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General Certificate of Education

Physics 1451

Specification A

PHYA2 Mechanics, Materials and Waves

Report on the Examination

2009 examination - January series

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GCE Physics, Specification A, PHYA2, Mechanics, Materials and Waves

General Comments

The paper provided many opportunities for all candidates to demonstrate their knowledge and understanding of the topics in the unit and to apply their knowledge and understanding in different contexts. Many candidates provided evidence of careful preparation although some candidates lost marks through basic errors such as confusing sines and cosines in question 2 (b). The dedicated marks for units and significant figures presented few problems for many candidates. Presentation was good and candidates usually showed full working for calculations although these were sometimes set out poorly, leading to incorrect answers due to unnecessary arithmetical errors.

Question 1

Part (a) proved to be a very easy question, with the majority of candidates correctly plotting all the points and gaining all five marks.

A large number of candidates only got one mark out of two for part (b) (i), because they did not point out that the gradient is the deceleration - though it is possible that the majority knew this. Most recognised the significance of the straight line.

For half the candidates, part (b) (ii) was a straightforward calculation of the area. However, many candidates did not recognise its simplicity. A common incorrect approach was to select a kinematics equation and substitute in 15 m/s and 3.5 s. Candidates would gain higher marks on this type of question if they routinely state the principle they are using, e.g. in this case ‘distance travelled = area under line’.

Question 2

Part (a) was answered very successfully. A common error was to state ‘length’ or ‘height’ rather than distance, although ‘length’ was tolerated.

On part (b) (ii), candidates knew what to do but most did not gain full marks due to confusion over powers of ten or units for power.

Half of candidates achieved four or five marks out of five on part (c). Again there was confusion with prefixes/powers of ten and units. It is important that candidates stated ‘Pa’ not ‘pa’.

Question 3

Half of the candidates gained both marks for part (a). Nearly all pointed out that force is proportional to extension but half did not mention the ‘limit of proportionality’. Candidates need to ‘look for a second mark’.

Candidates had to apply their knowledge of Hooke’s law in part (b) (i). A significant number of candidates did not have a workable method and scored zero on this question. Many candidates picked up two marks by describing a simple comparison between extensions due to standard masses and the rock sample. A correct graphical approach and a point about accuracy were required for full marks. This question could perhaps form the basis of a practical activity to illustrate the significance of Hooke’s law in measuring mass or weight. A large number of candidates believed that the Young modulus of the spring should be found.

In part (b) (ii) most candidates knew how to stop the apparatus toppling over but a significant number could not describe this well enough to get the first mark, i.e. 'put a weight on the stand' did not gain marks but 'put a weight on the base of the stand' did. For the second mark, it was expected that candidates would give a correct explanation in terms of moments but hardly any candidates spotted this.

Question 4

In part (a), a large number of candidates thought that the horizontal component of velocity was to be shown rather than the instantaneous velocity at a tangent to the path. Many candidates who had the right idea still did not gain marks due to a badly drawn tangential arrow. The mark for the acceleration was gained by many candidates.

Of those candidates who gained no marks in part (b) (i), many simply could not rearrange s = 1/2gt^2. Those who successfully did this picked up both marks.

A majority of candidates gained two marks but some believed they had to use a 'suvat' equation and gained no marks.

Question 5

A large number of candidates struggled with part (a). This was mainly due to a lack of understanding of the fact that two waves must be travelling in opposite directions in order for a standing wave to form. They seemed to be describing one wave reflecting back and forth. Those who understood how the stationary wave formed and added further detail went on to score two or three marks fairly easily.

Some candidates in part (b) (i) did not multiply by two and only scored one mark out of the two available.

A majority gained two marks in part (b) (ii). A few candidates knew what to do but their sketch lacked acceptable accuracy, for example, the 'loops' were not of similar length. Only a quarter of candidates got the wavelength wrong.

Question 6

Many candidates incorrectly performed the calculation in part (a) (i) and some lost the mark by failing to round to three significant figures.

Most candidates comfortably picked up the first two marks in (a) (ii). The third mark required a correct indication of the partial reflection and very few candidates showed this.

A majority of candidates were able to point out that the angle exceeded the critical angle in part (b) (i). However, some candidates need to be careful not to say 'gone past' the critical angle as this does not clearly indicate 'greater than'. Only a few went on to mention that the critical angle was 49 degrees.

Many candidates picked up the first two marks for a carefully drawn ray reflecting from the surface in (b) (ii) but many then did not correctly show the ray refracting into the glass. Many missed the fact that TIR only occurs when n1>n2 when a ray travels from one to two. Many also went on to calculate the critical angle for the glass-air boundary (62.5 degrees) which only applies to a ray travelling from glass to water. There was also a common misconception that a

ray cannot pass into a medium with a higher refractive index. Some struggled to judge angles by eye and the use of a protractor should perhaps be encouraged for these candidates.

Question 7

Part (a) (ii) was answered well by many who knew the terminology very well; most gained three or four marks. The majority of the candidates who did not gain any marks had misinterpreted the words 'describe the formation' to mean 'describe the appearance' rather than 'how and why are they formed'.

Most candidates correctly rearranged the double slit formula in (a) (iii). It was then surprising that very few candidates realised they had to divide 3.6 by 4 to get the fringe spacing and this limited them to a maximum of two marks. Again many candidates who understood how to answer the question then failed to get to grips with the powers of ten and dropped marks.

Most candidates did not gain any marks in part (b) and only very few gained full marks. Part of the problem was that many believed that a single continuous spectrum would appear or that each fringe would be a different colour. A useful exercise to overcome candidate's difficulties with descriptive answers could be to show interference phenomena and ask students to write a detailed description as they are observing the pattern.

Mark Ranges and Award of Grades

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