Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE AS Mathematics

Statistics & Mechanics (8MA0/02)

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SECTION B: MECHANICS

Introduction

A significant proportion of the students were poorly prepared and showed little understanding of basic mechanics and displayed poor algebraic/numerical skills. There were a number of blank or incomplete responses to question 9 but it was difficult to determine whether this was due to a lack of time or a lack of knoeledge.

Question 7 was by far the most successfully answered with just under a third of students scoring 6 out of 7 but the last two questions worked well as discriminator questions for the more able students. Just under 30% of the students scored nothing on question 8 and about a quarter failed to score on question 9.

In calculations the numerical value of g which should be used is 9.8, unless otherwise stated. Final answers should then be given usually to 3 significant figures (unless otherwise stated) – 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 students 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, students 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 student runs out of space in which to give his/her answer than he/she is advised to use a supplementary sheet.

Question 6

This proved to be a reasonably accessible starter to the Mechanics section with a modal mark of 4 out of 4, achieved by just over a third of the students. There were various possible approaches to this question which involved a ball moving up and down freely under gravity. Those who attempted a solution using one *suvat* equation generally included appropriate terms, but sign errors were very common. If the resulting quadratic equation was incorrect an explicit method (such as factorising or using the quadratic formula) was required for the second method mark. Some split the motion into two or three separate stages with a fair degree of success. Again, however, sign errors (showing a lack of understanding of how to incorporate directions) were often seen. Those who just found the time to the greatest height or to the same horizontal level received no credit, and use of g = 9.8 m s^{-2} rather than 10 m s^{-2} as specified in the question was penalised as an accuracy error.

Question 7

The majority of students identified a correct value for the required constant speed (24 m s^{-1}) and then for the time of deceleration (48 s) although '24÷0.5=12' was a surprisingly common error. Most, but not all, produced a *velocity-time* graph in the shape of a trapezium starting at the origin and finishing on the *t* axis.

In part (b), those who tried to equate the area under the graph to the distance travelled sometimes did so successfully, although an unknown '*T*' value was often used inconsistently in the 3 sections of the motion. Some failed to use the correct structure (a trapezium or two triangles and a rectangle) or attempted a single *suvat* equation for the whole journey; such attempts gained no credit. Having found a correct relevant '*T*' value, a number of students forgot that the question required the time for the complete journey.

Part (c) required the identification of a possible improvement to the model. The model assumed periods of constant acceleration and instantaneous changes between constant acceleration and constant velocity. Therefore possible improvements to the model would be to allow variable acceleration and smooth changes between acceleration and constant velocity. However, valid responses were relatively rare; examples of the various comments seen included reference to the mass or length of the train, traffic lights, number of passengers and even the weather.

Question 8

In part (a), many students realised they had to find the velocity to determine when the particle is at instantaneous rest and attempted to differentiate the given expression for *x*. Some failed to multiply out the brackets first and made no valid progress. Nevertheless, a fair number derived the relevant cubic and solved it successfully to find the 3 values for *t*. On occasions, *t* was cancelled out from the equation and the solution $t = 0$ was lost.

In part (b), a lack of understanding of the difference between distance and displacement became very apparent with the vast majority of students substituting only $t = 2$ (and sometimes $t = 0$) in an attempt to find the distance travelled in the first 2 seconds. Surprisingly, many integrated their expression for v rather than using the one for *x* that was given in the question (or even integrated the expression for *x*). Very few used their answers to (a) to indicate changes in direction and thereby calculate the whole distance. Part (c) also proved to be a challenge with few students scoring either of the two available marks. Those who did write the expression as a perfect square (achieving the first mark) often claimed that therefore it had to be positive ignoring the possibility of zero. Common incorrect responses included: 'time cannot be negative' and 't^2' is positive and any number times by a positive number is always positive'. A handful of students used their values from (b) to describe the motion in detail and thereby deduce the fact that the particle never moved on the negative *x*-axis.

Question 9

In part (a), most students had some idea that it was necessary to write down an equation of motion for P in an attempt to find the value of the tension in this pulley question. Some wrote down equations for both particles at this stage. Sign errors and missing 'm' from terms were fairly common. Those who reached the correct expression ' $T = 2mg - 10mg/7$ ' often failed to simplify further or made errors when attempting to do so. An answer in terms of m and g was required and so use of $g = 9.8 \text{ m s}^{-2}$ lost the final mark.

The only acceptable answer for part (b) was that the accelerations are the same because the string is inextensible. Extra irrelevant or incorrect comments relating to, for example, light string, smooth pulley, constant tension etc. were penalised. In part (c) there were some reasonable attempts at an equation of motion for Q and, to gain credit, it had to be seen or used in this part of the question and not just in part (a). Attempts to eliminate T and solve for k often revealed some poor algebraic processing.

There were several possible acceptable answers to part (d). The assumptions of the model were listed in the question and any one of these (such as smooth pulley, light string, modelling the balls as particles) could therefore be used to describe a limitation of the model. Reference to the accuracy of $g = 9.8 \text{ m s}^{-2}$ (a numerical value was not required for the question) was not credited.