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General Certificate of Education

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 question 1 and at least 8 out of 9 marks for question 2. Unfortunately, apart from question 6 parts (a) and (b) and question 8, each of the later questions were found challenging by a significant proportion of the candidates.

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 their working bearing no real relation to the answer. For example, in question 4 part (a), the working should show $T = \dfrac{mg}{\cos 60 + \cos 40} = 46.4$, whereas a number of candidates wrote $T = \dfrac{mg}{2\cos 60} = 46.4$, ignoring, or not trying to find, the true result of their calculation. Candidates who got lost in their algebra occasionally ran out of time in the last question.

Question 1

Virtually all candidates answered this question well, with only a few forgetting to find the magnitude of the force in part (c).

Question 2

Many candidates showed that they knew how to answer this question. However, when considering the slide at the water park, many of them misread the phrase "inclined at an angle of $30°$ to the vertical" and based their calculations on the more commonly-seen slope of $30°$ to the horizontal.

In part (b), the question asked for both the kinetic energy *and* the speed, and some candidates only gave one of these. In part (c), candidates often gave a modelling assumption which had been quoted in the question: for example, that the plane is smooth. Only assumptions not given in the question were accepted, such as that Anne is a particle.

Question 3

The majority of candidates found the normal reaction at the foot of the ladder to be $112g$ and readily found the frictional force, $\mu \times 112g$, as given. In part (b), most appreciated that moments were needed and tried to take moments about A. However, in the terms, many forgot the distance or the angle necessary in taking moments.

Question 4

This question caused difficulty to some candidates as there were two strings to consider. Resolving vertically did not always give them the equation $T\cos 60 + T\cos 40 = mg$. Others used the result 46.4, given in the question to help candidates, and hence appreciated that they needed to add the two components of the tension. Unfortunately, many candidates then returned to their knowledge of more typical questions and only considered the component of one string when resolving horizontally.

Question 5

This question was badly attempted. Many candidates found θ, the angle of inclination of the slope. Instead of using $\sin\theta$, where $\sin\theta = \dfrac{1}{40}$ as given, many used an approximate numerical angle for θ, and then found $\sin\theta$, which clearly resulted in numerical inaccuracy. The decision of whether to add or subtract this result from the resistance force of $200\ 000$ N appeared random. Most candidates correctly multiplied their total force by 24 to find the power.

Question 6
Parts (a) and (b) of this question were answered well. In part (c), many complicated methods were used to find the work done; often speed was considered and it was common for the work done, exactly 48 J from part (a), to become a value fairly close to 48 J. Most candidates found the frictional force to be $5g\mu$, but relatively few candidates used work done by friction to be $5g\mu$ multiplied by the distance moved, which was 2 m.

Question 7
Many candidates made little progress in part (a) of this question. A number did not use conservation of energy correctly, with many not finding the change in potential energy to be $mga\,(1+\sin\theta)$. It was common for such candidates to resolve radially to obtain $R = \frac{mv^2}{a} - mg$, but then use the answer to change this into $R = \frac{mv^2}{a} - mg\sin\theta$. The printed answer meant that many candidates changed their original terms, enabling their answers to appear correct. However, they were rarely changed correctly. Part (b) was usually answered well, but a common error was, when $u = \sqrt{3ag}$, to give $\frac{mu^2}{a} = \frac{m\sqrt{3}}{a}ag$ instead of $\frac{m.3ag}{a}$, which was $3mg$.

Question 8
The answer printed in part (a) enabled virtually all candidates to create their solution. However, a considerable minority were not convincing. Part (b) was well answered, with most candidates appreciating that the differential equation needed to be solved by separating variables. Some found the resulting integral, $\int v^{-\frac{3}{2}}\,\mathrm{d}v$, challenging, and the $+\,c$ term was often omitted. In part (c), rather than using $\frac{2}{\sqrt{v}} = \lambda t + \frac{2}{3}$ to obtain t when $v = 4$, many used the last result, $v = \frac{36}{(2+3\lambda t)^2}$ when $v = 4$, and forgot to eliminate the negative root when calculating the square root of $4 = \frac{36}{(2+3\lambda t)^2}$.

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