volume and mass.

08.9 Around half of the students gained all three marks. Students were usually able to find the smallest whole number ratio once they had determined the volumes. Students often did not indicate on the graph where the volumes were from, but this was not an actual requirement, just an aid to answering the question. Many chose the limits of the lines, i.e. 120 and 480 cm^3 respectively.

Students should be aware that using very small portions of the graph for this type of calculation (and also in the rate calculation in **08.2**) potentially reduces the accuracy of their final answer. Many answers of 6:25 were seen and awarded credit because the error in reading the graph values was within half a small square.

Some students used two masses of sulfur rather than the volumes of each reactant and therefore did not gain any marks.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of how students have performed for each question.

Mark Ranges and Award of Grades

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