Examiners' Report/
Principal Examiner Feedback

Summer 2013

GCE Mechanics M2 (6678)
Paper 01

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Introduction

Candidates at all levels found this paper accessible. The mixture of familiar and slightly different questions asking candidates to apply their results allowed candidates to demonstrate what they could do but also allowed differentiation. Most candidates offered solutions to all questions, and some very elegant responses were seen. Clearly labelled diagrams in the course of the working give candidates a clear advantage. Candidates who use the same or similar names for more than one variable within a question frequently get lost in the course of their working.

Some candidates continue to lose marks by leaving answers with an inappropriate level of accuracy following the use of an approximate value for g.

Candidates need to follow the instructions in a question carefully – if a particular method is specified then they will not score marks for using an alternative, regardless of the accuracy of their answer. When an answer is given in a question, candidates should use this as an opportunity to check their work, and not waste effort in trying to fudge the result. All too often they alter work which was correct and lose marks as a result.

Question 1

This question was well answered by the majority of candidates. Almost all were able to set up an impulse/momentum equation correctly and went on to find the correct velocity. There were several processing errors in removing brackets and rearranging the equation, but most candidates found the velocity of P correctly. A significant number did not go on to finish the question by finding the speed of P, which was what the question asked for.

Question 2

This proved to be a straightforward question for the majority of candidates.
Part (a) the majority of candidates were able to resolve correctly, and almost all understood that finding the work done involved multiplying force by distance. The question was very specific in asking for the work done against the friction, and too many candidates thought that this needed to include the work done against the weight. It was common to see the final answer given to an inappropriate level of accuracy.

In part (b) the majority of candidates attempted this by forming a work/energy equation. Most attempts included all of the required terms, but there were frequently sign errors, either in placing the work done against friction or in the change in kinetic energy. There are still many candidates including both the work done against the weight and the change in gravitational potential energy, not recognising that this is the same thing. Some energy equations did not include the work done against friction at all.
Candidates using the alternative approach via the suvat formulae often muddled the signs in their equations. Several did not realise that the acceleration up the plane was actually a deceleration.

Question 3

Fully correct solutions to this question were rare, although most candidates made a correct start to each part.
Part (a) was usually fully correct.

In part (b) the majority of candidates did not appreciate the subtlety of this question, not realising the difference between a maximum and a local maximum. Those whose solution was accompanied by a sketch were most likely to reach a correct solution. Candidates who started by finding the local minimum velocity (maximum speed) frequently went no further. Candidates who started by finding values of velocity for different values of time often discarded the negative values without realising that they needed to be comparing the magnitudes of their values.

In part (c) the difference between displacement and distance was frequently either ignored or went unrecognised. Despite the hint given by part (a), the majority of candidates did not consider the actual motion of the particle and did not recognise that the particle was re-tracing its previous path and that they must split the integral to calculate distance rather than displacement.

Question 4

In part (a) there was a wide variety of approaches to this question, which resulted in a wide range of responses, from those which made the question look trivial to those which struggled to deal with the chosen dissection of the lamina. The most surprising feature of many responses was that not all candidates understood the geometrical properties of a hexagon. In particular, candidates could not find the ratios of masses of the parts without attempting to find the areas, apparently not realising that the regular hexagon comprises six identical equlilateral triangles. The most elegant solutions split the lamina into two identical rhombuses, but popular alternative approaches were based on four triangles or on a hexagon with a rhombus removed. Some candidates did not appreciate the line of symmetry OC and that they only needed to consider vertical distances from O. A few thought the shape was just made up of rods and did not seem to understand what a lamina is.

Part (b) many candidates correctly identified a triangle with the required angle, but their labelling was often incomplete or inaccurate. A common error was to treat the angle EOC as a right angle. The two approaches suggested in the mark scheme were equally popular with candidates who reached the correct conclusion. Most solutions involved two stages of working but a few candidates were successful in using the sine rule with angles θ and $60-\theta$.

Question 5

The majority of candidates took moments and combined their results correctly in part (a). Candidates who overlooked the weight of the rod frequently fiddled the given result rather than look for their error. This commonly led to further difficulties in part (b).

In part (b) most candidates made sensible attempts to resolve horizontally and vertically following the request for horizontal and vertical components of the force at A. Candidates who resolved parallel and perpendicular to the rod at this stage usually found the subsequent algebra beyond them.

In part (c) some candidates offered no attempt to this part, but following part (b), the most common approach was to use $\tan\theta$. Some candidates were not able to work through the resulting algebra and trigonometry to reach a conclusion. A number of very elegant solutions, involving moments about B or C or resolving perpendicular to the rod, did not depend on part (b) at all.

Question 6

Part (a) of the question asked candidates to consider the energy of the ball, so solutions which used the suvat equations scored no marks. The most common errors in the energy equations were to omit either the initial or the final kinetic energy, or errors in expanding $(2u)^2$.

Part (b) was often correct, but there were sign errors in setting up the equation $-8 = u\sin\theta \times 2 - 2g$ and the 2 was often missing from $u\sin\theta \times 2$.

In part (c) many candidates did not realise that the minimum speed occurs when the vertical speed is zero. With an allocation of two marks, they should have realised that there was more to it than simply writing down an answer of zero.

Question 7

In part (a) most candidates were successful in forming correct equations for conservation of momentum and for the impact law and using these to deduce the given answer. A few made the task more difficult by finding the velocity of P first and then finding the speed of Q. There were a few sign errors and arithmetic errors which resulted in attempts to fudge the answer rather than find the source of the error.

Part (b) those candidates who started by substituting the given value for e tended to be more successful in forming and solving equations to find the speeds of Q and R after the collision. Some candidates did not use the value of e at all. Solutions were often spoiled by careless algebra.

In part (c) a lot of candidates did not realise that the rate of increase of distance is the same thing as speed of separation. There was also an element of confusion over which speeds should be used, with many using the speed of Q after the first collision rather than the speed of P.

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