GCSE
PHYSICS

8463/2H: Paper 2
Report on the Examination

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General

It appeared that most students had sufficient time to complete this paper.

The writing of some students was extremely difficult to read, which made marking their responses challenging, particularly in the longer questions.

The majority of the students had taken the time to learn the required equations. This allowed the students to access subsequent calculations.

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 Less than half of the students were able to the distance as the focal length.

01.2 Nearly half of the students showed themselves to be familiar with drawing ray diagrams and scored both marks. Most correctly drew one line and usually chose to draw a line passing through the centre of the lens without deviation. A significant number of those students that drew a second line did so incorrectly. About 20% of the students that drew a line correctly did not go on to draw an arrow to show the position and inverted nature of the image.

01.3 About 50% of the students scored zero, most of these simply described similarities or differences in the diagrams eg 'ray goes through centre of both lenses'. Students were not always confident in the use of the term 'virtual' to describe an image and instead wrote 'not real'. A number of answers simply referred to Figure 1 or Figure 2 rather than the type of lens.

01.4 Almost 90% of the students were able to complete the calculation and obtain the correct answer. The most popular wrong answer was '9 x 6 = 54'

Question 2 (Standard demand)

02.1 Most of the students did suggest using a piece of apparatus that was, recognisably, one that could be thought of as having been designed to measure a length. Many, however, failed to describe it with sufficient clarity to be given the mark. The most common answers that did not gain a mark were 'ruler' and 'metre stick'. A minority of the students opted for pieces of equipment from Figure 4, such as 'signal generator'. Only 57% of the students gave a correct answer.

02.2 Just over 81% of the students knew this equation.

02.3 Some students failed to convert 80 cm to 0.8 m but they were usually able to substitute values into the correct equation and calculate the answer. There were a number of students who used 50 Hz in their calculation despite 55 Hz appearing in the stem of this part question and in Figure 4. There were only a few answers that involved the use of an incorrect value for wavelength.

02.4 Nearly 80% of the students scored at least one mark with half of these scoring both marks. Moving the bridge was a more popular correct answer than changing mass. Some students gave both movement of the bridge and changing the mass but contradicted themselves by, for example, moving the bridge to the right and decreasing mass. References to shortening the string suggested that the students understood what was required but did not describe how to adjust the apparatus to change the length. Similarly, some answers mentioned changing tension but gave no indication of how this could be achieved.

02.5 The majority of the students were able to describe how to vary the tension in the string by changing the masses. Most were able to continue to describe measuring the wavelength and some then described how to calculate wave speed. The aspect that was missing, from all but a few of the answers, was a description of how to obtain a new wave pattern on the string, by moving the bridge or adjusting the frequency.

Question 3 (Standard demand)

03.1 Just over 32% of the students gave a level 3 answer with 20% of those scoring full marks. Most of the students were able to give a good number of factors, and then tried to give at least one linked explanation. Many of the students used half a page to describe the meaning of Thinking Distance, Braking Distance and Stopping Distance, which was not required. There was a great deal of confusion about how to explain and link reaction time to a factor or group of factors. Many of the students confused reaction time and thinking distance. A significant number of students seemed to think that slower reactions meant a shorter reaction time and that the thinking distance was consequently shorter. When giving condition of tyres/road surface/wet/icy as a factor the explanation was often written in terms of grip/traction/sliding rather than using friction as a scientific term. Where speed was a factor, an explanation in terms of 'greater distance travelled in the reaction time' was seen a few times, but mainly the 'in the reaction time part' was missing. A greater distance to stop was the common explanation. Very few students linked kinetic energy and work done, most getting the idea of increased kinetic energy but then not linking it to work done. Even students that had an idea about work done being force × distance seemed to think that a larger force would be required from the brakes to stop in a certain distance, rather than the idea that the distance for a fixed braking force would be longer.

03.2 Nearly all of the students were able to recall this equation. Those students who did not score the mark just seemed to put an equal and a multiply sign in the quantity order of the stem or rearranged incorrectly.

03.3 Nearly all of the students scored all three marks. Where marks were not scored it was usually for putting the numbers into a calculator incorrectly or by missing powers of 10.

03.4 This was poorly answered with just below here quarters of the students scoring zero. There were lots of answers in terms of the effect on passengers, their momentum, possible crashes into the back because of braking too quickly, whiplash injury, what would happen if a seatbelt was not worn and the idea that the car would flip over. Few students wrote about

the brakes overheating and of those that did only around 6% then linked this to possible loss of control.

Question 4 (Standard and standard/high demand)

04.1 Just over 11% of the students did not attempt this question. The majority of field patterns drawn showed a lack of precision. Lines joining and crossing at the ends were common. Most patterns that scored the first mark point were a bar magnet type field pattern. Confusion of arrow direction was very common with arrows going into and out of an end. Some students did not appear to understand the term 'solenoid'.

04.2 This question was not well understood. About half of the students understood that the rods became induced magnets but often then just wrote that they repelled with no mention of the idea of same polarity/like poles. Very few answers were really clear about like poles being on adjacent ends. Incorrect ideas that were common included that the rods were charged, with phrases such as 'charged with magnetism' used, as was the idea that they were attracted to the sides of the solenoid or were repelled apart when the current was switched off. Some students stated that a current was in the rods or that closing the switch meant that current was stopped and the solenoid was no longer magnetised.

04.3 Many of the students did recognise that two variables had been changed at the same time. Only around 18% of the students scored the second mark.

04.4 About half of the students scored this mark. Those that did not score often failed to mention that the strength reached a maximum value.

04.5 Nearly three quarters of the students scored this mark, recognising that the increase in strength from 10-20 turns was higher than the increase from 20-30. Some that did not score the mark simply quoted numbers from the graph but did not use them in any comparative way to show a general trend as they were for a specific point. Others that did not score the mark usually gave a description of the shapes and/or gradients of the three graphs with no comparison of the increase in strength.

Question 5 (Standard and standard/high demand)

05.1 Half of the students were able to answer this correctly. Distance, amount, speed and frequency were common incorrect answers.

05.2 Around 18% of the students scored this mark. The life cycle of stars was often confused with the Big Bang theory. Other incorrect answers gave one but not both of the required pieces of information, usually the 'dense' idea which was sometimes linked to small, but rarely the 'hot' idea.

05.3 'Further away is faster' was a common incomplete answer; a large number of correct responses had directly proportional rather than just proportional. If this phrase were not used, very few could describe directly proportional correctly. A significant number of responses just said positive correlation or linear relationships. 36% of the students scored this mark.

05.4 Approximately 47% of the students scored this mark.

05.5 This was not well answered; there seemed to be a lot of confusion over the graph, with some students appearing to be under the impression that it charted the speed of one particular galaxy over time as it moved away from its original location at the position of the Earth. The response 'directly proportional' required for **05.3** occurred frequently.

05.6 Many answers had 'expanding' but very few qualified this with 'faster' or 'at an increasing rate'. Quite a number of answers wrote about gravity getting less or running out. A fifth of the students scored this mark.

05.7 The reason for peer review was understood with around 72% of the students scoring this mark. Correct answers mainly addressed the bias and finding mistakes ideas. Incorrect responses included comments about proving the theory and there were vague statements about accuracy, repeatability and reliability.

05.8 Nearly half of the students scored both marks. Where students did not score both marks, it was often because they had not appreciated that the speed of light would be the same so if one factor increased, the other decreased. The inability to express answers coherently was evident in responses that referred to longer frequency or faster frequency or compressed waves.

Question 6 (Standard/high demand)

06.1 Incorrect answers often tried to define or use Newton's first or second laws and very occasionally third law. The students that did score this mark were usually precise and word perfect.

06.2 Although the context may be different this was basically a question asking student to explain a safety feature. The imprecise use of language meant that there were very few full mark answers. Some answers had the idea of the increased time but missed the 'to stop' part. Students that did score a mark often did so for the idea of the reduced force on foam or the increased force on concrete. Many less effective responses referred to the density of foam versus concrete or that foam is soft due to air pockets which absorb force. A lot of answers referred to energy changes.

06.3 Many students could not convert milliseconds to seconds. A significant minority thought 180ms were equal to 3 seconds. Those students who first calculated acceleration did not end up with the correct answer because they then tried using $v^2=u^2+2as$. There were many responses using w=mg, KE= $1/2mv^2$ or otherwise using the values given. However about half of the students used a correct method and scored either 3 or 4 marks.

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

07.1 Around 42% of the students scored this mark. Many students seem to think that the wave speed changes.

07.2 About 35% of the students scored both marks. Some students did not specify 'soft' tissue or a named soft tissue, which was required as bone is a tissue. Many students incorrectly described bones as reflecting X-rays rather than absorbing them. Some students appeared to confuse X-rays with gamma rays or even alpha particles.

07.3 A large number of the students failed to appreciate that the hot cube was the main hazard rather than the kettle. The majority gave an answer in terms of 'wear safety goggles and/or

gloves. Less than a quarter of the students gave a correct answer, these appeared to be evenly distributed across the alternatives given in the mark scheme.

07.4 Only a quarter of the students scored this mark, with most incorrect answers giving the temperature or volume of the water as the control variable.

07.5 There appeared to be some confusion of the term precise with either accuracy or resolution. The lack of repeat readings was sometimes given but then incorrectly linked to the idea of calculating a mean or identifying anomalies. About 10% of the students scored this mark.

07.6 About 64% of the students realised that two of the surfaces would give the same temperature reading and therefore undermine the conclusion. However most of these students then simply wrote that the conclusion would not be valid without then going on to explain why.

07.7 Just over 70% of the students gave the correct answer.

07.8 Only a small number of the students scored any marks on this question. Those that did usually scored the mark for 'clouds reflect radiation'. Virtually no students related their answer to night time. Marking points 1 and 3 were rarely awarded. Many of the students wrote about insulation with a few mentioning the cloud as a 'blanket' keeping the ground warm. These answers did not score any marks.

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

08.1 Just over 63% of the students scored both marks with approximately further 30% scoring one mark. Those scoring only one mark often did so because they incorrectly had the downward force equal in size to air resistance. A few students did not score the first mark as they drew two incorrect sideways arrows as well as the correct downwards arrow.

08.2 Just over half of the students scored the final two marks showing an understanding that balanced forces result in terminal velocity. Many students gave answers in terms of the resultant force being zero. Many of the students did not score the second marking point because they failed to explicitly link increasing air resistance to acceleration. A number of students used the term upthrust for the upward acting force and appeared to think the air resistance was caused by moving sideways through the air during the descent. Many stated the incorrect idea that there was a much larger value for gravity closer to the Earth's surface than at the height of the plane. A noticeable number did not refer to the forces involved in the motion despite being asked for this in the question and many then went on to explain what would happen once a parachute was opened.

08.3 About 82% of the students scored full marks on this question. A few of the students did not appreciate that they should calculate the gradient and incorrectly calculated speeds at individual points on the graph.

08.4 Only around 40% of the students scored any marks on this question. Few of the students described the lower density of the air correctly, with most simply stating there were fewer particles. Very few related the lower air resistance to being able to accelerate longer before reaching terminal velocity. The majority of the students simply stated that the skydiver would accelerate for longer because they were falling from a greater height, which was not creditworthy.

Question 9 (Standard and standard/high and high demand)

09.1 Just over 80% of the students correctly chose 'chicken'.

09.2 Just over 60% of the students gave the correct answer.

09.3 Whilst only just over 7% of the students gave the correct value of 0.025 m as their final answer, there were a whole host of alternative wrong answers that gained at least one mark. Many students did not appear to realise that the distance between the pulses showed the time taken for the ultrasound to travel to the crack in the aluminium and back; others appeared to misinterpret the third pulse as the crack in the aluminium and not the edge of the block. A significant proportion of the students made no attempt to give their calculated answer to 2 significant figures.

09.4 Only just over 13% of the students were able to give the function of a microphone. Most incorrect answers were in terms of amplifying sound. Some answers referred to converting sound into a current but did not indicate that the current would be varying.

09.5 Nearly half of the students scored zero or did not attempt the question. Only around 3% of the students gave a clear, complete and correct answer. The idea that the sound waves would cause the diaphragm and coil to vibrate was often given but so were vague terms such as 'moves'. Many students described the motor effect, starting with a current and eventually producing sound from the diaphragm. There were also answers that included referred to spinning coils, electromagnets, split-ring commutators, reversing magnetic fields and occasionally primary and secondary coils.

Question 10 (Standard/high and high demand)

10.1 There were a number of good answers here, though some students referred to momentum instead of moment, or work done = force × distance. A few students wrote about the distance between the rope and the spring (or the ramp) instead of the pivot.

10.2 Almost a third of the students scored all 6 marks and showed their working in a clear and logical sequence. Where students did not score all 6 marks, the equation for elastic potential energy was often correctly selected, but they did not appear to know how to use the other quantities given to find the spring constant correctly. Most students were able to use the moment and distance to calculate the force.

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.