Examiners' Report

Principal Examiner Feedback

November 2021

Pearson Edexcel GCE AS

In Mathematics (8MA0)

Paper 01 Pure Mathematics 1

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Introduction

This was the fourth AS level Pure Mathematics paper for the new specification. The paper seemed to be of an appropriate standard, although much of this small cohort who sat the paper found it challenging.

There were many blank responses towards the end of the paper which either reflected those candidates who struggled due to time, or those who had not covered some of the topics and consequently became overwhelmed and stopped attempting questions.

The questions which candidates found most challenging were 2, 7 and 13 and 15c and 16d.

Candidates should continue to be reminded to read the questions carefully and any emboldened instructions, which particularly draw attention to the use of calculators and showing all stages of their working. This was particularly evident on questions 1, 2, 6 and 12,

Comments on individual questions

Question 1

This was a short opening question to the paper, which enabled nearly all candidates to score at least one mark. However, several candidates did not find their critical values correctly, sometimes equating to 20 rather than rearranging and equating to 0 or making errors when factorising. Most, however, were able to find 5 and –4.

Typically, most realised that they needed to select the outside region, although there were a few responses with incorrect inequalities.

It was very rare for candidates to correctly give their answer using set notation, and very few being able to score full marks.

Question 2

This question proved to be one of the most challenging questions on the paper. Most were able to score one mark, however, it was very rare for a candidate to achieve the correct final answer.

A good number appreciated the need to make each of the terms as a 3 to the power of something. However, errors were often made in multiplying the power together on $3^{2(x-1)}$ or 9 was written as 3^3. Others opted to try and log both sides, but those who did not state the base were unable to score as working in base 10 would not be possible without a calculator. Those who selected a suitable base were often able to score at least one mark, although a significant number of candidates either applied index laws or laws of logarithms incorrectly.

It was disappointing that several candidates rearranged by multiplying both sides by 3^{y+2} such that the left-hand side became 243^{4y+8} thinking that the two base numbers could be multiplied together and that the powers would also be multiplied.

Those who did achieve an equation where all the terms were 3 to the power of something were typically able to equate the powers and proceed to find an equation for y in terms of x.

However, some poor rearrangements by applying incorrect inverse operations meant that a correct final answer was rarely seen.

Question 3

This question was very accessible; however, it was surprising that the majority were unable to score full marks on this question.

This should have been a very straight forward question for those who had understood integration. However, a significant number thought that you could integrate the numerator and denominator of the fraction. Another significant number made errors when splitting the fraction into two separate terms. Errors often occurred in dealing with the 2 on the denominator and, as such, this restricted the maximum marks to 2 out of 4.

Those who were able to separate the fraction correctly, were often able to score 3 out of 4, with typically the omission of the constant of integration being the reason for not scoring full marks.

Question 4

This question using vectors was generally well answered with most candidates scoring more than half of the marks available.

In part (a) candidates seemed unsure how to go about proving that the stone passed through the origin. The most successful attempts typically involved finding the equation of the line for the stone which was $y = \frac{5}{12}x$ and showed that the origin was on this line or stated that this linear equation would pass through the origin. Other attempts which candidates proceeded with involved either comparing the position vectors and showing that one was a multiple of the other or showing that the gradients of the position vectors were the same. Plotting the points on a graph was not an acceptable method to prove.

In part (b) most candidates were able to find the vector $\overrightarrow{AB}$ and proceeded to find the magnitude of their vector. Some forgot to then find the speed by dividing by 9, whilst others omitted or gave the wrong unit, or just gave the generic units per second as their unit for speed.

Question 5

This question was generally well attempted, although it was rare for candidates to score full marks.

In part (a), candidates knew that they needed to differentiate, and most had read the question carefully to realise that they also needed to substitute $x = 2$ into their $\frac{dy}{dx}$, enabling them to proceed often to the correct answer.

Part (b) was completed to a high degree of success. Candidates are clearly more comfortable with the idea of finding the gradient of a chord in terms of *h* and most were able to proceed to the correct answer. Some made slips in their multiplying out of the brackets and there was the occasional response where the candidate had differentiated again and substituted in $2+h$ which could not score.

In part (c) candidates still struggled with bringing the concept of the gradient of a chord tending to the gradient at a point on a curve it was extremely rare to see a correct response, although this could be due to candidates having made an error in (a) or (b) so they were unable to see clearly what the link was between them anyway.

Question 6

This was a question which was completed to a high degree of accuracy by a pleasing number of candidates. There seemed to be more notice taken by many candidates regarding showing all stages of their working.

In part (a) it was common for candidates to score full marks. Typically, candidates factorised out the *x* and then they proceeded to correctly factorise the resulting quadratic proceeding to the correct solutions. It was rare for a candidate to divide by *x* and hence lose the solution of 0.

Part (b) proved to be a good discriminator. Some candidates tackled this part well recognising the link from (a) and showing sufficient working of using their solutions to proceed to correct ones in (b). However, a significant number came unstuck with this part and tried to multiply out the brackets and start again. Some also tried to set $(y-2)^2$ equal to their solution, but then multiplied out the brackets and solve using the formula or factorising a new quadratic, rather than just square rooting and adding 2. It was rare for candidates to just use their calculator which could not score. Some squared rather than square rooted, and some forgot the negative solution from square rooting. Others thought you could square root a negative.

Question 7

Question 7 was testing a candidate's ability to apply trigonometry to solve a problem relating to a parallelogram. This was one of the most challenging questions on the paper and was largely as a result of the candidates having to draw their own diagram.

In part (a) there were many incorrect diagrams to begin with, which included incorrect labelling of the vertices. Some tried to find the required angle by splitting the parallelogram into a rectangle and two triangles. However, they made little progress with this and often just stopped. Other candidates who did correctly set up an equation using the sine rule, then forgot to find the obtuse angle. Some subtracted the acute angle from 360°.

In part (b) candidates often tried to apply Pythagoras to the two given sides when there was not a right angle and although some did proceed with the intention of applying the cosine rule, the sine function or omission of the square root sometimes prevented a correct answer being achieved.

Question 8

The binomial expansion question proved to be very accessible to begin with, but for many, part (b) was too challenging so full marks was extremely rare on this question.

In part (a), candidates were usually very successful in finding that $a=\frac{3}{2}$. Candidates typically wrote out all the terms up to the coefficient for x^5, although some did proceed straight to the required term. The small minority made errors with the correct binomial coefficient. Candidates were often able to equate their coefficient for x^5 to the coefficient given in the question, although bracket errors meant that the most frequent error was not achieving a^5 so no further marks could be scored in this part as they had simplified the question.

In part (b) candidates often recognised that 2^8 was a required term, but very few found the other term, and hardly any attempted to add the two required terms together.

Question 9

This question was typically answered well by most candidates and was possibly the most successful question on the paper. Candidates typically were able to manipulate the integral to achieve $...x^{-\frac{1}{2}}$, although those who omitted the negative did not score any marks on this question. Some candidates made errors dealing with the coefficient, but they were typically able to score half of the available marks on the paper. Whilst most proceeded to the correct answer, some incorrectly square rooted to find *k* rather than squaring.

Question 10

This question tested both proof by deduction and proof by counter-example. It was pleasing to see improved attempts made on this type of question.

In part (a) candidates were usually able to set up their proof using $2k+1$ or similar. Some continue to set $n=2n+1$ which was condoned on this occasion. Some candidates unfortunately set up their proof with $4k+1$ or n^2+1 which could not score. Candidates were usually successful in substituting into the expression, multiplying out and simplifying. Some candidates did forget later to subtract $2k+1$ or similar as they had become to engrossed in the multiplying out of the cubic, although most then knew they needed to take a factor of 4 out of their expression. The final mark was typically lost for bracket errors, or the omission of them, in their proof at some point in their working so candidates should be encouraged to check their work carefully. Most candidates knew that they needed to conclude at the end.

In part (b), this proved to be harder work for many candidates. A significant number seemed to not understand what a natural number was and opted to substitute a negative number, or a fraction, into the expression. There was also some confusion regarding whether 0 was a multiple of 4 as well.

Question 11

This question was generally answered well by most candidates. It was typically silly mistakes or not reading the question which resulted in full marks not being scored.

In part (a), most candidates were successful in finding the area to be 35 km^2. Some just opted for 80 and the units were also incorrect, at times, such as being given as trees.

In part (b), candidates typically were able to equate the expression to 60 and rearrange correctly. A pleasing number were able to proceed to the correct value for *c*, although a significant number did not then state the equation which the question asked the candidates to find a complete equation. Some over rounded the value of *c*, whilst others tried to take logs of each term.

Part (c) was answered well by many candidates. It was really pleasing to see so many comments where the candidate had clearly engaged with the model and recognised that the maximum area was 80 km^2. This type of response was much more frequent than last time when most opted to just substitute in the value given in the question and show that you cannot take logs of a negative number. Whilst this was accepted as a valid response, the engaging of candidates with the context of models should continue to be encouraged.

Question 12

Candidates were usually able to make good progress on the first half of this question on solving trigonometric equations, but they tended to run into problems halfway through. It was rare for full marks to be scored, although most were able to score around half of the available marks.

In part (i), nearly all candidates were able to proceed to the correct quadratic in $\sin\theta$, although the occasional candidate tried to incorrectly substitute $\sin\theta = 1 - \cos\theta$ into the right-hand side of the equation. Most candidates were able to apply the quadratic formula and proceed to finding all three angles. Some found additional angles, which even if they are outside the range, prevent full marks from being scored. Most candidates seemed to opt for sketching trigonometric graphs to find the other angles as opposed to using the CAST diagram.

Part (ii)(a) was poorly answered, however. Most candidates failed to score either mark, although those who did were usually able to make some reference to cancelling out $\sin x$. Just stating that not all the angles had been found was insufficient explanation as to the errors made so candidates should be encouraged to provide greater detail if they are able to do so.

Part (ii)(b) was attempted by most candidates, with many able to equate to the correct angle, rearrange and proceed to the correct answer. There were a number who equated to several angles, but either did not make their final answer clear, or did not rearrange to find the required angle.

Question 13

This question testing exponential decay and the relationship with logarithmic graphs was poorly answered. Very few were able to score even half of the available marks and it was clear that many candidates still struggle with this topic.

In part (a) candidates found forming a correct relationship between the linear graph and the given exponential model too difficult. Many produced incorrect equations and poor working with logarithms followed, resulting in incorrect values for *p* and *q*.

As part (a) was not completed successfully in many cases, part (b) automatically was limited in its accessibility. Some candidates just made a comment, rather than use the model as they did not have values for *p* and *q*, or even those who did seemed unsure what they were finding.

Part (c) had a range of responses, but it was extremely rare for a mark to be scored and most failed to appreciate that the resting heart rate related to a mammal with a mass of 1 kg.

Question 14

This question was one of the most successful on the paper. It tested aspects such as completing the square, simple integration to find an area and finding a turning point which candidates seemed comfortable finding in nearly all cases.

Part (a) was typically correctly answered. Most opted to complete the square rather than equate coefficients and it was only the minority who made slips with the -3 coefficient for *a*. Where errors occurred, it was usually in multiplying out to get the coefficient for *c*, but they were still able to score 2 marks.

Part (b) required candidates to find the turning point. Whilst the intention was for candidates to use their part (a) answer, and follow through was allowed on this, it was much more common for candidates to differentiate the quadratic and find the turning point. Therefore, nearly all candidates score both marks on this part as most seemed more confident using calculus and proceeded to the correct answer anyway.

Part (c) was typically completed correctly. Candidates usually opted to integrate the curve and find the area between $x=0$ and $x=2$ and then subtracted this area from 40. Those candidates who tried to form a single integral to solve the problem were the ones were errors typically occurred. Some candidates equated the line $y=20$ to the curve and rearranged to one side and integrated this expression. This method can work, although some responses did not appear that the candidates were that sure as to why they had achieved a negative value for the integral if they collected terms on the wrong side. In addition, errors in collecting terms resulted in an incorrect integrated expression and, ultimately, an incorrect final answer.

Question 15

This question provided a good range of marks between the candidates, although nearly all candidates struggled to proceed to the final answer in part (c). There were also several blank responses on this question which may have been down to candidates either running out of time or just getting overwhelmed towards the end of a paper.

In part (a), candidates were usually able to find the equation of the line. The odd error in rearranging their equation of the line or incorrectly sub substituting in the coordinates for x and y were the few situations where full marks were not scored.

Part (b) was generally attempted well. Most knew and attempted to find the point where the two lines intersected each other and found the point P correctly. They were then able to find the radius and usually proceeded to find the equation of the circle. Sometimes the equation of the circle had the squared missing from the brackets or it was equated to the radius rather than r^2.

Part (c) was either not attempted at all or candidates made an attempted but abandoned due to the expressions formed appearing so complicated that it seemed as though they were convinced they had gone wrong. Usually, candidates opted to substitute their part (a) answer into their part (b) equation of the circle. To score the first mark candidates had to multiply out the brackets and collect terms together to form a 3TQ where k was in both the b and c coefficients of the quadratic. Some candidates stopped before getting this far, although it was pleasing that some continued to persevere and pick up the first mark. Those who continued, realised the discriminant needed to be used, but disappointingly once they had their expression also decided to stop even if they had a quadratic in k which they could solve. Therefore only 1 or no marks was scored in nearly all responses. The easiest way was the vector approach, which was seen, but far too frequently, and even then, it was only a few candidates who were able to score full marks on this question.

Question 16

The last question on the paper was attempted by most candidates, although there were a significant number of blank responses. Again, this was possibly either due to time, or more likely due to candidates just feeling overwhelmed as the question was the longest on the paper.

In part (a) candidates struggled with the information being presented in reverse order. As a result, candidates typically formed the equation in a and b but then got stuck as they could not see how they would find a. It was those who differentiated and equated to -3 who were able to fully complete part (a) correctly. It was noted that a large number did not seem to be that confident with turning points and derivatives and it may have been that this had not been covered which prevented candidates from doing this question particularly well.

Part (b) also demonstrated the lack of confidence with using calculus in relation to turning points. Quite often they were able to differentiate to get a quadratic in x, however they seemed unsure where to go from there and often just state that there were no solutions or that it would not factorise. It was typical for candidates to only score 1 mark in this part.

Part (c) was completed to a much higher degree of success with the majority able to find the quadratic Q. Most opted to carry out algebraic division, although errors were seen with the subtraction lines in their method which demonstrated a lack of confidence with their method. They then proceeded to have a remainder value, but still stated the quadratic they had found. Where their value for b was incorrect this was condoned.

Most candidates did not attempt part (d), whilst some were able to find that $x = 20$ they failed to state the coordinates so hardly any candidates scored any marks on this part.