Examiners' Report
Principal Examiner Feedback

January 2023

Pearson Edexcel International Advanced Level In Mechanics M1 (WME01) Paper 01

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General

The paper seemed to work well with the majority of candidates able to make attempts at all eight of the questions and the modal mark on the first six questions was full marks in each case. 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 5 was very marginally the best answered question, and along with questions 1, 3 and 6, was well received by candidates. Questions 2 and 4 were found to be a little more testing but question 7 (the lift question) was, by a significant margin, the most challenging with a sizeable number 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. 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 5(a), 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.

Report on Individual Questions

Question 1

Almost all recognised the need to change kilometres into metres and minutes into seconds in this question. Part (a) was attempted by the vast majority of candidates. Many did not gain all three marks as it was common to omit the final expression, $(3T + 180)$, from the time axis. A common error was to halve the time taken to decelerate rather than double it. Where this misunderstanding occurred, it often led to a loss of marks in both parts (a) and (b). The mark for the shape of the graph was not given to symmetrical graphs or to those where the deceleration section was steeper than the acceleration section. Many responses only scored one out of three available marks in part (a) for correctly labelling 20 on the velocity axis.

The most popular approach to part (b) was equating the area under the graph to the distance travelled. The most successful of these considered a single trapezium with sides of 180 and $180 + 3T$ although many used two triangles and a rectangle. Some candidates chose to use *suvat* to find an expression for a and substitute

before finding the value for T. This approach was often successful. The vast majority scored both marks in part (c) where there was a follow through mark available for correctly using their answer to part (b) once the method mark was achieved.

Question 2

In part (a), a significant number of candidates did not appreciate that B would be moving faster than A after the collision and so although almost all realised that they needed to use a Conservation of Linear Momentum equation, there were relatively few correct solutions. Part (b) was better answered with many benefitting from a follow through mark when correctly using their answer from (a) in their impulse-momentum equation. Either particle could be considered although most opted to use B. The most common error was having an incorrect sign on one of the velocities.

Question 3

In part (a), the vast majority were able to find a correct velocity, although there were a few who multiplied the initial velocity by the time rather than the acceleration. However, a significant number then failed to go on and find the speed, losing two of the three marks available for this part. The second part was usually well done, with trigonometry (usually tangent) being used correctly to find a relevant angle. A small number of candidates adjusted their answer (e.g. finding $90^o + 26.6^o$) and lost the final mark. Occasionally the final mark was lost for giving a truncated answer of 26.5^o. In part (c), most candidates earned the first method mark but many then tried to equate coefficients using $(2\mathbf{i} - 3\mathbf{j})$ or attempted to use a *suvat* equation to find T, rather than use ratios. The vast majority of those who used a correct method went on to find a correct equation in T only, and a correct answer.

Question 4

This question involved the equilibrium of a beam resting on two pivots. There were two separate scenarios described, each one with a different force applied to the end of the beam. To make any valid progress it was necessary to appreciate that 'about to tilt' implied that one of the reactions had to be zero in each scenario. Those who failed to realise this often produced moments and/or resolution equations with too many unknowns which could not be solved despite their best efforts. A number of candidates equated the wrong reaction to zero i.e., in the case where the beam was about to tilt around C they assumed the reaction at C to be zero and similarly when about to tilt around D; this showed a lack of understanding of the mechanics of the situation and gained no credit. Some confused the two scenarios and included both the 150 N force and the 225 N force in a single equation, and a few produced dimensionally inconsistent equations. Those who understood the situation generally took moments about each pivot point to give two simultaneous equations and then solved them to find W and the distance x as required. A few took a longer route by taking moments about a different point and resolving vertically, then eliminating the reaction to achieve two equations in W and x. This approach was a little more prone to error but nevertheless mostly successful. There were a number of entirely correct solutions seen but also many who achieved no marks through having no valid approach.

Question 5

In part (b), the vast majority of candidates used one or more *suvat* equations for the motion from P to Q to show the given result '$x = 3u$ ' and achieved both available marks. The second part required a consideration of the second part of the motion from Q to R. Most applied '$v^2 = u^2 + 2as$' using the new acceleration and the given answer in (a) to produce an equation in u only. Occasionally the initial speed was taken to be u rather than $2u$ or the time as 12 s (from the first part of the motion). Sometimes longer methods were used which involved finding t. Those who used $2u^2$ rather than $(2u)^2$ and/or $3u^2$ rather than $(3u)^2$ in their equation for u lost

accuracy marks unless their subsequent working assumed the correct values. There were a fair number of correct answers for the value of u. In part (c) it was necessary to realise that in 14 s the vehicle would have travelled from P to Q and then for a further 2 seconds towards R. Many failed to appreciate that they needed to consider two stages of the motion and tried to use $t = 14$ in a single *suvat* equation thereby achieving no credit. A few of those who adopted a correct approach used an initial speed of u rather than $2u$ for the second section or even a final speed of $3u$ (which was the speed at R). However, such instances were fairly rare, and many correct answers were seen. Most, but not all, proceeded to add the distance from P to Q to obtain the required final answer.

Question 6

Most candidates attempted to resolve forces in the direction of motion of the boat. Occasionally an 'ma' term was included despite the fact that the boat was moving with constant velocity. Many also produced a second equation by resolving perpendicular to the direction of motion although a few added an extra term involving the 900 N resistance force. Not all, however, made any significant progress in solving their equations with some giving up without any attempt. One equation involved $P\sin\alpha$ and the other $P\cos\alpha$. Those who realised to divide to find $\tan\alpha$ were generally successful in finding values for P and α. However, earlier rounding sometimes led to inaccurate final answers. Although correct answers to any accuracy were acceptable here, it is often safer to round final answers to 2 or 3 significant figures. An alternative method was to consider a triangle of forces and use the sine and/or cosine rule (or Lami's Theorem). This was seen on occasion and generally used successfully**.**

Question 7

Most candidates attempted to set up an equation of motion for the whole system in part (a). However, the method mark was only available when the correct forces were teamed up with the correct mass. The most common error was to use the letter m in their 'ma' term but since this was the mass of the lift alone in this question, instead of the whole-system, candidates lost the method mark. Fewer candidates attempted part (b), especially if they had struggled in the previous part. For those that did, most realised that an equation of motion for P only was required but in this case the error was incorrectly identifying the forces acting on P, with the most common being the inclusion of the tension in their forces. However, a good proportion of the attempts went onto achieve full marks in part (b) even after an unsuccessful part (a).

Question 8

Although part (a) was completed successfully by very many candidates, there was a significant number who did not attempt it at all or scored only the B1 for use of $F = 0.3R$. A common error was to assume that the normal reaction was simply $2g\cos 30^{o}$. Occasionally marks were lost due to sin/cos confusion, an error in the manipulation when eliminating F and R, or over specification of the value of a, after use of $g = 9.8$, but the majority of candidates who attempted this part scored all 8 marks. There were many fully correct solutions to the second part but it was quite common for the final mark to be lost for giving an incorrect answer due to the premature approximation of their value of a. Often, candidates who had struggled with part (a) were able to pick up the first two marks by correctly using their answer from part (a) to find the speed. Part (c) proved to be a good discriminator. A minority of candidates used R from part (a) so were unable to score any marks here. Those who found the new R correctly also usually scored the method mark for the maximum friction. To achieve the final two marks, candidates were then required to make a comparison between the maximum friction and the weight component down the plane and state a correct conclusion. Some did this by comparing, some did it by subtracting and some actually found an acceleration. A few added the two forces and lost both marks.

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