Questions matter

A Level
Physics
7408/1

Report on the examination

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Question 1

Only about 25% of students obtained all three marks for Question 1.1. Many students did not read the question and labelled a proton and neutron instead of up and down. Many students also gave an antineutrino as one of the particles, or the gamma photon as the exchange particle.

The best answers to Question 1.2 referred to electron capture as the decay process and explained why a nucleus with no orbiting electrons would find this difficult. Many students made vague statements about nuclear stability in terms of neutrons or suggested that somehow orbiting electrons cause nuclear instability through an electromagnetic interaction.

The calculation in 1.3 was very accessible, with over 65% of students getting both marks. There were several correct routes that were given full credit. Some students who arrived at the correct answer decided to round their value down to 21 and lost the second mark. Examiners commented on how pleasing it was to see answers that were set out clearly.

Question 2

More than half of students obtained both marks for Question 2.1. A common error was to refer to the direction of motion or travel rather than energy transfer. Others did not refer to the oscillating nature of the waves.

Answers to Question 2.2 highlighted several misconceptions related to stationary waves. Many students suggested that the two waves are coherent or have a constant phase relationship. Several suggested they interfere, as though they are two waves meeting at a single point. Many alternative spellings for “superpose” were seen. These were tolerated on this occasion, but it may be that in future the correct word will be required.

Many students misunderstood Question 2.3 and only referred to the labelled points, writing answers consistent with a progressive rather than a stationary wave. The most common mark awarded was for stating that P2 and P4 were in antiphase. Note that ‘out of phase’ or ‘interfere destructively’ were not accepted for antiphase. Answers that allocated a phase relationship between stationary points rarely gained much credit.

Question 2.4 discriminated well and gave a good spread of marks. Over 20% gained all five marks for this question. Common errors included using 2m for L, or thinking that W was the weight of the wire. Correct answers worked out the mass per unit length for both wires, calculated the first and fifth harmonics for all combinations, and showed that the combination of wire B and 1N produced both harmonics between 1Hz and 50Hz. Many students missed out on the fourth marking point as they did not make an explicit comparison. Alternative approaches, using the wavelength of the standing wave for example, were seen and given full credit if correct.

Question 3

Question 3.1 discriminated well and produced a good spread of marks. Many students were able to calculate the amplitude and maximum acceleration. Much fewer went on to draw the correct line. Sine curves were the most common incorrect answer. Even those who drew a straight line often only used one quadrant or had a positive slope.

Question 3.2 was the hardest one on the paper. Only those who had a straight line in 3.1 had much chance of gaining this mark. For these students the most common error was to label the point halfway along the line.

Question 4

About 60% of students obtained the mark for Question 4.1. Common errors included the idea that breaking stress and Young modulus are the same quantity. Others failed to give the equation for Young modulus or failed to suggest that strain has no units.

The calculation in 4.2 was very accessible, with almost 70% of students gaining all three marks. Many students calculated their answer based on wire W rather than wire X. The structure of the mark scheme meant that these could receive partial credit provided it was clear what they were doing. Another common error was to use an incorrect formula for the volume of the wire. Power of ten errors were also fairly common.

Only about half of students received the mark for Question 4.3. The most common error was to suggest X and Y were the same because they had the same stiffness. Some students correctly identified W and Z, stating that their Young modulus was the same without supporting evidence.

Question 4.4 produced a good spread of marks and discriminated reasonably well, although it was not answered well by the majority of students. There were several routes through the question, all of which gained credit. The most common was to determine the Young modulus for Figure 5, calculate the Young modulus for wire W and then compare the two. Many students successfully chose to compare the stiffness.

Question 5

Question 5.1 was answered correctly by nearly 70% of students. Incorrect rounding and giving the lost volts as the answer were common errors that did not get the mark. Some power of ten errors were also seen.

Question 5.2 was answered correctly by the majority of students. A common mistake was not taking the reciprocal to find the resistance. Students who tried to use the emf equation rarely made much progress.

Very few students obtained all three marks for question 5.3. Some used values from the earlier part of the question, despite being told that the modules in this question were

different. It was clear that combining cells in series and parallel is a challenge for many students.

Question 6

Question 6.1 was answered correctly by 65% of students. Common errors included interpreting impulse as force and therefore getting an incorrect value for the speed. This led to a very small value for the kinetic energy. Students should be encouraged to check their work if they arrive at an unlikely answer.

Only about 25% of students obtained any marks at all for Question 6.2. Those who realised that the area under the graph was the impulse often made no effort to arrive at value for the force. The most successful answers introduced an unknown, such as x, for one unit on the Force axis. They then determined an area in terms of x and related it to the impulse. Solving for x and rounding gave a value for the scale. Some students followed this or a similar path but missed out on full marks because of a power of ten error, arising from the millisecond unit on the time scale. A common incorrect approach was to relate the peak value of F to the impulse in some form.

Most students completed the calculation in Question 6.3 correctly. Some incorrectly used the horizontal component of the velocity or used 18. Many students had problems using a consistent sign convention or choosing an appropriate constant acceleration equation. Although calculators often solve quadratics directly, students should still be encouraged to set out their answers so that intermediate marks can be given.

Question 7

57% of students obtained full marks for Question 7.1. As this was a ‘show that’ question, each step in the derivation had to be clear. Students given one mark often used ‘r’ for the radius in early stages before substituting R in their final answer without reason. It was expected that students used R throughout or wrote r=R at some point. Students who tried to work backwards from the answer rarely gained much credit.

The straightforward calculation in Question 7.2 was completed correctly by about 85% of students. Occasionally students lost the mark for incorrectly rounding to 59.0.

Most students suggested increasing the radius, and therefore obtained the mark for Question 7.3. Some suggested changing the banking. This was not rewarded as the question clearly referred to the curved section of the track in the earlier part of the question. Other correct answers in the mark scheme were also seen fairly frequently.

Most students obtained 1 mark for Question 7.4 by labelling the weight. It was expected that this would pass through the centre of mass of the car. Whilst some leeway was given, answers that showed a wobbly line or did not pass through a point near the centre of the car were not credited. Very few students labelled the two reaction forces that act through the wheels. A very common error was to see a centripetal force drawn, as though this was an extra force

rather than a combination of the horizontal components of the normal reaction forces. Students should be encouraged to use a ruler whenever drawing forces on a diagram. They should give attention to the line of action of these forces. It should also be stressed that a centripetal force gives rise to circular motion, and not the other way round.

Question 7.5 proved to be more difficult than expected. A common error was to suggest that the weight of the car had a horizontal component because of the slope.

Question 8

Question 8.1 was answered correctly by 64% of students. Surprisingly about 8% did not attempt this calculation. Several careless mathematical or substitution errors were seen.

Answers to Question 8.2 were often vague or based on the electrons starting with different speeds. The best answers made it clear that the kinetic energy of electrons was transferred to the gas atoms, or that the collisions were inelastic. Simply stating that collisions occurred was not enough.

Question 8.3 also proved to be very difficult. Few students applied their knowledge of how fluorescent tubes work to the information in the question. Successful answers identified the peak in Figure 12 to be in the ultraviolet region and then went on to describe how this can be used by the phosphor in the coating to produce white light.

More than 70% of students obtained all three marks for Question 8.4. Common errors included misreading the graph, not converting nm to m correctly and failing to convert to eV. The final mark was withheld from students who gave the answer ‘5’ as this is a 1sf answer.

Section B

The most straightforward multiple-choice questions were B11 and B13. Both were answered correctly by more than 90% of students.

Several questions had discriminators more popular than the correct answer.

The correct answer to B21 was the least popular. Most chose C, demonstrating that they did not understand that Newton's third law pairs have to be the same type of force and act on different objects. Option B was the next most popular, chosen by students who did not understand that at terminal velocity the drag force is equal to the weight. 17% of students chose option A, perhaps due to the videos of skydivers where the camera continues to fall rapidly while the skydiver slows down after opening their parachute.

The correct answer to B16 was the third most popular. Half of the students chose B. This is due to a common misconception about the resistance of a non-ohmic device. The next most popular was D. Students should be taught that it is the instantaneous values of current and voltage that are used to determine the resistance and power dissipated.

The correct answer to B14 was the second most popular chosen by less than 20% of students. Almost 60% chose D. These students were confused between square roots and squares perhaps. This was a demanding question that rewarded students who knew which equations to use and were capable of doing the necessary algebra.

The correct answer to B28 was the second most popular. 43% of the students chose B, suggesting that the current did not change, despite the circuit resistance being less.

Mark Ranges and Award of Grades

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