Version 1.0

General Certificate of Education (A-level)
June 2011

Mathematics MM03

(Specification 6360)

Mechanics 3

Report on the Examination

Further copies of this Report on the Examination are available from: aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

General

There were some excellent responses to this paper. Most questions were attempted by a high proportion of the candidates, who demonstrated sound understanding of almost all of the concepts examined. The exception came in question 4, where about three quarters of the candidates were not able to find the velocity vectors by using the speeds and direction vectors correctly. Almost all the candidates showed understanding of the principle of conservation of linear momentum and the experimental law of restitution.

Question 1

The candidates' responses to this question were generally good. However, for part (a), in failing to recognise momentum as a vector quantity, some candidates did not take into account the reversal of the direction of motion of the ball after hitting the bat. Some candidates did not understand how to find the impulse of a variable force. These candidates attempted to answer part (b) by treating the force as constant. There were some candidates who misread 0.09 seconds and instead used 0.9 seconds for the upper limit of their integral. A small number of candidates attempted to integrate the force but actually differentiated it. Almost all candidates showed understanding of the equivalence of impulse and change of momentum.

Question 2

Questions on dimensional analysis have been answered well in the past examination series. However, for this paper, a significant number of candidates used MLT^{-1}, instead of MLT^{-2}, for the dimensions of force. Also, some candidates used M or LM^{-1}, instead of ML^{-1}, for the dimensions of q. There were many candidates who made mistakes in collecting and simplifying the indices from their dimensional equation.

Question 3

This question was answered very well by the great majority of the candidates. Part (b)(i) of the question was prone to errors for some candidates who did not take sufficient care in getting a correct simplified quadratic equation in $\tan\theta$ and solving the equation to find the two possible values of θ. Some of these candidates wrote 89.8° for a possible value of θ and did not seem to question or check the reasonableness of their answer. For part (b)(ii), almost all candidates chose their smaller angle for the answer, but many could not provide a convincing reason for their choice.

Question 4

The majority of the candidates could not use the given speeds and direction vectors to find velocities for part (a). Some candidates took direction vectors for velocities and totally ignored the speeds. The candidates were generally familiar with the concept of finding the relative position vector at time *t*. The most popular method for finding the time for closest approach was differentiation and the use of the chain rule. Some candidates were able to use a scalar product method (not in the specification) to find the time with less effort. Unfortunately, some candidates who found the time when the helicopters are closest together did not continue to find the required distance.

Question 5

Incorrect answers to part (a) of this question were very rare. However, part b(i) proved to be too challenging for some candidates. Many candidates could not answer part b(ii) correctly. The most common approach for answering part (c) was using the constant acceleration formulae; but some candidates were able to use energy methods successfully. Almost all candidates were able to state a valid modelling assumption.

Question 6

The great majority of the candidates were familiar with the equations of motion of projectiles on inclined planes. Only a minority of the candidates confused the equations for projectiles on the horizontal with those for projectiles on inclined planes. Some candidates correctly transformed the problem into one of a projectile on a horizontal plane and answered both parts of the question accordingly. For part (b), most candidates found the time taken by the projectile to reach the maximum perpendicular distance by setting the vertical component of the velocity to zero and solving the resulting equation. Some candidates were able to use the fact that this time was half of the time taken by the projectile from O to T.

Question 7

Most candidates were able to apply the principle of conservation of linear momentum and the law of restitution along the line of centres. However, some candidates used v_A in one equation, and $v_A\cos\alpha$ in the other equation, to stand for the component of the velocity of A along the line of centres. Most candidates understood and used the fact that the momentum, or velocity, of the sphere A perpendicular to the line of centres is unchanged by the collision. Almost all the candidates who attempted part (b) understood that the magnitude of the impulse exerted on B was equal to the gain in momentum of B or the loss in momentum of A. However, some candidates used m for the mass instead of $3m$ or $4m$.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website. UMS conversion calculator www.aqa.org.uk/umsconversion