A-LEVEL
FURTHER MATHEMATICS

MM03 Mechanics 3
Report on the Examination

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General

There were many excellent responses to this paper. A high proportion of students attempted all questions and demonstrated a sound grasp of the relevant knowledge and skills. Many students showed a high level of competency with the methods of calculus and with the algebraic manipulation required for this paper.

Teachers should remind their students to give their **final** answer to questions requiring the use of calculators to three significant figures, unless stated otherwise.

There was no evidence of lack of time for students to complete the questions.

Question 1

This question was answered well by the great majority of students. Students were familiar with the use of square brackets in this context. A small minority of students used kg, m and s instead of using M, L and T, respectively. Some students showed that the dimension of the terms in the given equation were the same but they did not make any statement regarding the consistency of the equation.

Question 2

Almost all students answered part **(a)** of this question correctly, showing all steps of their working.

For part **(b)(i)**, a small number of students substituted 25 instead of –25 for y in the equation of trajectory of the projectile. Premature rounding of the values of $\tan\theta$ or rounding of the values of θ to less than three significant figures resulted in loss of accuracy mark(s) for some students.

For part **(b)(ii)**, some students found the time of flight for each possible angle of projection and then stated the shortest time. This was an acceptable approach.

Question 3

A very small number of students could not deal with variable force in this context and they attempted to answer this question by using the constant acceleration formulae or by treating the force as constant. The most popular method for answering part **(a)** was integration with a small minority using the 'area' method to find the impulse. Some students benefitted from follow-through marks in part **(b)**. Despite the question requesting the times when the particle has velocity $11\ \mathrm{ms}^{-1}$, a small number of students rejected their $8\ \mathrm{ms}^{-1}$ solution for part **(c)** and as a result lost one mark.

Question 4

This question was correctly answered by the majority of students who were familiar with applying the principle of conservation of linear momentum and the law of restitution to problems of collision in two dimensions. Very few students made errors in the algebraic manipulation of their work. Almost all the students who answered part **(a)** correctly were able to move on to answer part **(b)** of the question, gaining full marks.

Question 5

For part **(a)**, most students understood the requirements for the projectile to strike the inclined plane at right angles; they realised that the expression for the perpendicular height from the plane and the expression for the velocity component along the plane would both be equal to zero. Many students were able to give a correct solution to this part.

To answer part **(b)**, the great majority of the students substituted 20 for x in the displacement equation for the motion parallel to the plane. But some students were not able to proceed any further than this.

A large number of students, including those who were not able to answer part **(b)** correctly, were able to gain full marks in part **(c)**, thanks to the given answer for part **(b)**.

Question 6

Almost all students were able to answer part **(a)** of this question correctly.

A significant number of students were not able to answer part **(b)** correctly. The approach by the successful students was about evenly divided between a totally geometrical approach and one using calculus. A small number of students used a scalar product method to answer this part.

Question 7

There were many good responses to part **(a)** of this question. However, some students in reality worked out the distance $(36.7\ \text{km})$ but interpreted this as speed. In their attempt to determine the bearing, a small minority of the students could not use the sine rule correctly (eg $\frac{\sin\theta}{48} = \frac{\sin 45}{18.346}$ was seen).

The lack of a clearly labelled velocity diagram for part **(b)(i)** seemed to be the main reason for many students not being able to answer this part correctly. Premature rounding of partial results was a source of error and caused the subsequent loss of accuracy marks for this part of the question.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.
UMS conversion calculator