Examiner's Report
Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE
In Mechanics M4 (6680/01)

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Introduction

The paper proved to be accessible to all students, with many offering solutions to all seven questions. The slightly unusual format of question 4(a) and question 6(a) made them very challenging for some students. As usual, there were students who avoided vectors, and/or avoided the questions on relative velocity.

The best solutions were clearly laid out, with a narrative on what was happening at each stage. The weaker solutions had a more random line of approach and were sometimes very difficult to follow.

Students of all abilities let themselves down by making errors in the arithmetic and algebra that were surprising at this level.

Question 1

This was a straightforward question on potential energy, and many students scored well. In part (a) the most common error was for students not to reach the given answer because they made no mention of the "constant" term. A small number of students used the moving end of the rod as the reference point for measuring gravitational potential energy. In part (b) almost all students found the first and second derivatives of V correctly. Some students set about finding the values of θ for which the first derivative was zero, when all they needed to do was to substitute $\theta = \frac{\pi}{6}$ and verify that the answer was zero. A small number of students overlooked this stage entirely.

Question 2

Many students obtained the correct final answer. The most concise solutions started by creating variables for the components of the initial velocity perpendicular and parallel to the wall, and worked with these throughout the solution. Those students who worked with trigonometric ratios of the angles tended to have a more difficult task eliminating the unwanted variables. The most common error in setting up the initial equations was to place the 0.6 on the wrong side of the energy equation.

Question 3

The most common approach to this question was to create two vector equations for the true velocity of the wind, and to compare coefficients. An equally successful approach was to start by drawing vector triangles for the velocities, but this was often made unnecessarily difficult by students who confused East and West. A minority of students found only one of the two possible solutions. A small number of responses contained just a collection of lines that were never put together to form a vector triangle.

Question 4

(a) This part of the question proved challenging for many students because they were given the form of x and asked to find the values of constants of proportionality for the resistances. The most concise solutions came from students who recognized the form of x as the solution to a second order differential equation with an auxiliary equation having a repeated root. Having deduced this, answering the question was straightforward.

(b) For those students who had found an expression for $\frac{\mathrm{d}x}{\mathrm{d}t}$ as part of their solution to part (a), finding the value of t for the maximum height was very easy. There were a surprising number of errors in substituting this to find the corresponding value of x.

Question 5

For many students this was the most challenging question on the paper. There were three common successful approaches: focusing on distances, focusing on velocities, and working in vectors to compare the position vectors of Ali and Beth. Difficulties arose when students switched from one approach to the other and ended up with dimensionally incorrect triangles with combinations of distances and velocities for the sides. The two different start times contributed to the students' difficulties.

Question 6

(a) Students found this part of the question difficult because they were being asked to find out about the resistance to motion given the speed. Some students showed that if they assumed the given resistance then they arrived at the given speed. This is not the same thing as showing that for the given speed, this is what the resistance must be.

(b) This was completely independent of part (a), and many students gave fully correct solutions. A few students made the task unnecessarily difficult by first finding an expression for x and then differentiating it.

(c) The given answer helped many students to achieve a fully correct solution. Some students who completed the integration correctly could not complete the solution because they did not find the value of v when $x = 0$. A minority of students made no progress because they did not start with a differential equation in v and t.

Question 7

Those students who were confident working with vectors had little difficulty with this question. In part (a) the two successful approaches were to show that the impulse (or change in velocity) was parallel to $-\mathbf{i}+\mathbf{j}$ or alternatively to use scalar products to show that the components of the velocities parallel to $\mathbf{i}+\mathbf{j}$ were equal. Part (b) was a straightforward application of conservation of linear momentum. Part (c) was sometimes affected by sign and arithmetic errors, but the basic method was well understood.

Very few of those students who took a trigonometric approach, rather than using vectors, were successful. The diagrams were often unclear, and the angles not clearly defined (sometimes using the same name for two different angles).

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