Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

Summer 2019

Pearson Edexcel GCE AS Mathematics

In Mechanics (9MA0/32)

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General

Overall the quality of the scripts seemed very mixed with some clear and entirely correct solutions but a substantial number were well below standard, particularly for question 4. Question 2 and question 5 also proved to be quite challenging. There may have been some evidence of time being a limiting factor as some answers seemed rushed or unfinished, although it is difficult to be sure whether time or ability was the main issue here.

Question 1 was the best answered and proved to be an ideal starter with 41% of the candidates scoring 6/6. However, Question 4 proved to be extremely challenging with 30% of the candidates scoring no marks and 70% scoring 3 or fewer out of a possible 11.

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.

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.

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

In the first part, the majority of candidates attempted to differentiate the given vector expression for velocity to find the acceleration as required. This was completed mostly successfully with just the occasional slip. Occasionally the expression was integrated or the fact that it was a vector just ignored with the coefficients of **i** and **j** being added; however, such instances were relatively rare. Those who completed the differentiation generally substituted $t = 4$ to obtain the acceleration and many correct answers were seen. Some went on to calculate the magnitude which was not actually required here but generally the marks had already been achieved for a correct vector. Some candidates worked in column vectors throughout and some in **i** and **j** components; both are equally acceptable. In part (b) integration was required in order to find the position vector. Mostly the indices were dealt with correctly although errors in the coefficients were more common. Some stopped there without either using the initial conditions or substituting $t = 4$. Many failed to achieve the final mark as a result of numerical/sign errors. A minority attempted to use ***suva****t* formulae to solve the problem despite having used calculus in part (a).

Question 2

In part (a), although many candidates realised that finding an expression for the velocity was relevant to determining the direction of motion, only a minority could use the fact that it was specified as being in the direction of 3**i** – 4**j**. The most common error was in equating the actual vectors rather than either equating the ratios of components or equating to a multiple of 3**i** – 4**j**. A fair number attempted to use a displacement vector showing a lack of understanding of the situation. The second part was generally handled more successfully with many correct answers seen for the displacement vector (using $\mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$) although not all proceeded to find the distance by calculating its magnitude. Although most used **suva***t* formulae throughout the question, some successfully integrated the given constant acceleration to find the velocity and displacement. Use of magnitudes of vectors throughout and some invalid multiplication/division of vectors were seen on occasion.

Question 3

In part (a), many candidates earned the first mark for correctly finding R, but there were a number who resolved incorrectly, using $\sin\alpha$ instead of $\cos\alpha$. Almost all candidates obtained the second mark, very often from simply stating $F = \frac{2}{3}R$ somewhere on their paper. Most candidates who found the equations of motion correctly did proceed to find T. The most successful methods were either adding the two initial equations to eliminate T, finding a and substituting back into one of the equations or setting both equations to $6ma$ and finding T directly. Candidates who rearranged their equations to give a and then equated the quotients more frequently made errors when solving for T. Common errors were inconsistent use or loss of m, including an extra g in the acceleration term or forgetting to include g in their weight and, on the RHS of the equation, putting $3a$ and $2a$ rather than $3ma$ and $2ma$. A significant number of candidates set their equation of motion to zero, finding the tension which would keep A at rest on the slope and received little credit. It was surprising how many candidates simply wrote $T = \frac{12mg}{5}$ at the end of their incorrect working, assuming it would not be checked. In the second part, many candidates tried to describe what would happen without any supporting calculations. Many talked about the continued motion of A, ignoring the actual question. Others simply said that it would continue moving as B had more mass than A, ignoring the effects of the plane. Many who showed calculations did successfully compare the component of the weight acting down the slope with the maximum friction, although others continued to include tension or actually compared friction with tension, ignoring the weight altogether. A few candidates showed a deeper understanding of the problem and simply compared μ and $\tan\alpha$. Some candidates did not notice that the terms required were available from the equation of motion for A. Some candidates did not read the question carefully and considered what happened immediately after B reached the ground, rather than when block A came to rest. Some used an equation of motion rather than considering forces separately. A minority showed their lack of understanding by using tension in their explanation. The final part was generally well done, although candidates still persist in giving more answers than are required, which very often means that they include a wrong one and so lose marks. A few just restated the model – "light string" etc. Candidates who didn't score well in parts (a) and (b) were often able to gain a mark or two in (c) with correct refinements of the model.

Question 4

In part (a), the majority of candidates either produced a geometric reason for the reaction acting perpendicular to the ramp (such as the ramp being tangential to the circular drum) or gave an argument about action being equal and opposite to reaction. Many seemed to think that a reaction is, by definition, at right angles to the surface. Very few recognised the significance of the drum being smooth with the consequence that there is no frictional force and hence only a normal component of the reaction. The second part involved finding the components of the resultant force on the ramp at the point of contact with the ground and hence its magnitude. This proved challenging for many and some made little valid progress. A clearly labelled diagram would have helped to identify forces and distances. Most used a normal reaction and a horizontal frictional force at *A*; however, the latter was sometimes omitted which significantly reduced the number of marks available for subsequent equations. Some employed components parallel and perpendicular to the ramp; such attempts were rare but generally successful. A variety of resolution and moments equations were attempted but sometimes components were omitted, forces not resolved or perpendicular distances not used. Working was often difficult to decipher. Those who attempted vertical and horizontal resolutions and a 'moments about *A*' equation tended to be the more successful although a significant number stopped when they had found the normal reaction only. Some introduced a coefficient of friction which was not necessary to answer the question (even giving it the value $\frac{2}{3}$ from the previous question). Occasionally those who completed a correct solution by squaring and adding components to find the magnitude of the resultant failed to achieve the final accuracy mark for not rounding to 2 or 3 significant figures following the use of $g = 9.8 \text{ m s}^{-2}$. Some who had achieved very few marks for the rest of the question managed to secure the mark in part (c) for stating that the reaction at *C* decreases if the centre of mass is assumed to be closer to *A* than to *B*. No reason was required although some chose to give one. A minority claimed it increased or remained unchanged (although the explanation sometimes implied that candidates were considering the reaction at *A* rather than at *C*).

<u>Question 5</u>

In part (a), the majority of candidates obtained the first mark for the horizontal component and most candidates also made a good attempt to find the vertical component, although sometimes it was seen as part of their working for part (b). Of those who found the horizontal and vertical components of the velocity, only a proportion proceeded to calculate the speed and of those, very few found the direction. This was despite the clear lead from the question which had given each velocity as a speed with a direction. A sizeable minority broke the universal rule that answers must be given in terms of quantities which are given in the question, giving their velocity in terms of **i** and **j**, which had not been defined in this question. The second part proved to be quite discriminating although a significant number of candidates did successfully find the correct values of both θ and u. The most common error was for candidates to simply equate both the horizontal and vertical displacements at the time of collision and ignore the 50 m horizontal distance altogether. Others assumed that the particles met halfway between *A* and *B*. However, only a minority of candidates made errors when resolving their velocities. In the final part, a substantial number of candidates correctly identified a limitation of the model with the size of the balls being the most common response. Wind, spin and an inaccurate value for g were also relatively common. A significant number lost the mark by referring to mass or weight and some referred to air resistance even though the question specified "other than air resistance''.

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