Examiners' Report

Principal Examiner Feedback

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Pearson Edexcel International A Level

Mathematics in Mechanics 3 (WME03)

Paper : WME03/01

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General

Although there was some good work seen it was apparent that candidates found this paper harder than some recent papers. Particular instances of this were questions 2, 6 and 7 – especially 7(c). Candidates seemed to have a good feel for when to give a decimal answer and when an exact answer was preferable. Consequently, there were few rounding errors seen.

There were instances where candidates either forgot to resolve a force in an equation or resolved the wrong force; sin/cos errors when resolving were not seen frequently.

Candidates need to be very careful to include complete evidence when answering "show that" questions. For example, in part 6 (a) many did not mention $\cos\alpha$ and so gave no justification for including $\frac{4}{5}$ in their equation.

Report on Individual Questions

Question 1

In part (a) almost all candidates could easily find ω showing the formula used.Many found the amplitude either using $v = a\omega\cos t$ or use of $x = a\sin\omega t$ followed by $v^2 = \omega^2\left(a^2 - x^2\right)$. Some of those who used the latter approach were less successful as there were errors in their value of x. The most common error was to assume $x = a\cos\omega t$ and therefore $v = -a\omega\sin t$. A small number of poor responses used $v = a\sin t$.

Part (b) was well answered and incorrect answers were rare. Most used $v_{max} = a\omega$ directly but many did use $v^2 = \omega^2\left(a^2 - x^2\right)$ with $x = 0$.

A small number of candidates did not seem to be able to answer this question at all; surprising for a straightforward first question.

Question 2

Generally this was not answered well. Only a few fully correct answers were seen and a handful attempted to use the constant acceleration equations.

Almost all candidates found $x = 4$ when $v = \frac{1}{3}$ as a start for part (a). Those candidates who knew how to approach this used $a = v\frac{\mathrm{d}v}{\mathrm{d}x}$ although use of $a = \frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{1}{2}v^2\right)$ was common. A significant number of weaker responses used $a = \frac{\mathrm{d}v}{\mathrm{d}x}$ most likely confusing this with $a = \frac{\mathrm{d}v}{\mathrm{d}t}$. Others could not use the chain rule correctly. Some of the better candidates often left the final answer as a negative value not recognising the need for the magnitude to be positive. Other unsuccessful approaches involved some candidates confusing differentiation with integration and ln was involved. Some tried to separate variables and integrate having learnt this but not knowing that it does not apply here.

In part (b) most candidates could separate the variables correctly but there were some who had $(2x+1)^{-\frac{1}{2}}$ instead of $(2x+1)^{\frac{1}{2}}$ in their integral. A few candidates did not know where to start at all, either not using $v = \frac{\mathrm{d}x}{\mathrm{d}t}$ or leaving the answer blank. For those who separated the variables correctly most could integrate by increasing the power by 1 but a significant minority of these did not include $\frac{1}{3}$.

Almost all candidates could complete to find a value of the constant using indefinite integration and then substitute $x = 7.5$. Definite integration was only occasionally used.

Question 3

This was generally well answered although a small but noticeable number of candidates left it blank.

Part (a) was very straightforward and there were no issues.

Most candidates seemed to be well drilled with part (b) and could obtain full marks. Use of "a" instead of $\ddot{x}$ for the acceleration was seen far too often and only scored one mark out of four. Some poor responses were seen without a variable extension of x or just with x only as the extension. A handful set $T = m\ddot{x}$ without considering the weight mg.

In part (c) many candidates used $v_{\max} = a\omega$ although some did use $v^2 = \omega^2\left(a^2 - x^2\right)$ with x=0. Almost all could identify their ω and the correct amplitude. A significant minority attempted an energy approach and could give the correct GPE. However theywere usually unsuccessful as only one EPE was considered or there was an error in the extension for the initial EPE.

Most could identify that $\frac{T}{4}$ was required in part (d) and used this correctly for their value of ω. It was not uncommon to see an approach which found the value of x first using $x = a\cos\omega t$ or $x = a\sin\omega t$. This was not always successful as an incorrect value of x was used and often $\frac{T}{2}$ was found instead.

Question 4

Again, a small but significant number of responses were left blank for this question.

Part (a) proved to be quite successful and full marks were often seen. However a number of very poor responses were noticeable. Any errors in the energy equation were usually a result of a missing EPE term, although use of m for the mass instead of $\frac{1}{2}m$ was seen occasionally. Sign errors were rarely seen but multiple attempts with crossing out was fairly common due to the given answer.

Part (b) was not so well answered as the majority did not arrive at the correct answer. A few who completed part (a) left this part blank. Common errors were to ignore the resistance of $\frac{1}{4}mg$ or to set the tension to mg. Use of m for the mass was more common here than in part (a). Many did attempt an energy approach, most likely a result of this being a standard approach when finding the maximum speed. However very few of these were successful as the energy equation usually did not have a variable distance in some of the terms or the work done against resistance was missed out. A few did get the correct number of terms but with errors in their distances. Most could not go on to find a value of v_{max} from their equation. There were a handful of poor responses where the constant acceleration equations were used.

Question 5

In part (a) the majority did not consider the equilibrium of the ring although this correct approach was still seen a number of times. The equations of motion for the particle P were very often seen here in part (a) as many candidates thought these were needed. A few of these unfortunately did not go on to attempt part (b) so could gain no credit for these equations.

Fully correct responses were common in part (b) but a surprising number were poorly answered or left blank. Most candidates could set up the two equations for P (sometimes continued from part a)) and then solve correctly. One error seen was to use $2mg$ instead of mg in the vertical resolution on P. A few weaker candidates set the tensions equal to each other.

Question 6

Part (a) was very well answered but part (b) less so. There were again a few candidates who left the whole question blank.

The majority used energy in part (a) although a handful did use the constant acceleration equations and consequently received no marks. Correct responses usually showed clear working towards the given answer. However, a few candidates did not show use of $\cos\alpha$ and did not justify the $\frac{4}{5}a$ so were only awarded 2 out of 4 marks.

Part (b) was often well answered as about half of the responses gained full marks. However a significant minority scored no marks as this part tended to be all or nothing. Those who did not have the correct equation of motion lost all the marks as the rest of the question depended on this. Those who found the correct equation made few errors and most found the correct answer of $\frac{14}{15}$. Common errors were to not resolve the weight and set $mg = \frac{mv^2}{r}$ or to set $T = \frac{mv^2}{r}$ with T=0 and hence have v=0. A few weaker candidates simply assumed v=0, often the same candidates who used constant acceleration in part (a). A small number of candidates attempted to use energy to find v^2 which they substituted into the given equation.

Question 7

A significant minority of candidates left this question blank or only managed to complete part (b). Most candidates did not attempt part (c).

The majority of responses successfully used integration in part (a) to arrive at the correct given result with sufficient working shown. A small number of candidates used $y = -\frac{r}{h}x + r$ successfully. Weaker candidates just used $h - \frac{h}{4}$ or just simply didn't seem to have met the concept of finding a centre of mass by integration. A few responses were seen which quoted the correct formula with integral signs for the centre of mass but with no sign of any integration being used.

Many successful answers were seen in part (b). A moments equation with distances measured from the plane face was most common although measured from the vertex was also often used. Errors in the masses or distances were not very common and most could form a valid moments equation using their values.

In part (c) the lack of attempts seen here may have been due to the challenging nature of this question; it was not clear whether time was a factor on this paper. It was certainly the most poorly answered part question on the paper. However, there was a small number of fully correct answers which used a variety of different approaches. It was rare to see a correct method with numerical slips. Most of those who did attempt this struggled to produce any valid method. A few did manage to find a relevant distance or trigonometric ratio but then did not know what to do. Often some correct work was seen but without justification for the inequality.

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