AQA

A-LEVEL
MATHEMATICS

MM03 Mechanics 3
Report on the Examination

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General

The majority of students showed some understanding of most of the topics and, as the first half of the paper was quite straightforward, most started confidently. Questions 4(b) and 5(b) challenged many, as did question 6(b) and Question 7. There were few very low marks, and some students scored full marks. Students seemed to manage their time well with apparently very few lacking the time to complete their work.

Question 1

This question was well answered by most students, with many gaining all four marks. Some students lost the accuracy mark for each part by giving negative answers. A small minority of the students did not gain any marks for part (a) because they multiplied the wrong mass by a velocity.

Question 2

Most students gained full marks for this question. A small minority of students failed to recognise that the dimensions of E were the same as the dimensions of $\frac{Gm_1m_2}{r}$. As in previous years, a small number of students used kg, m and s instead of using the correct symbols M, L and T respectively. There were some students who were not familiar with the correct use of square brackets in the context of dimensional analysis.

Question 3

In part (a), almost all students showed full understanding of how to derive the given equation of trajectory and were able to gain full marks for this part of the question.

Part (b) proved too challenging for some students. Some students with a correct approach substituted $x = 6 + d\cos 45°$ and $y = d\sin 45°$ (where d=PQ) into the given equation of trajectory and solved the quadratic equation to find the answer. Others were able to substitute $y = x - 6$ or $x = y + 6$ into the given equation of trajectory, solve the resulting quadratic equation and then use a trigonometric ratio or Pytharoras' theorem to find the answer. Unfortunately some students assumed that the ball was at its maximum height when it reached the point Q without any mathematical reasoning, and they did not gain any marks for this part of the question.

Question 4

In part (a)(i), the great majority of students were very familiar with the principle of conservation of linear momentum and the law of restitution and used these correctly to gain full marks for this part of the question.

In part (a)(ii), most students were able to score full marks. However, students who did not form an inequality for their velocity of A scored zero.

In part (b), many students could not form a correct inequality involving the velocity of A and the velocity of B after collision with the wall. However, students often gained one mark for writing the correct rebound velocity of B.

In part (c), two correct momentum terms were required for the method mark. However, those students who mistakenly used m instead of $4m$ for the mass of B did not lose the method mark.

Question 5

In part (a)(i), even though the word horizontal was emboldened in the stem of the question, some students used $22\sin 70°$ instead of $22\sin 50°$ as the initial velocity perpendicular to the inclined plane. The other mistake made was using zero instead of -1 for the vertical displacement of the ball from the inclined plane.

The students who had answered part (a)(i) correctly moved on to answer part (a)(ii) without any difficulty. However, some students lost an accuracy mark for incorrect rounding of the velocity of the ball parallel to the inclined plane. The students who used the wrong angle in part (a)(i) almost always used the wrong angle here also.

Many students did not gain full marks for part (b). A correct inequality had to be formed in order to score the M1 mark. However many students gained a B1 mark for multiplying their vertical component of the velocity of the ball by e.

Question 6

Part (a) was answered very well, with most students gaining full marks. A small number of students used u instead of $u\cos 60°$ in their equations.

Part (b) proved too challenging for the great majority of the students. Some students gained two marks for stating the components of the velocity of B parallel and perpendicular to the wall. Many students had difficulty finding the components of the velocity of A after the collision. Some of the more successful students used correct ratios to form an equation but then made errors in their algebraic manipulation of the equation.

Question 7

Part (a) was poorly answered by most students. The students who made significant progress sketched combined velocity triangles. They used the sine rule to find ${}_T v_Q$ and then the cosine rule to find v_T before attempting to find the required bearing.

In part (b), to make progress, it was essential for the students to understand the condition necessary for the quad-bike to approach the truck as closely as possible, ie ${}_Q v_T$ and v_Q being at right angles. A minority of students were able to use scalar product of vectors (a valid method outside the specification) to successfully reach an answer. Some students who could not gain any marks for part (a) were able to answer part (b) correctly, thanks to the given answers in part (a)

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