Examiners' Report
Principal Examiner Feedback

October 2023

Pearson Edexcel International Advanced Level
In Mechanics (WME01) Paper 01

October 2023
Question Paper Log Number 74321
Publications Code WME01_01_pef_20240118

WME01 Examiners’ Report October 2023

General

The paper seemed to work well with the majority of candidates able to make attempts at all seven of the questions. The paper had a friendly start with the modal mark on both of the first two questions being full marks. There was no evidence of time generally being an issue but see the comment lower down. There were some excellent scripts but there were also some where the standard of presentation left a lot to be desired. This, in some cases, made it difficult for examiners to follow the working and award marks accordingly.

Question 1 was the best answered question, and along with questions 2 and 4, was well received by candidates. Question 5 proved to be the most challenging with a quarter of candidates scoring zero. The last question also had a significant number scoring zero and whether this was down to weaker candidates running out of time or running out of ideas wasn’t always clear.

In calculations the numerical value of g which should be used is 9.8 m s^{-2}. 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 given or printed answer to show, as in 2(a) and 4(b), then candidates need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available and in the case of a printed answer, 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

This proved to be a friendly starter in which many candidates earned full marks. The most common (and successful) approach was to first resolve vertically to find the size of T. Successful candidates then took moments about a number of different points to find the size of x; the most common point to take moments about was A, but C, G and D were used frequently too. The candidates who did not resolve vertically were usually able to write down two correct moments equations and solve to find T and x. However, this was a more time-consuming method and it also led to more manipulation errors when solving the two equations. A minority of candidates did confuse T with $2T$ or used $24g$ instead of 24, which caused the loss of the accuracy marks. Some candidates found it helpful to introduce another unknown length and occasionally forgot to find x. Other common errors included working in T_C and T_D and not then using $T_C = 2T_D$, using incorrect lengths and the careless removal of brackets resulting in sign errors. Where two moments equations were used, there was more opportunity for these errors. Greater constructive use of the diagram would have helped many candidates.

Question 2

This question was found to be more challenging than question 1 but there were still many high scoring solutions. In part (a), successful candidates carefully calculated the speed at t = 4 ($v = 8 - (0.5 \times 4) = 6$), realised that the speed would still be 6 at t = 10, and followed with a new calculation for the final speed, $v = 6 + (1.2 \times 10) = 18$. Since this was a 'Show that' question, full and accurate stages of working were required. Some candidates combined these into a single calculation, e.g. $v = 8 - (0.5 \times 4) + (1.2 \times 10) = 18$. A significant number of candidates tried to apply a single *suvat* equation to the whole of the motion e.g. $v = 8 + (0.5 \times 20)$ and scored nothing.

In the second part, candidates were required to draw the correct shape for the three phases of the motion and then to provide appropriate detail on both axes. The correct shape required three connected straight lines (negative gradient, zero gradient and positive gradient). Note that intermediate solid vertical lines are penalised. Some candidates produced the correct shape but had the second phase of the motion along the t-axis. Other errors resulted from wrong shapes and even curves. In part (c), most successful candidates calculated the areas of the shapes under the curve either as two trapezia and a rectangle or as an equivalent set of triangles and rectangles. Other successful candidates used *suvat* for each phase of motion and then added the three distances. If candidates had a correct graph in part (b), they invariably did well with their attempts for part (c). A few tried to apply a single *suvat* equation to the whole motion and scored nothing.

Question 3

There were many correct solutions to part (a), with the vast majority applying conservation of momentum and obtaining v = 9. Common errors were sign errors or incorrect mass/velocity combinations. Many were also able to score the first two marks in the second part, but either omitted units from their answer or had the wrong ones. A few included g in their impulse-momentum equation and scored nothing for a dimensionally incorrect expression.

The final part proved to be much more challenging. Calculating the deceleration/acceleration was well attempted and many found the value correctly using a distance of 0.12m. However, many used the distance as 12m when a little common sense would've spotted the error.

There were significantly more errors made in the second part of the calculation where inconsistent signs often occurred when writing down the equation of motion. A more serious error was to omit the weight term. A significant number who had a fully correct solution then forgot to round their answer to 2 sf or 3 sf, after the use of g = 9.8, and lost the final A mark.

Question 4

In part (a), most candidates were able to obtain a correct solution using an equation of linear motion and very few candidates left their answers in column vector form. The majority chose to state their answer with the **i**'s and **j**'s collected, although this wasn't required to gain the marks. There was a significant minority of candidates who either mixed up **v** and **a** or did not have a secure understanding of the correct formula **v** = **u** + **a***t*. Often these candidates did not quote a formula.

For the second part, since many candidates had already written their answer to part (a) with the **i**'s and **j**'s collected, using Pythagoras to set up the equation was straightforward for the majority although a few got in a mess with the square root. Most candidates showed sufficient detail to achieve the given answer but a small minority, once the unsimplified equation was set up, went straight to the given answer or managed not to write the equation in **exactly** the given form and lost marks. Candidates should be reminded that 'a show that' requires all steps and no short cuts, and the final answer to be **identical** to the one on the paper.

In part (c), the use of $\lambda = 2$ was commonplace with many candidates obtaining the correct velocity vector at $t = 4$ but a significant minority used $t = 5$ and lost marks. Most made use of their velocity vector to find a relevant angle using trigonometric ratios but a few wrongly used a displacement vector. Many were unable to calculate the correct 3 figure bearing. Of those that did, the answer was often not given to the nearest degree.

Question 5

This question was a good discriminator and weaker candidates were often unable to make much progress. A lack of a clear force diagram was often the problem with many unable to mark in the forces correctly, confusing the positions of the normal reaction and the friction. A sizeable number of candidates had the normal reaction force acting vertically. Candidates seemed unaware that the normal reaction and friction are perpendicular to each other.

In part (a), the usual sign errors meant that some candidates were unable to obtain the correct value of the friction force. A significant minority of candidates used $F = \mu R$, found a value for μ, before substituting to get the numerically correct value of F, overlooking the fact that the system was **not** in limiting equilibrium.

In the second part, many of those candidates who had obtained a correct value for the friction force often gave its direction incorrectly thus reinforcing the notion that candidates often did not have a real appreciation of the forces and their directions.

This was also borne out by some of the subsequent equations formed in part (c) where many candidates made reasonable attempts at finding the required values for T but often seemed unclear as to which was maximum and which was minimum. Some stated the obvious conclusions only once the values had been calculated. Many candidates lost an accuracy mark by over specifying their answer(s) after use of $g = 9.8$

Question 6

In part (a), the majority of candidates subtracted the two position vectors and divided by the time to find the required velocity vector. Nearly all identified $t = 0.5$ although those few who used $t =$ 30 (minutes) could achieve the method mark. Since the answer was given, the second mark required the expression to follow exactly from the working and to be written as printed; those who gave it as a column vector were penalised. The second part was also done well with almost all writing down an expression for the position vector of P in terms of **i**, **j** and t as specified by the question.

In part (c), most understood that a collision implied the same position at the same time. Since the time of collision was given, a common response was to verify that **p** and **q** were equal at $t = 1.5$ although a significant number failed to verify it for both the **i** and **j** components. Similarly, in the alternative method of equating **p** and **q** to find t, some only equated one set of components which meant the verification was incomplete. Most wrote down the position of collision correctly as 30**i**+30**j** for the final mark.

The final part proved more challenging and was completed with mixed success. Although some candidates omitted this part or made no significant progress, a fair number achieved the marks for a correct position vector of P at 14:30 and for finding the position vector of Q at 12.30. Identifying the new velocity 15 kmh^{-1} due north as 15**j** was a stumbling block for some who ended up with a mixture of scalars and vectors in the same equation. A few who had the right idea but used 15**i** could still achieve the remaining method marks. These required use of $t = 2$ in the new position vector of Q followed by Pythagoras to find the required distance between P and Q at 14.30. Almost all who reached this stage gave their answer as an exact surd as required. Those who tried to keep all their working in terms of t tended to go wrong because of inconsistent use of t and those who went straight to substituting $t = 2.5$ in both **p** and **q** could achieve a maximum of one out of the seven available marks having ignored the change in direction of Q.

Question 7

Part (a) involved the motion of two particles connected by a string passing over a pulley. The setting up of an equation of motion for the particle moving up the inclined plane proved quite straightforward for a lot of candidates for whom it was a familiar scenario. The most common error was to omit one of the forces. Those who omitted the weight component were usually able to score three out of the six available marks for finding R and using $F=\mu R$ but those who omitted the frictional force were unlikely to have found R and so failed to achieve any marks here.

A few with a fully correct equation made an error in solving to find the acceleration or else did not give the final answer as a multiple of g, as specified by the question. Candidates were often less successful in writing down an equation of motion for the particle moving vertically. It was not unusual for k to be omitted from the kma term or even from the kmg term. There were a minority who included incorrect terms in their equation, for example sometimes making an attempt at a whole system equation but not using the combined mass in the ma term. Many with a correct equation made errors in solving to find k or had an incorrect value for the acceleration from previous working and so lost the final mark.

Part (b) required a calculation of the resultant force exerted by the string on the pulley. Many omitted it completely or else made no valid attempt with some trying to combine ma terms rather than components of tension. The most successful method seemed to be resolving the tensions to give $2T \cos (90^{\circ} - \alpha)/2$ or quoting this as a learnt formula. Those who attempted to apply the cosine rule often used an angle $(90^{\circ} - \alpha)$ rather than $(90^{\circ} + \alpha)$ implying an incorrect triangle. The method of using vertical and horizontal components was seen more rarely but, apart from occasional errors in calculating the resultant using Pythagoras, was generally completed successfully.

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom