Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Mechanics (WME03)
Paper 01

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The paper proved very challenging for the majority. Question 7 was almost always completed so it didn't appear to be too long but candidates may have saved themselves time by not bothering with questions they found hard. Blank sheets were not uncommon in any of the questions.

There were some excellent, well-written solutions but the general trend was to supply minimal theory and to use numbers as early as possible. Candidates should be reminded (again!) of the importance of stating their method, however briefly, and of quoting formulae where relevant. In the "show that" questions, there were many attempts to fiddle the answers. In these questions it is imperative that candidates include every step of their working, however obvious they may think a step is. The instructions on the front of the paper state "You should show sufficient working to make your methods clear. Answers without working may not gain full credit". In a "show that" question missing working is often indicative of a fiddled solution.

Candidates are given more than enough space to answer every question and yet many seem to be trying to fit their entire solutions into the smallest possible area. Well-spaced working is much less likely to result in errors and is easier for examiners to mark accurately. Again in a "show that" question cramped solutions may be indicative of a fiddled solution as steps are frequently missing.

Question 1

There were a great many excellent solutions using the method on the mark scheme but a substantial minority reached the required answer by other means. Solutions which may or may not have been based on a triangle proved impossible to mark consistently and it was sometimes hard to judge whether solutions deserved 0 or 6. The statement $mg\tan\theta = m\omega^2 r$ was completely convincing if a relevant triangle was actually shown on the original diagram but without a visible triangle it was not clear whether the equation had been legitimately obtained or just written down because changing $\tan\theta$ to $\sqrt{3}$ led to the given result. Early substitution of 60° for θ was a good way for a candidate to convince the examiner that they knew how to deal correctly with the problem. The most frequent error among the weakest was to use $R - mg\cos\theta = m\omega^2 r$ as if this were a vertical circle. Even these false starts often apparently reached the required answer!

Question 2

Relatively few completely correct solutions were seen although it was pleasing to see that almost all used the correct form of the acceleration. In part (a) the main problem was misunderstanding the directions of the velocity and/or the acceleration. Many candidates used $v = 8$ to obtain the constant of integration resulting in an incorrect expression for v. The majority of candidates did not realise that there was a change of direction during the time interval in part (b) so integrated their expression for v between the limits 0 and 4. Those who did part (a) correctly and put $v = 0$ obtained a quadratic which factorised and generally went on to complete the solution correctly. Those who had used $v = 8$ had a quadratic which had to be solved using the formula and which only gave one valid solution implying that there was no change of direction. A few put the acceleration equal to zero and integrated between 0 and 3 and then 3 and 4.

Question 3

A few good (or maybe well-prepared) candidates answered this very well but the majority gave the impression that they hadn't studied banked tracks at all. The modal mark, even for good candidates, was 0. The most surprising fact was that relatively few candidates even attempted to draw a diagram and yet they went ahead and resolved forces they couldn't see using angles they hadn't properly identified. Most started with the wrong statement that $R = mg\cos\theta$ and continued with either an equation assuming that the acceleration was along the slope (in spite of the question clearly stating that the motion was in a horizontal circle) or, less frequently, a correct horizontal equation. Other errors were then irrelevant but it was noticeable that wrong signs occurred frequently in these wrong equations due either to friction being in the wrong direction or $\frac{mv^2}{r}$ being treated as an extra force rather than a mass$\times$ acceleration.

A few candidates produced the correct answer directly from the two original equations without showing any intermediate working. They must either have made extensive use of their calculator memories or done working in pencil which they then rubbed out. This is unwise. If no intermediate working is shown, no credit can be given if the answer is wrong.

Some otherwise excellent solutions lost the last mark by leaving the answer as 14.39.

Question 4

This was one of the more successfully answered questions and there were many correct, or almost correct, solutions.

It was again surprising that many candidates failed to draw a diagram, meaning that their equations then concerned undefined forces and unspecified angles. Although the majority knew how to tackle part (a), the given answer (although needed here) generated a number of probably manipulated but error-free solutions. Many of these failed to show any calculations of lengths or angles or the general statement $2T\cos\theta = mg$ but simply wrote a numerical equation straight away $\left(2\times\frac{3}{5}\times\frac{2\lambda}{3} = mg\right)$ – an impressive feat without a diagram. As before, they should be encouraged to show every step of their reasoning and calculations. There were a number of errors in Hooke's Law due to confusion between original lengths, extended lengths, whole and half strings but somehow almost all ended up claiming to have 'proved' the result.

The correct theory for (b) was well known and there were again many successful solutions. The most common error was to overlook the initial EPE, losing nearly all the marks, but a small minority left out both, settling for PE = KE. There were a number of errors in the EPE formula $\left(\frac{\lambda x}{l} \text{ or } \frac{\lambda x}{2l}\right)$ and errors in simplifying correct EPEs. Again, some could have rescued lost marks by quoting the formula first. A few lost the last mark of an otherwise correct solution by applying the $\sqrt{\ }$ incompletely to their answer.

A very few tried to solve (b) using SHM but without a clear idea of what x or $\ddot{x}$ were measuring.

Question 5

As always with SHM questions, this discriminated well.

Part (a) was almost always successful, and mostly without any fudging.

The proof in (b) was more often correct than in many past papers but the proofs often felt more memorised than understood. It is unconvincing, although correct, to see a – sign added to one side of the equation as an afterthought.

The memorised standard solution involving a completely undefined and previously unmentioned e was seen a number of times. They need to know that this is worthless. Similarly, those who choose to make the working simpler by calling their extra extension xl need to know that this leads almost inevitably to a dimensionally inconsistent equation. Correct use of $\ddot{x}$ instead of *a* is now much more common than it once was but many still forget to state that they have proved SHM.

Part (c) was very well done, mostly using $\omega^2 a$ but occasionally by N2L. Some wrong formulae were also seen (ωa and ωa^2) and the amplitude was sometimes thought to be either $\frac{l}{5}$ or $\frac{6l}{5}$.

Quite a few candidates didn't attempt (d) at all and, although most who tried had a reasonable idea how to go about it, fully correct solutions were in the minority. It was often assumed that the time from the centre to the natural length was $T/4$ and there was the usual confusion between sin /cos, positive/negative lengths and whether to add or subtract their two times. However, failure to use radians was rare. Finding the value of *k* needed to express the answer in the required form proved a final challenge, even in solutions which had been correct up to that point.

Question 6

Part (a): many candidates had no idea how to find the centre of mass algebraically. Some of those who did know the formula used the given formula for the volume of a sphere for their hemisphere and adjusted the result of their integral accordingly. Others used the formula for a lamina or tried to find the centre of mass of a hollow hemisphere.

Part (b): this was the easiest part of the question but some made it harder by using either volumes or volume x given mass and ended up with the wrong answer. Many found the distance from the common face and then forgot to adjust their answer.

Part (c) was rarely done correctly. Different methods were attempted but the most successful was to use the distance of the centre of mass from the centre and to consider the critical position using the semi vertical angle of the cone. A common mistake was to incorrectly assume that $OA = 4r$. Many of those who found the relationship between *M* and *m* at the critical position moved from an equality to the given inequality with no reason given for the direction of the inequality, thereby forfeiting the final mark.

Question 7

In part (a) candidates needed to make it clear that $v > 0$ at the top for complete circles before they could score any marks. Most used an energy equation successfully but those who put $v = 0$ with no explanation lost all the marks. Some thought that the conditions was $T > 0$ at the top so also scored zero.

There were some very good clear solutions for part (b) but there were others where candidates did not know where the tension was greatest or least and who used u indiscriminately to represent all their velocities. The candidates who used Newton´s second law at the top and at the bottom and also found the corresponding velocities using energy measured from A were generally successful. Others used energy to find the velocity at the top and then another energy equation from top to bottom and were also successful. A common error was to assume that the v in Newton´s second law at the top was the same as the v in the equation at the bottom. These candidates lost many marks as they had omitted essential equations from their work.

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