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Mathematics 6360

MM2B Mechanics 2B

Report on the Examination

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General

The early questions proved to be a pleasing introduction to the paper with most candidates achieving full marks for questions 1, 2 and 3. Unfortunately, apart from question 6, each of the later questions were found challenging by a significant proportion of the candidates. Most candidates' algebraic manipulation was good, with many quick and simple solutions seen to equations such as $40v^2 + 1500g\sin 6.v - 100000 = 0$ in question 4 part (c).

A number of answers were given on the question paper to enable candidates to proceed onto the next part. Some of these printed answers were arrived at by candidates, despite bearing no real relation to their working.

For example, in question 8 part (b)(ii), the working should show $\frac{150\times(0.3)^2}{2\times 0.6} = 11.25$, whereas a number of candidates wrote $\frac{150\times(0.9)^2}{2\times 0.6} = 11.25$, ignoring, or not trying to find, the true result of their calculation.

By contrast, in question 8 part (b)(iii), the printed answer was used sensibly by many candidates who used it to correct their working. Candidates who got lost in their algebra frequently ran out of time in the last question.

Question 1

Most candidates answered this question well, with only a few making algebraic or arithmetical errors.

Question 2

This question was also answered well by many candidates. A few lost a mark in part (a) by not showing that the two tensions were different, and a number of candidates used incorrect moments in part (b), but spuriously obtained the given answer by approximating $\frac{40g}{1.9}$ to $21g$.

Question 3

The majority of candidates answered this question well, although some divided all the masses by two or tried to consider a lamina. A few candidates interchanged $\bar{X}$ and $\bar{Y}$.

Question 4

In general, part (a) was answered well, but again a number of candidates spuriously concocted an answer: if they had obtained $80\ 000$, a factor of $\frac{5}{4}$ was clearly needed to give the printed result.

In part (b), instead of using $100\ 000 \div 25$, many candidates assumed that the force exerted by the engine was still 2000 N; the speed also meant that the resistance to motion had changed to 1000 N and therefore the accelerating force was $4000 - 1000$ N.

A significant proportion of candidates found the required quadratic equation and solved it very well in part (c). Some used $mg\cos 6$ instead of $mg\sin 6$, while others used $60°$ instead of $6°$.

Question 5

This question was badly answered. Many could not differentiate $\sin\frac{1}{4}t$ correctly, with $\cos\frac{1}{4}t$, $\cos\frac{1}{4}$ and $\frac{1}{4}t\cos\frac{1}{4}t$ all being seen regularly. Many of those who did find $\mathbf{v}$ correctly struggled to prove that $|\mathbf{v}|$ was a constant: they knew that $\sin^2\theta + \cos^2\theta = 1$, but often $(2\sin\frac{1}{4}t)^2 + (2\cos\frac{1}{4}t)^2$ became $4 + 4 = 8$.

Many dubious attempts were made to prove that the particle was moving in a circle. Only a few used the simple method: $r = 8$. In part (d), $v = \omega r$ and $v = \dfrac{\omega^2}{r}$ were used in equal measure. Candidates who used $v = \dfrac{\omega^2}{r}$ were misquoting the formula $a = \dfrac{\omega^2}{r}$. Often the values of r and v which candidates substituted were in vector form, with random attempts made at the division of two vectors.

Question 6

Virtually all candidates obtained $\dfrac{dv}{dt} = -0.05v$: only a few ignored the required step $m\dfrac{dv}{dt} = -0.05mv$. The equation $\int\dfrac{dv}{v} = -\int 0.05\,dt$ was a necessary step which needed to be seen in part (b). Candidates knew roughly how to obtain $v = 20e^{-0.05t}$. Unfortunately, too often algebraic skills were not sufficient and the equation $\ln v = -0.05 + c$ regularly became $v = e^{-0.05t} + c$ before becoming $v = Ae^{-0.05t}$. This and similar errors were not condoned.

Question 7

Many candidates made little progress in this question. A number did not use conservation of energy correctly, assuming that the kinetic energy at the top was zero. The fact that the bead could not complete full revolutions attached to a string with insufficient speed to remain taut at the top was usually ignored. It was common for such candidates to arrive at $v^2 = 4ag$, and then then use many techniques in dubious attempts to justify the addition of the missing ag.

In part (b), the required components, T and $\dfrac{mv^2}{r}$, appeared frequently in the equation, but often candidates did not find the value of v when the bead was at C. Part (c) was usually answered well.

Question 8

Part (a) tested work done $= \int F\,dx$. Few candidates found $\int_0^e \dfrac{\lambda x}{l}\,dx$ correctly. Instead of integrating, a few candidates used the value of the integral to be the area under the line $y = \dfrac{\lambda x}{l}$. Unfortunately, many candidates used techniques which were not credited: for example, elastic potential energy is $\dfrac{\lambda x^2}{2l}$ and $x = e$; or work done = maximum force × half the distance moved, without a clear justification.

Part (b)(i) was completed well, as was part (b)(ii), although a number of candidates did write down $\frac{150 \times 0.9^2}{2 \times 1.2} = 11.25$, which evidently it is not. In part (b)(iii), many tried to use the conservation of kinetic energy, potential energy and elastic potential energy. The printed result enabled many of those who obtained an incorrect answer to correct their working. Commonly, this was because they had used $\frac{\lambda(0.9 - x)^2}{2l}$ instead of $\frac{\lambda(0.3 - x)^2}{2l}$ for the elastic potential energy. Part (c) was completed well, but some candidates did not explicitly exclude $x = 0$.

Mark Ranges and Award of Grades

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