AQA

GCSE

COMBINED SCIENCE: SYNERGY

8465/4H

Report on the Examination

8465

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General

- Many questions throughout the paper were not attempted by a significant proportion of students. This perhaps indicates that some students would have benefited more from being entered for the Foundation tier paper.
- Students did not always appear to have latched on to the command word in a question. It would benefit students to be made aware of the different command words, and to be encouraged to look for them in questions. So for instance, if asked to 'evaluate' they should 'use the information supplied, as well as their knowledge and understanding, to consider evidence for and against'.
- In calculations, students should be encouraged to show the substitution of numbers into an equation and working out their answer. In more complex calculations, it would benefit students to identify briefly what they are calculating, or what equation they are using, to allow examiners to award working marks if the final answer is incorrect.
- The handwriting of some students was very difficult to read.

Levels of demand

Questions are set at three levels of demand on this paper:

- **Standard demand** questions are targeted at students working at grades 4–5
- **Standard/high demand** questions are targeted at students working at grades 6–7
- **High demand** questions are targeted at students working at 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 Fewer than 5 % of students drew the correct circuit symbol for the LDR. Some made some mistake such as arrows pointing away or an arrow through the resistor itself. A variety of different circuit symbols was seen, including many made-up ones. A common incorrect symbol was that for an LED, or an approximation of this.

01.2 Around half of students knew the correct arrangement of the ammeter and voltmeter in a circuit. A further quarter knew that one was in series and one was in parallel but chose the wrong way round. The remaining responses were fairly evenly spread between both in series and both in parallel.

01.3 Just under half of students gained at least one mark for stating that the given graph showed direct proportionality. Many attempted to describe why the graph showed this, but answers tended to be incomplete, either just saying that it was a straight line, or that it went through the origin, but rarely saying both. Some students attempted to describe what a graph showing inverse proportion would look like, but again, answers tended to be incomplete. Around 7% of students did not attempt this question.

01.4 The vast majority of students incorrectly drew a line from top left to bottom right through the origin. A few students drew a straight line through the origin with a positive gradient. Some of these were steeper than the given graph line. The number who correctly drew the line with a shallower gradient was small.

01.5 A few students gave equations which did not connect all the quantities shown, for instance the equation for electrical power or for a transformer were seen several times.
About half of the students were able to write the equation in one of its correct forms. Credit was given for answers in terms of symbols, for instance V = IR, but incorrect symbols such as C for current were not credited. Students would be advised to write the equation in words if they are unsure of the correct symbols. The triangle notation which helps students with re-arranging was not acceptable as an equation.

01.6 Around 5% of students achieved the correct answer of 440Ω. A further 40 % scored three of the four marks for doing a correct calculation with a value of the current which had not been converted from milliamps into amps. In many cases, the conversion had not been attempted at all, leading to an answer of 0.44Ω. In other cases, students had attempted to convert by multiplying or dividing by a power of 10. Multiplying by 1000, rather than dividing, was a common mistake.
Students who gained no marks tended to multiply the values for the potential difference and current.

Question 2 (standard demand)

02.1 Around 7% of students did not attempt this question. Very few students were able to draw the correct diagram. Some scored one mark, either for the five single bonds within the bracket or for the two single bonds extending outwards from the two carbons.
The most common incorrect diagram was just a repeat of the structure of ethene which had been given in the question. Another incorrect answer was to ignore the monomer diagram and to draw out a structure, usually of an alkane, or an alkane-type structure but with carbon-carbon double bonds.

02.2 Most students attempted this question, with around one quarter gaining both marks.
A further 50% gained one mark, usually for pointing out that the LD poly(ethene) had side chains, whereas HD did not. A number of students also picked up on the difference between the polymer chains but commented about the difference in number rather than their proximity.
Despite the fact that both the polymer chains and the side chains were labelled, a minority of students chose to ignore these terms to talk about 'wiggly lines' and 'cracks'.

02.3 The question asked was to describe a method to investigate how the extension of poly(ethene) changes with the force applied. A number of students did not take on board that the command word was 'describe' but attempted to explain (a different command word) why poly(ethene) extends.
Many students who did describe a method failed to score more than two of the four marks available because their account lacked detail and would not lead to a valid outcome. In many cases, this was because 'measure the extension' was stated with no detail as to how

this would be done. In other cases, there was no indication that more than one force would be applied to the poly(ethene).
A small number of students described the extension of a spring experiment, with no mention of poly(ethene) at all.

02.4 Fewer than 2% of students scored both marks, although a further quarter gained one of the marks, often for stating that for both types of poly(ethene) the extension increases as the force increases.
Other answers tended to be too vague, such as 'LD's extension is greater than HD'. Answers which gained credit qualified such an answer with '…for a given force' or quoted a value for force and compared the values of the two extensions.
Some students stated that one extended faster than the other; as no time values were given, this is incorrect.

02.5 Around half of students scored two marks for this. Of those who did not gain both marks, some worked out 85% of 8 billion, and quoted this as their answer, failing to subtract it from the original 8 billion.
Another common error was to put an incorrect number of zeros for billion (instead of just leaving it as 'billion').
Some students made mathematical mistakes in performing the percentage calculation. To work out 85% of 8 billion, many students worked out 10% of 8 billion, and then 1%, then added 8 lots of 10% to five lots of 1%. Coupled with a large number of zeros, this method had the potential for errors to arise.

02.6 Many students made a good attempt at this 'evaluation' question based on LCAs.
A Level 2 answer (three or four marks) involved comparing the two types of carrier bag qualitatively, eg 'more waste is generated from the production of one disposable bag compared with a bag for life' and addressing both waste and carbon dioxide. Around 60% of students fell into this category.
Some students (around 14 %) achieved Level 3 (five or six marks) for going a step further and involving calculations such as 'around two and a half times as much waste is generated from the production of one disposable bag compared with a bag for life'. In addition both waste and carbon dioxide had to be addressed quantitatively. Also, a judgement needed to be made, either saying which type of bag was better, with reasons why, or giving the pros and cons of both types of bag.
Students whose answers were Level 1 standard (one or two marks) tended to discuss only one aspect of the information given, or to ignore the information altogether and write something from their own knowledge.

Question 3 (standard and standard/high demand)

03.1 Around one quarter knew the correct definitions of vector and scalar quantities, thereby scoring two marks.
Some students knew that vectors had both magnitude and direction, and realised that scalars don't, but opted for them having direction rather than magnitude.
A number of students defined a scalar as speed and a vector as velocity, rather than these being examples of the different types of quantity.

03.2 Fewer than 2% of students scored two or three marks, with a further 15% picking up one mark.
Many did not appear to be familiar with representing forces on diagrams, so did not realise that they were expected to draw labelled arrows to show the forces. A large number did not know what forces were acting in this situation, many indicating different types of energy, motion, speed or momentum.
Of those who were aware of forces, the most common ones shown were weight / gravity, air resistance and friction. Many did not realise that friction and air resistance act in the opposite direction to motion. In addition, a few seemed to think that gravity acts upwards or horizontally.
The main error amongst those who knew the forces and their directions, was to show them acting in random positions around the block rather than on the block itself; in such cases one mark was awarded.

03.3 It appeared that many students did not know what components of a force are.
Of those who made some attempt, very few showed the components on the diagram. Some lines on the diagram were measured, usually the dotted horizontal line and the line representing the tension force, and the forces were calculated using the scaling factor.
Around 9 % gained all three marks.

03.4 More than three quarters of students were able to calculate the missing value correctly, thereby gaining the two marks for this question. The method used by some students was to multiply the mean force by 3, then subtract the other two values from this figure. An alternative method, done by many more students, was a trial-and-error approach, substituting various values in turn as the missing 'X' and working out the mean, until they found a value of 5.4 N.
Some students who did not know how to do this calculation ended up with very odd values, indicating that they either did not understand the concept of a mean value or they had not thought about whether their answer was sensible.

03.5 Approximately 45 %of students achieved 1 mark, with a further 13 % gaining 2 marks, but very few gained all three marks. The most common answer was the weight of the block, with few students opting for the angle between the block and the string.
When asked for control variables, answers which include the same equipment or the same person doing the experiment are unlikely to gain credit. A large number of students included the independent variable, ie the type of surface, and / or the dependent variable, ie the force, as control variables.

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

04.1 Over 80% of students correctly drew the electronic structure of the atom.

04.2 Many students are aware of basic laboratory safety procedures, however in a question such as this, 'wearing gloves' and 'tying hair back' etc. do not gain credit. The safety precautions required were things specific to this experiment. Around 60% of students gained at least one or two marks. Using a safety screen and keeping a safe distance away were the most common creditworthy answers.

04.3 Just under half of students chose the incorrect response of K^+, with around one third opting for the correct answer of OH^-. The other two responses were seen but were chosen by a minority of students.

04.4 The command word in this question was 'explain'. A good answer would therefore state how the reactivity changes as the diameter changes and then would explain why.
Just under one half of all students gained one mark, usually for stating that as the diameter increases, the reactivity also increases. There were a number of imprecise expressions used for 'reactivity increases', for instance 'the reaction is higher' or 'it reacts stronger'. Many students did not attempt an explanation or referred to there being a larger surface area for the reaction to take place. Some students had the correct idea of the explanation but talked about 'electrons' rather than 'the outermost electron'. Around 5% of students scored all four marks with well written explanations and a further 7% gained three marks.

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

05.1 The correct answer (Oxygen) was chosen by, just over 10 % of students. 'Sulfur' and 'sulfur dioxide' were equally popular incorrect choices and accounted for around two thirds of student responses.

05.2 Some who made an attempt did not seem to realise they would need a cell / battery or an ammeter, and the vast majority omitted a variable resistor. Where students had included some of these components, they often did not know the correct circuit symbols or how to connect them in the circuit.
Fewer than 2% achieved all three marks, with 40% gaining no marks.

05.3 Only 1% gained all four marks, with nearly 70% scoring no marks at all.
A common misconception was that because the mass of copper deposited increased as the current increased, this showed direct proportionality.
A large number of students referred to the first set of results as being proportional, but the rest were not, indicating that they have an incorrect understanding of proportionality.
Few supported their claims with any calculations; of those who attempted to do so, these were often incorrect, eg 'the mass of copper is double the current'.
A few realised that if the current doubles, the mass of copper deposited should also double. However, most of these went on to say that for the first two results, doubling the mass of copper would give 0.048g, whereas it is only 0.047g, so this shows they are not proportional.
Very few realised that if mass is proportional to current, then mass/current would be a constant. The few who calculated this constant for all six pairs of data were able to identify the anomalous result at 0.36A.

05.4 Of those who made an attempt, many did not realise that they needed to use the table to find the mass of copper which was deposited when the current was 0.72A. They then took the values of current and relative atomic mass and added, subtracted, multiplied or divided in various combinations.
Students who correctly identified the mass as being 0.142g were usually able to calculate the number of moles correctly. However, many either did not realise that the question asked for the answer in standard form, or they did not know how to do this.

05.5 Just over half of students chose the correct response of 'increase the time'. 'Increase the distance between the electrodes' was the least chosen, with the other two responses being almost equally chosen.

Question 6 (standard/**high** demand)

06.1 Many students did not seem to be familiar with Fleming's Left Hand Rule. Just under half of students scored no marks. Many students re-phrased the question or wrote something irrelevant.
Those students who showed some knowledge of the rule were often unable to link the correct digit with the correct quantity.
Many either omitted the fact that the thumb, first finger and second fingers needed to be at right angles to each other, or attempted to describe the orientation of the digits in terms of up / down, out / in or left / right.
Nevertheless, about 10% of students achieved three or four marks.

06.2 Three quarters scored no marks. A very small percentage gained all three marks.
The majority did not think to link this question with the previous one relating to the motor effect and came up with some creative ideas as to why the balance reading should increase. Common answers were that the weight of the magnets would increase, or gravity would become stronger, or the current has mass.

06.3 Students seem to be more willing to tackle calculations than written answers, with around 94% of students attempting this question. Although only around 4% gained the full four marks, a further one third scored three marks, being able to select the correct equation and to manipulate it successfully.
The main error was in not converting the force from mN to N, or incorrectly converting it – many seem to think that 1mN = 1000 N. A substantial number of students had taken note of the requirement to give their answer to two significant figures. Unfortunately, some did not do this correctly.

Question 7 (standard/**high and high** demand)

07.1 Over 11% of students made no attempt to answer this question and more than three quarters scored no marks.
Few students realised that this question was linked to the vector nature of velocity and acceleration. Indeed, several students stated that the question was incorrect because the moon could not be accelerating because it was moving at constant speed.
Students who attempted an incorrect explanation attributed the acceleration to a variety of causes – global warming, astronauts landing on the moon and the earth's changing magnetic field were fairly common answers.
Students who scored marks for this question usually cited the constant change in direction of the moon, linking this to a change in velocity, but omitting the link between velocity and acceleration.

07.2 Around half of students chose the correct response to the calculation. The next most popular choice was the final box, which was similar to the correct one, but with '2' as a multiplier. The other two responses were equally chosen.

07.3 Around 3% of students performed this complex calculation correctly to gain all six marks. Some students attempted calculations, but it was often difficult to follow the line of reasoning. Strings of figures, apparently randomly multiplied or divided, were often seen, with no attempt to explain what was being worked out. It would benefit students to explain, just with a word or two, what they think they are working out. Some students attempted to deal with all stages of this multi-stage calculation in one equation – such answers seldom scored any marks.
Of those whose working was clear enough to follow, the most frequent mistake was working out the input power as 72% of the output power, ending up with a smaller value for the input power than the output. However, such answers could go on to gain up to three of the marks by using the P = IV equation and/or multiplying by four.

07.4 In order to gain marks, students needed to refer to the old theory and what it would suggest about the composition of Moon rocks compared to Earth rocks. Very few answers made reference to the old theory, so very few students gained marks.
Many answers stated that if the Moon rocks had a similar composition to Earth rocks, it was likely that they originated from the same place – this is what was stated in the question so there was no credit for repeating it.
There was evidence that a number of students had mis-read or failed to understand the question, as they referred to the Giant Impact Hypothesis as being incorrect because the Earth would have been destroyed in a collision.

Question 8 (standard/high and high demand)

08.1 Around half of students chose the correct response of $C_{16}H_{34}$. The next most popular choice was $C_{17}H_{34}$, with the other two responses being almost equally chosen.

08.2 Whilst many students appeared to have some idea of how crude oil is separated using fractional distillation, they were often unable to express themselves coherently using the correct terms, so were unable to access many marks – around 40% scored no marks.
Many started off by saying that the crude oil rises up the fractionating column, without stating that it is heated to vaporise the hydrocarbons.
Some indicated that the hydrocarbons would condense but did not refer to the different fractions condensing at different points as they rise up the column.
A number of students referred to the melting points of the hydrocarbons and did not make reference to the different boiling points.
Around 12 % gained three or four marks with well-expressed answers.

08.3 Many others did not understand the principle behind the calculation, so added or subtracted various numbers from the given table, without reference to any of the bonds shown in the displayed equation. A common incorrect approach was to find the average of the bond energies listed in the table.
Other students appeared to understand the method they needed to adopt. Unfortunately, many missed out various bonds from their calculations, so did not correctly calculate the energy required to break the bonds or the energy released when the bonds are formed. However, those students who set their calculations out clearly were able to gain a mark for the correct subtraction of these two figures.
Students who wrote out a list of figures, with no explanation as to what they were doing, were unlikely to score any marks.

It was noted that the writing of some students was so poor that they were unable to read their own figures correctly and made mistakes in copying their values down from one part of the calculation to another.
However, 15% of students worked through the calculation clearly and logically to arrive at the correct answer.

08.4 Many appeared to be confused by the concept of fuels obtained from plants. Some seemed to think that crude oil got into the plants underground, then the plants were dug up and the crude oil extracted from it. Very few seemed to realise that the plant material would have to be burned as a fuel.
Whilst many students referred to crude oil as polluting the atmosphere, not many were specific as to what was doing the polluting – 'bad gases' and 'harmful gases' were common phrases used. A common misconception was that burning fuels destroys the ozone layer in addition to adding to the greenhouse effect.
It was apparent that many students had not latched on to the command word 'evaluate' so did not in general address more than one issue, that issue either being 'polluting the atmosphere' or 'affecting biodiversity'. Just over 1% of students achieved a Level 2 answer (three or four marks).

08.5 Some attempted calculations, but it was often difficult to follow the line of reasoning. Strings of figures were often seen, with no attempt to explain what was being worked out.
There are various ways of approaching this calculation. Some students made an attempt to calculate the masses of 2 moles of butane and 13 moles of oxygen. If done correctly, they were able to gain one mark. Unfortunately, many students made mistakes; a common error was to calculate $2 \times C_4 = 96$ and then to multiply by 10 (presumably for H_{10}) to arrive at an answer of 960 g. Having worked out the masses, students were then usually unable to proceed further.
Another approach was to calculate the number of moles in the given masses of butane and oxygen; students who were able to do this correctly gained 2 marks. However, students were unlikely to progress further than this stage. Only a very few gained three or four marks.

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.