INTERNATIONAL A LEVEL PHYSICS

(9630) PH03

Report on the examination

January 2020

REPORT ON EXAMINATION: INTERNATIONAL A LEVEL PHYSICS 9630 PH03 JANUARY 2020

General

There was a broad range of marks in this component with the average mark for Section A being slightly below the average for Section B. There was no indication that students were short of time and all questions were attempted. Students could generally answer questions from across the component; they found those on magnetic field theory the most challenging.

Calculations and numerical “show that” questions were handled well. There is continuing evidence that students entering the exam are competent at algebraic derivations and manipulations. Written explanations proved to be more challenging. In some questions (e.g. 2.5 and 3.5), students quoted equations. This is acceptable when the equation supports the written argument but the equation alone is insufficient for credit.

Students are reminded that “show that” questions are often given to provide a value that can be used in a subsequent question. When students fail to calculate a value that rounds to the given “show that” value, they **must** use the “show that” value given in subsequent calculations, rather than their incorrect value. This issue was particularly relevant to question 2.4.

Question 1

1.1

Most students gained at least one mark, usually by suggesting repeats to find an average or by timing over multiple oscillations. Mixed ideas such as “time for 10 oscillations and find the mean” were not awarded credit. The answers had to refer to procedures using a stopwatch, so any comments about other timing equipment were ignored.

1.2

About 60% of students gave a correct answer. Common errors were to state that the direction of the force was always opposite to the direction of motion or that the negative sign suggested an inverse proportionality. Students who focused on the direction of the acceleration, ignoring the force, were not given credit.

1.3

This question discriminated well with many coherent derivations seen. Students with the best and clearest derivations quoted the equation just before substituting into it. Some students tried to carry out the derivation in terms of energy; this was not the instruction they were given in the question. Others tried to manipulate the given equation to show that $F=ma$.

Question 2

2.1

This question was well answered, with nearly 75% of student gaining full marks.

2.2

The quality of answers for this “show that” was particularly good. It was common to see the equation stated, values substituted, and a final answer given to better than two significant figures.

2.3

This question discriminated well. There were several valid methods to do this and a range of methods was seen. Students who chose to use the gradient method needed to use at least half the abscissa range.

2.4

This question also discriminated well, with just over 50% gaining full credit. The most successful approach was to carry out two distinct calculations: to evaluate the total resistance using the time constant, and then use that value in the parallel-resistor equation. Students who attempted to find a single, general, algebraic expression for the resistance were often unsuccessful. Questions 2.2 and 2.3 provided the values necessary for students to obtain the correct total resistance. These were not used by a significant number of students.

2.5

This question also discriminated well. Many students successfully argued that the total resistance (in Figure 4) would be larger and so would the time constant, but incorrectly concluded that the initial rate of discharge would increase as result.

Question 3

3.1

Almost all students achieved the mark for this question.

3.2

About half the students achieved one mark and a little over a quarter gained both marks. This question tested knowledge of vector addition by drawing, so the arrows had to be drawn “head-to-tail”. For the second mark the arrow for R had to be horizontal. Although some drawings were not always done as directed (“in the space below”) they were given credit if correct.

3.3

This question was answered well by most. Common errors here were quoting the value as 1.19 kN, or failing to give a subject for their equation.

3.4

This question discriminated well with many achieving full marks. Partial credit was given for some use of the centripetal-force equation.

3.5

Very few students achieved more than two marks for this question. The common focus of answers was on increasing centripetal force leading to smaller radius. Many students incorrectly deduced that the lift force would increase as the angle increased because the vertical component had to remain equal in magnitude to the weight. A sketch drawing of the new situation might have helped many students to appreciate the change to the resultant force.

Question 4

4.1

This question was answered successfully by almost all students. As with question 2.2, the quality of the “show that” answers was particularly good.

4.2

About 70% of students achieved full credit. The two main reasons for gaining only one mark were an answer quoted to only one significant figure or a failure to convert from kilometres to metres.

4.3

This straightforward calculation was handled well by most. Students who failed to convert kilometres to metres in question 4.2 were not penalised again.

4.4

This question was the most challenging for students. The most common line of argument used $v = r\omega$ to explain that the satellite must have a larger tangential speed when the radius is larger but the angular speed is the same. Very few considered the fact that the satellite was moving in the presence of both the gravitational field of the Earth and of the Moon.

4.5

Students who demonstrated a knowledge that field lines run perpendicular to equipotential lines were given credit even when some of the transitions were dubious. The most frequently seen incorrect answer was a straight line connecting the Moon to point K.

Question 5

5.1

About 60% of the cohort recognised that the maximum rate of change of flux linkage was given by the peak emf. Attempts to obtain the gradient were often seen in incorrect answers.

5.2

This question discriminated well with the most common scores being one or two marks. Loose explanations in terms of the coil “cutting field lines”, for instance, were condoned for one mark. Better explanations referred to changes in “flux”, but students are directed to use the specification term of “flux linkage”. The most common marking points were awarded for explaining the cause of an induced emf and why the emf was sometimes zero. Explanations in terms of Lenz’s law were often too imprecise to gain any credit.

5.3

Students who made an estimate based on some relevant data (distance or time) gained one mark. Those who deduced an appropriate length with the matching duration gained both marks. Students who failed to gain any marks often had not seen that the estimate could be made simply using the equation that connects speed, distance and time.

5.4

Most sketches for this question were of a decent quality. The two aspects most considered by students were narrower peaks that would be closer together. Some realised that the peak emf would be larger. It was rare to see the difference between the two peaks which arises due to the acceleration of the trolley.

Section B

Students were particularly successful at questions 7 to 15, 17, 23 to 27, and 34.

Students found questions 22, 28, and 33 particularly difficult.

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