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Mathematics MM1B

(Specification 6360)

Mechanics 1B

Report on the Examination

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General

The early questions in the paper proved to be accessible and there were many good responses to these questions with a wide range of students gaining good marks. The later questions provided more challenge and provided good discrimination at the A grade level. Questions 5 (b), 7(c) and 8 were the most demanding.

Question 1

This question was done very well by the vast majority of students with many gaining full marks. Minor mistakes were the main reasons that students lost marks. Occasionally, students treated the car as if it was moving with constant velocity, for example using $\text{Time} = \frac{\text{Distance}}{\text{Speed}}$ or similar. There were a few cases where students quoted constant acceleration equations incorrectly. Also there were a few, but not many instances, in part (c) where students found the mean of two speeds.

Question 2

Again this question was done well by many students although some made minor errors. In part (c) a few students found the acceleration (as $1.4\mathbf{i} + 1.6\mathbf{j}$) and did not calculate the magnitude. Also, in part (d) some students found the angle as $41°$ rather than $49°$. However many students gained full marks on this question.

Question 3

While this question was generally done well there were more errors than in the first two questions. In part (a) the most common error was to include a force directed down the slope. Part (b) was done well, but a few students gave the answer 29.4 and a few used $\sin 40°$ instead of $\cos 40°$. Part (c) was done very well and follow through marks were awarded to those with errors arising from part (b). Part (d) was a little more demanding, with the most common error being to work with only one force. There were many good answers to part (e), but some students gave answers that were not about the forces. For example, a statement like "The box is a particle." did not relate to the forces acting on the box as was requested in the question.

Question 4

While there were many good solutions to this question, there were a number of errors in the solutions of some students. For example in part (a), some students ignored the tension in the tow bar acting on the tractor and created equations like $2500 - R = 3500 \times 0.2$. A number of students were able to find R correctly by finding the tension in the tow bar first before considering the forces on the tractor to find R. It was not uncommon to see students gain no marks in part (a), but gain full marks in part (b), when they considered the forces acting on the trailer correctly.

Many students realised that the answer for part (c) was expected to be the same as the answer to part (b) and simply stated this as expected. However, some worked with the forces acting on the tractor to find the tension and produced an equation rather than simply stating the value.

Question 5

Some students did very well on this question, but there were two main stumbling blocks. The first was for those students who did not appreciate the significance of the fact that the two particles were moving towards each other. This resulted in them treating the particles as if they were both moving in the same direction thus finding the total momentum before the collision to be $20 + 12 = 32$ rather than $20 - 12 = 8$. The second issue was not introducing a negative sign with the 0.6 when considering the velocity in the second case. Some students thought that the second speed could be found by considering the particles as if they coalesced during the collision.

Question 6

Part (a) was completed successfully by almost all students, but part (b) was completed successfully by very few students. In part (b), the students who were able to draw a diagram that correctly represented the return journey were able to make a good attempt at this part of the question. However, a large number of students incorrectly worked with a right-angled triangle and ended up with an answer of 5.

Question 7

Parts (a) and (b) of this question were frequently done well. In part (b) some students omitted the initial position. An unusual error that was seen a number of times was to write something like $13.6\mathbf{i} = (6\mathbf{i} + 2.4\mathbf{j})t + \frac{1}{2}(-0.8\mathbf{i} + 0.1\mathbf{j})t^2$ often followed by

$(6\mathbf{i} + 2.4\mathbf{j})t + \frac{1}{2}(-0.8\mathbf{i} + 0.1\mathbf{j})t^2 - 13.6\mathbf{i}$.

Part (c) was generally not done well. A great many students tried to use the position vector instead of the velocity vector. Of those who did realise that the velocity vector was required a few did not introduce a negative sign and simply equated the components of the velocity as if the direction of travel was north-east rather than north-west. Also a few students who made good progress stopped when they had obtained $28\mathbf{i} + 36\mathbf{j}$ and did not find the magnitude of this to obtain the distance as requested in the question.

Question 8

There were very mixed responses to this question. Some students worked through this very easily, but others found it difficult to get started and produced very little meaningful work. A very common issue was mixing up aspects of the horizontal and vertical motion. For example equations like $38.4 = V\sin\alpha t - 4.9t^2$ were seen. Another incorrect approach was to assume that the ball was at its maximum height half way through the motion.

Some students attempted the question in an order that did not match the parts of the question. Typical of this was simply stating $V\cos\alpha$ in part (a) and then finding the value of 16 while doing part (b). It should be noted that if an answer of this type was required it would have been asked for in terms of V and α. (However please note that full marks were given to these students). Many also found the angle $39.1°$ while working on part (b). As a general principle, students should make sure that they give the answer that they intend for each part where they have written the part letter (eg (a)) on their script. In this question it did not cause issues for the marking, but in another case it could be more problematic.

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