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Mathematics MM2B

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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 good marks for questions 1, 2, 3 and 4. Unfortunately, candidates found difficulty with questions which required resolving, so questions 5 and 6 part (b) were often answered badly.
The differential equation, in question 7 part (a) was given on the question paper to enable candidates to proceed on to the next part. All too often this equation was obtained by candidates despite their working bearing no real relation to the required result.

Question 1

Parts (a) and (b) were usually answered correctly but in part (c)(i), a number of candidates subtracted the two energies rather than adding them. Part (c)(ii) was usually completed correctly.

Question 2

This question was also answered well by virtually all candidates, who showed that they knew the techniques involved in answering it. In part (c) the majority of students integrated to find the position vector but a common error was to forget the $+ c$ term and thus to ignore the initial position vector. Some found the $+c$ incorrectly assuming that **c** was zero without completing the necessary calculation.

Question 3

Part (a) of this question was usually answered well. A significant proportion of candidates, in part (b), tried to use angles and found the distance of the centre of mass to one of the points, often A. Some forgot to involve g in their calculations.

Question 4

In part (a) many candidates attempted to prove that the particle moved in a circle by showing that the particle was a constant distance, 4, from the origin at certain times. The general proof that the particle was always 4 from the origin was required. In parts (b) and (c) a small number of candidates did not include the $\mathbf{i}$ and $\mathbf{j}$ in their solutions. In part (d), many candidates attempted to divide vector **a** by vector $\mathbf{r}$ to obtain the value of k. In spite of the fact that two vectors cannot be divided in this way, many candidates found k to be –9. In part (e) a significant proportion of candidates assumed that the vectors $\mathbf{i}$ and j were in compass directions and gave the acceleration as, for example, north west.

Question 5

Many candidates resolved horizontally for particle A and obtained $m\omega^2 r = mg$ without appreciating that the m in $m\omega^2 r$ was 1.4, being the mass of particle A, whereas the m in mg was 2.1, being the mass of particle B. Other candidates found the speed, v, to be 2.1ms^{-1} but never found ω, or even included any equation involving ω.

Question 6

In part (a) most candidates realised that they needed to consider the kinetic energy at the lowest point and the change in potential energy moving from P to the lowest point. Methods used to find the change in height between points were interesting, but often not correct. The answer for the change in height was often truncated and this caused inaccuracy in the answer for the maximum speed. In part (b), many candidates correctly found an equation involving T.

Question 7

Most candidates answered part (a) correctly but some just wrote down the printed result. In part (a) some candidates started with $m\frac{\mathrm{d}v}{\mathrm{d}t} = -9.8v$ but found that this did not give the printed result, and just invented a term in g. This was not accepted. Some were penalised for ignoring the *m* term or for changing signs.

In part (b) candidates were expected to use $\int \frac{1}{v-5}\mathrm{d}v = -1.96\mathrm{d}t$; some split $\int \frac{1}{v-5}\mathrm{d}v$ into $\int \frac{1}{v} - \frac{1}{5}\mathrm{d}v$. However there were many good answers to this part with both the integrations required being successfully completed. The difficulty which some candidates had was in the simplification needed to convert $\ln(v-5) = -1.96t + \ln 2$ into $v - 5 = 2e^{-1.96t}$ which often became $v - 5 = e^{-1.96t} + 2$

Question 8

In part (a) most candidates found the initial EPE correctly, but a number forgot to add on the initial KE to find the energy of the block at A. In part (b) (i), most candidates found the frictional force to be $0.4\,\mu g$ but often failed to multiply this by 5.5 to obtain the work done by the frictional force. Other candidates used $v^2 = u^2 + 2as$, ignoring the fact that constant acceleration formulae cannot be used with elastic strings. In part (b)(ii), candidates often used the speed after rebounding to be half the speed of the block before the impact, but when finding the kinetic energy forgot to square the half, when calculating v^2. The required equation on part (ii) included three terms, KE when leaving B, work done by friction and the EPE in the string when the block came to rest at B. Unfortunately many candidates forgot that the string had a non-zero EPE when the block was at B.

Mark Ranges and Award of Grades

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