Examiners' Report
Principal Examiner Feedback

January 2017

Pearson Edexcel International A-Level
Mechanics M2 (WME02)

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The majority of students offered responses to all eight questions on this paper. Many students had clearly covered the full range of topics and methods outlined in the specification and showed a good level of problem solving skills. Questions 1 (power), 4 (impulse and momentum), 5 (impact) and 8 (projectile) were answered well. In questions 3(velocity as a function of time) and 6(work-energy) many students overlooked key information and scored very few marks as a result.

It continues to be true that those students who base their response on a clearly labelled diagram are more likely to be successful in reaching a correct conclusion. Many students highlight key information given in the question as they read it through, but in this paper, particularly in question 5, there were several students who did not make full use of the information given.

This paper had three questions (2(a)(i), 7(b) and 8(a)) where the answer was given. In these cases, a student is expected to show full working to demonstrate that they have reached the given result correctly – it is not sufficient to take short cuts with the algebra or arithmetic.

The rubric for this paper is very clear about the value to be used for g and the accuracy that is expected to be given in the answers that follow. Several students lost accuracy marks through giving "exact" values following the use of an approximation for g, or giving decimal answers to more than 3 significant figures.

Question 1

Most students made a confident start to this paper, with the majority giving a fully correct solution to part (a)

Part (b) presented more of a challenge. There were a number of fully correct solutions, but some students omitted the component of the weight from their equation of motion, some used the value of R obtained in part (a) rather than the value given in the rubric for part (b) and some made sign errors in their equation. Some students made slips in converting 50 kW to watts, and some gave more than 3 significant figures in their final answer.

Question 2

(a) Most students were able to divide the lamina into standard shapes and locate the centre of mass of each part correctly. The majority used AB and AD as axes when they took moments, but a few students took the longer route of using parallel axes and then going on to find the required distances. The answer to part (i) was given, so students were expected to show how they had simplified their moments equation to reach the required distance.

(b) Students used a range of approaches to find the value of k. The most direct route was to take moments about an axis through the point of suspension – this was usually successful, provided the student was measuring distances along AD. The most common alternatives were to take moments about an axis through A or D – several students who attempted this went wrong because they left a term out of their moments equation.

Question 3

Many students scored only 2 of the 6 marks available for this question. Although the velocity is given in factorised form, most students did not realise that the particle changes direction twice in the interval $0 \le t \le 3$. The integration of v to find an expression for distance was usually correct, although some students made errors in multiplying out the brackets. Relatively few students had a correct strategy for finding the total distance travelled, most simply found the distance AB. Those students who drew a sketch of the given quadratic were more likely to establish the need to solve $v = 0$ and to split the integral into three sections using the absolute value of the second integral. A small minority of students treated this as a question about constant acceleration and scored no marks.

Question 4

(a) Most students wrote down a correct impulse – momentum equation. The majority found the velocity of P correctly, but several did not go on to find the speed, as asked for in the question.

(b) A few students used the cosine rule or the scalar product of the two velocity vectors, but most used the tangents of the angles. Many students who drew a diagram combined their answers correctly to find the angle between the two directions, but a large number of students found two relevant angles and went no further. Some students found the angle between the impulse and one of the velocities.

Question 5

Many students showed a good understanding of this topic and gave fully correct solutions.

(a) The most common error here arose from confusion over the directions of motion of the two particles. The question is very clear that they start off moving towards each other and that after the collision they are moving in the opposite directions. Several students made sign errors in the equation for conservation of linear momentum. The impact law was usually applied correctly and the signs in the resulting equation usually followed correctly from the momentum equation. The solution of the resulting simultaneous equations was usually correct but there were some algebraic slips.

(b) As the solution to this part was independent of the solution to part (a) many students were able to score full marks. Almost all students scored the mark for the correct speed of Q after impact with the wall. Forming a correct inequality to compare the speeds of P and Q proved to be more difficult, and some students gave only one boundary on the range of possible values of e.

Question 6

This question requires students to use the work-energy principle. “Correct” answers acquired solely through the use of *suvat* equations scored no marks. It is possible to answer this question by direct application of a work-energy equation for the motion from the instant of projection to the instant when the ball comes to rest. Many students engaged in unnecessary work using *suvat* equations to find additional values such as the maximum height reached or the speed of impact with the ground. Most students did notice the different units in 1.5 m and 2.5 cm and dealt with this correctly. The most common error in the work-energy equation was to leave out the GPE lost in the final 2.5 cm of the motion. Some students who worked from the maximum height included a KE term which should not have been there as the ball is starting and finishing at rest.

Question 7

(a) Most students made a correct start here, taking moments about A and reaching the correct answer. It is possible to answer the question by taking moments about a different point, but then additional work is needed to find the required force.

(b) Many students lost marks here by focusing on the required answer and not thinking the problem through. Answers which started with a clear attempt at vertical and horizontal resolution of the forces on the rod were unusual. Many started by equating the maximum possible friction to the force at B, which is incorrect unless the rod is in limiting

equilibrium. Some students were unsuccessful because they had given the same name to more than one unknown force and became confused in their working.
(c) Most students started their solution with a correct moments equation. Errors arose because several students brought forward values from earlier in the question without realising that the additional particle would have an effect on the vertical component of the force at *A*.

Question 8
(a) Students who started by writing down an equation for the horizontal distance *OA* and the vertical distance *OA* usually reached the given answer with no difficulty. Similarly, students who realised that the vertical component of velocity at *A* would be equal in magnitude and opposite in direction to the vertical component of the velocity at *O* reached the correct conclusion. Students who started by finding the maximum height reached sometimes forgot to use half of the total time when substituting values into $s = ut + \frac{1}{2}at^2$. Correctly applied, this method results in a quartic equation in U. As the solution $U = 14$ is given, students were expected to state their value of U^2 as part of their working before the final A mark was given.
(b) Many students did not attempt to find the speed of the ball at *A*, they found the vertical component of the velocity and went no further. Correct solutions often stopped at the exact value $14\sqrt{10}$ which is not an appropriate final answer because the working depends on the substitution of 9.8 for g.
(c) This part of the question does not depend on the work in (a) and (b) so students were able to make a fresh start here, and often showed a good understanding of the problem. Many found the correct value for the magnitude of the vertical component of the velocity and reached a correct value for t. To score full marks they needed to realise that there were two points satisfying the criteria, one on the way up and one on the way down. A small number of students misunderstood the problem and started by equating the ratio of the horizontal and vertical distances travelled to $\frac{1}{4}$.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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