Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International A Level
Mathematics in Mechanics 1 (WME01)
Paper : WME01/01

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General

Overall the quality of the scripts was very mixed with some clear and fully correct solutions but a substantial number were well below standard, particularly for question 5. There was some evidence of time being a limiting factor as some answers, particularly question 8, seemed rushed or unfinished, although it is difficult to be sure whether time or ability was the main issue here.

Question 1 proved to be a friendly starter with 70.8% of candidates able to score at least 4 out of the 6 marks available and question 4 was well answered with almost half of the candidates scoring at least 7 out of 8.

Question 5, on the other hand, proved to be particularly challenging and it was clearly an unfamiliar scenario to many with 34% of candidates unable to score any marks at all.

In calculations the numerical value of g which should be used is 9.8. 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 candidates 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, candidates 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 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.

Individual questions

Question 1

Generally, this question was done well with many candidates scoring full marks. Most used vertical resolution for one of the equations. Some made very heavy weather of the algebra, especially those who took moments about two points (usually C and D). A few took moments about G and found d very quickly.

Question 2

In part (a), most candidates were able to apply conservation of momentum correctly. A surprising number left their answer as $-u$, losing the second A mark. A few used impulse but often with a sign error. In part (b), those who found the correct value of u or $-u$ usually gained the mark for a correct statement. Statements that did not gain the mark included ‘to the left’, ‘backwards’, ‘to the west’ or just an arrow. There was varying success with part (c). Many used *suvat* first to find a value for a. Those who were attempting an appropriate method usually gained the mark for $R = 4mg$, although occasionally the m was omitted. Those who had a correct equation of motion usually went on to score full marks. However, it wasn’t uncommon to see an additional term in the equation of motion. A few candidates had inconsistent equations and ended up with a negative value for μ. Surprisingly $2u^2$ was frequently used instead of $(2u)^2$.

Question 3

In part (a), most candidates found this straightforward and scored both marks. There was mixed success with part (b). Some tried to use a single *suvat* equation with $s = 48$. Others had partial success, often finding $t = 2$ and $s = 38$, while many scored all 4 marks. In part (c), candidates who had struggled with part (b) were more successful here and gained the first mark for the time taken when decelerating. There were a lot of completely successful solutions but a common error was to forget to find the total distance travelled in reaching 13 m s^{-1} and this was taken as 38 instead. Many correct solutions were obtained by finding the area under the graph.

Question 4
In part (a), the majority of candidates found the position vector correctly and used an appropriate trigonometrical ratio. The final mark, however, was often lost by not finding the correct angle between **r** and the vector **j** or not giving the angle correct to the nearest degree. Although there was mixed success with part (b), those who knew the correct method usually went on to score full marks. A few made errors with the simplification and consequently lost the last three marks.

Question 5
A number of candidates misunderstood the directions of forces acting and assumed throughout that the reaction was in the opposite direction to the weight i.e. both vertical or both horizontal. This represented a significant mechanics error which meant that the only possible mark that could be achieved was for the use of $F=\mu R$ in part (b). A less significant but fairly prevalent error was to assume there was a tension rather than a thrust in the rod. This led to a sign error in each vertical resolution equation. Those who achieved a correct value for the magnitude of the frictional force in part (a) were in a minority and the requirement to state the direction was often omitted even if the rest of the working was correct. Although some candidates made little or no progress in part (b), those who interpreted the directions of forces correctly were generally able to resolve appropriately and use $F=\mu R$ to find the coefficient of friction as required. A few attempted to resolve parallel to the rod but invariably failed to resolve the friction and reaction, and some just assumed the reaction was equal to the weight.

Question 6
In part (a), the given velocity-time graph was generally interpreted correctly with the vast majority of candidates using $v=u+at$ and zero vertical velocity after 2.5 seconds to find the initial speed. Occasionally more than one equation was used e.g. first finding the distance travelled in 2.5 seconds, but these methods were mostly successful and many correct answers were seen. Sometimes a time of 7 rather than 2.5 seconds was used but such instances were relatively rare. Part (b) was found more challenging although there were a fair number of correct solutions. The most straightforward method was to use $t=7$ in $s = ut + 1/2at^2$ (or t=2 if considering the relevant part of the downwards motion). Apart from an occasional sign error, most who attempted this reached the correct answer. Two of the three available marks could be achieved if an incorrect value for initial speed was being carried through from part (a). Some successfully split the motion into up and down and subtracted the two distances to find the required result. However, those who added the distances or only considered either total distance up or down achieved no credit. Some used times which were not consistent with the other values being used in *suvat* equations showing a lack of understanding of the situation.

Question 7
In part (a), the majority of candidates produced an equation of motion of the correct structure for each particle. However, one particle was moving up a rough inclined plane and occasionally either the weight component or friction was omitted.
In part (b) most identified the reaction and hence frictional force correctly and proceeded to solve the simultaneous equations to find the acceleration in terms of g. Occasionally masses of 2 and 3 rather than $2m$ and $3m$ were used or m was included in some terms but not others. Nevertheless, there were a fair number of fully correct solutions seen.

Part (c) required the resultant force acting on the pulley to be found and this proved significantly more challenging. Those who realised an expression for T was required from one of their previous equations sometimes lost the available mark through dropping the 'm' and making it dimensionally incorrect. Only a minority knew a correct method for combining the tensions acting on the pulley. Sometimes they were just added, squared and added, or an angle of 45° was assumed. More often a formula was quoted as $2T\cos(\alpha/2)$ but then α used as the angle of inclination of the plane (as defined in this question) rather than the angle between the two strings. Some omitted this part of the question completely.
In part (d) the information that the pulley is smooth was used in assuming that the tension was the same on each side of the pulley. The fact that it is also constant throughout the string depends on the string being light. Consequently comments such as 'tension same throughout' or 'tension same at A and B' were not credited. A fairly common response was that a smooth pulley means there is no friction. This, however, does not answer the question of how this fact was used in the solution.

Question 8
In part (a), most candidates knew a correct method but some failed to convert 36 minutes to 0.6 hours to ensure consistency of units. The fact that the answer was given alerted some, but not all, to their error. It is important in a 'show that' question that there is sufficient correct working and that the final answer is stated exactly as given; although working in column vectors is perfectly acceptable, in this instance the given answer in **i-j** notation was required for the final mark. In part (b) the general position vector in terms of t was mostly stated correctly. Although some candidates were unsure how to proceed in part (c), many did attempt to substitute at least one value for t into their position vector. Some used $t = 1.48$ (1 hour 48 minutes) rather than 1.8. However, a fair number achieved 3 out of the 4 available marks for correct substitutions of $t = 1.8$ and $t = 2$. Deducing the position of the lighthouse for the final mark proved a stumbling block for many who often gave up at this stage. Those who completed this part generally equated the **i** component of the ship's position vector to the **i** component of the lighthouse position as required in part (d). The value of t found could then be used to calculate the position of the ship when due south of the lighthouse. The two method marks were available even if an incorrect answer for the lighthouse position was being carried forward. Occasionally **j** components were equated or the **i** component was equated to zero.

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