Examiners' Report
Principal Examiner Feedback

November 2020

Pearson Edexcel International GCSE
In Further Pure Mathematics (4PM1)
Paper 02R

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International GCSE Furth Pure Mathematics – 4PM1
Principal Examiner Feedback – 4PM1 02R

Report on Individual Questions

Question 1

Many students handled this question efficiently, with many gaining full mark. Most were able to set up two equations correctly and eliminate to find r and d. Some students mixed up arithmetic and geometric series and therefore gave incorrect equations for the nth term of these series. A few used the formula for the sum of an arithmetic and geometric series rather than the nth term and so were unable to find r and/or d.

Question 2

Part (a)
There were many complete correct answers given here with many students knowing how to apply the remainder theorem correctly. Many were able to set up and solve the two equations to find correct values of p and q

Part (b)
Virtually all students correctly substituted 3 into $\mathrm{f}(x)$ and showed the given result.

Part (c)
Many students were able to express $\mathrm{f}(x)$ as the product of linear factors using the fact that $(x-3)$ was a factor. Even though $(x-3)$ was implied by part (b) a few students found that $(x+1)$ or $(x+2)$ was a factor, so divided by these usually ending up with the correct product of linear factors. A small number of students divided by $(x-3)$ and left their answer as $(x-3)(x^2+3x+2)$ not realising that the quadratic needed to be factorised as well. A small number made arithmetic errors when factorising the quadratic

Part (d)
Virtually all students were able to find the values of the three roots.

Question 3

Part (a)
Generally this was split into camps, those that knew what to do in the question and those that did not. For those that did many students applied the cosine rule correctly to find $\cos(\angle B)$. Many went on to use this again to show that $x = 11$. A few students however lost the final A mark as their solution used rounded values and gave an answer which rounded to 11.

For those that did not they often used the fact that $x = 11$ to find angles BAD or BDA and then used the sine rule to show that $x = 11$. It is worth pointing out to students that using a result you are trying to prove, to prove the result will inevitably fail to score many marks. This was part was often left blank by the less able students.

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Part (b)
This part was done well by many students. Even those that had struggled with part (a) was able to use $\frac{1}{2}ab\sin C$ correctly for any angle in the triangle *ADB*. A few students however did lose the final A mark as they failed to read the question carefully. The question asked for 3 significant figures and an exact answer of $\frac{45\sqrt{7}}{4}$ or any other answer that was not 3 significant figures lost this A mark.

Question 4

Part (a)
This part of the question was answered well by virtually every student. A small minority lost a mark for incorrect rounding the y value of 7.22 incorrectly (the question explicitly stated two decimal places where appropriate)

Part (b)
The plotting of the points was generally accurate. A number of students attempted to join the points with straight line segments, whereas a smooth curve was required. For those few students who had made errors in calculating the y coordinate or in plotting their points, the resultant very irregular curve should have been an indication to check their work in part (a).

Part (c)
The less able students left this part out. For those that did the question many were able to identify that $8\ \ 2x+1+\frac{2}{x^2}=8$ was required. Many of these were able to give both $x = 0.6$ and $x = 3.4$. However some students lost this mark as they only gave an answer of $x = 0.6$, failing to read the question carefully as it asked for the roots in the interval $0.5 \leqslant x \leqslant 3.5$. A significant number gave a value that was 'too accurate' (the question specified one decimal place)

Part (d)
This part of the question caused problems for many students. Many were unable to rearrange into the correct form. Most students who successfully deduced the correct line went on to easily find the required values 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 marks.

Because the question clearly states ‘By drawing a suitable straight line on your graph’ the correct roots in the given range without the correct straight line drawn received no marks at all in this part.

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Question 5

This question had a wide spectrum of responses from efficient and compact correct solutions to much work worth little (or no) credit. The lack of scaffolding to this question caused some students problems as they had no idea where to start. Some students decided to change to degrees and in those cases students were less successful in answering the question. The only mark that less able students seemed to access was for finding the area of the sector using $\frac{1}{2}r^2\theta$

Other errors included incorrect formulae, most often $r^2\theta$. Those students who were successful usually took a logical approach by finding the area of the quadrilateral $OBAC$ – area of the sector = 10. A few then made errors in their rearrangement of the equation to solve for r. Some students approached the question by finding the area of triangle ABC – area of the segment and only the more able students were able to go on and find that $r = 3.82$

Question 6

Part (a)
This was done well by the vast majority of students and many gave correct coordinates of A and B. Some students lost marks as they solved the quadratic correctly ($x = 1$ and $x = 4$) but failed to write coordinates for A and B.

Part (b)
Many students took the approach of finding the equation of both tangents and then equated to find the coordinates of T. Those that took this approach were usually successful and gained full marks. A few however lost marks through arithmetic errors in their algebra. Less able students often scored a mark as they realised that they needed to differentiate $y = x^2 - 5x + 4$ but a common error for these students was to then say the gradient was $\frac{5}{2}$ which was the x coordinate of the turning point. For these students very few marks were then available throughout this question.

Part (c)
For those students took the approach of finding the equation of both tangents and then equated to find the coordinates of T, they usually approached this part in a similar fashion. They found the equation of both normals and then equated to find the coordinates of N. Again those students that took this approach usually scored full marks. Less able students at this point seemed to give up and did not attempt this part of the question.

Part (d)
A variety methods was seen in this part of the question. The most successful method was by finding the area of the two triangles ANB and ATB and adding. Other methods usually resulted in an error somewhere e.g the "determinant" method was often see with only four columns instead of five. Less able students did not attempt this part of the question.

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Question 7

Part (a)
Most students were able to use the discriminant to form an inequality. A common error was to use $c = 2k$ rather than $2k - 7$ as they had not realised that the given quadratic was = 7 and not 0. Once the inequality was formed students were able to solve the 3 term quadratic and many gave a correct final answer.

Part (b)
This part of the question proved problematic for some students and full marks were only achieved by the most able. Again like part (a) a common error was to use $c = 2k$ rather than $2k - 7$ and this meant that very few marks were available after this. Many students were able to find expressions for the sum and product of the given roots in a form that allowed them to use their values for $\alpha + \beta$ and $\alpha\beta$. Where marks were lost, this usually resulted from careless slips in the algebraic manipulation needed. For those that had correct expressions many substituted the values of $\alpha + \beta$ and $\alpha\beta$ but a significant number of students made errors in their simplification of these expressions. Even those students that obtained correct expression, many lost the final A mark as they missed the final line of wording of the question "Give each coefficient in terms of k" and left their final answer as $x^2 - \frac{2(2k-5)}{2k-7}x + \frac{3(k-1)}{2k-7}$

Question 8

It is very pleasing to report how well this question was answered throughout with many students scoring full marks. It is clear that knowledge of logarithms is well established for those students who are entered for this paper.

A common error for some students was to say that $\log_3 x = -1$ was not valid and so they rejected this and lost the final A mark.

Question 9

This question proved to be a nonstarter for the less able students. For those that attempted it, most students were able to construct a correct chain rule expression for $\frac{\mathrm{d}x}{\mathrm{d}t}$. It is worth noting that virtually all candidates went on to use the chain rule again when differentiating $2\mathrm{e}^{-t}\cos 2t - \mathrm{e}^{-t}\sin 2t$ rather than simplifying the expression to $2\mathrm{e}^{-t}\cos 2t - x$ which would have been considerably quicker. However those students that took this approach were usually successful in obtaining a correct expression for $\frac{\mathrm{d}^2x}{\mathrm{d}t^2}$. Very few students then took the approach shown in the mark scheme but instead proceeded to substitute their $\frac{\mathrm{d}^2x}{\mathrm{d}t^2}$, $\frac{\mathrm{d}x}{\mathrm{d}t}$ and x into $\frac{\mathrm{d}^2x}{\mathrm{d}t^2} + 2\frac{\mathrm{d}x}{\mathrm{d}t} + 5x$ and showed that the terms cancelled to give 0. In some cases this resulted in arithmetic errors and the final A mark was withheld.

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Question 10

Part (a)
Virtually all students correctly substituted 3 into f(x) and showed the given result.

Part (b)
Many students were able to solve the equation using an algebraic method as stated in the question and scored all 4 marks. A few however made arithmetic errors when dividing by $(x-1)$ and the common incorrect quadratic resulted in $32x^2+32x+1$. Students need to realise that when the question says "using an algebraic method" just stating the values of x from a calculator will not score any marks. Too many simply wrote $x=1$, $x=\frac{-4\pm3\sqrt{2}}{8}$ or equivalent with no indication of how they arrived at this and so were not awarded any marks.

Part (c)
Virtually all students that attempted this part were able to score M1 for equating the two given equations and many went on to solve this correctly. A common error was to solve this to give $p=\frac{1}{8}$. This obviously affected the number of marks available in part (d).

Part (d)
Students found this part of the question a challenge and very few were able to score full marks here. There were a number of students that did not attempt this part of the question. For those that were successful in this question they usually took the approach shown in the mark scheme. Common errors included not using y^2, forgetting that π was required, use of incorrect limits and squaring the difference rather than subtracting the squares. Many valid attempts were often followed by algebraic and numerical slips and therefore resulted in marks being lost.

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