Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International GCE
In Mechanics Mathematics M1
(WME01) Paper 01

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General

The majority of candidates seemed to find the paper to be of a suitable length, and most candidates were able to attempt all parts of all questions. It also struck a good balance between accessibility and discrimination, with sensible and realistic grade boundaries. The first two questions proved to be the best answered, with 37% of candidates achieving full marks on question 2 and a further 32% scoring six of the available seven marks. On the other hand, question 3 proved to be by far the most challenging with 42% of candidates scoring two or fewer of the eleven marks available. It should be emphasised that when a question asks candidates to 'hence show that', as in question 1(c), a full explanation, including all steps, is required to earn full marks, where the explanation *must* use one or more of the previous parts of the question.

Candidates who used large and clearly labelled diagrams and who employed clear, systematic and concise methods were the most successful.

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

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.

Report on Individual Questions

Question 1

This impulse-momentum question proved to be a nice starter for many, with 51% of candidates scoring 5 or 6 out of the 8 marks available. In the first part, almost all candidates knew and applied the definition of impulse in terms of change in momentum of Q. Most took account of the reversal in direction of motion and so used signs correctly and many correct expressions were seen. In part (b) most candidates wrote down and solved an appropriate 'conservation of momentum' equation in an attempt to find the speed of P after the collision. Although there were occasional numerical or algebraic slips in rearranging, the most common error was in not taking account of the direction of the velocity and so not producing a positive answer as required for the 'speed' of P. An alternative method was to equate magnitudes of impulses but sign errors were more prevalent in this approach. Part (c) proved more challenging. Many candidates were unsure how to proceed and some effectively again wrote down equations for impulses or momentum. Successful candidates needed to appreciate whether their expression for velocity found in part (b) was > 0 or < 0 depending on the direction they had chosen as positive. Only the use of the correct inequality could lead to marks being scored in this part. Since the final answer was given it was important that there was sufficient correct working and that the final conclusion was *exactly* as stated in the question.

Question 2

This question was extremely well answered. For part (a), the most common approach was to resolve vertically and then take moments about the point A or C, although those who chose to take moments about two different points tended to be equally successful. The main errors were in the misinterpretation of the given information about the tensions. The tension at C was 20 N greater than the tension at A. However, pairs of values such as T and $20T$, T and 20, or T and T were all seen on occasion. Such errors meant that only the first two method marks could be achieved since they altered the nature of the question. Some assumed that the mass was W kg rather than a weight of W newtons as defined in the question; this was penalised as an accuracy error. Nevertheless, many entirely correct solutions were seen. Although in part (b) there was general appreciation that modelling the beam as a rod meant that it did not bend, some candidates failed to achieve the mark for including wrong or irrelevant extra statements. The most common incorrect answers related to the mass (or centre of mass) of the rod and comments such as 'clockwise moments equal anticlockwise moments'.

Question 3

Most candidates realised that P reaches its greatest height when $v = 0$ and used this and an appropriate *suvat* method to achieve the required expression $H = U^2/2g$ in part (a). Some used 9.8 instead of g but usually then reverted back to g when stating the answer. The second part was found challenging by many candidates and some made little valid progress. It was required to find the time to collision of the two particles. There were two possible approaches: measuring time from the instant the second particle Q is released (the most usual method) or from the instant P is released. Some candidates wrote down two correct expressions for the displacements but failed to realise that they referred to different starting times which led to inconsistent values of t; they were therefore eligible for only two out of the first four marks. Those who wrote down two correct expressions often had difficulty in combining them to form a correct equation; equating two distances rather than realising they added up to H was a fairly common error. Many candidates who attempted part (c) realised that they needed to substitute their value of t into one of their displacement equations to find the height at which the particles collide. However, a fair number with entirely correct working failed to interpret their result as implying the particles actually collide at the point of projection, O. Full marks were seldom achieved on this question.

Question 4

This question was the second worst answered after question 3 with many candidates unsure as to what forces were acting where. In part (a), most candidates resolved but a few used a triangle of forces or Lami´s theorem. The majority scored the marks for this part of the question, although $T\sin\beta = 3mg$ was a common error. Other errors were the use of $2T\cos\beta = 3mg$ and $T\cos\beta = 3mg$. In the second part, some put $R = mg$ and others had sign errors. Many with a correct resolution lost the last mark because they did not realise they had to substitute for T to obtain a value of R. A small minority put the horizontal and vertical components of all the forces into one equation. In part (c), a small number had different F 's ; their F was actually $T - F$, where F was the frictional force. Some were confused about F being equal to both $\cos\beta$

and μR. The elimination of T and solving for $\tan \beta$ proved impossible for some of those who had gone wrong in part (a) but some who had errors in the previous parts did gain the method mark and the B1 here.

Question 5

This question was quite well answered with a mean mark of 5.6/10 and 26% of the candidates achieving full marks. However, rather oddly for this type of question where even weak candidates tend to pick up a few marks, 13% of them scored zero. In part (a) the most common problems with the diagram were the two graphs not ending at the same value of t, the lines not crossing and having T at the end instead of $T + 15$. A very small number marked 15 and T in the centre of the time intervals, without delineators, instead of in the correct places. The second part was answered correctly by the vast majority. Part (c) was usually correct provided the candidate had obtained the final value of the speed as $T + 60$. The fact that distances were required to find the relevant equation was appreciated by most of the candidates, even by those who used T as the end time and by those who did not have the correct value for the final speed. The first B mark was almost always scored, the second less often because of T being at the end. Candidates knew that they should be equating distances, but there were many variations in the lengths used for the trapezium. Some had an extra section in their equation, while others missed a section out. Many gained M1A1 because the structure of their equation was correct but lost the last two marks because they had not been able to find $60 + T$. A few used a *suvat* equation to find the distance and were mostly successful.

Question 6

The vast majority of candidates used Pythagoras to find the magnitude of the given vector in part (a). Since an exact answer was required it was important that this value was given as a surd rather a decimal approximation. Part (b) involved finding the angle between two vectors and it was completed with mixed success. Some just found the angle between **F** and **i** and so achieved only one out of a possible four marks. The most common successful approach was to find the difference between the angles the two vectors made with **i** although the cosine rule (or scalar product) was used successfully on occasion. In the final part, some candidates considered (-15**i** + a**j**) to be parallel to the given vector rather than the **resultant** of **F** and (-15**i** + a**j**). Although valid methods of using ratios or equating to k(2**i**-3**j**) were often used with the resultant as required, it was not uncommon to see the incorrect method of equating the resultant to (2**i** - 3**j**) or (-2**i** + 3**j**). A minority of candidates omitted this part or had no valid approach for dealing with parallel vectors.

Question 7

Despite its length and the unstructured nature of its later parts, this question was quite well answered, with a mean mark of 11/18. Part (a) was almost always correct but in the second part only about half had the correct reason – many just copied down the modelling statement for the string in its entirety or wrote down extra incorrect reasons. In part (c), a significant number found T correctly but were unable to find the force on the pulley. A few candidates who did work out the force correctly didn't round their answer to either 2 or 3 s.f. and lost a mark as a result. Most candidates answered part (d) very well, although some lost the final A mark for giving 5/8 as their answer. The instruction on the front of the question paper is very clear in that, whenever $g = 9.8$ is used, the answer must be given as a decimal to 2 or 3 s.f.. Part (e) was more challenging. Almost all knew that they needed to work out the speed of the particles when B hit the floor but a significant number used $0.7\ \text{m s}^{-2}$ as the acceleration throughout instead of finding the new deceleration, with a few including tension as well as a frictional force in their equation when attempting to find this deceleration. A substantial number lost the very last mark for not using 2 m, either directly or indirectly, in their reasoning for saying that it did not reach the pulley.

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