Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

October 2020

Pearson Edexcel International A Level

In Mechanics 2 (WME02)

Paper: 01 Mechanics M2

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October 2020
Publications Code WME02_01_2010_ER

General

Most candidates found this paper accessible, with many offering solutions to all questions. The work demonstrated a good understanding of the topics studied, and most solutions were set out clearly and were easy to follow.

Candidates should ensure that their final answer matches the demand of the question. This is particularly important when working with vectors, when the question might require the magnitude.

Candidates should take care with basic algebra and arithmetic: there were many instances of candidates obtaining correct equations but making errors in solving them.

The rubric for this paper makes it clear that if the candidate needs to substitute a value for g they should use $9.8\,\text{ms}^{-2}$. Several candidates are losing accuracy marks by using 9.81 in place of 9.8.

Report on individual questions

Question 1

This proved to be a relatively straightforward first question with a substantial number of correct solutions. Many of the slips were quite simple algebraic errors in the handling of the resulting quadratic equations. Some candidates used $\mathbf{I} = m(\mathbf{u} - \mathbf{v})$, some considered the change in speed rather than the change in velocity, and some produced equations that were dimensionally incorrect because the mass was omitted from the impulse equation. Some candidates had correct solutions for λ but did not go on to find the associated impulses.

Question 2

Most candidates understood the relationship between power, driving force and speed. They were able to form a pair of simultaneous equations and solve to find the values of P and R. Apart from sign errors in the equations, most errors were due to a confusion between mass and weight. Some candidates consistently worked through with a mass of 9000 kg. Several students worked with the correct weight, 9000 N, but then used $9000 \times \frac{g}{20}$ in place of $\frac{9000}{g} \times \frac{g}{20}$ in the equation for the motion down the hill.

Question 3

In a question like this it is important to start with a clear diagram showing the forces acting on the rod. Some candidates created confusion by using the same name for the reaction between the rod and the wall as for the reaction between the rod and the ground. Some candidates were confused about what would happen if the rod slipped, with several having the friction between the rod and the wall acting downwards.
The majority of candidates were able to resolve horizontally and vertically. A minority tried to resolve parallel to the rod and perpendicular to the rod, but there was no advantage to that approach on this occasion. Most errors occurred in the moment's equations, with forces omitted and incorrect distances used.

A small number of candidates realised that the most efficient way to solve the problem was to resolve horizontally and to take moments about the centre of the rod.

Those candidates who were able to obtain a correct set of equations invariably went on to find the correct value for $\tan\theta$ although there were some algebraic errors in the working.

Question 4

(a) Many candidates took advantage of the relatively simple shapes involved in this lamina and gave a fully correct solution. The majority of errors were due to inconsistent use of a throughout the working: the distances are given in terms of a, so it should appear in the moments equation, and not just at the very end with an incorrect statement such as $\bar{x} = \frac{42}{11} = \frac{42}{11}a$.
(b) The majority of candidates understood that the angle of $45°$ meant that the centre of mass for the system must lie on *BD*. Some combined this with the symmetry of the system to use the fact that the centre of mass must lie at the midpoint of *BD*.

The most common approach was to find coordinates of the centre of mass of the system in terms of k and to equate the two components. There were a few slips in the algebra, but many candidates obtained the correct value.
A minority of candidates offered no solution to this part of the question.

Question 5

There were many fully correct solutions to this question.

(a) The majority of candidates differentiated correctly to obtain the correct acceleration. Several candidates also stated the magnitude of the acceleration, but this was not required.

(b) Almost all candidates understood that to find the position vector of P they needed to integrate the velocity. A small number treated the velocity as a scalar, adding together the two components before integrating.

Most candidates understood that for P to be at instantaneous rest both components of the velocity needed to be zero, and that the only time that this was true was when $t = 2$. Some of those candidates who found a correct expression for the position vector of P did not go on to find the required distance.

Question 6

(a) There were many fully correct solutions to this part of the question. The most common error was to give the final answer to more than 3 significant figures following the use of 9.8.

(b) This part of the question specifies that candidates should be using the work-energy principle, so solutions using the *suvat* formulae were inadmissible. The most common errors in forming the equations were sign errors, the omission of terms, or double counting of the change in potential energy. In finding the value of w, both approaches, working from B to C and working from A to C, were equally popular.

Question 7

(a) There were many fully correct solutions to this question. Most candidates made correct use of conservation of momentum and of the impact law to form two equations in three unknowns. There were some errors in forming the equation for the gain in kinetic energy, either because of a sign error, or because candidates thought that the gain applied to the total kinetic energy of A and B.

Those candidates who started by using the kinetic energy to find the speed of B immediately after the collision usually had a straightforward path to the value of e. Candidates who used the momentum and impact equations to find the speed in terms of e and then used the kinetic energy had to contend with more complicated algebra and often made slips on the way.

(b) Almost all candidates who attempted this part of the question went on to find the correct value for f.

Question 8

(a) For those candidates who understood the vector representation of the velocities this was a very straight forward question. Some candidates found a correct expression for the velocity of the ball at O, but did not go on to find the speed. Most errors were due to confusion between the horizontal and vertical components of the velocity, which sometimes resulted in a horizontal acceleration.

(b) Here again, the vectors caused problems for the candidates. The simplest approach was to realise that if the speed is 10 ms^{-1} then the vertical component must be 6 ms^{-1}. The alternative, forming a quadratic equation in t, also relies on understanding that the horizontal component of the velocity has a constant value of 8 ms^{-1}. Several candidates obtained correct values for the two times when the speed is 10 ms^{-1} but did not then find the difference between them.

(c) Several candidates used a correct method to find the vertical component of the velocity at B or to find the time taken to reach B, but they frequently did not have a complete method to find the vertical distance required.

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