Examiner's Report
Principal Examiner Feedback

October 2018

Pearson Edexcel International A Level
In Mechanics M1 (WME01/01)

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General

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. Overall the paper seemed to be a good discriminator at all levels, with no question found to be entirely straightforward but with all students able to make some progress on all questions. Question 1 proved to be a very good choice for a starter as it was by far the most successfully answered question, with 50% of the students scoring full marks. On the other hand, questions 3 and 4 proved to be by far the most challenging questions with 29% of students scoring no marks at all on question 3. Students who used large and clearly labelled diagrams and who employed clear, systematic and concise methods tended to be the most successful.

In calculations the value of g which should be used is $9.8\ \text{m s}^{-2}$, as advised in the rubric 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 simple 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, as in question7(a).

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 and correct answers without working may not score all, or indeed, any of the marks available.

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.

Question 1

This question was very well done with most students in part (a) writing down an appropriate conservation of linear momentum equation. Although there were occasional sign errors and slips in solving to find the required speed, many did achieve the correct answer. Those who attempted to equate impulses tended to make more sign errors because of not properly taking directions into account. Similarly, in the second part, most knew and used the correct definition of impulse in terms of difference of momenta for one particle. It was possible to consider either particle but it made more sense to use P since this did not depend on carrying through a possibly incorrect value from part (a). The answer was almost always given as positive as required for a 'magnitude'. Units were not so well known with these sometimes being omitted or various wrong answers given such as N/s or N. The most common correct answer was Ns although kg ms^{-1} was also acceptable.

Question 2

The most popular and most successful approach to solving the first part was to form two equations by resolving vertically and taking moments about a point (usually *A*). The given information about the reactions was then used to find or eliminate '*R*' and hence the required unknown distance was found. A few took moments about two different points which was a valid method but more likely to lead to errors, and occasionally the two reactions were reversed. Nevertheless, many correct answers were seen. In part (b) the explanations of how the modelling assumptions had been used were not always completed so well. The key consequence of modelling the parcel as a particle in this question is that the weight acts exactly at the point *B*; those who just wrote that the weight acts at a point did not gain the mark. Some recognised that modelling the plank as a rod means that it is rigid or remains straight; however, many did not, with various comments offered about reactions, moments, weight and uniformity. Those who included wrong answers in addition a correct one were deemed to be 'hedging their bets' and were not awarded the mark.

Question 3

Although many students attempted to use appropriate *suvat* formulae to solve this problem, a significant number had difficulty in applying the information that the second one had started moving 3 seconds after the first. Most used $s = ut + \frac{1}{2}at^2$ for each particle in an attempt to express h in terms of T and then eliminated h to find T. Since h and T were both defined in the question it was essential that the equations formed were entirely correct, including signs, to gain the accuracy marks. A common mistake was to have a sign error in either or both equations or to use T as the time in both (or even T and $T+3$) rather than T and $T-3$. Some calculated the time for the first particle to reach the highest point (2 s) and formed an equation in $T-2$ or, alternatively, used the time for the first particle to fall through h on its way down ($T-4$). These attempts were generally successful. Most then substituted their value for T back into one of their equations to find h thereby achieving a method mark. The final mark depended on a correct value of h having been found from entirely correct working and rounded to 2 or 3 significant figures following the use of $g = 9.8\ \text{m s}^{-2}$.

Question 4

The vast majority of students attempted to solve this problem by forming two resolution equations (generally in vertical and horizontal directions) but a significant number did not identify a correct angle. The most common error was to ignore the information given in the question about distances and to assume that the angle that the string made with the vertical (or horizontal) was 45°. A few mixed up distances and forces in a triangle in an attempt to find the angle. Since exact values for the trig ratios ($\frac{3}{5}$ and $\frac{4}{5}$) were available, those who used a rounded value for the angle which led to an inaccurate value for F lost the final relevant accuracy mark. Alternative methods such as using a triangle of forces or Lami's Theorem were seen and often used successfully.

Question 5

In the first part, most students drew speed-time graphs with the correct basic shape (showing constant acceleration and then constant speed for each vehicle) but not all had them intersecting as required. Some graphs were not annotated with all the available information and a fairly common error was to have both graphs finishing at $t = 30$ showing a lack of understanding of the situation. In part (b) most made a reasonable attempt to equate the area under the graph to the distance travelled (816 m); however those who had assumed the total time was 30 s could only achieve the method mark here. Some used *suvat* formulae correctly for each of the two sections (even if their diagram was wrong) and achieved the marks. If a total time of 30 s was assumed in part (c) then no marks were available as the problem was simplified significantly. Otherwise, this part was generally well done with only an occasional slip. Only a very small number attempted to use a *suvat* formula for the whole motion of either vehicle; such attempts gained no credit.

Question 6

In the first part, virtually all students derived the value of the speed correctly from the given velocity vector. Similarly, in part (b), almost all wrote down a correct position vector for the ball at time t. Part (c) proved to be more problematic. It was necessary to realise that being due east of the given point ($\mathbf{i} + 6\mathbf{j}$) implied the $\mathbf{j}$ component of the position vector must also be $6\mathbf{j}$ which then led to an equation in t. Some attempted to equate $\mathbf{i}$ components which gave a negative value for t; sometimes the minus sign was then just dropped or else a subsequent attempt to equate $\mathbf{j}$ components was made. Occasionally the coefficients of the $\mathbf{i}$ and $\mathbf{j}$ components were equated to each other or one of them to zero. Nevertheless, there were a fair number of correct answers seen. Part (d) proved a challenge for many students. Some realised correctly they should substitute their value of t from part (c) into their position vector from part (b) but then could make no further progress. Others tried to work with an unknown t or else tried to find a new value by an invalid method. Those who could interpret the information about the boy running to intercept the ball and hence visualise the situation often reached the required answer without difficulty. However, a significant number either omitted this part or gave up very quickly.

Question 7

In the first part, most students found the required resistance in a valid way, either by considering the equation of motion for the whole system (the more efficient method) or by forming separate equations for the truck and car. In the latter case it was required to find or eliminate the tension in order to calculate the resistance and, since the value was given in the question, it was important that there was sufficient correct working seen. In part (b), virtually all students realised that an equation of motion for either the truck or the car was needed to find the tension and much correct working was seen. In the final part, motion on an incline meant that it was necessary to include components of weight in the equation of motion. Although a fair number of students produced an equation of the correct structure, sign errors (often from assuming the truck was moving up rather than down the hill) and/or omission of g from the weight component terms often resulted in loss of accuracy marks. Very occasionally an equation of motion was attempted for just one of the vehicles; those who just assumed the previous value of the tension had an incomplete method and achieved no credit. Following the use of $g = 9.8$

m s^{-2}, it was important that the final answer for the acceleration was given to 2 or 3 significant figures. More accurate values were penalised as was the use of $g = 9.81\ \text{m s}^{-2}$.

Question 8

In the first part, the vast majority of students attempted to resolve forces perpendicular to the plane in an attempt to find the normal reaction. Occasionally the component of the 5 N force was omitted but such instances were rare and many correct answers were seen. Following the use of $g = 9.8\ \text{m s}^{-2}$, only a correct answer to 2 or 3 significant figures was credited for the final mark. In part (b) most proceeded to resolve parallel to the plane, again generally successfully, to find an equation in F (friction) and then used $F = \mu R$ to calculate the coefficient of friction. Again an answer to 2 or 3 significant figures was expected (although over-accuracy is only penalised once per question). In part (c), where the force of 5 N had been removed, most attempted a valid resolution equation parallel to the plane but there were occasional sign errors and, more rarely, omission of the weight component term. Although virtually all used $F = \mu R$ to obtain an equation in a (acceleration) only, it was important to realise that the value of the reaction was different, with the component of 5 N now no longer acting; those who had no new perpendicular resolution and just used their answer from part (a) showed a lack of understanding of the mechanics and lost four marks. Having found a value for the acceleration and, providing this was a positive acceleration down the slope, most achieved the final method mark for using a suitable *suvat* formula to find the required speed. Once again only answers to 2 or 3 significant figures were acceptable. Those who had used rounded values from previous working often reached an incorrect value to 3 significant figures. However, those who chose to give their final value to 2 significant figures generally achieved the mark for a correct answer.

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