Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2019

Pearson Edexcel International Advanced Level
In Mechanics M2 (WME02/01)

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January 2019
Publications Code WME02_01_1901_ER

The response to this paper was very varied. The majority of candidates offered responses to all 8 questions, although there was a significant minority who offered no response to at least one question. Much of the work seen was of a very good standard.

The best work was well presented, making it very clear what the candidate was attempting to do at each stage. In contrast, there were some candidates who became confused in their work. The lack of a clear diagram can make it more difficult to keep track of angles and directions, and the use of the same name for more than one variable in a problem presents difficulties for the candidate and the examiner.

Although it has been included in many past reports, there are still some candidates who lose marks due to inappropriate accuracy in their answers following the substitution of a value for g.

Candidates who have prepared thoroughly for the mechanics content of this paper often lose marks through basic errors in algebra and arithmetic - practice of the core skills should not be overlooked.

Question 1

For many candidates this proved to be a straightforward start to the paper. The majority of candidates started by writing down a vector equation combining the two moments equations. There were slips in the arithmetic, but most candidates solved the resulting simultaneous equations correctly.

A significant number of candidates demonstrated little understanding of the topic - it was common to see the masses of the particles being ignored and candidates attempting to locate the centre of mass of the particles by finding the average of the position vectors of the particles.

Question 2

(a) The majority of candidates understood exactly what they needed to do and many obtained the correct answer. There were a few sign errors in writing down the impulse-momentum equation and some arithmetic errors in the process of rearranging the equation.

(b) The majority of candidates attempted to find the correct angle. All the methods on the mark scheme were seen, but the majority of candidates favoured the use of tangents. Several candidates left their answer as $72°$, but those candidates who drew a diagram were more likely to go on to reach the correct final answer. Several of the incorrect solutions involved finding the angle between the impulse and a velocity.

Question 3

Most candidates showed a good understanding of the methods required here and many correct solutions were seen. The most common error was a sign error in the equation for the motion down the road and there were some algebra slips in solving the simultaneous equations. A few candidates made an error in converting 10.8 kW to 10800 W, and there were some incorrect equations for the relationship between power, driving force and velocity.

Question 4

(a) The majority of candidates obtained the given answer correctly. Although the question asks for the distance from *B*, many candidates preferred to start by finding the distance from *O* or from *A*. A small number of candidates misquoted the formula for the area of a circle.

(b) Those candidates who started by using the given angle to find the distance of the centre of mass of the loaded lamina from *O* usually found the value of *k* correctly. Candidates who started by using moments to find an expression in terms of *a* and *k* for the distance of the centre of mass from *O* (or another point on the diameter of the circle) often went no further, or simply equated their expression to $\frac{3}{4}$. The most common error was to form a moments equation based on the incorrect assumption that the centre of mass of the loaded lamina was located on the line *DO*.

Question 5

Many candidates adopted a correct strategy for working through this unstructured question. They understood the correct method for finding the time at the instant when the velocity of the particle is zero and the method for using the velocity to obtain an expression for the distance. The most common error was to try to find the total distance travelled, rather than the distance *OA*, an error which required the candidates to find the time at the instant when the direction of motion changed. There were some errors in the coefficients when differentiating and when integrating. Some candidates left the final answer as a negative number, but "distance" will always be positive. A few candidates tried to make inappropriate use of *suvat* equations.

Question 6

(a) The simplest way to find the magnitude of the required force is to take moments about *A*. The majority of candidates did this and many obtained the correct answer. The most common error was to assume that the weight of the plank acted through *C*.

(b) There are several alternative methods for this part of the question. Most candidates tried to resolve vertically and horizontally, but resolving parallel and perpendicular to the plank was also popular. When resolving vertically and horizontally, many candidates overlooked at least one component in one of their equations, most commonly the friction acting at C. Some candidates used the same value for the coefficient of friction at each contact point on the plank. Some solutions were made very difficult to follow because candidates used the same name for more than one unknown and they did not always show the forces on a diagram.

Question 7

(a) Although this part of the question can be answered by simply considering the equation for conservation of linear momentum, many candidates chose the alternative approach of finding an expression for the speed of P in terms of u and e. The conclusion in this approach depends on the fact that e cannot be negative, but most responses made no reference to this.

(b) A minority of candidates reached the correct conclusion about the possible values for e. Some candidates changed their minds about the directions of motion of the particles part way through their solutions, resulting in a degree of inconsistency between the equations used in part (a) and the equations used in part (b). Those candidates who drew a diagram showing the direction of motion of the particles usually produced much clearer work. Without a clear indication of the assumed direction of travel of Q, it was difficult to form a correct inequality for e. Some candidates made the false assumption that Q would change direction if it was moving faster than P after the impact.

(c) Some candidates made a fresh start for this part of the question, forming and solving equations using the given value of e. They often went on to reach the correct answer.

The majority of candidates understood the correct process for finding the loss in kinetic energy. Those candidates who had made errors in their work in parts (a) and (b) did not always start with correct values for the speeds of P and Q but they could still work through the correct process.

Question 8

(a) Many candidates found the value of F correctly. The most common error was to state that the work done against friction was F, rather than $6F$. There were also some sign errors and some candidates omitted a term from the work-energy equation, or counted the change in gravitational potential energy twice. Some candidates lost the final mark due to giving an over-specified answer.

(b) Several candidates gave a fully correct solution. The most popular approach was to consider the horizontal and vertical components of the velocity at C, but the use of energy was a common alternative. Some candidates were confused between the speed of $10\ \mathrm{m\,s^{-1}}$ and its horizontal and vertical components. The statements about the direction of motion of P at C were not always clear; here again, a diagram can be very useful.

(c) Most candidates used *suvat* equations to solve this problem. There were many correct solutions, but a few candidates found the additional height above B and went no further.