Examiners' Report
Principal Examiner Feedback

January 2020

Pearson Edexcel International GCSE
Further Pure Mathematics (4PM1)
Paper 2R

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Paper 02R

Introduction

Further Pure Mathematics

Principal Examiner's Report

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

This was a straight forward introduction to the paper with many students scoring full marks. Those who lost marks usually muddled the use of π in their formulae or converted to degrees incorrectly.

Question 2

This question was accessible to most students with many scoring some marks in each part of this question.
The common error in part (a) was to give two correct equations but neither in the form as asked for in the question and so the final A mark was withheld.
Many students were able to follow through their answers in part (a) to give correct inequalities. A few mixed up which way round the inequality should be. The most common error was to give an answer of $y \geq 0$ rather than $x \geq 0$

Question 3

The majority of students were able to score full marks on this question as they realised that to find two possible lengths of AC required first finding two angles. Students that did not score full marks usually only found one angle and therefore only one length of AC was found.

Question 4

Part (a) was answered well by the majority of students and sufficient working was usually seen to show that $h = 9$
Part (b) was answered well with many students scoring full marks. When errors were made it was usually when applying $BX = \sqrt{145}$ into the cosine rule, usually the numerator was correct but the denominator was written as $2 \times 145 \times 145$

Part (c) was not answered as well as the previous parts. Those students that knew that they had to bisect *BC* to make a right angled triangle often scored full marks from a variety of methods. For those that did not the common error was to calculate angle *ABX*.

Question 5

This question was answered well by the vast majority of students.
In part (a), sufficient working was usually seen to award both marks.
Part (b) was answered well and the majority of students used the result given to obtain a correct answer and so scored full marks. Occasionally arithmetic errors caused students to lose marks.
In part (c), sufficient working was usually seen to award both marks.
Part (d) was generally answered well by many students and many scored full marks. Errors usually occurred when finding the product of the roots and a few students failed to use the given information to help them answer this question. Many students knew that they had to use $x^2 - \text{sum}x + \text{product} = 0$ and so the M mark was often awarded. Only a few students failed to set their answer as an equation = 0

Question 6

This question caused some students difficulty.
In part (a) whilst many correct solutions were seen too many students were unable to show sufficient correct marking for these marks to be awarded. Some students started with $V = \frac{1}{3}\pi r^2 h$ and then stated that $r = \frac{1}{\sqrt{3}}h$ without working and substituted into *V* and so scored 0 marks.
In part (b) whilst many correct solution were seen the notation used was varied. Some students could find $\frac{\mathrm{d}V}{\mathrm{d}h}$ but then failed to use the chain rule. As we allowed the use of ± 0.9 leading to an answer of ± 0.597 many students scored full marks.

Question 7

Many good solutions were seen to this question, with many students scoring full marks in multiple parts of the question.
In part (a), many students were able to show sufficient working to score full marks. Both methods as shown in the mark scheme were equally seen. For those that did not score any marks then they usually failed to use $\frac{ar^6}{ar^3} = r^3$
In part (b), many students were able to score full marks. Both methods as shown in the mark scheme were equally seen. For those students that did not score full marks they usually scored the first M1 for $a = \frac{e^{x+2}}{e^{-\frac{3}{2}}}$
In part (c), many students were able to score full marks and all methods shown in the mark scheme were seen. Those students that did not score full marks often scored M1 for use of S_∞. A common incorrect answer was $p = x + \frac{7}{2}$
In part (d), many students were able to score full marks and both methods as shown in the mark scheme were seen. Those that failed to score full marks usually scored at least three marks and usually the final answer mark was withheld for an answer of 5 or 5.47

Question 8

Parts (a) and (b) were answered well by many students but part (c) caused more issues than previous parts.
In part (a), virtually all students were able to score this mark as they stated $k = 2$
In part (b), many students scored full marks. For those that did not the common error was to substitute $k = 2$ and proceed no further. Those that used the alternative version in the mark scheme were usually more successful in scoring 2 marks.
In part (c), most students were able to score at least 3 or 4 marks. Usually students were able to score marks for $\sin 2\theta = \frac{1}{2}$ and then $\theta = 0.262, 1.31$ or their equivalence. Some scored an extra mark for $\tan 2\theta = 3$. Those that did not score full marks usually quoted that $\tan 2\theta = 3$ could not be solved and proceeded no further.

Question 9

In part (a), better students quickly found correct values for p and for q but others struggled with this part of the question. It was common to see $p = 2$ as well as mistakes such as $q = -\frac{1}{2}$
In part (b), the binomial expansion was applied well to gain the method mark in part (b) and the simplification of coefficients was done carefully. Those who started with the correct expression frequently scored both accurate marks and those that used $p = 2$ and $q = \frac{1}{2}$. Often gained the first A1 mark.
In part (c), many students scored 2 out of 3 marks. Even when they used the incorrect values of p and q they ended up with $a = 3$.
In part (d), students generally gained a correct answer from correct working and scored full marks However if $p = 2,\ q = \frac{1}{2}$ was used then $a = \frac{3}{16}$ and $b = -\frac{13}{8}$ which substituted into $3a + 3b$ gave an answer of $-\frac{69}{16}$ but scores A0

Question 10

The first two marks in part (a) were generally scored by the majority of students – good integration including a constant was seen. Many students then correctly substituted the given points and formed two equations in c and p and then solved simultaneously to achieve the given answer. A small minority of students made slight errors which were then later corrected and so lost the final A mark.
In part (b), those students who equated the curve and the line to find that $x = 0$ and $x = 2$ generally went onto score full marks. Some students missed this and invented values for the limits usually using –1 and 2 which were the x coordinates of the two points given in the question. The majority integrated correctly the difference of the two functions. A few students lost the final mark due to numerical errors when substituting in the limits.

Question 11

In part (a), many students were able to write correct equations of the asymptotes to C. The common error was to mix up which asymptote was parallel to which axis. Students should be encouraged to mark sure they clearly label which part of the question they are attempting to avoid any ambiguity.

In part (b), the majority of students were able to find the coordinates of the points where *C* crossed the coordinate axes. Any errors usually resulted from poor algebra e.g. $3x - 2 = 0 \Rightarrow x = \frac{3}{2}$

In part (c), many students were able to sketch the required curve and it was pleasing to see that many students followed the instruction ‘showing clearly the asymptotes and the coordinates of the points where *C* crosses the coordinate axes. A few students lost the first B mark as their sketch had only one curve rather than two. The curve they drew usually was the one that crossed the coordinate axes and so the 3rd B mark could be awarded.

Part (d) of the question caused students more problems and only the better students scored full marks. Many students scored the first mark as they equated the curve and the line. Some students simply stopped at this point. For those that continued their attempt was often spoilt by numerical errors in their work. Some students failed to realise that as there were no intersection between the line and the curve that $b^2 - 4ac < 0$ was required to from a three term quadratic and so progressed no further. Students should be encouraged to show their method when solving quadratics as often answers from the calculator appeared. The question stated ‘show algebraically’ and such the method for solving the quadratic was expected.

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