Examiners' Report

Summer 2015

Pearson Edexcel International Advanced Level in Mechanics M1
(WME01/01)

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Summer 2015
Publications Code IA042162

Mathematics Unit Mechanics 1

Specification WME01/01

General Introduction

This paper offered the well-prepared students an opportunity to demonstrate their understanding of mechanics. A lot of high quality work was seen, with the best students offering clear and concise solutions to all 8 questions. A common feature of the best work is the inclusion of clear diagrams and a commentary to explain where each new equation comes from.

For several students there is a clear need to become more confident in the use of vectors – the responses to Question 1 were disappointing, and correct solutions to Question 7 were unusual.

The rubric on this paper is very clear about the value that students are expected to use as an approximation to *g*, and the accuracy expected in answers derived using this value. Despite this, many students are losing marks by using $g = 9.81$ ms^{-2}, and by giving the following answers to more than 3 significant figures. Marks are lost in each question where the error occurs.

Report on Individual Questions

Question 1

Some students offered no attempt to answer this question. Those students who knew what to do did equate the sum of the forces to zero and then form a pair of simultaneous equations by separating the **i** and **j** components. Almost all who got this far managed to solve their equations correctly, but a few arrived at incorrect values of a and b. Incorrect methods usually involved equating the sum of two of the forces to the third force, or equating the forces one pair at a time. Those students who understood forces and equilibrium, but not how to deal with the vectors, usually earned the first mark.

Question 2

(a) The majority of students started by forming an equation for conservation of momentum. Many of these equations included sign errors, and many students assumed, incorrectly, that the speed of B after the collision would be $\frac{3u}{2}$. Having written a momentum equation, only a few students achieved the next 2 marks for showing that $k < 1$. Very few stated that $v > 0$ for their v and worked through correctly to derive the given answer.
A few students answered part (b) first and then equated impulses, but this approach tended to produce sign errors.

(b) This part could be answered independently of part (a) and was generally well done. Some students attempted a change in momentum but made sign errors, and several left the final answer as $-3mu$.

Question 3

(a) This was a straight forward application of $s = ut + \frac{1}{2}at^2$ and many students reached the correct answer. Some students tried to form an equation of motion using the 30 N and the normal reaction between P and the plane, and a few just divided the distance by the time to get speed and then divided by time again to get what they thought was the acceleration.

(b) Most students formed a correct equation for the normal reaction between P and the plane, although there were a few sign errors. Many students did not include the acceleration in their attempt to form an equation for the motion parallel to the plane, so scored no further marks. A small number of students used $\sin\alpha = \frac{4}{5}$ and $\cos\alpha = \frac{3}{5}$. The final answer was often given as 0.2, suggesting a greater accuracy than merited following the use of 9.8.

Question 4

Most students gained the first two marks for writing a correct equation for the displacement of the first particle, but the time used for the second particle was often inconsistent. The most common error was to use $t+1$ or just t (or a mixture of the two). Most students went on to equate their expressions for h and then solve for t. The majority of students with a correct pair of equations went on to find the correct value of t, but many lost the final accuracy mark for over-specified answers - commonly 11.03 or 11.025.

Most students used t for the first particle and $t-1$ for the second, but some worked through successfully using $t+1$ for the first and t for the second. Several students made algebraic errors, most notably in squaring $(t-1)$.

Question 5

(a) Almost all students had the correct shape for the speed-time graph, but a few triangles were seen, and a few that continued at constant speed. Many students did not draw the right hand section clearly steeper than the left hand section (to illustrate the relative magnitudes of the acceleration and deceleration). Most sketches had the numbers correctly positioned.

(b) There was a variety of approaches for working out the acceleration. Most used t as either the time for acceleration or deceleration, but some wrote these times implicitly in terms of a and $2a$. Not all students showed clearly on their diagrams that the time for deceleration was half that for acceleration and many did not indicate this in their working. The majority realised that they needed to form an expression for the area under the graph and equate it to the distance – some split the area into a rectangle and two triangles, while others thought of it as a trapezium. The latter was the easier approach, using T as the time of travel at constant speed. Some students used times instead of time intervals, which made the algebra more difficult, but still produced the correct answer for the deceleration. Several students obtained 80 s as the time of travel at constant speed but then got lost when trying to use this answer to find the deceleration, often because they tried to include a in their equations at this point instead of subtracting 80 from 170 and then dividing in the ratio 2:1. The final answer for deceleration often given as a negative value.

Question 6

(a) Most students resolved vertically to find the reaction at B and then doubled this value to find the reaction at C. A few took moments about two points. The over-specified value 137.2 N was a very common answer although some gave the exact answer 14g.

(b) This part was often completed correctly, with most students choosing to take moments about A, although B was also a popular point. The correct answer was achieved by the majority of students, but some gave the answer incorrectly rounded to 2.46 m.

(c) The majority of students did recognise that in this part the reaction at B would be zero, (and the reaction at C was 21g), although the most common error was to continue to work with the values found in part (a). Most students took moments about *C* but a large number used *A* and a vertically resolution to get the correct value for *AY*.

Question 7

A minority of students did find the magnitude of 5**i** + 12**j** to be 13 and then divided this by 2.6 to get the time as 5. They then divided the 5 and 12 by 5 to get the correct values for *c* and *d*. However, most students had little idea of how to tackle this question. Many demonstrated little understanding of the difference between vectors and scalars - they worked out the magnitude of 2**i** + 9**j** and -3**i** – 3**j** , then stated that $\sqrt{85} = \sqrt{18} + 2.6t$. They concluded that $t = 1.91$ then divided 5**i** + 12**j** by 1.91 thinking that this gave the acceleration. Others divided 5**i** + 12**j** by 2.6 to give time as a vector.

Question 8

(a) This part of the question was done well and two correct equations of motion were common, although some students used an extra *g* with the acceleration. A few students set up an equation for the whole system and used this, along with an equation for just one of the particles to find *T*. The majority of students found the acceleration of the system first, then substituted their value into one of the equations to find *T*. A small number of students deduced that the acceleration must be 0.7*g* from the given answer to part (b) and then just used this to work out the tension. The question asks for an answer in terms of *m* and *g*, so students were expected to work through without substituting a value for *g*.

(b) Some students used $a = 6.86$ so they were not able to reach the given exact answer correctly, but the majority did use 0.7g. In order to score any marks here the students needed to have a value for *a* obtained from the working in part (a).

(c) Some students used *a* as 0.7*g* or *g*, but most of those who got this far realised that they needed to work out a new value for the acceleration and did this correctly. The additional distance moved was usually found correctly, but a few stopped after the calculation and did not relate their answer to the length of the string.

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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