Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

January 2020

Pearson Edexcel International GCSE

Further Pure Mathematics (4PM1)

Paper 1R

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Paper 01R
Introduction

Further Pure Mathematics
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The overall response to the paper was good. Low total scores were usually an accumulation of fragments from a range of questions, rather than an inability to access anything on the more difficult topics. At the other extreme, there were some impressive scripts that showed a deep understanding of the theory involved, often using sophisticated mathematical language to communicate concise answers clearly. Most students followed the rubric and attempted to show sufficient working to justify their answers but the quality of notation and detail varied considerably. Some students misunderstand the instruction 'show'. Show questions require **every** step to be seen, so that examiners can be assured that what was required to be proved has indeed been proved.

Report on Individual Questions

Question 1

It was clear that students knew the method to rationalise such a surd and so this question was answered completely correctly by the majority of students. Some students incorrectly multiplied numerator and denominator by $\left(2-\sqrt{3}\right)$. The students that took the alternative approach usually did so with success, forming two linear equations and solving simultaneously to achieve $a=4$ and $b=6$.

Question 2

Overall, the majority of students did this question successfully and got full marks with a few exceptions.

In part (a), some lost 1 mark as they wrote $11-\left(x+2\right)^2$ instead of $11-\left(x-2\right)^2$

In part (b), some students used differentiation to find maximum value and even students that in part (a) didn't get full marks, often got both marks in this part. Students should be encouraged to clearly label question parts so that there is no ambiguity as to their answers to each part.

Question 3

In part (a), most students recognised that they needed to differentiate using the product rule and in most cases were generally successful. The most common error was to have $e^{2x}(x^2+1)$ instead of $2e^{2x}(x^2+1)$

In part (b), most students understood the process for finding the equation of a straight line and were able to use the derivative in (a) to find a gradient of the tangent. As the required form for the line was $y=mx+c$ the vast majority of students gave a correct answer.

Question 4

In part (a), most students recognised they needed to differentiate and then use the given information to set up two linear equations in a and b. The majority went on to solve these correctly to obtain a fully correct solution. A few students made arithmetic errors when solving the simultaneous equations and therefore ended up with incorrect values for a and b. The most common error was to set $f(2) = 5$ rather than $f(2) = 0$

In part (b), the majority of students were able to divide $f(x)$ by $x - 2$ to obtain a 3 term quadratic, factorise and get all three terms correct. Even students that had incorrect values of a and b were able to score 2 marks. A few students lost mark here as they failed to answer the question 'Express $f(x)$ as a product of linear factors' and used their calculator to give the answer to part (c)

In part (c) the majority of students gave correct answers. The follow through allowed for students who had previously lost marks to gain full marks here.

Question 5

In part (a), a variety of methods were seen, often scoring both marks. However as this was a 'show that' question some students lost marks as show questions require **every** step to be seen.

In part (b), many different approaches to the solution of this problem were offered, some succinct and elegant others rather more convoluted, but this question was a good source of marks for most students as eventually most students could be seen to use the required laws of logarithms in some part of their solution. The more able students who had a good grasp of the rules of logarithms and that were well prepared usually manipulated the logarithms correctly and generally reached the correct three term quadratic, and then most went on to find the exact solutions of the equation. Less able students found this question challenging and failed to deal with the $\frac{1}{4}\log_x 16$ term and such made little progress in answering this question. Basic algebraic errors also let some students down

Question 6

Part (a) of this question was answered well by the vast majority of students. The majority successfully found the required values for the table but a small minority made arithmetic errors and some failed to give their answers to the accuracy specified in the question.

In part (b), the plotting of the points was generally accurate. Only occasionally, the points were plotted incorrectly but the curve was generally accurate and smooth.

In part (c), only the less able students were unable to obtain the required line $y = 3x - 6$. Most students who successfully deduced the correct line went on to easily find the required value of x, but a significant number gave a value that was 'too accurate' (the question specified one decimal place) - perhaps suggesting they had found the value on their graphic calculators, and thus lost the final A mark unless the correct rounded value was seen.

Question 7

In part (a)(i), many students were awarded both marks. However, like Q5, as this was a 'show that' question some students lost marks as show questions require **every** step to be seen.

In part (a)(ii), students were able to use the given answer to correctly find the value of a and many scored both marks.

In part (b), again students were able to use the given answer to correctly find the value of *x* and many scored both marks.

Part (c) of this question was not done as well as the previous parts of this question and many students found this part a challenge, possibly due to lack of familiarity with the notation. The less confident students seemed to struggle to know how to approach this type of problem. Some students used the formulae for a GP. The first 2 marks were accessible to the majority of students but only the more able students were able to use $\frac{n}{2}\left(2a+(n-1)d\right)$ correctly when dealing with S_{n+1}

Question 8

This question proved challenging for many students. Most knew that differentiation was needed at some point and a score of 1 only was not unusual for the weaker students. Some students knew integration was required and went on to correctly find $s = 5 + 3t + \frac{5t^2}{2} - \frac{2t^3}{3}$ but then failed to realise that they needed to solve $3 + 5t - 2t^2 = 0$ to obtain a value of *t* to substitute into *s*. Others realised that they needed to solve $3 + 5t - 2t^2 = 0$ to obtain a value of *t* but did not have the required equation to find the maximum value. Only the well prepared students were able to do both. Once obtaining a correct answer some students then failed to show that it was a maximum, some forgot to do this part, whilst others found an incorrect expression for the 2nd derivative.

Question 9

In part (a), the majority of students scored both marks as it was straight forward and they knew how to find the values of *a* and *b*.

In part (b), the majority of students scored the first 2 marks as they could state the gradient of l_1 and therefore the gradient of l_2. Many then were able to either use the gradient of the perpendicular to obtain an equation or used $PR = 6\sqrt{5}$ to obtain an equation. Only the better students were able to find both equations. Once both equations were found many of these students could go onto solve simultaneously to find the possible value of *e* and *f*. A few students mixed up their pairings or wrote coordinates in the form (*f*, *e*).

For those students that struggled with part (b) it appeared that they gave up and left out parts (c) and (d)

Only the better students scored marks in part (c). Some scored 1 mark for using Pythagoras' to find PQ . A few used $\text{Area} = \frac{1}{2}\begin{vmatrix} a & c & e & a \\ b & d & f & b \end{vmatrix}$ but a few students omitted the $\frac{1}{2}$. Some students failed to realise that $e < 0$ and used the incorrect value of (e, f)

Part (e) was only answered correctly by the best students. Often this was left blank or an incorrect method for finding the coordinates of *c* were given. Many failed to realise that *RQ* was the diameter and even those that did failed to realise that $e < 0$ and used the incorrect value of (e, f)

Question 10

In part (a), most students were able to get full marks here. Only a small minority of students made mistakes in the addition of the direction vectors.

In part (b), students generally knew what was required here and were successful in obtaining a relationship between the vectors $\overrightarrow{AB}$ and $\overrightarrow{OC}$ using vector addition or subtraction. Many students were able to state the conclusion as a relationship between two vectors.

Part (c) divided students into those that knew how to use a vector method to find the ratio and those that did not. Of those that did know how to use a vector method a variety of correct methods were used with most succeeding in getting a fully correct final answer. Those that did not know how to use a vector method were limited to scoring the first B1 for $\overrightarrow{AC} = 5\mathbf{b}$. Generally these students failed to proceed any further as they failed to write any further vector which included an unknown multiple of a vector.

Question 11

Part (a) was answered well by the majority of students and sufficient working was usually seen to show that $b^2 = a - 2$

In part (b) many students made the connection between part (a) the solution to this question. Those that did usually were able to score well in this question. Students seemed well prepared to find a volume when rotated around the x-axis and even though this question was asked in reverse many students scored full marks. For those students that failed to make the connection between this question and part (a) this proved to be a difficult question and many were unable to score more than 2 marks. There were many attempts to combine the two functions into one integration, but many left their answer in terms of b^2 , with many students then not knowing how to proceed any further. A few tried to substitute for b^2 later in their solution but was then spoilt by poor algebra leading to incorrect answers.

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