Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

October 2023

Pearson Edexcel International A Level

In Mechanics (WME02) Paper 01

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Introduction

The majority of candidates found this paper accessible, and most offered solutions to all of the questions.

If there is a given or printed answer to show, as in questions 2(a), 6(a) and 7(a), then candidates need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available and in the case of a printed answer, that they end up with **exactly** what is printed on the question paper.

In all cases, as stated on the front of the question paper, candidates should show sufficient working to make their methods clear to the examiner and correct answers without working may not score all, or indeed any, of the marks available. A candidate who says what they are trying to do, but makes a slip, is more likely to gain credit for the work than a candidate who leaves the examiner guessing what an equation represents.

In calculations the numerical value of g which should be used is 9.8 m s^{-2}. Final answers should then be given to 2 (or 3) significant figures – more accurate answers will be penalised, including fractions. There were several candidates this time who lost accuracy marks due to the use of $9.81\,\mathrm{m\,s^{-2}}$.

If a candidate runs out of space in which to give their answer then they are advised to use a supplementary sheet – if a centre is reluctant to supply extra paper then it is crucial for the candidate to say whereabouts in the script the extra working can be found.

Candidates who have spare time at the end of the paper should check through their work very carefully. Many marks were lost unnecessarily – through rounding errors, not reading the question properly, not reading specific instructions in the question, basic arithmetical mistakes, sign errors following correct equations, omitting **i** and/or **j** in vector equations and candidates misreading their own writing.

Question 1

(a) There were many fully correct solutions. The vast majority of candidates differentiated the position vector to obtain **v**, although there were a few who integrated. The majority of candidates equated the correct component of **v** to zero to obtain a value for t, but there were several who used the wrong component or a component of the position vector. The final answer should be a vector, but several candidates omitted **j**.

(b) This was answered well. The majority of candidates understood what they needed to do. Most errors were due to slips in substituting for t. Several candidates lost time by going on to find the magnitude of the acceleration, which was not asked for.

Question 2

(a) Many students showed a very good understanding of what was required and obtained the given answer correctly. The question asked candidates to find the value for d, but several conclusions made no mention of d. Some candidates set up a correct equation but did not show sufficient working to justify the given conclusion. There were several instances of a appearing, disappearing and reappearing in the course of the working.

A minority of candidates did not take note of the fact that the components of the figure were not all of the same density. Many responses adopted the vector approach, which lead to both horizontal and vertical distances being calculated at the same time.

(b) The majority of candidates started by finding the horizontal distance for the centre of mass. A few candidates who had found this distance correctly in (a) did not appreciate its relevance here and consequently scored no marks for it. Many candidates adopted a correct strategy to find θ. Some stated the value of θ without ever stating the value of $\tan\theta$, so they did not score the final accuracy mark.

(c) This was the least successful part of the question. Most students attempted to form a moments equation about *Q*. However, this frequently involved the use of incorrect distances or they tried to resolve *F* and *Mg*, not realising that the distances were perpendicular to the forces already.

Question 3

The most common approach was to form two impulse-momentum equations by working parallel and perpendicular to the initial direction. The equations produced were usually dimensionally correct, but there was some confusion between sine and cosine. Some candidates lost marks through incorrect use of brackets: what should have been 0.25×8 was written as 8 and the candidate lost four marks.

Having obtained two valid equations there were then two options, to eliminate α and obtain a quadratic equation in *I*, or to eliminate *I* and obtain an equation in α. The first approach was often successful. The second approach was longer and the solution often involved incorrect use of trigonometrical relationships. It was very rare for candidates to resolve parallel and perpendicular to the impulse. When attempted, this approach proved to be successful.

A minority of candidates drew a vector triangle and applied the cosine rule to reach a quadratic equation in *I*. This approach proved to be very effective and often earned full marks.

Question 4

The majority of candidates found this question accessible. There were a few who tried to work with the magnitudes of the vectors and made little progress.

(a) The majority of candidates completed this task successfully. The common errors were to leave the answer as a fraction or to give a decimal answer to more than 3 significant figures.

b) There were many candidates who showed correct working to obtain the required answer. Some candidates found the distance between the two particles rather than the vertical distance, and some found the difference between the highest points attained by the two particles. Some candidates were confused between the horizontal and vertical components of the initial velocity of *Q*. The question asked for an answer to 2 significant figures, but many candidates overlooked that.

(c) Most candidates understood that the time taken would be $2T$, but some had to re-calculate this. Many candidates then went on to find the vertical component of the speed of Q but there was confusion over whether the initial vertical component was 5 or 7. Most candidates knew which angle they needed to find, but several used 4 rather than 5 as the horizontal component of the velocity. Many candidates who used rounded values in their calculations did not obtain the correct final answer for the angle. A minority of candidates worked with distances rather than velocities.

(d) This proved to be the most challenging part of the question, and several candidates offered no attempt. Those candidates working with the velocity in vector form were most successful at obtaining the correct vertical component of the velocity. There were several sign errors in forming an equation for T_2, and some candidates used a formula for distance, not velocity.

Question 5

(a) The majority of candidates were able to set up the correct equation of motion and use $P = Fv$. A small number of candidates omitted 60 and there were a few slips in the arithmetic.

(b) Although the question asks for the work done by the cyclist, many candidates did not attempt to use work and energy. The majority of candidates did score at least one of the first two marks, often with a correct expression for the gain in potential energy. A common error was to find the gain in kinetic energy between day 1 and day 2. The common error for candidates who did attempt an expression for the total work done was to overlook the work done against the non-gravitational resistance. Several candidates double counted the gain in potential energy. Candidates with a correct expression for the work done often gave their final answer to more than 3 significant figures.

(c) Most of the candidates who did not complete part (b) recognised that they could attempt this part. Many candidates scored at least the first three marks. The common errors were confusion between sine and cosine, sign errors and the omission of g from the equation of motion. The most common error was to give the final answer as 694.4, which lost the final accuracy mark.

Question 6

a) Most candidates who attempted this question were able to form the moments equation with all of the terms dimensionally correct. There was an occasional sine/cosine confusion which they cancelled out and candidates thought that they had a correct answer. There were many candidates who had a correct unsimplified equation but did not show any further working towards the given answer. A small number of candidates did not find the angle in the triangle.

b) The majority of candidates who attempted this question did so by resolving horizontally and vertically then using Pythagoras. Many left their final answer in exact form. A few candidates obtained two correct equations by resolving, but made no further progress.
For candidates who attempted the alternative methods, the most common error was to overlook a component of the force acting on the rod at A, or to resolve this force incorrectly. A few candidates included a reaction force at D when considering the forces acting on the rod.

Question 7

(a) Almost all candidates formed the equation for conservation of momentum and attempted to form the equation for kinetic energy. Several candidates overlooked the information about the directions of motion for *P* and *Q*, resulting in sign errors. For the kinetic energy, some candidates subtracted terms that should have been added together, some had the 2 on the wrong side of the equation, and there were several slips in the arithmetic. Several candidates formed the two equations required, but then made no attempt to combine them to obtain the given answer. Many engaged in "wishful thinking", simply stating the given answer when it was not justified by their working.

(b) Using a correct equation for conservation of momentum and the given answer to part (a), the majority of candidates completed this part correctly. There were some sign errors in applying the impact law, but very few candidates tried to use it the wrong way round.

(c) Most candidates made a correct start to this question, using the impact law for the collision with the wall, and forming an inequality comparing the speeds of *P* and *Q*. A fully correct solution was rare. Some candidates did not include the possibility that *P* and *Q* might have the same speed, and many candidates did not say that *Q* must rebound from the wall.

(d) The majority of candidates who attempted this part formed an impulse – momentum equation. The common errors were to use a mass of m rather than $2m$, and not taking account of the change in direction of motion of *Q* in the collision with the wall. The question asks for the magnitude of the impulse, so the final answer should be positive.

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