GCSE
COMBINED SCIENCE: TRILOGY

8464/P/2H: Paper 2 – Physics (Higher)
Report on the Examination

8464
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General

There was no evidence that the timing of the paper was not appropriate with most students being able to complete all questions. There were fewer students incorrectly entered for higher tier this year, and that resulted in fewer students being unable to access the questions.

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 Over 70% of students were able to gain both marks. Many wrote their answer without showing any working. Students who failed to score a mark mostly misread values from the graph.

01.2 Just over 40% of students were able to determine the deceleration of the runner. Students either took values from the graph and used an equation to calculate the deceleration, or determined the gradient.

01.3 Around 65% scored the mark for this question, realising that wires would get in the way, or restrict movement when running. Those that did not score tended to give incomplete answers ('no cables involved', etc), or to describe the advantage of using a smart watch as a monitor, regardless of the method of connection.

01.4 Two third of the students could recall the equation. Some students just used the terms in the order they appear in the stem and inserted = and × in between to give frequency = wave speed × wavelength. Those who chose to use forms other than $v = f\lambda$ seemed more likely to get the question wrong. There were only a few instances of students choosing to use symbols, rather than write the equation out in words, and then using incorrect ones.

01.5 Over half of the students were able to gain full marks on this question. For those who did not, the most common mistake was to arrive at the reciprocal of the correct answer. A significant number of students did two different methods to arrive at 8 and 0.125, then chose an answer of 8.

01.6 Nearly half of students gained some credit on this question. Many students scored MP1 but MP2 was rarely awarded as students did not explicitly link the power drain with the battery/heating effect. A common response was that a high power would be dangerous to the person. Other incorrect responses were those in terms of radiation given off by phones.

Question 2 (Standard demand)

02.1 Around 10% of students were awarded level 3. Many students used half of the available space describing how to set up the ripple tank, by just repeating the information they were given in the question. The result of this was to condense the description of how to take measurements and suitable calculations, meaning they were sometimes vague. Some students gave detailed accounts showing a clear understanding of the procedure with others just stated what frequency and wavelength are.

02.2 A quarter of the students gained the mark on this question. There were many poorly worded, incomplete answers, which did not gain marks. Many students knew water waves were transverse and that transverse waves were perpendicular but could not say what they were perpendicular to, often missing out the direction or travel/transfer part of the definition.

02.3 Over 60% of students scored at least 1 mark on this question. Most students who scored 1 mark worked out the mean maximum and minimum heights. A third of students appreciated the need to work out the difference between these two and gave an answer of 11. Less than 10% of students went on to halve this value.

Question 3 (Standard and standard/high demand)

03.1 More than half of the students identified only one scalar, 30% identified both.

03.2 More than half of the students correctly described the difference. There were quite a lot of clear 'by the book' definitions. Many students chose to use examples to illustrate the difference between scalars and vectors (eg velocity is speed with direction) often without identifying which was a vector or indicating that they were aware that these are just examples.

03.3 Around 60% of students were able to access both marking points; the most common factors offered were mass and velocity, possibly from knowledge of the momentum = mass × velocity equation. Quite a number of students offered a combination which included one or both of weight and speed. It was rarer to see friction, air resistance or drag – and many who went down this route offered both friction and air resistance. Some students drew on their knowledge of cars stopping and chose to offer thinking distance and/or braking distance as factors affecting the bumper car's momentum, scoring no marks.

03.4 Fewer than 10% of students gained more than 1 mark. A large number of answers mixed Newton's first and third laws stating that the cars exert equal and opposite forces on each other, therefore the resultant force is zero. Many others wrote 'every action has an equal and opposite reaction' which was not creditworthy. The strongest responses used route 1 from the mark scheme and made a statement about the momentum being zero before and after the crash. Many students made statements about the momentum being equal before the crash, ignoring the direction.

Question 4 (Standard and standard/high demand)

04.1 A quarter of students were able to correctly determine the direction of the force on the wire.

04.2 Over half of the students gained at least 1 mark on this question. Some students knew that changing the magnetic field in some way would have an effect. Some students used expressions such as ‘change the magnets’ or ‘move magnets over’ which were insufficiently specific to score the mark. A number incorrectly stated that increasing, decreasing or changing the field strength or current would have the effect of changing the direction of the force.

04.3 A quarter of the students scored 0 marks on this question. Of those that did score marks, the vast majority scored 3 marks as few converted the flux density from mT to T to score full marks.

04.4 Very few students scored full marks on this question. Three quarters of students scored 0 marks. Some students drew force arrows on the diagram, which enhanced their response. Less effective responses often scored mp1 and mp4. Common errors included mixing magnetism and charges attracting or repelling, discussing motion of either side of the coil rather than forces, or only discussing current and force on one side of the coil. Many students spent too long discussing the interaction of the magnetic fields so ran out of space for other points.

Question 5 (Standard/high demand)

05.1 Approximately half of the students identified that force $\propto$ extension.

05.2 Around 70% of students gained full marks for this calculation.

05.3 Around 15% of the students gained full marks for this calculation. Many students could not recall the equation $F = ke$ and tried to use the elastic potential energy equation given on the equation sheet instead, thus could not score any marks. Most students who recalled the correct equation successfully rearranged it and scored the three marks for the calculation but a sizeable number could not give the unit N/m for the spring constant.

05.4 Only 5% of students scored 2 marks. Some students implied that the more the springs were compressed, the softer the mattress became rather than a softer mattress would have springs that would compress more. Few students referred to the spring constant in answering this question. Some tried to discuss changes to the construction of the mattress as a whole, rather than individual springs. Many tried to answer in terms of weaker, more malleable, more elastic, longer, shorter springs or by discussing elastic and plastic deformation.

Question 6 (Standard/high and high demand)

06.1 Whilst over three quarters of students scored marks on this question, few scored more than 1 or 2 marks. Many students struggled to articulate the effect of the change in forces, many stating that the thrust increases to make the plane land. A large number of students stated that the weight would increase.

06.2 Nearly 30% of students gained 5 marks on this question. Around 8% of students gained 2 compensation marks for correctly calculating the acceleration. In order for students to be awarded compensation marks on extended calculations they must show their working out, and it must be clear, in this case, that they are calculating an acceleration. No credit will be given for manipulating numbers with no evidence of an understanding of the underlying physics.

Question 7 (Standard/high and high demand)

07.1 Approximately a quarter of students scored marks on this question. The vast majority of those stated that the light slowed down. Very few linked the question to the diagram above, and those that did lacked detail in their answers.

07.2 Around 60% of students did not score any marks on this question. A third of students gained the first mark for the first refraction, but very few scored the third mark for correctly drawing the emergent ray and even fewer remembered to add in a normal at the emergent ray. Incorrect answers included; no refracted ray, reflections at the normal line inside the prism, refraction along the normal line, normal lines on the emergent ray parallel to normal on the incident ray and the emergent ray parallel to the incident ray.

07.3 This was intended to differentiate between students working at grades 8 and 9. A quarter of students scored 1 mark. Most of these correctly identified violet light as having the shortest wavelength but did not go on to make the link between refraction and change of speed. Around 1% of the students scored all 3 marks, showing they could interpret information presented in an unfamiliar way and in an unfamiliar context.

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.