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Mathematics MM1B

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Mechanics 1B

Report on the Examination

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General

The paper seemed to provide a good amount of accessible material in the earlier questions with more challenge in the later questions, particularly 7 and 8. Candidates' use of vectors provided evidence of a poor understanding of the difference between vectors and scalars in many cases. This was particularly seen in question 7. It was interesting to see that the equation $s = \frac{1}{2}(u+v)t$ was used inappropriately, particularly in questions 3, 4 and 8.

Question 1

This question was done very well, with almost all candidates gaining full marks. The two main areas where marks were lost were simple arithmetic errors and candidates not using the total mass of $10\ \text{kg}$ in their equations.

Question 2

This question was generally done well. There were very many good force diagrams, with the most common error probably being the omission of arrow heads. Part (b) was done very well. While there were many good answers to part (b) some candidates simply calculated $4 \times 3 = 12$. There were also a few candidates who made a sign error, producing equations such as $F - 50 = 12$. Candidates were generally able to apply $F = \mu R$ to their answers from the previous parts, and many gained the follow through marks that were available. There were many good explanations for part (c), but also a number of confused answers, in which it was claimed that the coefficient of friction would have to increase.

Question 3

There were very many good solutions to this question, with many candidates gaining full marks. There were some arithmetic errors that were introduced in parts (a) and (b) when calculating the distances. The questions about the displacement and the average velocity in parts (d) and (e) did cause some confusion, particularly for some candidates who tried to use the formula $s = \frac{1}{2}(u+v)t$.

Question 4

The candidates were more successful with part (a) than with part (b). Many were able to produce the correct speed of 6. The most common errors were to use cos instead of sin, for example $V\cos 30° = 3$, or to resolve the 3 instead of V, for example $V = 3\sin 30°$. In part (b), candidates often used a speed that did not correspond with the distance that they used. The particular response $t = \frac{200}{6} = 33\,\text{seconds}$ was the most common of these. Some candidates tried to use Pythagoras's Theorem to find the speed along AB. While some were successful, a significant number used $\sqrt{6^2 + 3^2} = \sqrt{45}$ instead of $\sqrt{6^2 - 3^2} = \sqrt{27}$. Some candidates ignored the instruction to give the answer to the nearest second and some made errors with the rounding, for example $38.49\ldots = 38.5 = 39$ seconds.

Question 5

Candidates tended to do either very well or very badly on this question, although some were able to gain follow through marks in part (b) from an incorrect answer to part (a). Those candidates who realised that they had to consider the whole system in part (a) and did not include tensions usually obtained a correct solution. A large range of errors were seen which included adding a tension force, considering the weight or having the wrong multiple of R for the total resistance. The candidates seemed to find part (b) easier and were often able to

form an equation, which they solved by just considering the car or the caravan. It was most common for them to consider the caravan, and most realised that the tension was given by $T = 1600 + 2R$.

Question 6

There were very many good attempts at both parts of part (a) with a lot of correct answers. However, there was quite a bit of confusion with part (b). A very common wrong answer was 686 N, and it appears that there was some confusion between the words 'resultant' and 'reaction'. There were some good solutions to part (c), although this part of the question was more demanding. A considerable range of incorrect responses were seen, including the omission of g, as in $70\sin\alpha = 58.8$, the use of cos instead of sin or the use of the normal reaction from part (b), as in $686 = 70g\sin\alpha$.

In the second part of part (c), it was not unusual to see the 30 N force with the wrong sign which produced the following incorrect equation: $70g\sin\alpha = 58.8 - 30$. In part (d), there were many good answers where the candidates linked the resistance to the speed of the cyclist. However, some simply said things such as "the resistance will not be constant" and did not give a reason to support this answer.

Question 7

Parts (a) and (b) of this question were often done well, while part (c) proved to be very demanding. In part (a) some candidates left their final answer as $840\mathbf{i} + 500\mathbf{j}$ and did not extract the **j** component as the height. The errors in part (c) were often due to candidates creating an expression in which a scalar is seen as equal to a vector, often through use of the equation $v^2 = u^2 + 2as$. These candidates did not seem to appreciate how to work with vectors and did not realise that they needed to extract the vertical component to find t. A few candidates stopped when they had obtained the velocity in part (c) and did not complete the question to find the speed.

Question 8

This question proved quite difficult, but candidates did tend to pick up marks as they progressed through their attempts. Many candidates gained 1 or 2 marks in part (a) for their attempt to find the angle. Some, however, tried to use the speed of 8 rather than the distances and scored zero.

In part (b), a reasonable number of candidates produced a quadratic equation, but often with incorrect signs, $8t$ instead of $8\sin\alpha t$ or the wrong distance. Once an error of this type was made, they began to lose marks, although those who showed how they solved their quadratic equation often gained the method mark. Even those with poor attempts at part (b) were able to gain some marks in part (c) by using $8\cos\alpha t$ and subtracting their answer from 10, although there were very few completely correct solutions.

Mark Ranges and Award of Grades

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