A-LEVEL
PHYSICS

7408/3BD: Paper 3B Turning Points in Physics
Report on the Examination

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General Comments

There is clear evidence that students are being prepared well for this paper. They show familiarity with calculations and demonstrate recall of the general ideas. Difficulties arise when students are expected to reach a judgement. This is related to the testing of Assessment Objective 3 (AO3) and this report highlights where they occur. There is also evidence to suggest that, when faced with less familiar questions, some students resort to their knowledge of the core content of the specification. This can be seen particularly in questions 1.3, 3.1, 4.2 and 4.3. Because of the overlap between this option and the core content, mark schemes will continue to require students to demonstrate knowledge and understanding of content relevant to this option in order to gain full credit.

Question 1

1.1 This question was generally well answered with nearly half of the students receiving both marks. Most students were able to identify the two forces but, for the second mark, students were required to make it clear that the two forces are equal in size and opposite in direction *and* to give the direction of at least one of the two forces. It was this latter point that prevented some students from gaining the second mark. Although '*electromagnetic force*' was condoned, it would be helpful for students to understand that the force is electrostatic in nature. This would prevent some students from wrongly stating the force as '*magnetic*'. Writing the relationship between the forces as an equation was acceptable if it was clear what the symbols referred to, but it should be noted that the use of '*e*' for '*q*' in the electrostatic-force equation was not given credit in this context.

1.2 It was clear from the answers seen that many students were familiar with this type of calculation. Common errors included missing the *g* in the equation for gravitational force, and, to a lesser extent, confusing *v* (velocity) and *V* (volume) in the algebra. Most students understood that, in a 'show that' task, they need to quote their final answer to at least one significant figure better than that given in the question.

1.3 A fundamental aspect of this part of the specification is the discrete value of electronic charge. It was very disappointing to see that a large number of students failed to apply this information to this question. It is in the nature of AO3 questions like this that students will often be expected to reach a conclusion or make a judgement based on their own analysis. Some students who did realise that the charge involved three electrons and therefore couldn't be split evenly did not gain the third mark as they did not make it clear that one drop would rise and the other fall.

Question 2

2.1 This multiple-choice question was answered correctly by the majority of students.

2.2 Questions about Newton's and Huygens' different theories on the nature of light have been asked many times in the past and it was clear that many students were familiar with their main points. A downside of this familiarity perhaps was that some students spent time describing reflection rather than refraction. The important features of Newton's theory that were often missed are related to the behaviour of the particles at the interface, and the fact that the parallel component of momentum is unchanged, but the perpendicular component

increases, thus causing the light to bend towards the normal. Even more commonly, students failed to mention the secondary wavelets that are the key feature of Huygens' theory. Many students recalled that the predicted speed of light in water is different in the two theories and linked this to an appropriate experiment. Some also went on to describe a relevant diffraction experiment in support of Huygens, but some gave unnecessary detail. A significant minority of students incorrectly suggested that one theory predicted that light would bend away from the normal as it entered the water.

2.3 In order for students to gain any credit, they had to make it clear that both an electric field and magnetic field are involved. Some excellent labelled diagrams that gained full credit were seen. Common errors included failing to label the direction of propagation, making it unclear that the two waves are perpendicular, and failing to ensure that the two waves appear in phase. Examiners were aware of the difficulties of making these points clear in a diagram and full credit was given to students who stated these points in the text. Although it was condoned on this occasion, it is unlikely that students who suggest that polarisation causes either the electric field or magnetic field to be completely absorbed will be given full credit in the future.

Question 3

3.1 Vague and incomplete answers to this question often prevented students from gaining both marks. An equation on its own only gave access to the second mark. Also, for this mark point, the symbol *p* was not accepted on its own for momentum.

3.2 This calculation was familiar to many students. The need to make a comparison and state a consistent conclusion prevented some students from gaining the second mark. This is another example of an AO3 assessment that requires students to make a judgement.

3.3 There were several approaches that were given credit in this question. The most common correct answers referred to the increase in potential difference and the decrease in distance between the foil and film. However, some students found it difficult to explain clearly why this would lead to a narrower pattern. Some students referred to changing the size of atoms rather than their spacing and therefore did not gain credit.

Question 4

4.1 Examiners saw many different correct solutions to this question, all of which scored. In order to gain both marks, examiners required three or more data pairs to be tested. As with other AO3 questions, a relevant statement or conclusion was also needed to gain the second mark.

4.2 Very few students obtained all four marks for this question. Answers were often too general or vague with some simply stating the two postulates, and therefore getting no credit. A clear reference to the data in Table 1 was needed for the first mark, and this was often missed. The idea that '*an increase in* v *also led to an increase in* m' was the most common mark awarded. More rarely, responses referred to the limit in *v*, with *m* tending to infinity, or discussed a link between this and the increase in kinetic energy (k.e.). A common statement that showed little extra understanding of this area was that the k.e. increases as *v* increases.

This was perhaps another example of students falling back on their knowledge and understanding from the core curriculum.

4.3 This calculation proved more difficult than the other calculations in this paper. A common error was the use of 0.95*c* in the calculation of E_0. There was also evidence of students taking no account of relativistic effects and simply calculating $\frac{1}{2}mv^2$.

Mark Ranges and Award of Grades

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