GCE
MATHEMATICS

MM05 Mechanics 5
Report on the Examination

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General

The majority of the students were well prepared for this examination and able to tackle most of the questions well. There were relatively few weak scripts. The students did particularly well with the questions on variable mass and damped harmonic motion.

Question 1

Part (a) was done very well by most students, who seemed to know the required formula and were able to apply it easily. The students did have more difficulty with part (b). Many students recognised that the maximum speed would be given by $a\omega$ but did not realise what was required for a. Many used $\frac{\pi}{20}$ and did not include the length of the string in their calculations. A few students used an energy approach to find the maximum speed, but some worked with the incorrect height, using $2\cos\frac{\pi}{20}$ rather than $2\left(1-\cos\frac{\pi}{20}\right)$.

Question 2

This question was done well by students, with many good responses. In part (a) some students did not make it clear that they had used the identity $\sin^2\theta+\cos^2\theta=1$ and jumped too quickly to the printed answer. It is important in this type of "show that" question that all key steps are shown. In part (b), the majority of the students differentiated correctly and obtained the required answer. A few gave their answer in degrees instead of radians. Part (c) was also done well with many students reaching and justifying the correct conclusion. The value for $\frac{d^2V}{d\theta^2}$ was occasionally given as 5 rather than $5mga$.

Question 3

In part (a), there were many good responses, but in a number of cases there were issues with the students not obtaining correct expressions for the tensions in the two strings. One common error was to simply give the tension as $T=\frac{45x}{0.4}$ and take no account of the fact that the string was already stretched. Another common error was to give the expressions of the form $T=\frac{45}{0.4}(0.8\pm x)$ for the tension. Most of these approaches "produced" the printed answer, but credit was only given where this was correctly obtained from correct working. Part (b) was usually done well although some students did not include the mass and ended up with an incorrect value for ω of 15 which they used later in the question. Part (c) followed on and was also done well in the main. In part (d) several students correctly used the formula $v^2=\omega^2(a^2-x^2)$, but a number of students used incorrect values for a. The values 0.5 and 0.7 were seen several times. In part (e), students often gave answers of the correct form, but where they had an incorrect amplitude or value for ω from earlier incorrect working this was carried through into their answers.

Question 4

The answers to part (a) were generally good but in a few cases they were almost non-existent. Those who knew what was expected dealt with this part of the question very quickly and produced the required answer and showed that $k = 4$.
Part (b) was more challenging. Two early errors that were seen a number of times were to not use the fact that $\ddot{\theta} = 0$ and also to produce an incorrect expression for $\ddot{r}$. Quite a common mistake was to have $\ddot{r} = \pm 8\cos\theta$. Many students were able to show that the transverse component was equal to $-64\sin\theta$, but had incorrect values for θ which they then substituted.

Question 5

Part (a) was done well by many students, but some struggled to provide a convincing justification for the differential equation. A clear statement of the resultant force and then a clear application of Newton's Second law would have helped some students.
The majority of students did very well with the solution of the differential equation and seemed to be comfortable with this part of the question. The most common error seen was probably to use $\dot{x} = 0$ rather than $\dot{x} = 12.5$. There were however a whole variety of minor arithmetical and algebraic errors. Part (c) was done well but obviously some students were using incorrect expressions for the speed.

Question 6

There were many good responses to this question and a fair number of students gained full marks.
In part (a), there were many good responses, but some students did not make their formulation of the differential equation clear enough. One particular issue was that $F = 0$ appeared towards the end of the working as if to fix the working to obtain the required answer, rather than as a key statement at the start of their work.
In part (b), there were some errors with the integration, but the biggest issue was that some students used $m = M - \lambda t$ rather than $m = 2M - \lambda t$. Most students who completed the question gave their answer in a sensible simplified form.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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UMS conversion calculator www.aqa.org.uk/umsconversion