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General Certificate of Education (A-level)
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Mathematics MM04

(Specification 6360)

Mechanics 4

Report on the Examination

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General

There was a mixed response to this paper, with a significant number of candidates well prepared for all aspects, whilst others displayed patchy understanding at best. Questions 4, 5 and 6 proved to be most demanding. The structure of solutions was generally good with sound explanation.

Question 1

Candidate responses were more mixed than expected. A number of errors that lost accuracy marks occurred in part (b): for example, a wrong sign in the **j** component, simple numerical errors such as $0 \times 2 = 2$ or loss of negative signs elsewhere. Candidates who used $\mathbf{F} \times \mathbf{r}$ were penalised only the final mark if the solution was otherwise fully correct. For part (c), candidates had to make reference to the moment calculated in part (b) and the resultant force being zero.

Question 2

The majority of candidates were aware of the required formulae for part (a). Candidates should always state the full formulae first before cancelling the π. In part (b)(i) candidates were aware of the three forces but failed to have the forces all passing through one point. In part (b)(ii) most candidates scored at least two marks; quite often the r/d ratio was incorrect. Part (c) was well understood, but candidates needed to make an explicit comparison for full marks to be awarded.

Question 3

This question elicited the best responses from candidates. It was pleasing to see clear references to symmetry in part (a), and most candidates successfully used this to find the magnitudes of the reactions. Part (c) was well done, with the printed answers helping candidates. Very few candidates used the symmetry to produce an efficient solution in part (d). Also in this part, sines and cosines were often mixed up. One common error when substituting calculated values was to use the magnitude of the force rather than making use of the fact that the force is a tension or compression (positive or negative). Part (e) was the most challenging part with plenty of scope for sign errors or only having two terms in the equation.

Question 4

Candidates were very good at parts (a) and (b)(i) with almost all of them scoring full marks. In part (b)(ii), the final mark was often lost through candidates not explicitly showing how to get the final printed answer. Part (b)(iii) proved more challenging; some candidates failed to attempt this part altogether. The equation of motion for the pulley often contained T rather than rT. Sometimes the right hand side of this equation contained m rather than I. The equation of motion for the bucket was more successful but even then the mass was sometimes mixed up with the pulley or candidates failed to connect linear acceleration with the rotational acceleration. The alternative method was rarely seen but was more successful when it occurred. Some slight, but valid, variants to both solutions were noted.

Question 5

This is one topic that candidates do not appear to be confident with. In part (a), sign or magnitude mismatches occurred with regularity. A small number of candidates left the requested magnitude as a negative answer. Candidates were required in some way to comment on a cancelling or point to it explicitly to be awarded full marks. Vector product methods were done well. Part (b)(i) was done better than in the past, although some left the

answer with a in it. Candidates would have been well advised to sketch a simple diagram, as in the mark scheme, for part (b)(ii) as it would lessen the error of '$8d$' occurring.

Question 6

This proved to be the most challenging question on the paper. It was disappointing to see only a limited number of fully correct answers for part (a). The specification clearly states the standard proofs that candidates are required to learn and they would be well advised to ensure that they can do them all. Many candidates scored the first B1 and M1 but then often failed to arrive at the correct integral. The $(r^2 - x^2)^2$ proved elusive to many candidates. On occasions, the moment of inertia of a disc was not used to form the integral. Candidates who used the shell method were far more successful, although it was rarely seen.

Part (b)(i) was done very well indeed, as was part (b)(ii), showing excellent understanding of the parallel axis theorem. Part (b)(iii) produced a varied response. A number of candidates tried energy methods to no avail. Errors with the angular momentum of the clay before the collision were often seen with no use of the $3l$. In forming the equation, a number of candidates wrote down terms that were dimensionally mismatched, thus scoring zero. A similar question has been set before and pleasingly the responses to the last part were better this time.

Mark Ranges and Award of Grades

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