A-LEVEL
PHYSICS

7408/1 Paper 1
Report on the Examination

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General Comments

This paper was similar to those of previous years in terms of demand and specification coverage. The questions gave students many opportunities to demonstrate their knowledge, understanding and skills across a range of topics. A variety of question styles including short answers, single and multi-step calculations, extended writing and multiple choice were used.

The balance of assessment objectives and the mathematical demand was in keeping with previous series.

Question 1

None of the parts in question 1 was particularly demanding.

01.1
The majority of students correctly identified the quark structure. There were some students who believed the particle was a meson and therefore did not get the mark.

01.2
The two marks were awarded independently. The majority of students scored both marks, but a significant number identified the change in strangeness but linked it to the strong force. Many other students knew it was a weak interaction but explained it in only general terms. These answers only received one mark.

01.3
Just over half of the students gave the correct answer. Ambiguous and contradictory answers were relatively common. Students should be advised to make their answer clear in order to get credit.

01.4
This straightforward calculation caused little problem for the majority of students. There were some who had difficulty with the unit conversion, being unsure about whether to multiply or divide by the charge on the electron. With only one mark available, no marks were given for partially correct answers.

01.5
This dealt with the nature of Particle Physics research. A common answer was related to peer review, which, whilst important, is related to separate, independent teams. The context of the question was the large international teams involved in particle physics research. Answers that identified the collaborative nature of these teams gained credit.

Question 2

There was a range of demand to the parts of question 2 that meant it produced a good spread of marks.

02.1
There were several alternative routes available for the first mark, and the majority of students were able to pick up credit for one of them. The second mark proved to be more difficult, with only about half of the students getting both marks. Almost all of the students who worked out the answer correctly realised that a two significant figure (s.f.) answer was inappropriate in the context of the question.

02.2
Few students had any difficulty calculating the kinetic energy. This proved to be one of the most accessible questions on the paper.

02.3
This four-mark question was answered correctly by almost half of the students. It was clear that, although the graph was unusual, the support given in the question allowed students to access the marks. The mark scheme was designed to credit each step in the calculation separately. Students who set out their answers logically and clearly benefited from this.

02.4
This was much more demanding with only about one in six students receiving both marks. The assessment objective for this question required some flexibility in the approach students could use. Students should be encouraged to develop their skills in answering AO3 questions of this kind.

Question 3

Questions on electricity continue to provide challenge for many students. The question and mark scheme succeeded in providing marks across the range, however.

03.1
Many students had difficulty answering the question. There were clear misconceptions associated with energy and potential difference, for example. Many students also missed out any reference to the internal resistance of the cell.

03.2
This was much more accessible with over 90% receiving at least one mark and almost two-thirds obtaining all three marks. Common errors included using the emf as the terminal pd or rounding early. Answers that were set out clearly and gave a value to at least three s.f. were most likely to get full credit.

03.3
The mark scheme allowed students to receive partial credit for some idea of how to approach this question, which meant that over 70% obtained at least one mark. A common error was using $29.8\ \Omega$ instead of $129.8\ \Omega$, giving an answer of $2.5\ \text{V}$. Answers that simply divided $2.89\ \text{V}$ by 5 were only given full credit when it was clear that they were using the terminal pd.

03.4
There were five marking points for a maximum of four marks. The mark scheme was designed to reward partial credit for those students who made errors. Most students had some problem understanding what was happening at position Q on **Figure 5**. The question produced a very good spread of marks, with over 70% of students picking up at least one.

Question 4

Questions about refraction and total internal reflection have been asked several times in the past and usually prove to be relatively challenging to many students.

04.1
A straightforward calculation that over 80% of students completed successfully. Transcription errors when writing down the angle were common with students who did not get the mark.

04.2
This question proved to be much more difficult than 04.1. The best answers correctly identified the process of total internal reflection and could explain why it happened in terms of the incident and critical angles. They then went on to explain why the ray was undeviated as it left the prism. Many answers missed out the second marking point, or failed to identify the angle of incidence. Other answers often described the changes in direction without any explanation.

04.3
Nearly 90% of students managed to get at least one mark on this question. This mark was usually given for showing that the ray remains within the prism. Students who used a protractor for the reflected ray were more likely to get the second mark. There was some leniency for students who chose to draw the ray by eye, however. The third mark was for a ray that left parallel to the incident ray. Those who had read the question carefully and those with a good understanding of refraction were most likely to obtain this mark. Students should be encouraged to read the question carefully: for example, the stem of the question stated that the prism acted so as to "*reverse the path of the light*". A carefully-drawn, reflected ray would be clearly parallel to the refracted ray, which would also have provided a hint for the third marking point. Each mark was awarded independently. Over one-third of students obtained two marks whilst about one in eight students managed to get all three.

04.4
This was one of the most discriminating questions on the paper. The most successful answers either used **Figure 8** on the facing page, as was suggested, or re-drew **Figure 8**, and labelled the angles. A common error was misidentifying the critical angle as either the angle between the ray and the surface at the second boundary or the incident ray at the first, despite these angles being clearly greater than the 45^{o} in **Figure 7**. Students were told that **Figure 8** was '*not to scale*' so that they did not attempt to take measurements from the diagram. Simply using Snell's Law with the critical angle was common. Other incorrect answers showed a negative value for the refracted angle and students who took this route often did not go back to check what they had done wrong.

04.5
This tested the assessment objective AO3. More than half of the students managed to get at least one mark, usually for identifying that the critical angle in **Figure 10** would be greater. The best answers showed some understanding of the context and realised that in **Figure 9** the prism would no longer function as required as the path of the ray would no longer be reversed, whatever the value of θ.

Question 5

This question included parts with a range of difficulty, giving most students the opportunity to pick up some marks.

05.1
A straightforward calculation that required students to use an appropriate section of the graph to obtain the Young modulus. Power of ten errors prevented some students obtaining the mark.

05.2
A range of responses was acceptable but the idea that there was no increase in strain beyond the linear section of the graph did not get the mark. These answers implied that students knew what brittle meant but did not apply it to **Figure 11**.

05.3

The calculation was reasonably accessible with nearly half of the students getting full marks. The question discriminated well, giving students who got the wrong value some credit provided their answer was set out sufficiently clearly to show what they were doing. A common error was using $200\ \mathrm{N}$ for the load; this gave access to two of the three marks.

05.4
This was also one of the most discriminating on the paper. Over half of the students were able to get at least one mark, usually for providing evidence of a moment equation. Students who did not see that for AB to be horizontal the extensions of the two wires had to be equal made little further progress. The mark scheme produced a range of marks, rewarding students who set out their work sufficiently clearly to obtain intermediate marks. Using the value of extension from question 05.3 gave partial credit to some of these students.

Question 6

This question included some parts that many students found very challenging but also parts that were quite accessible.

06.1
It was clear that many students had little idea about how the equation for SHM can be obtained. Having the force equation on page 20 of the question paper gave some students a starting point, but relating it to the acceleration with a negative sign, or stating which factors were constant, was rarely seen. Commonly students simply stated the conditions for SHM without relating it to the context.

06.2
The calculation was much more straightforward with over half of students getting both marks. The mark scheme allowed those who could go no further to gain one mark for using a value of ω or similar. Common errors included adding the amplitude when calculating the period, or using the total distance submerged as the amplitude when calculating the acceleration.

06.3
This proved to be quite challenging. Students who made no reference to the amplitude being a maximum at resonance were limited to one mark. Other answers showed some difficulty with the idea of driving frequency. Some good answers were seen that made use of a labelled sketch graph.

06.4
A question that discriminated very well. More than 60% of students were able to get at least one mark, usually for working out the wave frequency. Nearly 40% of students were able to go further, often for stating that this was close to the natural frequency and therefore the boat should move. Full marks were given for those who also made some reference to what happened to the driving frequency when the boat was moving. This is another example of a question that tests assessment objective AO3. Students should be encouraged to practise answering questions of this kind in preparation for this examination in the future.

Section B

The multiple choice questions covered parts of the specification not covered in Section A. The distractors in these questions were written with common errors and misconceptions in mind. These questions are therefore an extremely useful resource when preparing students.

The easiest questions were 7, 12, 20, 10 and 11, with over 75% of students getting these questions right. The most demanding were 18, 26, 22, 21 and 13; fewer than 40% of students got these right. For several of these the correct answer was not the most popular choice.

Question 18 was about the displacement of a projectile. The most popular answer was A, followed by B. These answers suggested that students did not identify that displacement, and not distance, was required.

Question 26 was about tensile stress in a heavy cable. The most popular answers were B and C, the latter suggesting that students did not realise that the weight of the cable was **not** negligible.

Question 22 was about the equilibrium of forces. The most popular answer was A. Drawing the weight of the trapdoor and the tension in the rope on the diagram would have shown their lines of action. This would have indicated B as the only force with a line of action that would pass through a common point and therefore give no turning effect.

Other questions with popular distractors were 21 (D), 13 (D and C), 17 (B) and 8 (A).

Mark Ranges and Award of Grades

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