Examiners' Report/
Principal Examiner Feedback

Summer 2015

Pearson Edexcel International GCSE
Further Pure Mathematics (4PM0)
Paper 02

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Summer 2015
Publications Code UG041560

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Question 1

This question appears to have caught a great many candidates out. While there were many correct answers to part (a), mostly using $\frac{n}{2}\left(2a+\left(n-1\right)d\right)$, part (b) confused large numbers of candidates. Finding the sum of the multiples of 7 less than 100 was beyond the vast majority. For those who could identify these, failing to follow the instruction 'hence' for one of the summations required in part (b), either for the sum of the 100 integers or the multiples of 7, meant scoring zero even though their calculation using other approaches gave them the correct numerical answer. A popular misconception was to realise there are 14 multiples of 7 lower than 100, subtract 14 from 100 to give 86 and therefore find the sum of the first 86 integers.

It was surprising as well, how many candidates just could not attempt this question at all.

Question 2

Most candidates completed the table correctly, with few errors seen. Common errors when plotting and drawing the graph included plotting (1.25, 5.90) instead of (1.25, 5.09), but not drawing the graph through it. There were few cases where a ruler had been used for part of the curve but most candidates had been able to draw a smooth curve.

Many candidates omitted part (c), either with or without some failed attempts at rearranging. For those who had been able to draw the correct line several failed to give their answers to the required number of decimal places.

Question 3
Given that candidates were not provided with any of the formulae required for this question, it was very well answered with many candidates achieving 6 or 7 marks.
Part (a) was generally done well with candidates forming an acceptable equation linking the third, fourth and fifth terms. However, there were several who had their difference the wrong way round and then found it impossible to progress to the required result. Some candidates realised their error and started again or just changed signs in their working to obtain the correct quadratic. Those who arrived at a quadratic usually attempted to factorise it although the quadratic formula was sometimes used.

Correct quadratics usually produced the correct solutions of $r = -1$ and $r = \frac{1}{2}$ and the majority of candidates who reached this stage successfully rejected the $r = -1$ solution although it was sometimes difficult to discern whether they were using the fact that the geometric series was convergent with positive terms or whether they just knew they needed to end up with $r = \frac{1}{2}$.
Part (b) was very well done with almost all candidates able to recall and use the correct formula. There were a few examples of $\frac{a}{r-1}$ and also some unfortunate slips from otherwise correct working leading to *a* = 800 which usually also had an effect on the answer to part(c).
Part (c) was also well done and the majority of candidates understood what was required of them. A correct formula was usually used although there were some cases where the power appeared outside the brackets or slipped outside upon substitution. A correct formula again usually lead to full marks although some candidates were hampered by an incorrect value of *a*. The majority attempted to use a formula which required substitution of their value of *a* rather than using $400\left(1-\left(\tfrac{1}{2}\right)^{10}\right)$. Only a handful of candidates who used a correct formula with correct values then went on lose the final A mark and this was presumably down to incorrect calculator work although a couple did round incorrectly to 400 and 399.61. The correct final answer was usually given to 6 decimal places and only a few used fractions.

Question 4
Part (a) was generally well done, with the most common error being addition of the vectors instead of subtracting. The concept of a unit vector in part (b) did not appear to be well understood by about half of the candidates, and it was a case of either the candidates knew how to answer part (c) or they didn't have a clue. The method of gradients was the most popular approach among those who could answer this, although there were a number of wrong attempts using *x/y* instead of *y/x*, and 'inverse ratios' of the vector coefficients. There were very few wrong attempts by the minority who used Pythagoras, while those few responses that used the scalar product were almost always correct.

Question 5

This seemed to be a very accessible question and most candidates understood what was required and how to proceed in each part. It was common to see full marks being awarded and even more common to award 9/10 due to the answer in part (b) being left as -1 m/s.

Apart from the few candidates who felt they needed to differentiate straight away, part(a) was very well answered with the factor of t being successfully dealt with either by factorisation or division and the resulting quadratic usually also correctly factorised or solved to produce the two required values of t. Several candidates also produced $t = 0$ which was ignored although it sometimes also reappeared in their working for part (c).

The answers to part (b) demonstrated that the majority of students were familiar with this type of question and that finding a speed or velocity would require differentiation of the expression for s. However, there were also some very poor attempts based on using speed = distance / time. The differentiation was usually correct with the only errors being slips of the sign or miscopying from a previous line. Some candidates were able to recover from an incorrect attempt at part (a) and re-use their differentiated expression in (b). A minority of candidates automatically set their derivative to equal 0 and solved the resulting equation and the same thing sometimes occurred in part (c). Almost every other candidate attempted to substitute $t = 1$ into something and this was usually a correctly differentiated expression which usually produced an answer of -1 m/s. Unfortunately, many candidates stopped there and failed to reach a speed of 1 m/s.

Part (c) seemed the most accessible and the majority of candidates scored at least 2/3. Some candidates used $t = 0$ to get $a = 10$ which was ignored. Some attempts at part (c) suggested a lack of understanding of 'magnitude' in this context as answers of $a = 2$ and $a = 8$ followed by a Pythagoras statement and the square root of 68 were seen. This may also have been a consequence of the two correct answers already being positive and candidates feeling that they still had something left to do. The equation $a = 6t – 10$ leading to the square root of 136 was also seen.

Question 6

In part (a), most candidates were successful in achieving the given expression for the area of the shaded region by using correct formulae for the area of the sector, although candidates using degrees and the conversion formula to radians often included an extraneous π in their answer.

In part (b), some candidates lost their marks by not showing the evidence of differentiation or the chain rule. In part (c), almost all candidates realised they had to calculate a value for the angle theta and most candidates were aware of the method for finding the perimeter of the shaded region. A common mistake was subtracting the perimeter of sector *ODC* from the perimeter of sector *OAB*.

Question 7

Many candidates were able to prove h = 4 in part (a) though some did not know the formula for volume of pyramid and used 1/2 instead of 1/3 times base area times height. In part (b) most candidates managed to find *AC* or *FH*; the most common error was an incorrect height as a few candidates thought h = 4 was the height for the whole solid. In part (c) most candidates found the expression for the tangent of the required angle but some candidates found $\cos A = \frac{5}{\sqrt{41}}$ and then also correctly reached A = 38.7^{o}. Part (d) proved most challenging; a significant number of candidates did not find the correct angle. Some thought *VBH* was the required angle. Some candidates found one of the angles shown in the mark scheme, but did not round it as required. Many used the cosine rule and some of these made errors when calculating the lengths needed for substitution in the rule.

Question 8

A tricky question but again candidates who knew how to approach this problem generally got it almost completely correct. Part (a) caused more difficulty than might have been expected, as many candidates thought 'it's obvious' but weren't sure how to put this into writing. There were numerous cases of candidates substituting x = 2 and x = 4 and arriving at two equations with three unknowns. In part (b) setting up and solving the simultaneous equations was mostly handled accurately and was by far the most popular approach, but with either of these values incorrect the remainder of the question became a real challenge with part (c) almost impossible to demonstrate in this situation, although most candidates managed to gain some marks through correctly differentiating and/or attempting the gradient of the line or equation of the tangent.
If candidates reached part (d) they mostly knew how to perform the integration accurately, with most success coming from subtracting the line from the curve. Those who separated the areas frequently made errors with the limits, while correct answers using this method took considerably longer to obtain.

Question 9

It was pleasing to see a large number of fully correct attempts at this question, especially given the number of marks on offer.

Part (a) was very accessible and many candidates used a correct approach to get the correct midpoint coordinates. A typical error was to subtract the coordinates in the formula and this proved to be very expensive as it meant the candidate lost further marks throughout the rest of the question.

Part (b) was the most accessible part with few errors which were usually the result of miscopying values or using the coordinates of *M*.

Answers to part (c) demonstrated that working with the gradients and equations of straight lines was well understood and most candidates made a reasonable attempt. In terms of errors, some candidates failed to change the sign when taking the reciprocal of the gradient of *AB* whereas others failed to change the gradient at all or tried to substitute the wrong coordinates. A few candidates with otherwise correct working, lost the final A mark by failing to rewrite their equation in the required form. Fortunately, these candidates were still able to score full marks for parts (d), (e) and (f) and they quite often did.

Part (d) was well done with the majority earning at the least the M mark and a correct equation in any form from part (c) usually meant the correct value of d was found. Although candidates were sometimes using an incorrect equation, fully correct working was usually seen. Errors were usually careless sign slips although a few candidates attempted to use $x = 2$ instead of $y = 2$.

In part (e), several candidates produced some sort of diagram which seems to have been very helpful. They then simply counted across and up or used vectors and the given ratio. Both of these approaches usually obtained the correct coordinates for *E*. Other lengthy approaches included using the equation of *DM*, Pythagoras and simultaneous equations although these were all far less successful and it was sometimes difficult to ascertain exactly what the candidate was attempting to do. Some candidates ended up with coordinates of (0, -2) as they did not realise that *E* was on the other side of *M* to *D*. Unfortunately, any previous error usually meant 0/2 for part (e) although it was still sometimes possible to obtain one correct coordinate.

As with part (e), a diagram seemed very helpful in part (f) although, due to earlier errors, some diagrams did not represent kites and therefore made the situation worse. If candidates had full marks up to this point, they usually scored 4/4 here although there were some careless slips with coordinates or when substituting into a formula. Many candidates were aware of the formula for the area of a kite or used the equivalent of finding the area of two triangles. As with previous series, the 'determinant' method for calculating the area of a polygon was often used and, in most cases, it was used correctly. There were also examples of more lengthy methods such as 'boxing in' the kite and subtracting the required areas. Significant earlier problems meant many attempts were abandoned part-way through.

Question 10

Parts (a) and (b) gave the majority of candidates little problem, although incorrect division in part (b) led to $k = 2$ far too often. The answer to part (c) was given, which led to all sorts of dubious routes to reach the “correct” answer. Very few used the method or order as shown on the scheme – the most popular first step was to take the coefficients into the logs as powers. Signs were often confused with minus signs coming and going. Some recognised the connection between this and part (b) when changing base but the majority started again. There were many missing brackets and in general the presentation was poor. Very few candidates obtained both answers in part (d) with $x = 4$ being the most common single answer.

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