Examiners' Report

October 2016

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

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October 2016
Publications Code WME01_01_1610_ER

Mathematics Unit Mechanics 1

Specification WME01/01

General Introduction

Overall this proved to be a fair paper which provided a good test of students' understanding of mechanics. Time did not seem to be a limiting factor on performance with mostly full attempts at all of the questions and there were few blank responses seen. Q3 (moments) and Q5 (equilibrium of a particle on an inclined plane) were particularly well answered with full marks often awarded. There were also many good responses seen to Q8 (pulley and inclined plane). Although there was evidence of a fair understanding of vectors in components in Q2 and in Q4(a), the implication of the parallel vectors in Q4(c) was not always recognised. Q6 (kinematics) proved to be challenging for a number of students who were unable to develop a valid strategy for solving the problem. 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 but exact multiples of g are usually accepted. 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 candidate 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 candidate to say whereabouts in the script the extra working is going to be done.

Report on Individual Questions

Question 1

In part (a), the vast majority of students equated the given impulse to the change in momentum of *P*. However, a fairly common mistake was not to take into account the direction of the impulse leading to a sign error in the equation. Following correct working, some gave the answer as $-u/2$ and lost the final mark since a positive value was required for the speed. A correct statement that the direction was reversed was only credited in part (b) if it followed from previous valid working. In part (c) those who employed the impulse formula generally used correct signs, although again the final mark required a positive value for the speed. The alternative approach of using conservation of linear momentum was also widely seen but this had the disadvantage of relying upon a possibly incorrect answer from part (a).

Question 2

This question required the summing of three given forces (in terms of components) and equating the result to $m\mathbf{a}$. A surprising number equated the sum to the acceleration only or, on occasion, to zero. Most realised that they should equate coefficients of **i** and **j** and proceeded to find the values of the constants as required with just the odd numerical slip. Part (b) was also generally well done. The majority of students found the required velocity by using $\mathbf{v} = \mathbf{u} + \mathbf{a}t$. Some, however, stopped there rather than proceeding to calculate the magnitude of their vector to give the speed as required.

Question 3

Most students used vertical resolution to calculate the two reactions and then equated moments about a point to find the required distance, *x*. Those who used two moments equations gave themselves simultaneous equations to solve and consequently a greater likelihood of errors. Occasionally an equation was missing a term but generally the only errors seen were in writing down the relevant distances. Such instances were relatively rare and overall the topic seemed well understood with full marks often achieved.

Question 4

Almost all students wrote down a correct positon vector in part (a). Most realised that one point being due west of another implies that the **j** components of the two position vectors are equal and hence, by comparing these, found a value for *t* in part (b). A significant minority equated **i** components or, on occasion, equated a component to zero. A method mark was still available for substituting the resulting value of *t* into the expression for the position vector. Part (c) was generally found to be more challenging. Here the direction of motion of *P* was specified as being parallel to a given velocity vector; however, many students were not able to use this information in any valid way. Some just equated the two vectors, whilst others set one (or both) components equal to zero. A surprising number treated the given vector as parallel to the position rather than the velocity vector of *P*. Those who had the right idea sometimes had the ratio of terms the wrong way up or as positive rather than negative; the two method marks were still available in these cases. Nevertheless, there were a fair number of fully correct solutions seen.

Question 5

This question involved the equilibrium of a particle on a rough inclined plane. The standard approach was to resolve in directions parallel and perpendicular to the plane. The main errors included equating the normal reaction to only the weight, having friction acting in the wrong direction or confusing 30^o (angle of inclined plane) and 40^o (angle between force and inclined plane) within equations. The majority of students used $F = \mu R$ appropriately to calculate the value of μ to 2 or 3 significant figures as required (following use of $g = 9.8$) although premature rounding sometimes led to a loss of accuracy. Generally the topic seemed well understood with an encouraging number of fully correct solutions seen.

Question 6

Although there were a fair number of students who achieved full marks on this question, there were also many who achieved zero. The question required a calculation of the speed of one car as it overtook another having originally been 200 metres behind. Those who made no valid progress often tried to use $v^2 = u^2 + 2as$ with $s = 200$ for one car thereby ignoring the fact that the other car was also moving. Others assumed that the relevant condition for overtaking was that the speeds were the same. Only those who realised that it was necessary to find the time taken for the cars to draw level could achieve any credit. Some attempted to use $s = ut + \frac{1}{2}at^2$ for either one or both cars with $s = 200$ (or just equated the two distances) rather than using $s_A + 200 = s_B$ as required. A minority who reached this stage added 200 to the wrong side of the equation; this was penalised as an accuracy error. The correct method led to a quadratic in t. Students should be reminded that if they just write down solutions to a quadratic from their calculator they will achieve all the marks provided both the original equation and the answers are correct. However, if any are incorrect and no method is shown, both the method and accuracy marks will be lost. Those who found a value for t almost invariably used it correctly to find the required speed.

Question 7

Virtually all students drew a speed-time graph of the correct shape (trapezium starting at the origin and finishing on the t axis). Sometimes not all the given values were included on the diagram and, in particular, T written somewhere below the t axis was not deemed specific enough to credit unless it was clear exactly to which time it referred (using delineators, for example). A surprising number of students achieved no marks in part (b). Some tried to somehow use the total distance rather than the acceleration for each section. Since it was a ‘show that’ question it was particularly important that working was clear and correct; just dropping a minus sign from a calculated value of t (for the deceleration) to achieve the required result was penalised as a method error. The general strategy of equating the area under the graph to the distance travelled in part (c) was generally well known and employed with a fair degree of success. Again, it should be pointed out that solving the resulting quadratic equation on a calculator without showing any method did risk losing the method mark if the original equation and/or answers were incorrect. Many students stated two correct solutions of the quadratic but either failed to reject $V = 80$ or gave no reason for rejecting it. The final mark did require some indication of why $V = 40$ was the relevant solution here

Question 8

In the first part, although a number of students went straight to writing down equations of motion for the two connected particles, most then realised that it was necessary to find the acceleration using *suvat*. They then used this successfully in an equation of motion for Q to find the value of the tension as required. The solution $T = 23.52$ was widely seen but was penalised since the use of $g = 9.8$ meant that the answer should have been rounded to 2 or 3 significant figures. In part (b) the vast majority knew that resolution parallel to the plane was now relevant. Some seemed to forget about the acceleration (despite having found its value previously) which resulted in a significant loss of marks. Most, however, produced an equation of motion for P with the correct number of appropriate terms. Only very rarely was the component of weight omitted or the friction taken in the wrong direction. Some proceeded to eliminate T from the two equations whilst most substituted the value of T from part (a). Although there were occasional slips in solving to find μ, many reached the correct answer ($\mu = 0.5$). Substituting a rounded value for T led to $\mu = 0.499$ which was penalised unless subsequently rounded.

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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