GCE

MATHEMATICS

MM1B Mechanics 1 Option B
Report on the Examination

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General Comments

This paper offered a range of questions, with most of the earlier questions being accessible to all students while some of the later questions, particularly questions 6, 7(b) and 8 being more demanding.
For some questions, there were students who took fairly long approaches to using trigonometry, for example using the cosine rule when the sine rule would have been much easier. Also some used the sine rule with a $\sin 90°$ term or similar when a simple trigonometric ratio would have been sufficient.

Question 1

This question was done very well by the vast majority of students with many correct solutions. Some students worked in grams instead of kilograms. The most common error was to include a 200 in the calculation for the total momentum before the collision.

Question 2

This question was also done very well with a high success rate. The main issues that prevented students gaining full marks were arithmetical errors or reading incorrect values from the graph. A few students omitted one section when finding the area. Occasionally, students would incorrectly take the mean of some velocities, for example calculations like $\frac{5+6+7}{3}=6$, but this could not be described as a common approach.

Question 3

There were very few problems with part (a) and these marks were gained by almost all students. However in part (b), while there were many good answers, there were some students who either incorrectly found the bearing directly as $79°$ or found $11°$ and then subtracted this from $90°$ to get $79°$. There were also some students who had answers that were of the form $360-11=349°$ or $180°\pm 11°$ and some who did similar calculations with $79°$.

Question 4

The students approached this question either using the cosine and sine rules or by finding components. The big issue for those who used the cosine rule was that some students used $30°$ and did not realise that in the triangle they should be considering that it was a $150°$ angle that was required. This approach made it very difficult for them to gain marks on the question, whereas those who had the correct angle often went on to gain full marks.
Those who used an approach based on components could do well, but there were a couple of common mistakes, typically due to getting mixed up with the values that they had obtained. A common error of this type was to use 70 instead of 104.6 in part (b) when finding the angle.
All the students who had difficulties with this question would probably have been helped by better diagrams.

Question 5

Part (a) was a very standard question and many students did well with this part of the question. However, a small number of students ignored the instruction to form two equations of motion.
In part (b), some students did not convert the 40 cm to metres and obtained speeds that related to moving 40 m rather than 40 cm. These students did gain some marks, but lost the final accuracy mark.
In part (c) a common error was to use the wrong acceleration, with some students continuing to use 4.9 m s^{-2} rather than -9.8 m s^{-2}. In this part there was also some confusion between the values to use for u and v, with some students taking u as zero at the maximum height.
Most students were able to say that the acceleration would be reduced, when answering part (b), but a much smaller proportion of the students could give a good explanation. Those who mentioned the effect of the air resistance on the resultant force normally gained both marks.

Question 6

Students tended to do either very well or very badly on this question. This projectiles question, which did not contain a specified angle, seemed to confuse many students and some even tried to find an angle that they could use in some way. The problems were generally focussed on a confusion between the horizontal and vertical motion and the inability of students to relate the information given to these directions. For example in part (a), some students used 20 m to try to calculate the time, or in some cases the length of a line from the top of the cliff to the boat. In part (b), which required consideration of the horizontal motion an acceleration of 9.8 m s^{-2} was sometimes included. Similarly in part (c), the same type of confusion was present.
Also in Part (c), there were a few students who correctly found the two components of the velocity, but who did not then find the speed of the car.

Question 7

Part (a) was often done very well by students, with a reasonable number of students gaining all 11 marks. There were a few issues with the force diagram, with missing or additional forces. Many students seemed to have been helped by the answer that was given for the normal reaction and this in turn enabled many to find the friction correctly. Finding the acceleration was also done well, although there were a few sign errors and some students simply used 150 instead of $150\cos 20°$.
Part (b) was much more demanding and there were far fewer correct responses. The most common error was not to take account of the changed angle when finding the normal reaction and to simply continue to use the value of 243 from part (a).
In part (c) there were some good responses, but a fair number of students incorrectly stated that the tension would be greater for a greater constant speed.

Question 8

Part (a) was the most accessible part of this question. While there were a good number of correct responses, there were also a significant number of students who had problems with the initial position. Often this was initially placed on the wrong side of the equals sign so that the students ended up with $-(500\mathbf{i}+200\mathbf{j})$ in their expressions for the position vector.

Part (b) was much more challenging for the students. Those who were able to form two quadratic equations from the components of the position vector were usually able to go on and solve these to find the correct time. Incorrect approaches included trying to work with the magnitude of the position vector or not using the position vector of the rock.

Part (c) was also problematic for some students. Many ended up with $\dfrac{300\mathbf{i}+600\mathbf{j}}{\text{time}}$ instead of $\dfrac{-300\mathbf{i}-600\mathbf{j}}{\text{time}}$.

The explanations in part (d) were generally inadequate, with answers like velocity has direction and speed does not, which did not go far enough to justify the award of the mark.

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