Examiners' Report
Principal Examiner Feedback

November 2021

Pearson Edexcel GCE
In Further Mathematics
Paper 3C Further Mechanics 1

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The number of candidates who sat this paper was quite small and the quality of the work ranged from candidates who appeared to have done little preparation to a small number who showed deep insight coupled with an ability to see how the skills acquired in Pure Mathematics could be used to assist in solving mechanics problems.
The better candidates were confident across the whole specification and offered solutions to all seven questions.

Question 1
This question was quite standard for this topic and the better candidates showed a good understanding.
(a) There were several fully correct solutions. Some candidates gave more figures than necessary in their final answer. The most common problem was not to interpret "constant speed" as implying no acceleration..
(b) This is a familiar scenario and several candidates formed an equation of motion including all the correct terms. There were some sign errors in the equations. The final answer depends on the use of an approximate value for g, so although calculator work will lead to an exact fraction, candidates should remember that answers not given to 2 significant figures or to 3 significant figures will not score the final accuracy mark.

Question 2
(a) The majority of candidates achieved the first four marks by setting up the equations for conservation of momentum and Newton's Experimental Law. The direction of motion was given in the question and candidates who chose not to use this did make the task more difficult for themselves. Few candidates could see how to proceed from that point - some did attempt to find the two speeds, but rarely understood how to combine the results with the information about the directions of motion.
(b) Several candidates understood the methods required here and were able to score marks for finding the value of e and the magnitude of impulse.

Question 3
(a) Many candidates started by drawing a diagram and were able to use it to show the correct components of the velocities in the direction of **j** after the impact. Those candidates who were confident working with vectors were usually able to set up the equations for conservation of momentum and Newton's Experimental Law parallel to the line of centres. The inclusion of the components perpendicular to the line of centres in these equations was a common error. Very few candidates made efficient use of the information given about the angle of deflection: most worked through with an unknown component and then used trigonometry rather than simply writing down the velocity of P after the collision as $\left(-\frac{4}{u}\mathbf{i}+2\mathbf{j}\right)\mathrm{m\,s^{-1}}$.
(b) For candidates who found a velocity vector, the most common approach to finding the angle was using the scalar product. Candidates who used this technique were able to find their angle correctly. Those candidates who used trigonometry to find the angle between the two velocities often made errors in combining the angles correctly.
(c) It was very rare to see a correct answer to part (c) with many candidates referring to **j**-components when they should have referred to components parallel and perpendicular to the surface.

Question 4

The candidates approached this question with confidence and several gained full marks. The method was generally well understood and most errors in finding the value of λ were due to slips in the arithmetic or algebra. Some candidates used the impulse and a velocity rather than the two velocities in their attempt to find the value of θ.

Question 5

(a) Those candidates who started by giving the components of the velocity after the impact with *AB* in terms of *v* and θ were noticeably more successful than those who introduced a new speed and a new angle. Some candidates started by introducing unit vectors parallel and perpendicular to *AB* and working with an initial velocity $\mathbf{v} = x\mathbf{i} - y\mathbf{j}$: if worked through correctly this was very efficient and effective.

(b) Here again, those candidates who introduced new variables added complications and often could not see how to solve their equations. There were only a small number of fully correct solutions.

Question 6

(a) The given answer enabled most students to complete this successfully. The candidates were confident using Hooke's Law together with an equation of motion and the given answer helped them to find their errors.

(b) The better candidates recognised the need to form a work-energy equation. The mark scheme helped those candidates who found some, but not all, of the required terms. The most common error was to omit the work done against friction.

Question 7

(a) Some candidates made good use of the scalar product to find the components of the velocities parallel and perpendicular to the wall. Those candidates who preferred to work in terms of speeds and angles often made rounding errors in calculator work and did not reach the exact answer required. Rather than work through in terms of impact with an oblique surface, one candidate used matrices to rotate the problem $45°$ clockwise at the start of their solution and then $45°$ anticlockwise to finish. The given answer did not assist those candidates who did not know how to approach the problem.

(b) Many candidates used the given result from part (a) to score full marks for finding the magnitude of the impulse.

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