Examiners' Report/
Principal Examiner Feedback

Summer 2015

Pearson Edexcel International GCSE
Further Pure Mathematics (4PM0)
Paper 01

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This year there have been fewer incidents of candidates using degrees rather than radians for their working in a question where radians are more appropriate. Although it is usually possible to do this and obtain correct answers considerably more work is needed doing the conversions twice and if decimal approximations are used instead of keeping π accuracy and often marks are lost.

Candidates should be encouraged to write down the general formula they intend to use before substituting their numbers. Sometimes this allows examiners to award a method mark even if a mistake is made on substitution; without the formula being seen, an incorrect substitution implies an incorrect formula. Examiners cannot read candidates' minds, they can only award marks on the basis of what has been written down.

In "show" questions candidates must be very careful to include every step in their working. In paper 2 question 10 (c) many candidates wrote down the result they were aiming for without covering every step. When the answer is not given the work may be acceptable but to reach a given result in this way will lose marks.

Question 1

This question proved be a difficult beginning for quite a few candidates, as many did not know the correct formula for the volume of revolution, and as the second method mark was dependent on the first, a significant majority of the entry achieved only the first mark for finding $x = (\pm)\frac{3}{2}$. Even when candidates knew the formula, many put in the lower limit as $-\frac{3}{2}$ leading to an incorrect answer. In this question, a simple sketch of a correctly placed curve of the quadratic, with the correct area to be rotated shaded (given clearly in the question), would have been of great use in identifying the required region.

Question 2

Part (a) was answered very well with all but a small minority unable to achieve the three marks available here. Virtually every candidate knew the formula for product rule and could apply it correctly.

There were two ways of answering part (b); either by working from the differentiated expression multiplied by *x* and then factorising, or starting from the given result and equating it to their differentiated part(a) showing that RHS = LHS. There were many responses earning full marks in this question.

Question 3

The majority of candidates opted to complete the square in part (a) of the question. The coefficient of x^2 caused quite a few problems. Virtually all who attempted this method knew they had to take out 4 as a common factor, but many then forgot to account for it at the end losing both accuracy marks and only gaining the M mark for a minimally acceptable response. Those who opted to compare coefficients were largely more successful, usually gaining full marks using this method.

The stronger candidates were able to interpret the work in (a) correctly and merely write the answers for part (b) straight down. The most common approach was to differentiate the given f(x), set it to zero and find the value of x at the minimum and then to substitute back to find the minimum value of f(x). This did have the advantage that the values were correct despite an incorrect (a), although full credit was given for followed through answers.

Question 4

In part (a) almost every candidate achieved 18 for the first term.

In part (b), the most common answer given was d = 14, which earned no marks, as although it is the second term of the series, the method was incomplete and therefore no marks could be awarded. It always helps to actually write out the first and second terms one after another; the value of the common difference is then obvious.

Part (c) was also answered well, with most candidates using the given expression for the sum correctly. Some use the summation formula, although as they had not achieved a correct d no credit could be given as they had a given expression. The next mark was a very easy to earn as it was for multiplying the bracket out to achieve a 3 term quadratic. Many candidates used the formula correctly to achieve both roots of 12.07 and −2.07, leading to a value of n = 12. It needs to be mentioned that those candidates who took short cuts, showed minimal or no working, and did not write down the formula with their values from the quadratic in full, did not score marks if they did not achieve the correct answer. Examiners must be convinced that a correct method is being used to award a method mark.

Question 5

There were a good number of completely successful solutions here. As is frequently the case with this topic, students either know how to answer the question or they do not.

Virtually every candidate multiplied out the expression correctly in part (a).

Those candidates who realised that part (a) leads into part (b) were able to find the value of $\alpha^3+\beta^3$ easily and quickly. Some found the value of $\alpha^2+\beta^2\,(=16)$ at the start, which proved to be a useful shortcut for the rest of the question. Some started again expanding $(\alpha+\beta)^3$ from scratch, but as the algebra is relatively straightforward, many achieved the correct answer.

Some candidates baulked at part (c) of the question as it could not be derived from the given expression. Some attempted to complete this part using simultaneous equations which was fine, except they needed to use the information that $\alpha > \beta$, and if they did not and guessed at whether either was positive or negative, (most commonly leaving ± in their roots) then the method was incomplete and so could not earn the single M mark available here.

Part(d) needed the given expression and the answer from (c) (also given). However, candidates who were successful thus far in the question also managed this part without a problem.

Question 6

Considering this is a standard GCSE question, most responses should have been fully correct.

Candidates needed to use the cosine rule in part (a) and virtually every response implemented this fully and correctly. At least half of the candidates did not read the question carefully which stated that answers should be given to 3 decimal places, and had it not been for the relaxation of this to awrt 1 decimal place, then a significant number of candidates would have lost a mark here for rounding. The second angle could have been found by using either the sine or the cosine rule but the third angle should have been found by using the fact that the sum of the angles in a triangle is 180º. Most candidates applied trigonometry three times in this part of the question, which had they rounded correctly as required in the question would have given three angles that add to 180°.

In part (b) far too many candidates assumed that bisecting an angle results in either a perpendicular with the intersection to the opposite side, or else bisects the opposite side. So many responses were using either 10 cm as a length using sine rule, or using right angle triangle trigonometry or even Pythagoras' theorem. Only about half of the responses were correct.

Virtually every candidate achieved the correct area of 137 cm^2 in part (c).

Question 7

As one would expect, most candidates knew the formula for the Binomial expansion, and knew how to apply it correctly. The majority of marks were lost in sign errors in the final simplification to a single fraction, thereby earning at least 2 out of 3 marks for each expansion.

In part (c) only about half of the candidates knew how to find the range correctly.

The later parts of the question discriminated well between the stronger and weaker students. Those who were able to tackle these parts of the question realised that the 3s cancelled and they were to multiply their expansions from (a) and (b) together. These more able candidates usually then went to integrate correctly, and even if there were errors from their expansions for (a) and (b) were able to achieve the M marks here.

The question specified ‘hence obtain an estimate’ and therefore candidates who used a graphic calculator to find the area achieved no marks in part (e).

Question 8

Many scored full marks in part (a), although once again, centres should teach their students that for a question that requires a ‘show’ or a proof to earn marks, full methods must be used and a conclusion reached, otherwise examiners cannot award marks.

Part (b) was a little more demanding, although it was clear that deriving sin $3A$ is a relatively well known proof, and many earned full marks here.

Part (c) proved far more problematic as the equation needed to be compared with the identity for
sin $3A$, and re-arranged to reach a solution. Many managed to achieve a value for sin$3A$ but relatively few were able to find the correct angles for $3A$ and even less actually found the three required angles within the specified range.

The last part of the question confounded all but the most able and there were very few correct solutions. Most attempted to integrate $\sin^3\theta$, which is possible of course, although virtually every attempt given was erroneous. By far the easiest way was to use the given identity for sin $3A$ and integrate that. Of those who attempted this part, many re-arranged and used the equation in part (d), which earned no marks.

Question 9
This was certainly better answered than some similar questions in previous series, possibly not least because those with sophisticated graphical calculators were able to gain an advantage here.
There were many correct solutions to parts (a) and (b) with both asymptotes correctly specified as well as intersections with the axes, most candidates knowing precisely how to find them. There was a little confusion with the asymptotes, but credit was given for correctly marked asymptotes on the graph.
Part (c) was drawn correctly in many cases. Some candidates drew impossible curves to force their lines through incorrect intersections. Those finding an impossible graph would have been wise to go back and check their work in parts (a) and (b).
The majority of candidates knew how to use quotient rule in part (d), although there were some errors in getting the terms the right way around in the numerator. Most substituted $-\frac{1}{3}$ correctly to find the gradient, inverted it correctly to find the gradient of the normal and used the formula correctly to write down an equation of the line. Simplification was not required and by far the safest method to use is to use the formula $y - y_1 = m\left(x - x_1\right)$ as no further processing is necessary and the mark is guaranteed for a correct substitution. Those using $y = mx + c$ cannot earn marks until they have found *c* and then substituted everything to form an equation.

Many candidates earned the first and usually the second M marks in part (e) for equating the line with the curve, but relatively few processed the algebra correctly to achieve the correct final coordinate of *x.*

Question 10
This question was well answered.
In part (a) the most common error was to use the formula for the volume of a cone and attempt to substitute this into the formula for the surface area of a cylinder. However, there were many correct and full responses.
Virtually every candidate knew they had to differentiate in part (b) and equate to zero and most earned at least two marks in this part, but some took the square root instead of the cube root.
Again, most knew they needed to find the second derivative in part (c) and to use the value found in part (b) to show that it was positive. However, quite a few candidates differentiated incorrectly, found their $\frac{d^2y}{dx^2} = 4\pi$, and because no substitution of a value for *r* was possible could earn no further marks. Full credit was only given for a correct value for the second derivative after substitution of *r*, as a correct conclusion can only come from correct work and values.
Part (d) was mostly very well answered with those candidates getting this far in the paper, who used their values of *r* correctly, earning at least the M mark here.

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