AS

PHYSICS

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Report on the Examination

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General Comments

This was the first paper for this new award and evidence from scripts suggests that an encouraging proportion of students were well prepared for the exam and were able to cope successfully with the broader scope of the questions and the change in emphasis of the assessment objectives. In general students seemed more confident with quantitative questions and less so with those that required extended written answers. There was a tendency not to present full arguments when applying physics principles: examples of this being questions 1.2, 3.4 and 5.1. The evidence from scripts suggests that students had sufficient time to answer all the questions and few incomplete papers were seen.

Question 1

This question required students to apply their knowledge and understanding of mechanics to analyse the principles involved in the operation of a jet engine. Students for the most part were able to apply the appropriate physics ideas in their answers. In question 1.1 the vast majority of students appreciated that momentum increased. Question 1.2 in contrast, resulted in a much greater variation of response. Many students appreciated that Newton's third law was important here and were able to quote it correctly. However, they did not often produce complete answers, missing out important detail such as the engine exerts a force on the air or that the air exerts a force equal in magnitude on the engine. Weaker responses tended to try and involve air resistance in their explanations of why there was a forward force acting on the engine. The calculations required to answer questions 1.3, 1.5 and 1.6 were well done with full credit being commonly achieved. The only major mistake seen in question 1.6 was confusion between initial velocity and final velocity. Question 1.4 required an explanation of why the momentum had changed when the deflector plates were deployed. The majority of students did appreciate this was because the direction of the air's velocity had changed but did not then give a full answer by explaining that momentum and velocity are vector quantities. Question 1.7 was quite challenging and only the strongest responses were able to suggest that this might be due to the decrease in the mass of air entering the engine per second.

Question 2

This question about the formation of stationary waves in a microwave oven was answered well by a good proportion of students. In question 2.1 the idea of reflection taking place was clearly stated in the majority of answers. The second marking point explaining how this resulted in the reflected and incident wave superposing was more discriminating. A significant proportion of students stated that the waves superimposed rather than superposed. Question 2.2 was only fully answered by those students who, having identified the melted chocolate positions as antinodes were then able to explain that this is where the amplitude of the wave was a maximum. Weaker responses tended to identify these positions as nodes or did not link the melted chocolate to stationary waves at all. Question 2.3 was a five mark calculation and this produced very good discrimination. About a third of students were awarded 4 or 5 marks. To obtain full marks students were required to give a clear indication, either on the diagram or in their working, that they had measured the distance between the first and third dot rather than measuring from the first to second dot and then doubling. It was sometimes hard to establish exactly what students had measured and it should be appreciated that showing full working in these extended calculations is very important. A lot of vague answers were seen to question 2.4 and it was the physics that needed to be explained. A common response was 'to cook the food evenly' and this was not seen as a physics explanation.

Question 3

Question 3.1 required students to state the meaning of tensile stress and tensile strain. Marks were frequently lost due to a lack of precision in technical language. For example it was common to see force per unit area rather than cross-sectional area and change in length per length rather than extension per original length. In question 3.2 a significant proportion of students were able to select an appropriate property for material but only about half of those correctly identifying the property were then able to give a suitable explanation. The calculation in question 3.3 was well done with over half the students being awarded full marks. The main errors were an incorrect calculation of cross-sectional area due to using the diameter as a radius or a power of ten error when using GPa. Question 3.4 was a level of response marked question and some very impressive answers were seen. About 30% of students were placed in the top band. Some answers were spoilt when students did not give complete answers. This was because although they correctly identified the material for the applications they did not explain why other materials would be rejected. Generally students were more successful in the selection of material for the lift cable than they were for the rope for bungee jumping. This was in part due to them thinking that in order for a material to be elastic it had to obey Hooke’s law and thus have linear stress strain characteristics. This led them to think that material D was not behaving elastically and therefore should be rejected for both applications. Overall however, this question seemed to generate better answers than has been the case with extended prose questions in previous specifications.

Question 4

Experience from past physics exams at this level indicates that students are better at answering quantitative questions involving electric circuits and this is supported by evidence from this question where the calculations were frequently done well. Question 4.1 required students to calculate the diameter of the wire and a high proportion of students were able to do this successfully. Full marks were obtained by over 70% of students. There was more variation in questions 4.2, 4.3 and 4.4. While the majority of students were able to calculate the resistance of the circuit, analysing the parallel arrangement was more discriminating. In particular, calculating the resistance of the probe proved challenging. A common mistake was the assumption that the current divided equally in the two branches and therefore the current in the probe was the same as that calculated for R_3. Many students found 4.5 difficult and tried to determine the percentage change in diameter using extended calculations which frequently led to arithmetic errors. The first mark was for recognition that the diameter must decreases and any indication of this such as a downward arrow or negative sign was accepted. The marks obtained for question 4.6 were disappointing in spite of the mark scheme being expanded to accept a greater range of answers. Very few students picked up that the question referred to the voltmeter reading rather than the pd between A and B. The first marking point was for explaining the effect the internal resistance would have on the circuit by for example reducing the current or terminal pd. The second mark was for a sensible suggestion explaining why the voltmeter reading did not change such as realizing that the closeness of the resistance ratios would make the pd being measured very small. Having the bridge circuit slightly off balance did mean that a comment on the high resistance of the voltmeter was relevant and some did identify this point.

Question 5

Answers given to this question on the photoelectric effect provided evidence of the tendency of some students to not present full arguments when applying physics principles. In question 5.1 most students identified that electrons needed to leave the surface but the linking of this to the frequency of the radiation was quite vague. Responses that failed to mention photons were common and many did not emphasise the importance of the work function. It was not unusual to see discussions that confused the photoelectric effect with the excitation and ionisation of electrons in individual atoms. It was a similar story in question 5.2 where the majority of students realised that the current would increase but then failed to explain why in terms of the increased number of photons striking the metal surface per second. The calculation in question 5.3 was generally well done with nearly three-quarters of students scoring full marks. Surprisingly, far fewer were then able to use their correct answer from 5.3 to calculate the stopping potential in 5.4. Question 5.5 was another example of incomplete arguments. The majority did appreciate that the stopping potential would increase but were unable to give complete explanations for this effect. Better responses did link this increase to maximum kinetic energy but it was very rare to see answers explaining that this was due to greater energy transfer by photons.

Question 6

In this question students were required to extract information from an introductory passage. Question 6.1 was a straightforward starter but as with 3.1 a significant proportion of answers were spoilt by a lack of precision. Students were required to mention atoms or nuclei in their responses and a significant proportion did not do this. Question 6.2 required an explanation as to why two photons were produced. A number of students seemed to think this was necessary due to energy conservation. Of those who realised this was due to momentum conservation, a significant proportion then failed to appreciate the importance of the photons travelling in different directions. Question 6.3 was an extended calculation and students were told to calculate the maximum frequency of the photons produced in the annihilation of the two nuclei. Maximum was necessary to indicate that the whole rest energy of the nuclei should be used and excluded the possibility of calculating the frequency of photons produced due to annihilation of individual nucleons within the helium and anti-helium nuclei. It is true that higher frequency photons would be produced if the nuclei had significant kinetic energy but students were told to use information from the passage in which there was no mention of kinetic energy. For full marks students needed to explain how they dealt with two nuclei annihilating and two photons being produced. Questions 6.4 and 6.5 were well answered and the only common error was a failure to identify the positron correctly in the equation.

Mark Ranges and Award of Grades

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