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Examiners' Report
Principal Examiner Feedback

Summer 2017

Pearson Edexcel GCE
In Mechanics M3 (6679/01)

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Introduction

This was a very accessible paper. The initial questions in particular were tackled well by the majority of students although later questions were found to be more challenging.

The majority of students give answers to 2 or 3 significant figures when a numerical value of g has been used but a few students still give more figures in their answers or occasionally use $g = 9.81$.

Presentation continues to be poor in some cases. Some students squash up their work into the smallest possible space again making it difficult to read and hence to mark.

Students seem to be reluctant to explain what they are trying to do, instead simply presenting a muddle of equations. This suggests lack of clear thinking on their part and again can make the work difficult to mark. Large clearly labelled diagrams are helpful as are tables in, for example, centre of mass or energy questions.

There is always a small number of students who rush into a solution without reading the question carefully. This was particularly apparent in questions 4 and 6.

Question 1

This was a confidence building starter to the paper for which the majority scored full marks. The integration was straightforward and there were very few errors with the limits. Unfortunately a few students did not read the question properly and treated it as a solid of revolution thereby losing all the marks.

Question 2

This question was generally well answered but the method was sometimes very longwinded. Some students lost the last mark in (i) by giving their answer in radians when the angle was required to be measured in degrees.

In part (ii), the students who used $r = l\sin\theta$ early on did not need to work out the radius or angle in decimal form and so avoided introducing rounding errors. Some students found the radius and stopped instead of continuing to find the length of the string.

Question 3

The most popular approach in part (a) was to use an equation of motion with the acceleration nearly always expressed as $v\dfrac{\mathrm{d}v}{\mathrm{d}x}$. Only a very small minority omitted a term. The integration caused few problems with the constant of integration nearly always found by those using indefinite integrals and a significant number using definite integrals with appropriate limits. The alternative approach using energy caused more difficulties and a common and

fundamental error was treating the work done against the resistance as $\frac{1}{2}mx^2$ with no sign of an integral.
Part (b) caused no problems, although some left their answer as $\sqrt{3g}$. Very few students gave their answers to more than 3 significant figures.

Question 4

This was one of the least well answered questions on the paper. There were numerous errors, many caused by not reading the question properly. There were solids, cylinders with no base and cylinders with a base and a top and even occasionally hemispheres with a base. The formula for the surface area of a hemisphere was not well known – some used integration to work it out from first principles. Some students took the cylinder and base together with a centre of mass at a distance of $2a$ from O and could only score the first mark. Others worked out the position of the centre of mass of the cylinder with its base correctly and then produced another moments equation incorporating the hemisphere. It was a longer method but was usually successful. Those who made a table with the cylinder, base and hemisphere separately generally completed the solution correctly.

Part (b) almost always scored two or three marks – it was a standard question and a well known method.

Question 5

Almost all students successfully found the given result in part (a), with very few attempts to use uniform acceleration equations.

In part (b) most students found the velocity at the top correctly, but a fairly common mistake was to simply observe that when $\theta = 270°,\ v^2 > 0$ and conclude that this showed complete circles, with no reference to the reaction at the top. A number found the normal reaction at a general point in terms of $\sin\theta$ and either substituted $\theta = 270°$ or observed that with $\sin\theta > -1$, then $R > 0$ for all θ. Students who attempted to say that $R = 0$ and show that this had no solution rarely produced a convincing argument. Many students mixed up the general position for the energy with the reaction at the top. Although this led to the correct answer in the end, it did not make for good mathematics.

Almost all students gained the 2 marks in part (c).

Question 6

Almost all students gained full marks for part (a)

Part (b) caused problems for a few who confused a half string with a full string when substituting into Hooke's Law – they used extension of one and natural length of another. There were occasional instances where the students forgot which was which and their natural length was in the numerator. The vast majority obtained full marks though students should be reminded to always check their working carefully.

However, part (c) was not well answered. The formula for EPE was not always known – the square or the 2 in the denominator being missed. Despite the fact that the motion was on a horizontal table and that the word horizontal was in bold twice more in the question, many students treated this as a vertical problem. This meant that they included a GPE term in their energy equation which lost them nearly all the marks. Some did not realise that there was still elastic energy when the particle reached *AB* so missed out one term, also losing nearly all the marks.

Question 7

Part (a) was very well answered with nearly all students scoring full marks. The most popular approach was to find the extension of the left hand string and then add 1.8. The more direct approach working directly with *AO* as the variable was occasionally seen.

Part (b) was answered reasonably well, with most realising what was required to prove SHM. Most measured the displacement from the equilibrium position, although some seemed to invent numbers that would cancel to give the desired result. Some students who chose the wrong extensions recognised that their constant term should disappear and simply removed it. Some failed initially to ensure that their acceleration was measured in the same direction as their displacement but often seeing the lack of a negative sign in their final equation 'tracked back' to amend their solution. Whilst some students still use a instead of $\ddot{x}$ this has now dwindled to a very small number compared to a few years ago.

A variety of correct methods were seen in part (c) to find the time from *C* to *D*. The quickest and most direct approach using $x = a\cos\omega t$ appeared most often, but finding the time from *C* to *O* followed by the time from *O* to *D* was also popular. It was pleasing that almost all students who used $x = a\sin\omega t$ did go on to give a complete method for the time from *C* to *D*. A few failed to realise that the amplitude of the motion was 0.5 and then made little significant progress. Finding the speed at *D* was done well with $v^2 = \omega^2\left(a^2 - x^2\right)$ being the favourite method although some found the speed by differentiating $x = a\cos\omega t$ or $x = a\sin\omega t$ mostly without errors. Most realised that the particle was travelling at a constant speed from *D* to *A* but a small number assumed that the particle was accelerating, losing the final 2 marks.

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