Examiners' Report/
Principal Examiner Feedback

Summer 2016

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

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Grade Boundaries

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International GCSE Further Pure Mathematics Specification 4PM0/01

The two papers were evenly balanced, with similar final grade boundaries. The most difficult question was the final question of Paper 2 and so no candidates suffered as a result of finding themselves unable to tackle this question satisfactorily.
As always some candidates needlessly lost marks by failing to round as instructed or by working in degrees when the answer had to be in radians. The latter is particularly dangerous if exact answers are required as once exactness is lost it can rarely be regained and so accuracy marks are lost.
Candidates should be aware of the hints given in the language used in questions. When a question asks for "possible values" of an unknown there must be more than one possible result. "Hence" (without being followed by otherwise) indicates that a result already found in that question must be used; no marks will be awarded for an alternative method even if mathematically valid. On the other hand, "hence or otherwise" indicates that any mathematically valid method may be used but use of a previous result will lead to an easier solution.
In "show" questions candidates must be careful to show every step of their working; no leaps of faith are allowed. If corrections to working are needed candidates must ensure that this has happened throughout the question; any error seen in the working will lose the final accuracy mark.

Question 1

(a) This was very well done with the majority of candidates using factor theorem correctly by substituting $x = 2$ to give f $(x) = 0$, with only a small minority dividing to achieve a quadratic factor with a remainder of zero.

(b) A few very observant candidates were able to merely write the answer down since the factor $(x - 2)$ was given. For the rest, division was the most popular choice of strategy, although a few stopped after a correct division, and others did not give the final answer in factorised form losing the ultimate mark.

Question 2

(a) This part was mostly very well done with most candidates gaining full marks here. There were isolated misreads of the negative power. A few candidates had problems with the simplification of the coefficients, but this was a small minority.

(b) Again, this was very well answered with most candidates correctly multiplying their expansion from (b) by $1 - kx^2$. Just a few attempted to expand $(1 - kx)^2$ first. There were some simplification errors when candidates attempted to factorise their product, but this was not required and therefore no marks were lost due to erroneous factorisation.

(c) Most candidates achieved the required $k = 4$. The most common erroneous answer was $x = -6$ arising from equating the incorrect coefficient of x^2 with – 5. [$1 + k = -5$]

Question 3

This was not answered well at all by a minority of candidates, most noticeably those who did not draw a sketch of the shape which was described and not given. It is almost impossible to attempt a question in which students are expected to interpret the description of a shape, without drawing a sketch of the shape.

(a) Having said the above, most candidates used Pythagoras theorem twice to achieve the correctly rounded answer. The most usual error was an answer of $\sqrt{89}$ arising from a height of 8 cm and a base of 5 cm.

(b) This part caused some problems. The first B mark was given for correctly identifying the angle required, and therefore the remaining two marks were virtually dependent on this mark. Some candidates found the angle *EAC*, and some who thought that the length of *AE* was $\sqrt{89}$ from part (a), and used sine ratio rather than the obvious tangent ratio then achieved the correct value for the required angle, but due to an erroneous method. These attempts received no marks, as we cannot award marks for a correct value obtained from an incorrect method. Quite a few responses gave the final answer as 60º, misinterpreting the instruction to round to the nearest degree.

Question 4

(a) This part of the question was not answered well due to two separate significant problems.
(i) Some candidates could not set up the required equations and generally went round in circles with t_5's and t_{10}'s , unable to proceed further.
(ii) The majority of candidates did find the two equations, but then failed to achieve the correct $a=5$ and $d=4$ due partly to poor simplification of their initial correct equations, the most common error being $3a-3d=3 \Rightarrow a-d=3$, and far too many candidates could not solve two very simple simultaneous equations, thereby also losing the two accuracy marks in part (b).

(b) The vast majority of candidates knew the correct formula for the sum of an arithmetic series and were able to apply it correctly using their usually erroneous *a* and*d*. Candidates should look at their answers, and if they arrive at negative fractional values for the position of a term in the sequence which must necessarily be a positive integer, they should go back to check earlier work. Only very few candidates used the very sophisticated and quick method of adding the last two terms in the S_{p+2} series, because they noticed that
$S_{p+2}-S_p=t_{p+2}+t_{p+1}$.

Question 5

(a) Any question that requires candidates to 'show' must necessarily involve showing every step of working to show examiners that the process is understood. Having said that, this was a very well answered question indeed, with virtually every candidate able to expand both $\sin(x+\alpha)$ and $\sin(x-\alpha)$ correctly, and many went on to show the required identity.
Some candidates expanded and collected like terms to achieve, $8\cos x\sin\alpha = 2\sin x\cos\alpha$, but went straight to $\tan x = 4\tan\alpha$ from that point, thus gaining only the first 2 marks out of 5 because evidence was needed that the identity $\tan A=\dfrac{\sin A}{\cos A}$ was being used and applied.

(b) Most used the given identity to solve the equation, though a few did start again, usually without success. Some lost marks by rounding prematurely to the nearest integer by writing $2y=67^{\circ}$ thereby losing the final two marks, or by giving the answer as, for example 123.3º losing the final mark. The required range was $90\le y\le 180$, so the very commonly given answer of 33º was not penalised, but another common answer of 147º arising from 180º − 33º was penalised as it was within range.

Question 6

This question was answered very well indeed with many candidates gaining full marks throughout, and there were virtually no errors at all in parts (a) and (b).

(c) The first M mark in this part was for 'preparing' either of the log terms ready for combining them, and the second M mark was for actually combining the terms. In general however, this part was answered very well indeed.

(d) Virtually every candidates change the base of the log correctly, and many then realised that a quadratic equation would result from this. There were some attempts to change the base to base 10, but these attempts were largely unsuccessful.

Several candidates thought either $\log_b = -2$ or $\log_7 b = -\frac{1}{2}$ was impossible, and indeed several wrote $b = 7^{-\frac{1}{2}}$ (ignore), but we were able to use these comments as the correct answer had been given using a correct method.

Question 7

(a) Most candidates completed this part well, although some made rounding errors, with 1.67 being a common *y* value when *x* = 2.5.

(b) It was surprising to note how many candidates failed to plot the point at coordinate (2.75, 2.73) thus losing a mark but virtually all joined up their points in a smooth curve.

(c) This was a good discriminator for the strongest students. Many just found that $\log_2 7 = 2.81... \approx 2.8$ without using their graphs, or drawing a line at $y = 2.8$ to their curve and finding an intercept on the *x*-axis which was not then used. These attempts gained no marks at all. We required to see evidence of *y* = 3 in their written work and/or the line *y* = 3 drawn on their graphs in order to award marks, although those attempts that found the correct line gave a final answer of *x* = 2.8 in nearly every case.

(d) The line $y = 3 - 3x$ was mostly correct, and mostly correctly drawn. Quite a few lost marks by not being as precise as they ought (using a very thick pen/pencil did not help), and finding $x = 1.45 \Rightarrow x = 1.5$ thereby losing the final mark.

Question 8

This question very clearly differentiated between the strongest and weakest candidates. Most attempted part (a) with some success, but success in parts (b) and (c) were quite rare.

(a) Most candidates found the vector $\overrightarrow{AD}$ correctly. Most candidates found a correct vector statement for $\overrightarrow{OE}$ and $\overrightarrow{BE}$, but less actually found correct simplified expressions, mainly due to an inconsistent approach to directions which are crucial in this work.

(b) The most popular method by far was by attempting to find the vector $\overrightarrow{BF}$ which necessitated using a second constant to give $\overrightarrow{BF} = \mu\overrightarrow{BE}$. Many candidates however, simply did not use a second constant thereby making it impossible to find λ. Those who did use this method correctly, were usually at least partly successful, although many candidates had simply given up on the question by now. Quite a few candidates miscopied their own work from (a) by writing $\frac{4}{15}$ as $\frac{4}{5}$ which was costly in terms of accuracy marks lost.

(c) Of those that did attempt this part of the question, few used a correct method of ratios to find the required area of *OAD*. The most common error was simply to square the value they had found for λ (even if it was correct), and multiply that by 5. Other than the few careful and neat fully correct solutions, most attempts were disorganised and difficult to follow.

<u>Question 9</u>

There were many high scores in this question.

(a) Most candidates knew what to do here and went about the task well, but some careless calculations and/or algebra defeated a few. The most common error was to give $\alpha^2+\beta^2=(\alpha+\beta)^2$. Others missed out the = 0, for their final equations in this part as well as part (b), but were only penalised once for this error in the question as a whole.

(b) The algebra when finding the product in this part gave a few problems, which was surprising given that $(2\alpha+\beta)(\alpha+2\beta)$ is a very simple product and subsequent simplification is also easy, although mistakes in simple work appeared to be far too frequent in this paper as a whole.

(c) Most candidates achieved the correct values of *A* and *B* but finding *C* was less successful as some forgot to multiply $\frac{25}{36}$ by 3, or to subtract 4.

(d) Virtually every attempt used b^2-4ac on $3x^2-5x+4=0$ correctly, although some lost the final mark by not writing a conclusion. The minimal conclusion required was $-23<0$ so not real roots. Some wrote $\sqrt{-23}$ is 'impossible', or 'math error', but this is incorrect or inadequate and so only the M mark was gained for this part. A few advanced candidates wrote $x=\frac{5\pm 23\mathrm{j}}{6}$ hence roots are complex, for full marks.

<u>Question 10</u>

Many candidates were able to make very good progress in most parts of this question to gain many if not all marks. Those that did not, however, usually did not include a sketch, which is essential for this work.

(a) Virtually every candidate achieved the correct coordinates of *C* using either the formula or much simpler division and vectors.

(b) There was some unnecessary work in this part, with some candidates finding equations of lines rather than just the gradient, and a few isolated attempts to use trigonometry or Pythagoras theorem to show that $\angle ACD$ or $\angle BCD$ were 90º. Otherwise virtually every candidate knew that the product of the negative reciprocal of the gradients = −1.

(c) The only real loss of a mark in this part arose when candidates did not follow the instructions in the paper and left their answer as $y=\frac{1}{2}x+\frac{1}{2}$, or simplified it incorrectly to give $2y=x+\frac{1}{2}$.

(d) Most candidates found point *E* correctly.

(e) By far the most favoured method of finding the area of the shape (which incidentally was a kite) was by using determinants. An advantage of using this method is that geometrical properties of shapes are not required to be known. If candidates are to use this method, they need to apply it correctly by firstly starting and finishing at the same coordinate, and secondly, going round the shape in consecutive order.

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