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Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Mathematics M3 (WME03)
Paper 01

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Mechanics M3 (WME03)

General introduction

The general standard of presentation seemed poor. A number of attempted solutions were almost impossible to read, sometimes because the handwriting was tiny and very bad but often also because multiple alterations and corrections had been written on top of the original work. Sometimes bad handwriting appeared to have been used intentionally to conceal a complete fudge, the “show that” questions ending up apparently “shown” at the end of illegible, but initially wrong, working.

The paper seemed to be a good length. A few seemed to have stopped in the middle of sensible reasoning in the last question but most seemed to have done as much as they could.

Question 1

This should have been an easy starter question and the majority knew the appropriate expression for acceleration but many candidates failed to spot the easy method: squaring v and then differentiating. The $v\frac{\mathrm{d}v}{\mathrm{d}x}$ method was much more popular than the one on the main scheme. Common errors were failures to use the chain rule correctly when differentiating the bracket, believing that the acceleration is $\frac{\mathrm{d}v}{\mathrm{d}x}$ or finding $\frac{\mathrm{d}v}{\mathrm{d}x}$ but calling it $\frac{\mathrm{d}v}{\mathrm{d}t}$.

Question 2

Most recognised this as a work-energy question and found a correct expression for the work. Many of these, however, overlooked the fact that there would be a final as well as an initial EPE, allowing a very brief solution and only one available mark out of 9. Candidates should consider whether their solutions warrant the marks allocated. Algebraic errors which caused the reasoning not to result in a 3 term quadratic equation also proved very costly. Candidates should probably be reminded that evidence of a full solution to a quadratic equation should be shown. Some candidates used a 2 stage method, considering the motion to the natural length and then the extension and this method was usually completed successfully.

Question 3

This proved very straightforward for those who knew the method, in spite of a degree of confusion over whether the maximum tension occurred at the bottom or the top. Even so, there were a lot of completely correct solutions and quite a few more which lost only the final mark for not giving the answer to the nearest degree. The weakest attempts showed little grasp of the mechanics of the situation. Several tried to use the given maximum tension and final velocity at the same general position; others wrote equations for vertical equilibrium or $T\cos\theta = mg$ or $T\cos\theta - mg = \frac{mv^2}{r}$.

Question 4

The work here suggested a clear preference for pure mathematics by being generally very well done. The given volume was almost always found correctly and most then quoted a formula to do (b). A few used area formulae here and so scored no marks for (b). A few candidates failed to simplify their final answer sufficiently; Further Mathematics candidates should be aware that a muddled fraction, with numerator and denominator containing fractions, cannot be an acceptable form for a final answer. Very few candidates provided decimal answers although some did give a decimal following a final answer in the demanded form.

Question 5

Part (a) was usually correct, although often only after a failed first attempt with the density of 3 attached to the wrong solid. It was surprising to see a lot of candidates giving the relative masses immediately as $2:3:5$ without any prior working. While it is just about possible to do this mentally, it is certainly not easy so it seems more likely that vital work had been done in pencil and rubbed out, which is not good practice. As is ever the case some decided to show no working at all between writing a correct moments equation and the given answer. The most common mistake among the incorrect solutions was to use the densities as relative masses; a few used incorrect formulae for the volumes or the distance for a hollow hemisphere. Almost all of these incorrect solutions managed to make their answers appear to arrive at $\frac{9r}{4}$.

In part (b) moments were taken about various points – the point of contact, the point of action of P and the centre of the common plane face. Those who used the point of contact had difficulty in working out the appropriate distance for the weight term, often forgetting to subtract $r \cos \alpha$. Those using other points sometimes forgot to include the normal reaction. Completely correct solutions were rare.

Question 6

Hardly anyone got both marks in (a); they mostly verified Pythagoras numerically but did not justify their answer. This might have been adequate had the answer not been given. However, in a 'show that' question the final result must be justified. A very few 'proved' the right angle by using $\sin A = \frac{6}{10}$ and $\sin B = \frac{8}{10}$ to 'find' angles A and B so that they could then calculate angle APB.

Strong candidates were able to attempt part (b) very concisely but there were also a lot of poor attempts. Although most were able to write reasonable vertical and horizontal equations, many did so with equal tensions in the two strings. Others failed to realise the significance of the right angle found in (a) and wasted a lot of time trying to calculate trigonometric values from one or other of the triangles with the radius as one side. Some never managed values for $\sin\theta$ or $\cos\theta$ at all; others found wrong values by assuming that AB was bisected by the radius. As in earlier questions, almost all claimed to have proved the final result by surreptitiously changing numbers several lines before the end. Most candidates marked an angle (or two) clearly on a diagram, allowing their work to be easily checked, although some confused themselves with messy diagrams. If they had made a mistake they would generally note that since their result was less than that on the paper, then the period must be less than the printed result, rather than thinking that they might have gone wrong somewhere.

Question 7

Part (a) was almost always correct and part (b) rarely so. The method of proving SHM is not well understood and many didn't even attempt it. As ever, many opted simply for $T = ma$ with $T = \frac{\lambda x}{l}$ and others wrote a reasonable proof but using a instead of $\ddot{x}$. Methods for parts (c) and (d) were more frequently correct, although a fair number identified the amplitude as $\frac{l}{2}$ instead of $\frac{3l}{8}$. It was rare to see a diagram making it clear where x was measured from and which was the direction of increasing x.

Part (c) was more frequently done by energy than using SHM equations, usually successfully, but this method did not require the amplitude to be known and energy methods often went on to have an incorrect amplitude in part (d).

The preferred method for part (d) was the alternative on the scheme – finding x first and then using a time equation. If the amplitude was correct, this x was usually right too, but many then used the wrong equation for the time.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
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