Principal Examiner Feedback

Summer 2018

Pearson Edexcel GCE AS Mathematics

Statistics & Mechanics (8MA0/02)

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SECTION A: STATISTICS

Introduction

This was the first paper in the new specification and sadly there seemed to be some students who were not well prepared for the change in content and question style. In the statistics section, the responses to questions 2 and 5 were particularly poor, with over 40% failing to score any of the marks.

Comments on individual questions

Question 1

Part (a) proved an accessible starter for students with most students describing the correlation as positive as required. We use the command "interpret" when we expect a comment related to the context and "describe" when all we are looking for is a description of the statistic. In part (b), some mention of the context and the idea of "rate" was required and we would also expect to see a mention of the correct value for the gradient. A typical answer was "an increase of 1 point gives an increase of £4.50 in pay". In part (c), the students needed to engage with the model and explain why it might not be suitable. One such reason focussed on the fact that for a score of less than 11 points the pay was negative which would not be reasonable. Some honed in on the small sample size and gave the sensible suggestion that the sample may not be large enough to be representative of all jobs in the company.

Question 2

This question was supposed to suggest to students that a tree diagram would provide a suitable method for solving the problem and many did use such an approach; formulating an equation for p, the probability of a faulty component coming from factory C, and solving it. Others were obviously thinking along the right lines and wrote down a calculation such as 6 – (0.9 + 0.9) = 4.2% which was the probability of a randomly chosen component coming from C and being faulty, though they rarely told us that. A correct answer could easily be derived from here.

Despite the large number of students scoring zero here, about 1/3 managed to answer part (a) successfully. Part (b) required an explanation which means both words and a simple calculation were required. Some found $P(B) \times P(F) = 0.018$ and others gave the probability of the component coming from B and being faulty as 0.009 but both of these calculations and a concluding statement were needed to secure the mark.

Question 3

In the new specification, students are required to evaluate binomial probabilities using their calculators. Some students seemed to be unaware of this and although they could answer part (a)(i) using a formula, part (ii) was not feasible that way . In the hypothesis test in part (b), the hypotheses were usually given in terms of p and most identified the correct model to use $B(32, \frac{1}{3})$. A correct probability calculation did not always follow: some found $P(X = 16)$ instead of $P(X \ldots 16)$ and we would usually expect values to be given to 3 significant figures, but some students gave no value at all simply stating that the probability was < 0.05. In order to award the mark we do need sufficient evidence that the correct value has been obtained. The final mark of a hypotheses test will always require a correct conclusion in context: in this case a statement saying there is evidence to support Naasir's claim is all that we expected.

Question 4

The new specification requires students to be familiar with the large data set and the first part of the question addressed this issue. In part (a) the students needed to realise that n/a in the large data set means that the data for that point was not available and this means that there are only 18 (not 31) pieces of data available. Another skill students are required to have under the new specification is to be able to calculate standard statistics using their calculators. In this case, we expected students to enter the data into their calculator and write down the mean (part (a)) and standard deviation (part (b)). It was clear that many students were not familiar with this requirement and we often saw several lines of working to derive these results which unfortunately under the new specification cannot receive any marks. A small number of students knew that wind speed was measured in knots but many did not know this.

In part (c) there were many good attempts and most students gave a correct response here and in (d)(i) most knew that the * represented an outlier. Part (ii) was very challenging and required some careful thought and inference. Some confused mean with median and assumed that C and D were the 2nd and 3rd box plots in the list since they had the same medians. The intention was that they should identify E as the 5th box plot and A as the 2nd (it has a low mean and standard deviation and clearly has the smallest range on the box plots). Looking at the other 3 they should notice that the range is large and the outlier too would suggest a large standard deviation. The box plot Y has the smallest median of these 3 so a lower mean is suggested which points to B. We were looking for some explanation using correct terminology so we expected references to the mean and median and the standard deviation and a suitable measure of spread from the box plots.

Question 5

There were a number of blank responses here which may have been due to a shortage of time as students wanted to make sure they had time to complete the mechanics section of the paper. Those who did attempt the question sometimes struggled with interpreting the meaning of $P(X = r) = P(X = r + 2)$ and this would often lead them to an incorrect probability distribution. Many did realise that $P(X = 2) = P(X = 4) = 0.35$ and were then able to find the other two probabilities = 0.15

In part (b) they needed to use their calculators again to calculate a cumulative binomial probability and also needed to appreciate the discrete nature of the distribution to find $1 - P(A \leqslant 30)$ and once again we expect answers to be given to 3 significant figures. The final part required students to either form a list of values for Y , or even $Y - X$, or solve an inequality to realise that they needed $P(X \geqslant 2)$. Some were able to do this and this proved to be a good discriminator on this section.

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.

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