Examiners' Report

Principal Examiner Feedback

January 2022

Pearson Edexcel International A Level

In Pure Mathematics (WME03/01)

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Introduction

Overall candidates were able to make reasonable attempts to answer all of the questions on this paper and time did not appear to be a limiting factor. Candidates appeared to be well prepared for the exam: they were able to recall and use formulae and were familiar with standard proofs. This was particularly evident in question 5 on SHM where many weak candidates were still able to earn most of the marks available.

Solutions were generally well presented with clear handwriting. However, there were occasions when candidates would produce numerical expressions without showing the underlying mechanics behind them, which risks the loss of marks. Candidates should also be reminded that where there is a printed answer to show, they must produce sufficient detail in their working to warrant being awarded all of the marks available. In all cases, as stated on the front of the question paper, candidates should show sufficient working to make their methods clear to the examiner and correct answers without working may not score all, or indeed, any of the marks available.

In calculations, the numerical value of 9.8 should be used for g unless otherwise stated. Final answers should then be given to 2 (or 3) significant figures and more accurate answers will be penalised, including fractions. Exact multiples of g are usually accepted.

Individual Questions

Question 1

This question made a strong start to the paper for many candidates who were able to recall the correct formulae and process the integration successfully to achieve all available marks. A common mistake was to find the x coordinate for the centre of mass and substitute this into the curve equation to find the corresponding y coordinate. A more common error was to consider a volume of revolution instead. On the whole, integration skills were strong although some candidates did not square the expression for y correctly.

Question 2

In the first ‘show that’ question of the paper, almost all candidates knew the basic approach: they successfully resolved the tension, correctly found the radius of the horizontal circle and used the correct form for acceleration. Candidates who gained full marks usually began with a vertical equation, including a normal reaction force, and a horizontal equation of motion. Introducing the inequality for the normal reaction and substituting from the horizontal resolution then led to the printed answer.

Unfortunately, many who made a strong start, progressed from an equation to an inequality without any justification and so lost the final marks. It was also very common to find candidates who formed a vertical equation that did not include the normal reaction or introduced the inequality sign in their horizontal equation of motion. Both mistakes were very costly in terms of the marks lost.

Question 3

This question was a good source of marks for many candidates with very few errors in the integration aspects seen. Most recognised the need for an equation of motion as their starting point but forming it correctly was a distinguishing factor. Candidates who understood that this was testing variable acceleration and were able to replace their acceleration with $v\frac{dv}{dx}$, usually went on to integrate correctly and complete both parts of the question successfully.

It is important for candidates to check that all relevant forces are included when they form an equation in mechanics. Some who recognised the need to integrate, missed out the component of weight from the equation, losing all marks in part (a). Treating the resistive force as constant was another common error meaning few marks could be gained.

In part (b) most recognised the need to use their previous result, to set $v = 0$ and solve.

The alternative work-energy approach on the mark scheme was used by a good number of candidates for part (a) with a similar success rate as the main scheme. Some attempted work-energy only in part (b). It was very rare for this to be successful as the integration was usually forgotten.

Question 4

This question was answered well by many candidates with sufficient working to progress from their moments equation to the given answer in part (a). Only a very small number of candidates used volumes instead of areas earning a maximum of one mark in part (a).

In some cases, finding the centre of mass caused difficulty where candidates did not know the appropriate formula. Some candidates combined the circular base with the cylindrical shell but failed to use the correct distance from O for the combined cylinder.

The presentation of solutions was varied. Working was much clearer amongst those who used a table and simplified their mass ratios before forming their moments equation. In contrast, it was often difficult to read the moments equation when it was formed straightaway due to the amount of cancelling that was required to reach the given answer. Since the answer was printed on the paper, it would be advisable for candidates to write another line of working with their simplified moments equation.

Part (b) was generally answered well, even by those who did not complete part (a), with candidates using either $\tan 30$ or $\tan 60$ with success. Candidates were usually able to manipulate the algebra successfully to obtain the correct three term quadratic and hence produce the final answer.

Question 5

In part (a), most candidates used the required notation, correctly differentiated twice and rewrote their result in the standard form to conclude that in fact it was SHM. It is worth reminding candidates that the correct form in mechanics must use $\ddot{x}$ and not a to earn the marks.

It was clear that a few did not know how to prove SHM but were still able to successfully identify ω and a from the given equation. This led to very straightforward solutions for parts (b), (c) and (d) with all available marks being awarded to the majority of candidates.

Part (e) was also well answered with candidates equally split between using the given cosine equation for displacement or forming their own sine equation for displacement. Both approaches usually earnt the first three marks for finding two correct times. However, a considerable number of candidates were not awarded the last mark due to combining the times incorrectly or for early rounding errors or errors with signs.

Question 6

In this question on elastic strings, it was thankfully rare to see candidates who thought that it was appropriate to use uniform acceleration rules.

It was quite common to find candidates earn only seven of the fifteen marks available. The three marks available in part (a) were usually achieved by candidates of all abilities using Hooke's Law to prove the value for λ.

The next three marks in part (b) for stating the correct extension and using it in Hooke's Law, were also completed successfully. It is worth candidates stating the values that they are going to substitute into a formula as these can earn marks in an otherwise unsuccessful attempt.

Unfortunately, the final three marks in part (b) were often lost as candidates did not form their equation of motion successfully. An equation of motion must include all forces, resolved where appropriate, to earn method marks. A good number of candidates did not recognise that there was a tension in both parts of the string so were missing a force, did not recognise that the tension needed to be resolved so were missing a resolution, or did not include the weight so were again missing a force.

In part (c), it was common for only one mark to be achieved for a correct EPE. Although the energy method was well known, many attempts were unsuccessful because EPE was only considered in the starting position. This error was seen in candidates of all abilities.

Question 7

Candidates of all abilities were able to access parts of this question with many gaining all seventeen marks.

In part (a), the majority of responses successfully set up an energy equation from A to a general position encompassing the difference of two PE and two KE terms to arrive at the correct given result with sufficient working shown.

Part (b) often followed successfully with three or four marks being awarded. Most candidates successfully substituted for u^2 and $\cos\alpha$ in the result from part (a), found the correct value for v^2 at the top of the circle and gave the correct final statement. A few candidates used KE at the top instead, to give a relevant final statement. However, some candidates did not know the required condition for complete circles, referring instead to the value of T.

The final part to the question distinguished between candidates: a good number produced beautifully clear solutions and appeared to gain full marks with ease. It was common to see candidates correctly form an equation of motion at the top and bottom of the circle and, providing that the speeds had been found using a valid method, they divided them to reach the correct value for k. Unfortunately, a considerable number of weaker candidates were unable to use the result from part (a) to find the speed at the bottom of the circle, and therefore the maximum value of T, which was required to find k.

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