Examiners' Report

Principal Examiner Feedback

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Pearson Edexcel International GCE

In Mechanics M1 (WME01)

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General

The paper seemed to work well with the vast majority of candidates able to make attempts at all of the questions. There were some excellent scripts but there were also some where the standard of presentation left a lot to be desired. This made it difficult for examiners to follow the working.

In calculations the numerical value of g which should be used is 9.8, unless otherwise stated, as in question 1. 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 and that they end up with *exactly* what is printed on the question paper.

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.

Question 1

Sign errors were common throughout this question and final answers in both parts needed to be given to 2 or 3 significant figures as $g = 9.8$ ms^{-2} had been used. Part (a) was generally done well. The most common and successful method seen was to use $v^2 = u^2 + 2as$ with $s = 3$ or -3 but a few candidates found the height of the stone at the top of the motion and then found the speed when it drops, from instantaneous rest, the appropriate distance. A few used the principle of the conservation of energy. A significant number of candidates did not interpret the question correctly and used $s = 2$ or -2, gaining no marks. In the second part, a complete method to calculate the time was required to earn any marks. The most efficient and successful candidates solved this using $s = ut + \frac{1}{2}at^2$ needing only one equation. Others split the motion into two or three parts e.g. to the top and then from the top to the ground or to the top, then back to the starting point and then to the ground. For those candidates who chose to split up the motion into several parts, sign errors often made it difficult to see what time they were trying to find. If candidates formed what seemed to be correct equations but then used these to find the wrong time e.g. finding the total time and then adding the time to the top then this was deemed to be an incorrect method and gained no credit. A few candidates lost marks by using $g = 9.81$ ms^{-2}.

Question 2

Most candidates were familiar with impulse = change of momentum. There was a significant number of candidates who were well rehearsed in answering this type of question and coped accurately with the signs in their impulse equations. Many candidates, however, chose to ignore the direction of the impulse in producing two impulse equations and often gained 4/6 marks.

Those who answered part (b) first and then used the conservation of momentum principle to do part (a) often got both parts right, while those who did part (a) first and used the conservation of momentum principle for part (b) got only 2 marks. Some candidates who chose to use the conservation of momentum principle failed to account of the initial opposite directions of travel of the particles and a few gave negative speeds.

Question 3

The majority of candidates scored well on this question and very few candidates confused sin/cos when resolving. Resolving vertically caused a few issues and there was a significant minority who put R equal to the sum of the weight and the vertical component of T and the 200N. There were also a few who thought that $R = 20g$. When resolving horizontally the most common error was to have friction acting in the wrong direction. Others omitted F altogether and hence thought that they were able to solve for T using only one equation. Some candidates opted to have friction acting in both directions and then selected the smaller value of the tension for their final answer. A few introduced acceleration to one or both equations. Many wrote down correct equations but then had difficulty solving them to reach the correct value for T or having found the correct value for T gave their answer to 4sf and lost the final mark due to over specification after the use of $g = 9.8$

Question 4

This question involved a non-uniform rod resting in equilibrium on two supports with a given force applied, in turn, at each end. Although many candidates realised that 'about to tilt' implied that one of the reactions was zero, a significant minority assumed that this would be at the pivot showing a lack of understanding of the mechanics of the situation. The quickest and neatest method of solution was to take moments about the pivot point in each scenario giving two equations in the unknowns x and W, and then to eliminate W to find the required value of x. Some chose a valid method of resolving and taking moments about a different point, but these solutions were more likely to contain either a sign or a distance error in an equation or a mistake in processing. Those who failed to eliminate a reaction term from their equations received no credit. Some candidates assumed both forces were applied at the same time whilst a few thought the reactions were the same in both scenarios; again, these attempts represented a fundamental misunderstanding and achieved no marks. The weight was given as W newtons in the question so inclusion of Wg in an equation was treated as an accuracy error. Although there was a fair number of fully correct solutions seen, there were many instances of candidates scoring zero as a result of not having a complete method or attempting an invalid method of solution.

Question 5

Clear diagrams usually led to a fully correct solution but these were few and far between. A significant number of candidates appeared to be unfamiliar with this type of question and struggled to get going. Blank pages were not uncommon. Some weaker candidates were happy just to add 8 to 10 or used Pythagoras with these forces. Some wrote a correct expression for **R** in vector form but didn't go on to find the magnitude. Some of those who used vectors subtracted 8cos 60 from 10 instead of adding them to get the **j** component and a few confused sin and cos when writing down the components. A few who used the cosine rule in part (a) used 60 degrees instead of 120 but most of the candidates who used the cosine rule achieved full marks in part (a). Most of those who gained full marks in part (a) went on to find a correct angle in part (b). However, many didn't give the bearing to the nearest degree. A few candidates correctly found a relevant angle but were then unable to convert this into the correct bearing. Most used the sine rule or the tangent from their components in part (b) with only a few using the cosine rule. Many who gained no marks in part (a) gained the first M mark in part (b) for attempting to use the sine rule with 60 degrees and their incorrect value of R from part (a). Diagrams with 240 degrees in the triangle were occasionally seen.

Question 6

Part (a) was well answered by the vast majority of candidates who understood how to find a position vector at time t. In the second part, most found the position of A at $t = 6$ but many failed to properly show that B passed through this point. This required candidates to check that both the **i** and **j** components of the position vector of A at $t = 6$ were the same as those of the position vector of B at $t = 5.5$. Part (c) was also a 'Show that..' question and therefore required full and detailed working leading to *exactly* what was written on the question paper. Thus, column vectors were accepted in the working but were not accepted in the final answer. Very few candidates gained full marks in the final part. Many were often able to apply Pythagoras Theorem to the printed result in part (c) but then faltered. Successful candidates could then use differentiation, complete the square or look at the discriminant to find the least distance. Those using calculus tended to be the most successful.

Question 7

In part (a), the vast majority of candidates found a correct value of the speed when the parachute opens with just the occasional error of using 3.9 m s^{-2} rather than g for the acceleration. Most graphs representing the motion of the parachutist produced in part (b) achieved the first mark for the correct shape. However, occasionally a continuous vertical line was included at $t = 20$ or the deceleration line was steeper than that representing the freefall acceleration in the first phase. The second mark was available for the correct placing of all the given figures. Here, the most common errors were in omitting V or using T rather than $T + 2.5$ at the relevant point on the t axis. Part (c) required the calculation of T given the distance travelled in the deceleration phase. Probably the most successful method was using $s = ut + \frac{1}{2}at^2$ and solving the resulting quadratic for T. It was given that $T < 6$ so it was important the solution $T = 5$ was chosen as the final answer. The main error here was in using +3.9 rather than -3.9 for the acceleration. Some successfully attempted to equate the area under the second section of the graph to the given distance but there were occasional errors in applying the area of a trapezium formula to obtain an equation in T only. Another possible approach seen was to use two *suvat* equations to find and use a value for V, thereby avoiding the use of a quadratic. A few candidates misinterpreted the information and tried to equate the whole area to the given distance. They tended to give up without attempting part (d) which might have alerted them to their mistake. Those candidates who attempted part (d) generally had the right idea. It was required to calculate the total distance travelled by the parachutist in the first 20 seconds. Most attempted to find the areas for the three sections of the graph (triangle, trapezium, rectangle) and it was important the structures of the expressions were correct to achieve the method mark; if, for example, the '1/2' is missed out from the formula for area of a triangle this mark was withheld. A few forgot that the value for the middle section had been given in the question and chose to re-calculate it (not always correctly). The most common errors occurred in the last term where either 20 or $20 - T$ (rather than $20 - 2.5 - T$) was used for one side of the rectangle. Sometimes wrong values of V or T were carried forward and the distance was not always given to the nearest metre as required by the question. Nevertheless, there were a fair number of correct final answers seen.

Question 8

The angle α was often calculated at the start of attempted solutions, but rarely used. Part (a) was often well attempted with many candidates scoring 8 or 9 marks. Assuming that $R = 2g$ was an occasional error, as was the omission of $2a$ in the equation of motion for A. The equation of motion for B was nearly always correct and was often the first to be written down. A whole system equation was rarely seen. The result $F = \mu R$ was well known and solving the equations for T was generally well done. Some very efficient solutions were seen, but there were also many laborious solutions which gave scope for errors to creep in. The final accuracy mark was often lost due to over specification after the use of $g = 9.8$, when 23.52 (N) was given as the answer. Even candidates who gained the mark with $12g/5$ often accompanied it with an alternative of 23.52 (N). A significant number of candidates who had completed part (a) successfully made no attempt at the second part. This was unfortunate as they had often found a correct value for the acceleration in part (a) and could easily have gained another two marks if they had attempted to use it in part (b). Many candidates who attempted this part had a clear picture of what was happening and what was required of them. There were some excellent, well-reasoned solutions. The most common difficulty was in assuming, or calculating, an incorrect deceleration for A. Some used 9.8, some continued with the 3.92 from part (a) and others ignored the weight of A and used 'Friction = $2a$' to find their new a. Most successful solutions stopped at $s = ½h$ and neglected the final part. It was rare to see a final inequality and it was even rarer to see it the correct way round. The final part was omitted by many candidates. There was limited understanding of what was meant by a "physical factor". Answers tended to repeat or explain the given conditions rather than suggesting modifications. Common answers included, "Tension is the same in both parts of the string" or "The particles move with the same acceleration". Friction at the pulley was the most common correct answer.

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