Examiners' Report

Summer 2015

Pearson Edexcel GCE in Mechanics M5 (6681/01)

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Mathematics Unit Mechanics 5

Specification 6681/01

General Introduction

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.

Report on Individual Questions

Question 1

The vast majority of students got this question completely correct. A small minority either used the vector **BA** instead of **AB** or gave two solutions, having missed the fact that a was a positive constant.

Question 2

The most common error in this question was to omit the minus sign when finding the integrating factor. A few students failed to multiply the RHS of the equation by their integrating factor. Similarly a few got mixed up when dividing their RHS by $\cos t$ at the end. Since the integral could be done in several different ways, the final accuracy mark was given for any correct answer, simplified or not.

Question 3

In part (a) a number of students forgot to find the magnitude of the resultant and a few stated that $\mathbf{F}_3 = \mathbf{F}_1 + \mathbf{F}_2$ but this part was usually correct. In the second part the technique for using one point on the line of action of the force $\mathbf{F}_3$ to find its equation is much better known than it was a few years ago. Some students had consistent sign errors when calculating the vector products. Others were unable to progress once they realised that there was no unique solution to their simultaneous equations.

Question 4

In part (a) most students found this question about variable mass one of the more straightforward ones. There was, however, still a substantial minority who have no idea how to go about this type of problem. Solving the differential equation in the second part was done in various ways. Many treated it as an equation with separable variables, either adding a constant or using limits. Others used an integrating factor. The two methods were equally successful. The only major error was that of putting v equal to 0 in the differential equation and subsequently working with a constant acceleration.

Question 5

In part (a) most students managed to interpret the three-dimensional scenario of the question and correctly found the moment of inertia as $\frac{5}{4}ma^2$ but a common error was to obtain $\frac{3}{2}ma^2$. A significant number got their angles mixed up and worked with $\sin\frac{\pi}{3}$ instead of the cosine (or the equivalent error using $\frac{\pi}{6}$). Those who wrote down an energy equation and then differentiated to find the angular acceleration were generally successful. In the second part, in addition to repeating the angle error of part (a), the problem of the direction of the component of the weight compared with the angular acceleration gave rise to sign errors. Few dimensional errors were evident in this question.

Question 6

The most common error, when calculating the moment of inertia about the axis through *A*, was to omit the 3 in the mass of 3*m*. Those considering the moments of the separate masses and those finding the centre of mass of the combined masses were equally successful, although those using the latter method occasionally forgot that the total mass was 5*m*. Nearly all students made sure that they got a minus sign in their equation of motion so that they could say that approximate SHM was taking place. Students who chose to use conservation of energy and then differentiate tended to miss out the kinetic energy term at the bottom of the motion, thereby scoring 0 for the method mark since there was a missing term. If they have to "invent" a minus sign, students should wonder what was wrong with their previous work. A few students tried to go straight to the period of the motion, using formulae that they had learnt. This did not lead to the correct answer in this set up. It was in the second part of the question where the dimension errors that usually crop up in rotational motion questions were most often seen, usually in the conservation of angular momentum equation. Note that conservation of linear momentum was not appropriate here.

Question 7

In part (a) solutions mostly split into three camps: completely correct solutions, solutions which ignored the need to use the parallel axes theorem, but had the right general approach and those who had no idea how to go about this sort of question. A few students, on looking at part (b), decided that their answer to part (a) should be $\frac{1}{5}ma^2$ and proceeded to change correct work in order to achieve this. Since the second part of the question was phrased as "hence find…", students only scored marks in this part if they used their answer for part (a) together with the idea of the mass of the hemisphere being half that of the sphere.

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

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