GCSE
COMBINED SCIENCE: SYNERGY

8465/3H
Report on the Examination

8465
June 2018

Version: 1.0

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

General

There were 8 questions on the paper with questions 1–3 being common to the Foundation Tier. A wide range of marks were obtained, with good differentiation seen on most questions. Students appeared to have sufficient time to complete the examination.

Students generally demonstrated competence in the questions involving mathematical skills. A significant number of students showed good practice by giving their answer to the same number of significant figures as used in the question in all calculation questions not just the one question which required an answer to three significant figures. It also appeared that the students had good experience of practical work when answering the questions on Required Practical Activities. However, the question involving a non-required practical from the specification was not well answered.

Students found it difficult to achieve the top levels in the ‘extended response’ questions. Students did not always include sufficient creditworthy information in their responses, as well showing a lack of precision with language in these and other prose responses. They are advised to avoid the use of words such as ‘it’ and ‘they’ as there is often a lack of clarity in the responses given.

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 59% of students were able to work out or knew that chlorine had seven electrons in its outer shell and consequently complete the diagram correctly. Others who gave an incorrect number of electrons were usually able to draw a bonding electron pair.

01.2 Many students were not able to recall that chlorine gas is a molecule with the formula Cl_2 but some were able to access mark point two which required the correct balancing of an equation with HCl given. Others, despite figure 1 showing a hydrogen chloride molecule, gave formulas such as H_2Cl_2 or H_2Cl.

01.3 This question was not well answered with a variety of responses seen from products and reactants to wavelength descriptions. Activation energy was the most common correct response. Few knew B was the overall energy change, with students often giving insufficient responses about energy released or lost, with no reference to change, for this marking point. 35% of students were able to achieve full or partial credit.

01.4 Responses needed to be specifically linked to the reaction profile diagram rather than stating what an exothermic reaction is. There were some responses showing that reactants were higher than products on the diagram but few related this to energy. 20% of students achieved the mark.

01.5 Generally there was a lack of understanding of the structure of a small molecule. 8% of students achieved two or three marks.

The first marking point was the lowest achieved of the three, with answers in terms of full outer shells and also suggesting that the non-conductance was due to the gaseous state and the larger spacing of the molecules. Those who did obtain this mark usually gave hydrogen chloride not containing ions rather than the lack of an overall charge.

A significant number of students gave answers for marking point two and three in terms of (delocalised) electrons rather than ions even though ions were mentioned in the stem of the question. For the third marking point, students often said that ions were free to move but failed to say how this facilitated conduction.

Question 2 (standard demand)

02.1 Of the 31% of students able to recall the test for carbon dioxide, usually also knew the result of the test. A few students answered in terms of using a straw to blow through limewater.

A large number of incorrect responses referred to the hydrogen ‘pop’ test, or to extinguishing a lit splint.

02.2 This ‘extended response’ question was centred around a Required Practical Activity, so it was expected that students would have knowledge of the methods of preparing a soluble salt.

Key steps in the process were: using the correct reagents, mixing in a suitable container; adding the magnesium carbonate in excess then filtering; a crystallisation method (not just evaporation to dryness).

Approximately half the students who attempted the question achieved three marks, usually for descriptions of the first and last stages. Few students referred to the filtration stage or realised that magnesium carbonate should be added to excess. Those who did usually described this in terms of excess magnesium carbonate being visible rather than the absence of effervescence when magnesium carbonate was added.

Many students evaporated to dryness rather than describing a method to determine the crystallisation point. Often having evaporated all the water, students then left the substances to cool and crystallise.

As this was an ‘extended response question’ a student who used reactants which would not lead to the production of magnesium chloride was unlikely to access level 3, as the plan would not lead to a valid outcome.

A significant number of students started with the product itself which made it difficult to access level 2. As the question was asking for the procedure, not for observations, any colour changes given were ignored.

Question 3 (standard demand)

03.1 45% of students were able to recall the equation with most incorrect responses answering in terms of input energy ÷ output energy.

Some students gave responses where the terms were subtracted and others used different equations such as V = IR

03.2 The majority of students who used the correct equation were able to calculate values given in standard form with 38% of students achieving full marks. Others were unable to correctly divide using standard form and gave an answer that included 10^{35}. Few students worked in terms of percentages with most answering 0.92.

Others who had an incorrect equation written for question **03.1** gave an answer of 1.08 or 108% therefore not appreciating that it is impossible to have an efficiency of this value.

03.3 More students answered in terms of low potential difference and a high current than the correct response.

03.4 63% of students were able to recall the equation with the two equations applicable to this question given on the Physics Equations Sheet being seen with a roughly 50 : 50 split.

Energy = power ÷ time, was the most common incorrect response.

03.5 32% of students achieved three marks here. Those who were able to recall the correct equation, often lost marks due to confusion over kJ and kW conversions usually giving a final response of 9600, which was awarded two marks. 6.6 was also a common response from the use of the required equation as power ÷ time. A few gave correct answers in standard form.

03.6 Many students didn't realise that the question asked for **environmental** advantages and disadvantages and gave general points relating to reliability, cost etc. Students were using general terms such as 'environmentally friendly' and 'non-polluting' without continuing to expand and give more scientific detail related to these terms.

The most common correct responses were renewable, lack of carbon dioxide produced, bird kill and visual pollution, although many different descriptions of this were credited. Comments such as taking up land space or destroying habitats were ignored.

78 of students were able to achieve some credit, with 20% of students receiving three or four marks.

Question 4 (standard & standard / high demand)

04.1 Those students who could recall the shape did so well, if somewhat untidily, and some of these were also able to add the correct field direction. Many students were unable to recall the shape and drew 'butterfly like' diagrams. Although some were able to show the direction of the field lines, others had North to South at the top, then South to North at the bottom.

04.2 This is a practical method that appears in the specification but many students demonstrated little knowledge of the process and 15% of students didn’t attempt it. A significant number referred to the use of iron filings or mathematical compasses in their answer. The idea of marking the position of the needle tip and the moving the compass to that point was rarely referred to.

This was an ‘extended response’ question which used a ‘level of response’ mark scheme. To get into level 2 it was expected that a method for sensibly moving around the magnet and for seeing the pattern was given. 10% of students managed to do this. However those who knew what to do often did not fully express their ideas.

04.3 Few students realised that compasses were magnets themselves, with many responses stating that there would be an interaction with the bar magnet because the needle is metal, rather than a magnet or magnetic. However more students were able to explain the attraction between magnet and compass. 14% of students achieved full marks.

04.4 The correct answer was the most popular response (35%). But almost as many gave their response as steel, not appreciating that steel although magnetic is not an element.

04.5 This question was not answered well with 3% of students achieving two marks. Students appeared to have little knowledge of this area of the specification and instead used knowledge from other areas, notably global warming and climate change, or ideas such as the Earth tilting to attempt to explain the changing poles. The most commonly seen correct responses were: the idea that the compass needle changes direction over time, or the change in migratory patterns of birds.

04.6 7% of students received any credit for this question that was also not answered well. Again, students appeared to have little knowledge of this area of the specification and instead used knowledge from other areas, notably global warming and climate change, or ideas such as the Earth tilting or solar flares.

Question 5 (standard, standard / high & high demand)

05.1 65% of students achieved marks on this question by being able to identify the glow (spreading through the mixture) as the observation that would be made. Many also had the idea that energy was transferred to the surroundings, but some linked this point to allowing the mixture to cool in step five meant that heat was given out.

05.2 20% of students were able to calculate the mass of copper produced in this question that differentiated between students well. For those not achieving full marks, finding the relative formula mass for copper oxide was also achieved by 23% of students, though few of these students were able to continue to correctly calculate the number of moles present. Many gave this as 79.5 ÷ 1.59 or having calculated the relative formula mass of copper oxide then used 1.59 ÷ 63.5.

Few students gave a full explanation of what they were doing instead just using numbers in various formats. The front of the paper does state that working should be shown in calculations and this may well help to gain more marks for students. Most students who were able to calculate the number of moles correctly were then able to continue to use this value to calculate the mass of copper. Few students used the alternative approach allowed in the mark scheme.

05.3 This proved a difficult question for students to score highly on, with 3% achieving three or four marks. A significant number of students' answers focused on zinc being more reactive and displacing copper, rather than the products of this reaction which was the mixture obtained in step five. In other cases, there was confusion about what had reacted; zinc reacting with hydrochloric acid for example.

Some students used the term 'dissolve', rather than react. Very few realised that copper remained as a solid as it did not react with hydrochloric acid and others just repeated the last part of the question.

05.4 Students found this question difficult with two of the other distractors proving to be more popular responses. 28% of students achieved the mark.

Question 6 (standard, standard / high & high demand)

06.1 The question asked for the name of the method, so this had to be given to access the organism mark. A common incorrect organism for bioleaching was 'leaches'.

Many students though had no knowledge of the processes with a variety of chemical methods being given which included fracking, distillation, electrolysis and smelting, usually without an organism being named. 21% of students achieved full or partial credit.

06.2 Answers were often vague and did not address the situation of copper mining. Examples included 'more environmentally friendly', 'cheaper' or 'safer.' Less energy used was the most common correct response whilst the specification statement of moving large amounts of rock was rarely seen. 5% of students achieved two or three marks.

06.3 38% of students realised that iron was more reactive than copper but a much smaller number were able to explain that this was due to a displacement reaction. Some who realised that it was a displacement reaction then described iron displacing oxygen or sulfur.

06.4 21% of students achieved full marks. Many did not know that this was a displacement reaction and were therefore unable to give the correct products of the reaction.

The clarity of the chemical symbols varied, with Fe often being written with a lower case curly f and Cu with many u's looking same size as the C.

The state symbols were not well known. Cu was often written next to the (aq) and $CuSO_4$ was described as liquid.

06.5 Being able to calculate the number of moles of copper ions present, using the Avogadro constant and expressing an answer in standard form was achieved by 21% of students. 14% of students gained two marks when the working was clearly set out and an incorrect calculation for the number of moles could then be credited when used correctly in steps three and four.

Question 7 (standard, standard / high & high demand)

07.1 42% of students were able to achieve two marks for the correct plotting of the points. However they were often then unable to draw a correct line of best fit. Some students drew a straight line in spite of the obviously curved trend. The ability of others to plot a smooth curve was limited, with most lines being very poorly drawn displaying errors such as using a ruler to draw dot to dot, drawing multiple or very thick lines.

The fourth marking point required students to extrapolate the lines by following the instructions to continue both lines until they met. Many changed the direction of the lines after the last plotted point and ended with a 'hump' or added a straight line to the already drawn line of best fit.

07.2 69% of students were able to use the graph correctly to give the maximum temperature. Often the answer was to the same resolution as the temperature values given in Table 1, eg 27.85 °C.

07.3 52% of students were able to give the correct temperature resolution.

07.4 Many students concentrated on improving the temperature measurement or gave vague statements concerning the resolution, which weren't credited. Others repeated the experiment, but without going on to calculate a mean. A significant number realised that smaller intervals of adding hydrochloric acid was required, but not all were able to express themselves clearly often just stating more volume was needed. 5% of students achieved both marks.

07.5 49% of students achieved some credit for this question, with 5% achieving five or six marks.

There were eight available marking points in this question:

- three of these dealt with pH changes
- four dealt with the ions in the solution
- one was for recognition that this was a neutralisation reaction.

Addressing the answer in terms of ions was rarely seen, especially relating changes in pH to factors of 10 changes in H^+ concentration. In the answers dealing with pH, some had the pH numbers the wrong way round, with the alkali being at low pH, with the pH then increasing as acid was added. Some related pH to the colour of universal indicator, which was ignored, rather than a numerical value.

07.6 10% of students appeared to know how to calculate concentration. Few students:

- realised that a conversion was required
- were able to correctly convert dm^3 into cm^3 with 1000 cm^3 being omitted completely or the use of 100 instead of 1000.

0.056 g/dm^3 was the most common response where no conversion was attempted, followed by 5.6 g/dm^3 where 100 cm^3 rather than 1000 cm^3 was used.

Question 8 (standard, standard / high & high demand)

08.1 Most correct answers gave air resistance, though drag was also credited. Incorrect responses included friction, gravity, wind, wind resistance, resistance, types of energy and acceleration.

08.2 86% of students were able to interpret the graph correctly.

08.3 23% of students achieved all three marks. Some students were not able to correctly apply the scale and incorrectly read the value for the velocity for the graph. The only incorrect velocity value which was credited when used in marking points two and three was 12.1 m/s. Many students incorrectly used the time of 6 s given in the question as the velocity.

08.4 To access the first four marking points, students had to draw a tangent. 4% of students who had the necessary mathematical skills were able to achieve full marks. A significant number used the co-ordinates of the point on the graph, whilst others made a triangle out of the deceleration part of the graph and tried to work from the *x* and *y* readings despite there being a curve on the third side. The unit mark was scored by the majority of students. Relatively few did not attempt this question.

08.5 38% of students realised that the acceleration value given led to a velocity of 9.6 m/s after six seconds and then correctly drew the line to obtain two marks. Others who didn't use the acceleration value given drew their line to a velocity of 1.6 m/s or 12.2 m/s.

Some students drew a vertical line upwards from six seconds until it reached the other athlete's 'steady speed' section at 12.2 m/s.

08.6 Those students who knew that the area under the graph represented distance were often then able to go on and achieve four marks. Others who gained some marks found it easier to calculate the area of the triangle for the distance travelled by the second athlete, rather than calculating the area of the trapezium for the first athlete. Few used the equation for the area of a trapezium, more usually splitting the trapezium into a rectangle and triangle.

For the calculation of the distance travelled by the second athlete an error carried forward was allowed from their answer to question **08.5**. Some tried to use the equation $v^2 - u^2 = 2as$ for both athletes, without appreciating that this could only be used for the second athlete.

Many tried to use $d = s \times t$ gaining an overall answer of 15.6 m. They were awarded marking point four if they had clearly indicated they had calculated the distance travelled for both athletes. Others just subtracted the two velocities after six seconds.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on 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.