GCE
MATHEMATICS

MM03 Mechanics 3
Report on the Examination

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General

There were many excellent scripts. A high proportion of the students attempted all questions and demonstrated sound understanding of almost all of the concepts examined. As the first half of the paper was quite straightforward, most students started confidently. The other questions offered more challenge. There was some poor attention on the part of some students as to what had been asked in some of the questions. Some students appeared to lack the ability to use a geometric approach to deal with questions on relative motion. This year, encouragingly, fewer students attempted to use the constant acceleration formulae to tackle the impulse of a variable force. Almost all students showed understanding of the principle of conservation of linear momentum and of the experimental law of restitution. There was no evidence of lack of time for students to complete the questions.

Question 1

This question was answered fairly well by most students. Most students were able to use the impulse-momentum principle correctly. Some students found the acceleration and solved the differential equation to find velocity as a function of time and hence found the value of T. The great majority of the students were able to deal with the impulse of the variable force and only a small minority attempted to use the constant acceleration formulae here.

Question 2

This question was answered very well by most students who found the dimensions of the quantities in the given formula in terms of M, L and T. However very few students used the square bracket notation and some students used kg, m and s instead of M, L and T respectively. Centres should encourage their students to use appropriate notations in dimensional analysis. A very small number of students attempted unsuccessfully to derive the formula itself, apparently misunderstanding that all that was required was to show that the formula was dimensionally consistent. Also, students should appreciate that dimensional consistency of a formula does not necessarily imply the validity of the formula.

Question 3

(a) Almost all students were familiar with the equations of motion of a projectile and they were able to use them to find the equation of the projectile's trajectory in terms of x, u, g and $\tan\vartheta$. (b)(i) Most students interpreted the context of the question correctly in relation to the given co-ordinates axes and they were able to make the appropriate substitutions into their equation of the trajectory. They were then able to solve the quadratic equation in $\tan\vartheta$. However, many students lost the last accuracy mark because they stated the given values of ϑ without writing down the unrounded values to at least four significant figures. (ii) This part proved more challenging for some students. Those who answered this part correctly were able to find the horizontal and vertical components of the velocity of the ball at the instant of reaching the basket and then used trigonometry to find the required angle. Students needed to specify the direction of the motion of the ball by giving a correct acute angle and stating whether the angle was made with the horizontal or the vertical.

Question 4

(a) The principle of conservation of linear momentum and the law of restitution were well applied by a great majority of students. However some students lost one or both of the last two accuracy marks by not simplifying their expressions for v_A and v_B. (b) Here it was required to state that as $e \leq 1$, then $v_B \leq \frac{u}{2}(1+5)$, or equivalent, and hence $v_B \leq 3u$. Many students gave satisfactory answers, but some lost marks due to either using a strict inequality or by not giving a fully convincing answer. (c) Many students lost marks here for using the speed of B together with the mass of A to state the difference of the two momentums.

Question 5

This question was generally answered well. Most students were familiar with the equations of motion for a projectile on an inclined plane. (a) The question requested an expression for u, but many students gave an expression for T and hence lost one mark. (b) Having found an expression for u in part (a), instead of rearranging this to find an expression for T, some students started all over again from the beginning to find an expression for T. Apparently some students overlooked that this was a projectile moving down an inclined plane and used $-g$ instead of using $+g$ in their equation of motion parallel to the plane.

Question 6

(a) Almost all students stated that there was no change in the component of the velocity perpendicular to the line of centres. Many students calculated angles in degrees and used decimal approximations to show the given answer, thereby losing one accuracy mark. Some students efficiently used the scalar product method (not in the specification) to gain full marks**.** (b) Many students were able to use the conservation of linear momentum correctly. However, some students showed a lack of understanding by writing the coefficient of restitution as a ratio of the differences of two pairs of vectors rather than of speeds along the line of centres. (c) Here the question asked for the impulse, but many students gave the magnitude of the impulse.

Question 7

(a)(i) Some students were well prepared for questions on relative motion and they were able to answer this question correctly. Others struggled to set up the velocity diagram. Some students found a correct angle but failed to give a bearing. A small minority of students gave a bearing to the nearest degree instead of to one decimal place as requested. (ii) Some students benefitted from follow-through marks allowed for this part of the question. A small number of students gave the time in hours instead of minutes as requested. (b)This part proved too difficult for many students. Often the students who attempted to draw a velocity diagram failed to recognise which velocities should be at right angles to each other. Very few students were able to make any progress with using the position vector of A relative to H to obtain the minimum distance in order to find an angle and the bearing.

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 www.aqa.org.uk/umsconversion