AS

PHYSICS

7404/1: Paper 1
Report on the Examination

7407
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Version: 1.0

General Comments

This paper consisted of six questions from across the AS specification. It made use of a wide range of question styles: short answer, single- and multi-step calculations, and extended writing. Some questions required students to draw a conclusion following some calculations or reasoning.

Section A

Question 1

This question was about isotopes of hydrogen and allowed students to demonstrate their knowledge and understanding of the physics of the nucleus.

01.1 A little over 60% of students achieved full marks for this question. About 20% gained only one mark. Mistakes seen included misuse of the atomic mass unit or misquoting the relative charge (+1) of the proton.

01.2 About 55% of the cohort selected the correct response.

01.3 Many students recalled the range of distances over which the strong nuclear force is attractive and repulsive. Some students stated only a single value of distance. This was not sufficient as a distance range was required. Few students were able to go on to describe how a balance between attraction and repulsion leads to the proton and neutron achieving an equilibrium position.

01.4 This question discriminated well, with some well-structured answers seen. Lack of a clear conclusion was a common feature of answers that gained partial credit.

Question 2

This question required students to carry out calculations based on electricity topics.

02.1 This two-step calculation was answered well, with over 70% of students gaining full marks. Clear working was commonly seen in this question.

02.2 In this question, the information provided allowed students to calculate any one of four quantities (resistance, length, area, resistivity). This needed to be accompanied by a conclusion about the suitability of the tape for the second mark. Comments following a reasoned comparison between values were expected. For example, '*the tape is suitable because the resistance will be 3.5 Ω and that is close to 3.7 Ω*'. In this series, comments were too often limited in their explanation ('*yes, it is suitable*').

02.3 This question discriminated well, with about 90% of students gaining some credit. Many students could read the current from the graph and then use it to calculate a resistance. The common error was to use 2.2 V, instead of 5.2 V. A number of students determined the gradient of the characteristic graph believing it gave the resistance of the LED; this is a continuing concern as this error is common and seen year after year. The determination of resistance must come from a calculation of $\frac{V}{I}$ at a single data point, never from an estimate of a gradient of a $V-I$ graph.

Question 3

This contextual question tested the ability to present '*show that*' calculations and fundamental ideas about forces and energy transfers.

03.1 In this question, students needed to find the vertical component of the tension, then take into consideration the two ropes and, finally, resolve the weight of the loaded cage. Credit was given to students when they clearly demonstrated these steps. Nearly 40% of students achieved full marks. Answers of a high standard were easy to follow and required little interpretation by the examiner. Students should consider briefly annotating their steps ('*Two ropes so double my tension*') when giving '*show that*' answers.

03.2 This question tested an understanding of Newton's laws. Over 60% of students achieved both marks. Many students understood that they needed to use $F = ma$ but did not appreciate, from Newton's third law, that the force given in 03.1 was needed. Students should be aware that a '*show that*' question often provides a value that will be used subsequently.

03.3 This question proved to be slightly more challenging than 03.1. Again, students gained credit for showing clear evidence of any of the steps in this calculation. A common error was to use the force from 03.1 in a Hooke's Law calculation.

03.4 Around one-third of the cohort gained full credit for this question. As a '*deduce*' question, there needed to be a conclusion about the justification of the claim. Over 50% of students gained no marks or did not attempt the question at all. Many did not make the connection with 03.3 and failed to consider energy transfers. A large number of students applied *suvat* (kinematic) equations but the acceleration is not uniform in this situation.

03.5 About 50% of students were able to convert the speed and to use it in the kinetic energy equation. Credit was given for an incorrect or no conversion of the speed so long as the substitution in the kinetic energy equation was fully correct. Mistakes in writing the 'square' exponent or in actually squaring the speed on the calculator were commonly seen.

03.6 In this question, students needed to compare their answer to 03.5 to the '*show that*' value of 03.3. Even though an error was carried forward, many students struggled to give a relevant conclusion.

Question 4

This question was about total internal reflection in water and in optical fibres.

04.1 Around 40% gained two marks and around 30% gained one mark in this question. Some students gave three explanations in their answer. Students should be aware that two marks will require two valid points. Giving more points than required, when incorrect, will negate previous valid answers.

04.2 About 80% of students could do this calculation, but only around 50% correctly chose the appropriate number of significant figures.

04.3 Again, about 80% of students could carry out this calculation successfully.

04.4 The extended-writing question showed good discrimination; three levels of response were used in assessing it. At the lowest level, the term ‘cladding’ seemed to be known better than ‘core’. Many students scored in the middle level by giving good descriptions of the functions of the core and the cladding. The understanding of dispersion mechanisms was often unclear or muddled. Only about 15% of students had a good understanding of at least one of the dispersion mechanisms and thereby gained credit at the highest level. A common misconception was that material dispersion was to do with the cladding either breaking or distorting the signal.

04.5 This question asked students to suggest reasons for changes in an unfamiliar context. Almost 60% of students could give one plausible suggestion, which was usually a comment about a change in the way the light ray interacted with the impurities.

04.6 The demand of this question is not beyond GCSE level but, nevertheless, the question discriminated very well. About one-third of the cohort gave fully accurate descriptions of both waves. A further third of students gained one mark. The common mistake limiting students to one mark was a failure to reference explicitly the direction of the energy transfer. One-third of candidates attempted the question but gained no credit.

Question 5

This question required students to have an understanding about systems in equilibrium.

05.1 Nearly 70% of students determined the answer by considering the balance of forces.

05.2 This question was poorly answered, with over 60% gaining no credit. The definition of a couple was required and this was not well expressed. Only about 12% of students could define a couple and then explain why **A** and **B** could not be a couple. It was very common to read that **A** and **B** were a couple because of the symmetry of the system.

05.3 This question proved challenging for many students and barely 20% achieved full marks. Of the remaining cohort, few were competent in selecting an appropriate pivot position for the application of the moments principle.

05.4 This question was not answered well. Students could have helped themselves by drawing a diagram of the new situation. Had they then drawn the vertical forces on this diagram, they may well have realised that the readings would be the same. Most students, however, considered the question in terms of moments and drew incorrect conclusions.

Question 6

This question tested knowledge about particle physics and quantum phenomena.

06.1 Just over 50% of students gave two specific properties of an antiparticle. Students should understand that ‘*different*’ does not mean the same as ‘*opposite*’ when describing charge.

06.2 This recall question was well answered.

06.3 This question discriminated well. Many students applied $E = mc^2$ even though this equation is not included in specification. Full credit was allowed for this approach. A difficulty for many students was converting the rest energies from MeV to J.

06.4 Few students could describe the formation of a line-emission spectrum concisely. Most began by explaining the process of atomic excitation, which gained no credit. Students should be guided to consider the number of marks available and the specific question. In this case there were three marks and three parts:

Why is it a <u>line</u> (rather than continuous) spectrum?
Why is it an <u>emission</u> (rather than absorption) spectrum?
Why is it a <u>spectrum</u>?

Mark Ranges and Award of Grades

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