AQA

AS
PHYSICS

7407/2: Paper 2
Report on the Examination

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General Comments

The overall performance on this year's paper improved compared with that in 2018. Many students were more successful in applying their knowledge to the synoptic questions in Section B where the proportion of non-attempted questions fell significantly. Many students were well-prepared and able to attempt most questions in the paper. The work of these students was thorough and well presented. Their answers to both quantitative and qualitative questions demonstrated an appropriate level of knowledge and understanding. As is often the case, students at lower attainment levels found the questions on the electricity section challenging. Such students often failed to present their work in a convincing manner, offering disorganised calculations and errors in re-arrangement and substitution.

There were numerous examples where students had failed to read a question correctly. They should be advised to read through whole questions completely before attempting any parts of them.

Rounding errors usually led to the failure to gain marks. Advice about this is provided in the comments on individual questions.

Section A

Question 1

1.1 Students with high marks could recognise the difference between measurements and readings. They were able to describe the associated uncertainty in determining the position of the centre of a spot and to realise that the measurement required two readings. Some students thought that the smallest division on the ruler dictated the uncertainty in a reading. Teachers are referred to the Physics Practical Handbook for the treatment of such matters: https://filestore.aqa.org.uk/resources/physics/AQA-7407-7408-PHBK.PDF.

1.2 Many were unable to answer this question and obtained an incorrect answer of 1.5 %. They had added the percentage uncertainties in **a** and **b** instead of adding their absolute uncertainties. Students need to ensure they know the correct procedure for combining uncertainties.

1.3 This question highlighted the students' misunderstanding of the terms measurement and reading. It is important that students take account of the Practical Handbook and are able to use technical vocabulary appropriately.

1.4 Most students gained this mark, with a wide range of safety measures being accepted. A significant number of students seem to be reading questions too quickly and failing to capture important information; this was demonstrated here by those who provided 'safety goggles' as their response.

1.5 / 1.6 Less than half of the students were able to obtain full marks. Many students were unable to determine d, choosing to use 3×10^{5} m. Other common incorrect answers included use of the double slit formula and use of n as 1.28.

1.7 Many students confused this experiment with the Young's double slit experiment. They suggested taking a measurement across several fringes then dividing by the number of

fringes to find the mean fringe spacing. Students needed to make a clear statement that the percentage uncertainty decreased. Stating that the uncertainty decreased was incorrect and therefore penalised.

Question 2

Students would have improved their performance in this question by reading parts 2.1 to 2.3 before beginning.

2.1 Many students missed the fact that Ohm's law was only valid up to (8, 360) on the graph when drawing their best-fit line. Students often drew a straight line using all the data points (including those on the non-linear portion) for its judgement.

2.2 Less than half of the cohort could identify a suitable data point. Many had little appreciation of the situation and circled points that lay in the upper end of the non-linear section.

2.3 Some attempted to determine the resistance by finding the gradient of a tangent to the curve. This approach (that examiners see year after year) is incorrect and gains no credit. Mid-calculation rounding should be avoided. Students are advised to use their calculator appropriately by carrying all numbers forward rather than truncating the number early. Other students incorrectly chose to determine the percentage decrease from the resistance of the 550 mA value to the 22.2 Ω value.

2.4 This question proved very challenging for all but the most able students. The terms series and parallel are not well understood. Students often made incorrect statements about the position of the meters. Students thought that the voltmeter was not in parallel with R in circuit A. Many students were put off by the circuit B, stating that the circuit was incomplete. For circuit C, many stated that the voltmeter was in series with R.

Section B

Question 3

3.1 Almost half of students achieved both marks. However, over 30% scored zero. Students gaining 1 mark did so by correctly identifying this proton–neutron conversion. Students gaining more than 1 went on to describe correctly how the quark character changed. Students scoring zero usually thought that a neutron converted to a proton in beta-plus decay.

3.2 Students need to take more care in reading the opening stem to a question. The required equation was provided and any use of this obtained credit. Many students were unable to convert 0.52 MeV to joule. This conversion is a key skill expected of AS physics students and should be treated as such.

3.3 / 3.4 Over 80% of students were able to select the appropriate detector. They were familiar with the fact that two photons would be produced in the annihilation event. The most effective answers contained detailed explanations supporting the conclusion.

3.5 Many students gained some credit for attempting to determine the gradient of the graph. Common mistakes included: failure to appreciate that the velocity axis had a false origin, failure to convert the time from hours correctly, leaving the velocity in mm s^{-1}, and failure to read-off accurately from the graph.

3.6 Many students were able to state that the acceleration would increase. Only the most able students were able to provide a good explanation of why this was the case. A significant number of students thought that the acceleration would decrease because '*less of the photon's energy was absorbed*'.

Question 4

4.1 One mark was gained by at least 75% of the cohort. This was usually for use of $E = IVt$ with t = 200 ms. Generally, grade A students appreciated that the charge was the area under the curve and determined this to an acceptable level of accuracy.

4.2 The most effective answers typically scored at least two marks. Most students who gained 1 mark determined either the potential energy (p.e.) or kinetic energy (k.e.) correctly. Many students did not recognise the sum of the p.e. and k.e. as the useful energy output, often using only p.e. Others didn't realise that the answer to part 4.1 was the input energy and instead attempted to find some ratio of p.e. to k.e.

4.3 Many students gained 1 mark for stating that the resistance of the thermistor would decrease. Only the most successful answers gave an explanation of why this property was useful in this context. The most able students were able to provide quality descriptions that incorporated the potential-divider aspect of the series circuit.

Section C

Question 5

Many students had difficulty in analysing the base units of these quantities. Where working was seen, it often included errors in the use of indices.

Question 6

Most students identified the correct answer showing good understanding of the term *isotope*.

Question 7

Over 50% of students selected the correct response. A common wrong answer was B; students thought that the nuclides must have different proton numbers because they have undergone radioactive decay.

Question 8

Well answered, with almost 70% of students being successful. The most common wrong answer was C; where students didn't appreciate that the charge on this particle was +1.

Question 9

Almost 90% of students selected the correct answer.

Question 10

Around 70% of students selected the correct answer. The most common incorrect answer was B; students need to make sure they are selecting the best answer. Answer B was incorrect because the muon decays into an electron and (muon) antineutrino rather than an electron only.

Question 11

About 70% of students selected the correct answer. The most common incorrect answer was A; these students did not incorporate the work function into their reasoning and simply applied a conservation of energy approach.

Question 12

Over 80% of students selected the correct answer here. Option A was the most common incorrect answer; this indicated the students' lack of understanding of recognising a description of the photoelectric effect or its importance.

Question 13

Students had a good appreciation of the order of magnitude of the energy in this context.

Question 14

Over half of students selected the correct answer. The most common incorrect response was D; these students selected the transition with the largest energy change, thinking that photons of red light are more energetic than photons of green light.

Question 15

Most students were able to deal with this longer calculation in which they had to determine the wavelength and then multiply this by the number of waves in the pulse to determine the length of one pulse. In the most common wrong answer, students had found the wavelength of a wave and stopped there. It is important for students to read the question carefully to minimise the risk of misinterpretation.

Question 16

Almost 70% of students selected the correct answer. The most common incorrect response was D; this gave the regions in order of *decreasing wavelength*.

Question 17

Over half of students were able to select the correct answer. The most common incorrect answer was D; these students disregarded the equation and simply doubled the frequency when the tension doubled.

Question 18

About 70% of students selected the correct answer.

Question 19

Most students performed this calculation correctly. The most common incorrect answer was B; these students performed the calculation and became confused with order number and included the zero order in their answer.

Question 20

About 57% selected the correct answer here. The most common incorrect response was B; these students had discounted change in wavelength.

Question 21

Most students recognised the description of the diffraction pattern for a single slit.

Question 22

Less than half of students were able to perform this calculation correctly. Many have difficulty in resolving forces and dealing with equations in equilibrium situations. The most frequent incorrect answer was A; these students assumed the weight was shared between the tensions but failed to take into account that this was only the vertical component.

Question 23

This was a straightforward recall question and around 88% of students were able to select the correct answer.

Question 24

This question proved to be very challenging. Around 11% of students were able to select the correct answer. The most frequent answer, however, was A; this showed that the students had a very limited appreciation of the situation. They had difficulty in realising that the weight had not been included in the diagram and that the reaction force had to be equal to the sum of the downward forces.

Question 25

Over 60% of students selected the correct answer. The most common incorrect response was D; these students had a limited understanding of the independence of the vertical and horizontal velocities.

Question 26

A significant number of students selected answer A; these students were unaware of the conditions required for collisions to be elastic.

Question 27

Less than 40% of students selected the correct response. The most common incorrect answer was D.

Question 28

A quarter of the students were successful in this question. The most common answer was C; students found it difficult to deal with the diameter when trying to determine the new stress.

Question 29

The success rate in this question was quite low considering that it was a straightforward recall of specification content. This indicates students' lack of confidence with this section of the specification.

Question 30

This question had a low success rate, with around 27% of students selecting the correct answer. The students seemed unaware of the rules regarding adding identical cells in parallel.

Question 31

Around 40% of students selected the correct answer. The most common incorrect answer was D; these students assumed the whole 10 kV was dropped across the cables. They did not notice that this meant there was more power being output than input.

Question 32

Over half of students selected the correct answer. The question was challenging for these AS students and it was encouraging to see so many selecting the correct response after completing this multi-stage calculation.

Question 33

Almost half of students were successful in this question. These students appreciated the condition under which the terminal pd halves when there is a current in the cell.

Question 34

About 35% of students selected the correct response. The most common incorrect answer was B; this was achieved by dividing the 3.0 V by the resistance of 5.0 Ω. It highlights the inability many students have in deconstructing this style of problem and their lack of confidence in applying the rules for voltage, current and resistance in resistor networks.

Mark Ranges and Award of Grades

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