# GCSE

# COMBINED SCIENCE: SYNERGY

8465/4H Physical sciences
Report on the Examination

8465/4H
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## Question 1

1.1 – Fewer than one-quarter of the students knew that water was the other product of the complete combustion of a hydrocarbon fuel. The most popular response was ‘hydrogen’, followed by ‘carbon monoxide’.

1.2 – Around 60% of students either did not attempt this question or failed to gain a mark. Some students knew that something turned cloudy, but either left the ‘test’ line blank, or had something other than limewater. The most popular incorrect responses were the squeaky pop test and bleaching litmus paper.

1.3 – Around 70% of students scored at least one mark. Some responses failed to score marks because they referred to finding either the ‘amount’ or the ‘volume’ of the fuel.

1.4 – Around half of students named a control variable correctly, the most popular answers being the same volume of water and heating for the same length of time. Some answers were imprecise, eg ‘amount’ of water rather than ‘volume’.

1.5 – Over 60% of students scored 2 marks, usually by referring to both the least mass of fuel burned and the highest temperature increase, with other students calculating the values of temperature change divided by mass of fuel burned. A further 25% gained one mark, usually for referring to the temperature increase. A minority just quoted values of mass of fuel burned and temperature change for fuel C, without comparing them to the other fuels, so did not gain any marks.

1.6 – Whilst many students had the correct idea, they did not gain the mark because of the use of absolutes, eg, no energy will be dissipated into the surroundings, all the heat will go into the water, etc. Around one-quarter gained the mark.

1.7 – Almost half of students gave a credit-worthy answer. Some students seem to have lost the idea that water was being heated and referred to reactants mixing, or reacting particles having more successful collisions, etc.

## Question 2

2.1 – Around 25% of students either did not attempt this question or failed to score marks. Basic answers such as ‘alter the height and measure the voltage’ added no value to the information given. Some did not seem to realise that this question had 6 marks attached to it and so they needed to give details in their answer, eg how to measure the height, what range of heights, what increments, etc. Many went into detail about how the various pieces of apparatus were connected, just repeating what the diagram showed – there was no credit for doing this. Some students described variations of the experiment, eg doing it with different light sources, using different solar cells, etc.

2.2 – Around half of students realised that the LED would be emitting light when there was a current in the circuit, and so were able to give the corresponding range of potential differences. A few chose 0 as the start of the range.

2.3 – Almost everyone gave the correct equation.

2.4 – Around two-thirds gained all four marks for this question. A number of students mis-read the value of current from the graph as 0.9 A instead of 0.09 A. They were able to gain some marks if they used this value in the correct equation to work out a value of resistance consistent with the incorrect current value. A few students were unable to re-arrange the equation in terms of resistance.

2.5 – Around one-third of students gained one mark for realising that the resistance would decrease as potential difference increased. Although some realised that there was no current in the circuit for potential differences up to 1.8 V, most said that the resistance was therefore 0 Ω and very few said that that the resistance was very high. Many students seemed to think that the graph was showing resistance rather than current on the x-axis. A fair number of students did not address the question as to what happened to the resistance, but instead wrote about the relationship between current and potential difference.

**Question 3**

3.1 – The majority of students gave the correct feature of ‘power output’. More than half were able to score the second mark for saying that the power output was higher than the bladeless turbine or that it generated more electricity. The phrase ‘creates more energy’ was seen several times and did not score the mark – students should be aware that energy cannot be created. Some who did not score the second mark did not compare the power output with that of the bladeless turbine. Several answers indicated that the question was asking for an advantage of the bladeless turbine compared to the three-blade turbine. Despite the question asking for a ‘feature’ and prompting students to use Table 2 with its list of features, several students attempted to make up their own advantage.

3.2 – Around 90% of students were able to score at least one mark for the basic statement ‘as the frequency increases, the power output also increases’. However, fewer than one-third attempted to describe the non-linearity of the relationship. The command word for this question was ‘describe’ – a number of students seemed to think they had to ‘explain’ why the relationship was as it was. This did not preclude them from gaining marks for the description, but students should pay attention to the command words to answer with the necessary detail.

3.3 – Almost everyone gave the correct equation.

3.4 – Around 90% of students were able to use the equation to calculate a correct value of time and give the unit. It was acceptable to leave the answer in seconds, but also acceptable to convert to minutes or hours. Unfortunately, a number of students who did this were unable to do so correctly.

**Question 4**

4.1 – Around 20% of students did not attempt to answer. Fewer than one-third gained the mark. A number gave the response ‘bioleaching’. Of the large number of other ‘guesses’, ‘photosynthesis’ was a popular response.

4.2 – Again, around 20% of students did not attempt to answer, and fewer than one-third gained the mark. A number gave the response ‘phytomining’.

4.3 – Only around 4% of students answered correctly in terms of the scarcity of copper ores. Common answers were ‘environmentally friendly’ and ‘cheaper’.

4.4 – Only around 8% of students gave a suitable advantage. There were many vague answers such as 'better for the environment' without specifying in what way.

4.5 – Around 10% of students gained at least one of the two marks. Of the few who knew that a temperature was reduced, some referred to the boiling point rather than the melting point.

4.6 – More than two-thirds of students either did not answer or scored no marks. Those who knew that the electrodes were made of carbon were often able to give a good explanation, scoring at least two of the three marks.

**Question 5**

5.1 – Students who knew to use the momentum equation were usually able to score at least 3 marks for calculating the change in velocity. Many left this as their answer and a few added on the initial velocity rather than subtracting from it. Those who did not use the momentum equation attempted to use the equation $v^2 = u^2 + 2as$, often substituting values for other quantities given in the question.

5.2 – Around three-quarters of students either did not answer or scored no marks. Some students were able to state the version of Newton's Third Law 'every action has an equal and opposite reaction', but were unable to apply it to the given situation. Very few answers indicated that the forces were equal in magnitude or size and opposite in direction.

5.3 – Over 90% of students scored at least three of the four marks for this question – they were able to apply and re-arrange the correct equation, but some failed to convert the distance of 1.2 cm into metres, or converted incorrectly.

**Question 6**

6.1 – Nearly two-thirds of students either did not answer or scored no marks. The few who understood the principle usually arrived at the correct answer, scoring all five marks. A number of students gained one mark for correctly calculating the energy released in forming bonds but did not know how to progress from there. A common error was to either divide or multiply the individual bond energies by 2.

6.2 – Of the many students who knew what a reaction profile was, the vast majority drew the wrong profile for this reaction. However, marks could still be gained, many students labelling the reactant and products correctly and some labelling activation energy correctly. Very few gave the correct labels for the axes, 'time' being a common label on the *x*-axis.

**Question 7**

7.1 – Around one-quarter of students gained the mark for this question. However, the majority said that the spring would not return to its original length / shape.

7.2 – Fewer than half of students gave the correct answer of 20 cm. Many others gave 30 cm – the value for extension at the end of the given line.

7.3 – Fewer than 15% of students gained all four marks; however, a significant number were able to score three marks for using the correct equation with a consistent pair of values of force and extension but failing to convert the extension from centimetres to metres. Some students had written down the correct equation but used values of force and extension from the non-linear section of the graph. Some attempted to use the equation for elastic potential energy.

7.4 – Around half of students scored both marks. Some drew a vertically upwards arrow but of the wrong magnitude. Some did not seem to know the terms magnitude and direction and drew 2 arrows, usually horizontally, labelling them ‘magnitude’ and ‘direction’.

**Question 8**

8.1 – Around 60% of students named the independent variable correctly. Incorrect responses included control variables, the dependent variable and various pieces of equipment.

8.2 – Around three-quarters of students did not draw a tangent to the curve, but read the value of volume at time 60 seconds. If a correct calculation was carried out using these values, with an answer given to 2 significant figures, one mark was gained. Around 10% of students who drew a tangent at time 60 seconds went on to gain all 5 marks. However, others mis-read the values of the *x*-step and *y*-step or divided these values the wrong way round.

8.3 – Fewer than one-quarter of students related the decrease in the rate of reaction to the gradient of the line becoming less steep. Common responses which did not gain the mark were ‘the line curves’, ‘the line plateaus’ and ‘no more gas is collected’.

8.4 – Around 90% of students either did not answer or failed to gain any marks. A common response was that the reactants had been used up, so the reaction had stopped. Very few referred to particle collisions. Of those who did, not many mentioned the frequency of the collisions.

**Question 9**

9.1 – Fewer than 5% of students seemed to know that the distance travelled was represented by the area under the line. The most common error was to use the equation distance = speed x time, substituting the initial speed of 7 m/s and the time of 0.70 seconds.

9.2 – As with the previous question, very few students realised that the area under the line represents the distance travelled and as both areas were the same, the distances travelled were the same. However, students were able to score 1 mark in a number of ways, the most common being that the initial speed and final speed were the same.

9.3 – Only around 3% of students realised that the gradient of a velocity / time graph represents acceleration. The most common incorrect response was along the lines of ‘the gradient shows the velocity, which is constant’. Another common error was to describe a line of constant gradient, eg ‘it doesn’t have any kinks in it’, ‘it is a straight diagonal line’, etc.

9.4 – Many students failed to score marks because they mentioned factors about the ball’s motion, rather than how the graph would have changed, eg saying ‘the ball won’t go as high’, rather than ‘the area under the line would be smaller’, etc. The most common correct answer was that the line would be curved.

9.5 – Around two thirds of students gave the correct response.

**Question 10**

10.1 - The question asked what was meant by 'thinking distance'. The majority of students started their answer with 'the time taken…' or 'how long it takes…', not appreciating that distance and time are different quantities. However, there were some correct, well-expressed answers, and around one-quarter of students gained the mark.

10.2 – Despite the prompt to tick two boxes, around 10% of students chose only one response. The vast majority of students chose the two correct responses.

10.3 – Many students gained the first mark for correctly saying that the braking distance for the 2020 car was less than that of the 1975 car, but very few said that this was true for all speeds (the second marking point). A few realised that the command word was 'explain' and gave an explanation in terms of more advanced braking systems or tyres. The complexity of the graph proved to be difficult for some students, who seemed to think it was showing time on the *x*-axis.

10.4 – The majority of students made some attempt at this high level, multi-step calculation. Many realised that they would need to use the equation F = ma. This then caused a problem, as the value of acceleration was not given. At this stage, many students just substituted the value of 27 m/s, which was the speed given in the question. A few students attempted to work out the acceleration, usually (incorrectly) by time = distance/speed, then acceleration = change in velocity/time. This was incorrect as the distance was the total distance, whereas the speed was the final speed, which was not constant.

Very few students attempted to use the equation $v^2 – u^2 = 2as$ to calculate acceleration. Whilst this was the correct method, some did not realise that the instruction to 'use Figure 19' would enable them to get the distance 's'. Others used the Figure 19 graph, but mis-read the distance.

An alternative approach was to calculate the kinetic energy. Students who realised this were often able to gain 2 marks. However, very few went on to use this value in the equation W = Fs.
More than two-thirds of students scored no marks, and around 3% gained all 6 marks.

**Mark Ranges and Award of Grades**

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