Examiners' Report

Summer 2014

Pearson Edexcel GCE in Mechanics M3R (6679/01R)

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Mathematics Unit Mechanics 3

Specification 6679/01R

General Introduction

Presentation is important when writing solutions and there were cases seen where students had mis-read their own figures. Those who work entirely in formulae until the final line of a calculation should be reminded how risky this is; if something goes wrong they could leave very little which is worth any marks. Values need to be substituted throughout the working. Also, surds are generally acceptable in any form.

Question 1

Being given an expression for $\frac{\mathrm{d}v}{\mathrm{d}x}$ caused a challenge for many students who did not know how to start Q01(a). Some of those who integrated forgot to include a constant of integration and often little progress was made as students did not realise that they could find a by using $a = v\frac{\mathrm{d}v}{\mathrm{d}x}$ and then obtain the magnitude of the force by using $F = ma$.

Q01(b) required the integration of v with respect to x and those who had not integrated in Q01(a) were unable to start here too. There was a mixture of definite and indefinite integration and those who had found a correct expression for v in Q01(a) were usually successful here.

Question 2

This was a "conical pendulum" question. The inclusion of a normal reaction from the surface of the cone as a second non-gravitational force acting on the particle was seen as a challenge for many students. The angles they needed to use when resolving were found by some simple geometry but many seemed to be confused.

Q02(b) brought another set of challenges. Many seemed to think that the tension in the string had to be greater than (or equal to) zero for the particle to remain in contact with the cone. This was a necessary condition of the motion regardless of any contact with the cone. Those who were unsuccessful in Q02(a) were unlikely to obtain a correct expression for the reaction.

Question 3

Many students did not recognise Q03(a) as a work-energy problem and tried to find an acceleration which they could use, ignoring the fact that the acceleration was in fact variable; others mixed forces and energy terms in their equation. This is a "show that" question and so students must show every step of their working. The equation $\mu mg\cos\theta = mg\sin\theta - \frac{mgx}{2a}$ is not a suitable starting point as it will be interpreted as a forces equation (with an incorrect Hooke's Law) and not as a work-energy equation with a distance cancelled. The student may have intended the latter but the work does not show that.

In Q03(b) as the particle has already slid down the plane and come to rest, any further motion will be up the plane. Students therefore needed to show that the tension in the string at the point where the particle stopped was less than or equal to the sum of the component of the weight down the plane and the maximum possible friction force. Some failed to realise that finding the tension was an application of Hooke's Law.

Question 4

Q04(a) was a standard vertical circle question and most students could obtain valid energy and Newton's law equations. Setting the reaction equal to zero and solving usually gave the required expression for V. Although V was the required quantity here, many solved their equations for $\cos\theta$ and then used their value to obtain V.

Q04(b) considered the motion of the particle after it left the circular path and was moving as a projectile. Many students could not correctly identify the direction of motion of the particle at the instant when it left the surface of the sphere and as a consequence the following work contained a sine/cosine interchange. Students failed to realise that use of the horizontal distance travelled to the wall would give them an expression for the time of flight. Those who obtained the time of flight could usually use it to obtain the vertical distance travelled. It was rare to see a student who managed this forget to subtract this from $\frac{4a}{5}$ to obtain the distance AX.

Question 5

The majority of students found part Q05(a) accessible and managed to legitimately obtain the distance as given.

Q05(b) was found to be much more challenging. The cut-out cylinder was offset and consequently the distance of the centre of mass of S from the axis of the original cylinder was needed before any work involving the given angle could be done. As many students omitted to find this distance they scored zero for this part of the question. Those who found this distance correctly rarely encountered any problem finding r in terms of h although occasionally the tangent ratio was used upside down.

Question 6

Most students could use Hooke's Law to obtain the equilibrium extension required in Q06(a). The proof of the simple harmonic motion required in Q06(b) was found to be challenging. Many students used a for the acceleration instead of $\ddot{x}$ and so restrict themselves to a maximum of 3 of the available 5 marks, while others fail to give a concluding statement and so lose the last mark even if their work is fully correct. Those who achieved an equation from which ω could be deduced were usually able to obtain the amplitude as a multiple of l in Q06(c).

In Q06(d) it was not uncommon for those who had a correct ω and amplitude to be confused about the distance and trigonometric function to be used to obtain the time. Perhaps thinking about the motion in relation to the sine curve would have helped. Answers were almost always given using radians. If a numerical value was substituted for g the answer was usually given to 2 or 3 significant figures.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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