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Examiners' Report

Summer 2014

Pearson Edexcel GCE in Mechanics M2R (6678/01R)

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Mathematics Unit Mechanics 2

Specification 6678/01R

Most questions on this paper proved to be accessible to all students, and a lot of good quality work was seen. The best work was clearly set out, with clear methods and accompanied by fully labelled diagrams.

Students need to be reminded to read the rubric and the questions carefully. In all cases, where a value for g is substituted, the value should be $9.8\ \text{m s}^{-2}$. The use of 9.81 will be penalised as an accuracy error. The rubric on the paper gives students a very clear reminder about the accuracy expected after the use of 9.8, but many students lost marks for giving too many significant figures in their final answers. If the question asks for the magnitude of a quantity, then a positive answer will be expected.

Report on Individual Questions

Question 1

This question was found to be accessible. The most common error was an over-specified answer at the end of Q01(a). Many students left their answer as 882.5, which is inappropriate after the use of 9.8 as an approximate value for g.

Question 2

In Q02(a) most students started with a correct impulse-momentum equation to find the velocity of the ball before the impact, but many did not go on to find the corresponding speed.

In Q02(b) students with a clear diagram usually found the correct angle, and it was pleasing to see a number of students with enough knowledge of vectors to use the scalar product (although this method was not expected). Some students found the angle between a velocity and the impulse, and some found the angle between a velocity and a fixed direction (usually the unit vector $\mathbf{i}$).

Question 3

Some good responses to this question were seen, but many students had difficulty in working with a non-uniform rod. It was common to see attempts to use moments, which only required resolving. Students needed to name the forces for themselves, and this led to some confusion, often involving the same name being used for the friction between the rod and the ground, and for the friction between the rod and the wall. A significant minority of students had the friction at B preventing the rod from slipping up the wall.

Those students who formed a correct moments equation in Q03(b) usually went on to find the correct value for the distance AG. Although they were looking for a distance from A, several students chose to find this by taking moments about B.

Question 4

In Q04(a) most students gave a correct answer to this part of the question. Errors were usually due to having the area of the triangle incorrect, or to adding the square to the triangle rather than removing it from the triangle.

In Q04(b) many students made a correct start to this part of the question, and they often got as far as finding the distance of *O* from an axis through *A* or through *B*, but they found it more complicated to find the distance from *DC*. Some students did not recognise that they needed to work back from the $25°$ at some stage in their method.

Question 5

Many students demonstrated a good understanding of the work-energy principle. Although only one part of the question specifically asked for use of the work-energy principle, it was common to see students working the whole question by this method rather than resorting to the equation of motion of P in the latter parts of the question. Although there were students "double counting" by considering both the change in gravitational potential energy of P and the work done against the weight of P. It was seen that some students worked through the method correctly but then lost accuracy marks through the use of 9.81 as an approximate value for g or gave over-specified final answers. The rubric on the paper is very clear about what is expected, and students need to take note of this.

Question 6

In Q06(a) almost all students found the correct answer for the vertical distance from A to the maximum height, but several did not go on to find the greatest height above the ground.

In Q06(b) many students understood the method required to find the distance OB, but there were often sign slips in using $s = ut + \frac{1}{2}at^2$, resulting in an incorrect quadratic equation in t. Students should be aware that if they start with an incorrect quadratic in t, and simply state answers without demonstrating any method for solving the equation then they will not gain any credit for their solution.

Q06(c) resulted in many incorrect assumptions. There were a good number of concise and correct solutions, usually using similar triangles or differentiation of the equation for the trajectory. However, many students incorrectly assumed that reversing the vertical component of the velocity would give a perpendicular direction of motion.

Question 7

In Q07(a) many students earned full marks for correct work in this part of the question, although there were some errors in forming the equations and some inconsistent use of signs, usually from students with poor diagrams or no diagram at all.

In Q07(b) some students found it challenging to find a way of introducing an inequality in e. Most of the marks in this part of the question depend on using the information about the direction of motion of P after the collision. The initial inequality does need to match the student's velocity for P, whether or not they have already taken account of the change in direction. For the final mark they also need to state the maximum value for e.

For Q07(c) the work on kinetic energy was usually very good, and often resulted in a correct answer for *k*.

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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