Examiners' Report/
Principal Examiner Feedback

Summer 2016

Pearson Edexcel GCE in
Mechanics M5 (6681)
Paper 01

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2016
Publications Code 6681_01_1606_ER

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

General

The vast majority of students seemed to find the paper to be of a suitable length, with no evidence of students running out of time, and the paper proved to be much more straightforward than some in recent years, with some parts of all questions accessible to the majority. There was a clear divide in the level of performance between the first four non-rotation questions and the rest of the paper. Questions 5 and 7 proved to be the most challenging. There were many impressive, fully correct solutions seen to all questions. Generally, students who used large and clearly labelled diagrams and who employed clear, systematic and concise methods were the most successful.

In calculations the numerical value of g which should be used is 9.8, as advised on the front of the question paper. Final answers should then be given to 2 (or 3) significant figures – more accurate answers will be penalised, including fractions.

If there is a printed answer to show then students need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available.

In all cases, as stated on the front of the question paper, students should show sufficient working to make their methods clear to the Examiner.

If a student runs out of space in which to give his/her answer than he/she is advised to use a supplementary sheet – if a centre is reluctant to supply extra paper then it is crucial for the student to say whereabouts in the script the extra working is going to be done.

Question 1

Most students answered this question using the work-energy principle. A small minority used forces and acceleration, but they were generally less successful. One error that occasionally occurred with the work-energy approach was to use the position vector of *B* rather than a vector along the wire.

.

Question 2

There were many completely correct solutions to this standard second order vector differential equation problem. Of the few errors, the odd student wrote down the wrong auxiliary equation and so had the wrong complementary function. The only error seen when finding the particular integral was to forget the vector element of the question and lose **i**'s and **j**'s **.** A few were able to simply write down the PI as $\mathbf{r}=\sin t\,\mathbf{i}$ without any differentiation and substitution. All used the conditions given but a few made errors in evaluating constants. A few obtained **r** but then forgot to find **v** and lost the final mark.

Question 3

This question was answered very well. A few used **F**x**r** rather than **r**x**F** for the vector moment and unfortunately, in this case, this error led to an incorrect final solution. Some chose to take moments about (1,–1,1) rather than about the origin. There were very few errors in evaluating vector products. A small number had the couple on the wrong side of their equation and I only saw one making a sign error in their final equation.

Question 4
There was some confusion as to what is meant by a cylindrical shell, with open or closed ends. From the formula book, it is clear that it was intended that the shell should have open ends. However, if students worked with closed ends (or with a solid cylinder), this was treated as a misread and so they could gain 8 out of the 10 marks for this question. Many students gave an organised and succinct solution to this question, showing that they were familiar with the processes involved. Some did not use both the moment of inertia of the hoop about its diameter and the parallel axes theorem to move to the end of the cylindrical shell, thereby gaining no more marks for the question. A few students who talked about a hoop or a ring then used the formula for the volume of a cylinder, rather than the surface area.

Question 5
In part (a) many students who thought that they had successfully answered this part of question in fact had not done so. The parallel axes theorem can only be used to move the axis about which the moment of inertia is calculated from an axis through the centre of mass. They therefore needed to start from an axis through the centre of *BC*, not through *B*, although this gave the same answer for this configuration.
The second part turned out to be the most challenging part of the paper. Students who started by finding the position of *G*, the centre of mass of the wire, were frequently successful, since the variable angle needed to be measured from the vertical to the line *AG*. A common error was to omit the minus sign from their moments equation.
Students who tried to write down a moments equation considering the two masses separately almost always measured their variable angle from the vertical to the line *AB*, which was not a valid approach. They therefore scored very few marks on this question.

Question 6
The majority of students in part (a) were able to set up a correct impulse momentum equation with the right number of terms, and consistent in terms of the signs. A few included δm terms which were eliminated at the next stage of the working. Only the occasional student worked without using $-mg\delta t$ thus not actually having an equation, but with correct terms on the RHS. Simplifying to give a differential equation was almost always successful. Most were able to use the expression for m to give $\mathrm{d}m/\mathrm{d}t = -2m_0$, which then led to the printed answer. Most students were also able to answer part (b) correctly. Errors included the omission of the negative sign when integrating, and a failure to realise or determine that the fuel was spent when $t = 2$ but these errors were rare.

Question 7
In the first part he vast majority of students were able to find ω correctly, although a few used $^1/_3ma^2$ rather than $^4/_3ma^2$ for the moment of inertia. The first M mark in part (b) was usually earned, but the equation was often incorrect due to the loss of the minus sign. This error usually resulted in the loss of marks in part(c) when the final substitution was done. Most students were able to obtain the magnitude of the angular acceleration. A minority attempted to use an energy equation but were usually let down by errors in differentiation or sign errors. A careful choice of zero PE level

helped considerably. In part(c) problems occurred mainly in deciding the direction of the forces and the acceleration, although the correct angle was almost always used. It was helpful to students if they drew a diagram with the forces and acceleration correctly aligned. There were some spurious 'correct' answers from using an acceleration in the wrong direction and their incorrect value from part (b). If the forces on the LHS were the wrong way round some credit could still be obtained. Final answers ranged from $7mg/8$ to $-3mg/8$.

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London WC2R 0RL