Examiners' Report

Principal Examiner Feedback

Summer 2024

Pearson Edexcel GCE

In AS Level Mathematics (8MA0)

Paper 22 Mechanics

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General

Overall, the paper proved to be very accessible and the quality of the scripts was reasonably good with most candidates able to make some attempt at all four of the questions.

Questions 1 and 2 both proved to be fairly friendly with 45% able to score 4 out of 6 for question 1 and 50% able to achieve at least 6 out of 7 for question 2. Candidates found question 3 by far the most challenging with 40% unable to achieve any marks.

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

There was a printed answer to show in question 2(b), and candidates need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available. They should also ensure that their final answer is **EXACTLY** the same as the printed answer.

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 their answer then they are 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

Part (a) proved to be a good starter question for almost all of the candidates. Successful candidates found the area under the graph by either separating into two triangles and a rectangle (the most popualar method) or by going directly to a trapezium. A few candidates applied *suvat* formulae to each part of the motion. Unsuccessful candidates used incorrect formulae or had a correct, unsimplified expression for the area but then made mistakes in the arithmetic. A few, oddly, found the length of the hypotenuse instead of the area of the triangles.

The second part proved to be much more of a challenge, although the majority of candidates did offer a graph with three sections. Most had three straight lines with different positive gradients or one continuous straight line but quite a few attempts included lines with negative gradients or horizontal lines for the first and/or last sections. Most candidates only gained one mark out of three in this part of the question. Successful candidates realised that the first and third sections of the graph needed to be quadratic, from *suvat* formula, whilst the middle section was a straight line with positive gradient. In addition, the numbers 5, 20, 30 and their total distance were not always clearly shown on the axes. Some candidates had graphs that were unclearly drawn, often without straight lines. Many candidates with the three sections correct struggled with the transition between the sections and failed to produce a smooth curve, often exaggerating the curves, but they were not penalised for this. A few candidates simply recreated the speed-time graph trapezium with different axis labels.

Question 2

In part (a), most differentiated the given expression for v with respect to t to get to an expression for their acceleration. Candidates usually handled the powers correctly but there were the occasional errors in the coefficients or an error in the substitution of $t = 4$. Some tried to use *suvat* formulae to find the acceleration and a few integrated rather than differentiated.

In part (b), successful candidates integrated the expression for v with respect to t and were usually able to obtain a correct, unsimplified expression for the displacement of the particle at time t. There were then occasional errors with the simplification often due to incorrect coefficients. There was no penalty for not including a constant of integration. Successful candidates then used the limits of $t = 1$ and $t = 2$ to calculate the distance XY. A surprising number of candidates thought that finding XY meant that they then had to multiply these two values. Since there was a printed answer, candidates needed to clearly show all stages of their working including the use of surds to get to the required form of the answer. Of those that tried to use surds, some struggled to reach the given answer whilst others did not show enough working to gain the final A mark. Ignoring the instructions at the top of the question, many candidates used calculators and decimals appeared in their solutions which resulted in the solutions being incomplete and losing the final mark. Very few candidates used differentiation in this part.

Question 3

This was a challenging question for many candidates since forces were given as vectors, but the acceleration was given as a scalar. Although most realised that the two forces needed to be combined to produce a resultant, some subtracted the components rather than adding, thereby failing to achieve the first mark. This also required the **i** and **j** terms to be collected to enable an expression for the magnitude to be found. A common starting point was to equate the vector sum of the forces to a scalar '*ma*' term often leading to no further valid progress. Those who attempted to work in scalars sometimes equated the magnitude of their resultant to $\sqrt{5}$ (acceleration) rather than $2\sqrt{5}$ (*ma* term) and managed to secure one of the two available method marks. Where a correct unsimplified equation in *c* was reached, processing errors such as not squaring each side or in expanding brackets sometimes led to incorrect answers. The few who found the acceleration vector and equated the magnitude to $\sqrt{5}$ or the square of the magnitude to 5 tended to do so successfully despite the slightly harder algebra.

Question 4

In part (a), those candidates who attempted to produce an equation of motion for the whole system were mostly successful in finding the resistance on the car, possibly helped by the fact that it was a given answer. Some used equations for the car and trailer separately, often finding the tension from the trailer equation and using it in the car equation to find *R*.

Part (b) required the tension to be found. Either the car or the trailer equation could be used, and some did both just to confirm their answer. However, there was confusion evident in many attempts with either extra or incorrect terms included or the wrong mass in the *ma* term. Some even included weight terms which were not relevant since the motion was horizontal.

Few scored the mark in part (c). Although often a correct equation was used to find $a = 5/6$ or $a = -5/6$, it was not always made explicitly clear that 5/6 was the deceleration.

Those who had achieved few marks in the previous parts of the question were sometimes able to use a correct *suvat* method in part (d) to find the distance travelled by the trailer once the tow bar had broken. Occasionally the acceleration from before the break was used but generally this was well done with the correct numerical value obtained. The question required the value of '*d*' so some indication was expected that the calculated distance was actually *d*.

In part (e), it was fairly rare to see two acceptable correct reasons for why the distance was likely to be different from that calculated. Many scored one mark for 'resistance unlikely to be constant' or 'deceleration not constant'; however, these are not independent factors, so they were not credited as different reasons. Other common correct responses included that the mass of the broken tow bar was not considered, and the trailer would be unbalanced. The most common incorrect responses involved claiming that the model did not consider friction or air resistance. Also, some explanations included the car whereas this part was specifically about the trailer. It should be remembered that two reasons were asked for and if a candidate listed more than two then incorrect extra answers were penalised.

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