INTERNATIONAL A-LEVEL PHYSICS

PH03 Paper 3

Report on the examination

June 2018

REPORT ON EXAMINATION: INTERNATIONAL A-LEVEL PHYSICS PH03 UNIT 3 JUNE 2018

This was the first examination for this module and the cohort of students was small.

The paper seemed to be accessible to the students. There were no indications that students faced significant time constraints. The average performance of students was the same in section A (extended questions) as it was in section B (multiple choice questions). Among the extended questions, students were, on average, most successful with question 1 (simple harmonic motion). The other questions in the section had broadly similar success rates.

Students tended to be successful with written answers when they called for directly learnt responses but less successful when asked for deeper understanding or of the application of their knowledge to a novel context. Some written answers lacked detail. Students could usefully be reminded that, when a question contains data, it is likely that reference to that data is expected in the answer.

Mathematical work was well done when calculations were straight forward but students found multi-step calculations to be more challenging. There was a lot of poor setting out of calculations. As ever, there was a high correlation between rigorous setting out of mathematical work and success in those calculations. There was some poor use of significant figures. Graphical work often lacked the required detail even when prompts were included in the question. Standards of sketching were sometimes poor. Students are not required to produce perfect sine curves but some attention to detail is expected.

QUESTION 01

In part 1, most of the students remembered that, in simple harmonic motion, the magnitude of the acceleration is proportional to the displacement from the equilibrium position but fewer were clear that the direction of the acceleration is opposite to that of the displacement.

The calculation in part 2 was well done by most students. Students should be advised that, for “show that” questions, they should give their answer to more significant figures than the target number.

Question 1.3 was also well done by most of the students.

Many students were partly successful with question 1.4 although few got all of the detail correct. Errors included not drawing 2 full cycles of the oscillation; failing to give appropriate labels on the axes; not having the appropriate functions displayed (eg cosine for the 1st graph paired with minus sine for the second). Some of the sketches of trigonometrical functions were poor.

QUESTION 02

The first part of this question was done correctly by most of the students.

In part 2, some knew that potential was zero at infinity but tended to have difficulty in explaining why that fact requires all gravitational potentials to be negative.

In part 3, all students took the correct approach but most forgot to use the masses of both the boulder and the spacecraft.

Question 2.4 proved to be difficult for most students. A common incorrect approach was to use $\boldsymbol{T = 2\pi\sqrt{\frac{l}{g}}}$ and to equate *l* with the radius of the orbit. Students could usefully advised that the technique of equating an expression for centripetal force with $\boldsymbol{mr\omega^2}$ or with $\frac{mv^2}{r}$ is common when analysing circular motion in many contexts.

Most students succeeded with the calculation in part 5 but there were some who could not use the equation provided effectively.

QUESTION 03

In the first part of this question, many students did not know which equation to use and some showed uncertainty in the relationship between frequency and angular velocity.

Part 2 was usually done correctly: often with an error carried forward from the previous part.

Most students were also successful with part 3.

Answers to part 4 were often lacking in detail. When a question states that a parameter is doubled and asks for the effect that may have on other parameters, it is expected that answers are quantitative in nature. There were a few good answers to this question but also many that revealed confusion about electromagnetic induction and power dissipation.

QUESTION 04

In part 1, the majority of students could not define the decay constant. Some confused it with half life and others with decay rate.

The majority of the students made good progress with the calculation in part 2 but many stopped when they had calculated the number of thallium nuclei remaining instead of going on to calculate the number that had decayed.

Part 3 was less well done. The majority of the students showed a decay curve rather than a curve showing the growth of the number of lead nuclei. Few students attempted to show appropriate detail even though they had already made calculations that would make it easy for them to do so.

QUESTION 05

The majority of the students made good answers to part 1. A few chose not to give appropriate detail even though the question was numerical. Students were expected to say that the capacitor could store 80 μC per unit potential difference between the plates. A non-specific statement that capacitance is the charge stored per unit volt was not considered to be sufficient.

There were very few correct answers to part 2. The action of a dielectric was not well understood. In addition, answers lacked detail. For example, it was common for student to state that the dielectric increased the capacitor’s ability to store charge. It is necessary to refer to the capacitor’s ability to store charge at the same potential difference.

In part 3, most students made some progress with this calculation although relatively few got through to the correct final answer. It was again noticeable that, in this multi-stage calculation, those students who organised their work clearly tended to be more successful.

QUESTION 06

In part 1, a surprisingly large number of students did not attempt to draw the paths of the particles. Those that did attempt it often provided acceptable answers. Students could usefully be advised to annotate their drawings. In this case, both paths should have been circular arcs. It would be wise to label them accordingly.

Approximately half of the students made good progress with the calculation in part 2. Again, the calculation is an example in which two expressions for the centripetal force are equated. Students could usefully be advised that such techniques are common. Some students attempted calculations by writing strings of numbers without any algebraic guidance. Such attempts were rarely successful.

In part 3, students were expected to recognise that the force experienced by the particles was always at right angles to the velocity and so only the direction of movement changed and not the magnitude of the velocity. Few recognised this.

SECTION B

Questions 8, 14, 16, 19, 29 and 33 found to be relatively easy. Students found questions 10, 12, 23, 27,28 and 32 to be difficult.

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