Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE
In Further Mathematics (8FM0)
Paper 01 Core Pure Mathematics

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Question 1

This question proved to be an accessible start to this paper with many fully correct solutions seen.

In part (a), the methods for finding the modulus and the argument were well known. A common error seen was to incorrectly identify the correct angle to use for the argument. A diagram is always useful in this identification.

In part (b), there was insufficient detail in the required diagram. When placing points on an Argand diagram, learners should clearly show the positions of the points, either by indicating scales on the axes or by indicating the coordinates of the points. Without such indications, it was assumed that the scales on each of the axes was the same. In such cases, the positioning of the points, particularly *P*, was insufficiently accurate to award marks. Some learners had incorrect complex number *Q* with $\sqrt{3}+3\mathrm{i}$ common.

In (c), the most common response was to say that the transformation was a rotation with a correct angle and direction about the origin. There were responses where the centre of the rotation was omitted and thus lost a mark.

There were other alternative transformations which were correct for the two points *P* and *Q* such as a reflection in an appropriate line, a matrix, or a translation.

Question 2

In part (a), the vast majority of the learners identified that $(z+5)$ is a factor of f(z) and then correctly found the quadratic quotient, usually by using long division. A minority of the cohort lost the A mark by not expressing f(z) in the required fully factorised form.

In part (b), many of the learners using the quadratic formula to find the two complex roots although completing the square was also seen here. A significant minority of the cohort did not show sufficient working in obtaining the required roots, going from substitution into the quadratic formula to the answer. This mainly involved not seeing the term 4i in the working and this lost the A mark here. A few learners tried to use the roots to show the quadratic either using the sum, product a conclusion is needed or substituting in one of the roots into the quadratic to get = 0, this gained no marks as a calculator was used.

In part (c), a number of the learners incorrectly substituted those roots found in (b) into the expression $2z-1$ and hence scored no marks. Those learners who are familiar with the transformation of roots coped well here and scored both of the available marks

Question 3

Most learners understood how to proceed in this question and produced good responses.

In part (a), the correct determinant was usually achieved. However there were errors seen in forming the inverse matrix with a common error being not changing the sign of the elements on the counter diagonal.

In part (b), learners were able to form two simultaneous equations correctly from the matrix equation. Algebraic errors in the manipulation of these equations led to a loss of marks. A common mistake was failing to multiply both sides of the equation completely when multiplying through by the denominator of the fraction.

Question 4

In part (i), the vast majority of the learners recognised that the matrix **P** represented a stretch with scale factor 2 parallel to the x-axis. Descriptions which involved stretches from the origin, about the origin, in the x-axis and along the x-axis were condoned here although representation by an enlargement was not allowed. A few learners commented that y-axis was invariant. An invariant line was correctly found by the majority of the cohort.

In part (ii), the correct area of the triangle T and the correct determinant of the matrix **Q** were found by many of the cohort with the main error arising here being $\det(\mathbf{Q}) = \cos 2\theta \tan 2\theta - 1$ which subsequently resulted in a loss of marks. Obtaining an area scale factor of ½ was obtained by the majority of the learners who then went on to find possible values of θ, having simplified the determinant of **Q** to $\sin 2\theta$. Very few of the cohort identified the fact that det(**Q**) could equal ½ or – ½ and thus obtained only four of the eight possible values of θ.

Question 5

Learners found this to be a challenging question with only a minority achieving full marks.

In part (a), the circle was usually drawn in the correct place although there were cases of the circle being centred on the imaginary rather than the real axis. Learners should have produced a diagram that was labelled at least with the centre as (1, 0) so that it was clear that the radius was correct.

In part (b), the more successful attempts started with a diagram clearly drawn so that the geometry of the situation could be seen. In this geometric approach, a common error was to incorrectly identify the side length of 1 to be perpendicular to the x-axis resulting the use of tangent rather than the sine and thus gained no credit.

An alternative approach using the equation of the line in the form $y = \tan\theta\,(x + 1)$, the equation of the circle as $(x - 1)^2 + y^2 = 1$ and then considering the condition for the line to be tangent to the circle was also seen and usually produced correct answers.

Part (c) proved to be the most challenging. The use of geometry resulting from a clear diagram would have made solution more straightforward but many used the equation of a tangent, often incorrectly and so failed to make progress. Very few recognised that the second solution must be the complex conjugate (again, use of a clear diagram would have helped) and solved for two values of x. A common error was to find $x + 1$ and think this was the real part of the complex number required.

Question 6

This standard proof by induction question was confidently solved by the vast majority of the learners and much success was seen. The key steps, such as proving the result being true for $n = 1$ and then deducing the result is true for $n = k + 1$ on the assumption that the result is true for $n = k$, were handled well. In the majority of cases, learners correctly equated the sum of $k + 1$ terms to the sum of k terms $+(k+1)^3$ and coped with the subsequent algebraic demands. Any marks lost here were mainly due to not expressing the $(k+2)$ as $(k+1+1)$ to show the use of $n = k + 1$. A few learners stated what they were aiming for and successfully achieved this result. Some algebraic errors seen for those learners who chose to multiply out the sum of k terms $+(k+1)^3$. In general, the concluding statements were well phrased.

Question 7

Perhaps surprisingly, part (a) was only answered correctly by a small minority of learners. The common error was to use the given coordinate $y = -12$ in the curve equation resulting in the equation $0 = (0)\left(A - (-12)^2\right)$ which erroneously led to A = 144. A few learners did not substitute $y = 12$ into the whole equation just $\left(A - 12^2\right) = 0$ scoring no marks.

In part (b), the volume of a solid of revolution was well known. The usual next step was to expand the brackets $(12 + y)^2\left(144 - y^2\right)$ to achieve a sum of four terms. Errors in the location of powers and other errors in simplification led to loss of subsequent accuracy marks. In the stage of evaluating the integral between the two limits, learners should be strongly advised to show explicit substitution of the upper limit into the integral minus the substitution of the lower limit rather than going straight to decimals which if evaluated incorrectly would lead to the loss of method marks. The majority of learners who achieved the correct answer rounded to 2 significant figures and gave the required units.

In part (c) it was very rare to see the answer $411x^2 = (13 + y)^2\left(169 - y^2\right)$ which resulted from using an enlargement of the curve by a factor of $\dfrac{13}{12}$. For answers aiming for the alternative $350x^2 = (13 + y)^2\left(169 - y^2\right)$, errors seen included not replacing 12 with 13, 144 with 169 or both and also the misplacing of the powers.

Learners continue to find questions asking for comments on a model used to be challenging.

Comments that just referred to the ballon e.g. “the balloon may not be smooth” gained no credit. There needed to be reference to the model, maybe implied, for there to be a chance of awarding the mark. Perhaps surprisingly, the more obvious response that the model and balloon did not have the same shape where the basket was rarely seen

Question 8

This question was well answered with many completely correct solutions

In part (a), the vast majority of the cohort were able to express the required series as the sum of two standard natural number series and then went on to correctly deal with the algebraic demands, such as factorisation, required to obtain the given result. The main reason for any loss of marks in this part was due to the omission of the factor ½ in forming the initial summation.

In part (b) much success was achieved with nearly all the learners finding the correct positive solution of the resulting quadratic equation in n.

Question 9

This question was well answered with many completely correct solutions.

In part (a), the common approach was to use the formula for the perpendicular distance of a point from a plane and was usually completed successfully. A common error was using +1 instead of – 1 for the value of + d. An allowable approach taking longer to complete used a more basic method starting with the parametric equation of the line, using the condition that the line is normal to the plane to find the coordinates of the foot of the perpendicular and then finding the length of the perpendicular. This was the work intended for part (c). To achieve credit in (c) there needed to be some acknowledgement that this earlier work was relevant.

The reasons in part (b) usually referred to the flatness of the ground or that the water may not be at a single point. Responses such as the source of the water may not be at the given point did not receive credit. A few learners said that it was reliable as they had found the perpendicular distance not commenting on the model.

Part (c) was usually well answered. Only rarely did learners resort to decimals in their final answers. An error when substituting the parametric form of the point into the plane was to equate the scalar product to 1 rather than 0 so losing all marks in this part.

In part (d) a comparison of the answer to (a) with 2.52 was required to comment on the appropriateness of the model.

The comparison has to look at the difference between the two values in some way to draw an appropriate conclusion. This may be explicit value, a percentage or something similar but not just a statement like 2.77 > 2.52.

Question 10

In part (a), the vast majority of the learners recognised the need to equate the scalar product of the two normal vectors to zero and thus correctly found the value of a.

In part (b), the method used to find *b* was equally split between those who used the determinant of the 3x3 matrix formed from the normal vectors of the three planes and those who used the three plane equations to form two equations by eliminating one of the variables *x*, *y* or *z*. Either way, much success was achieved in finding both *b* and *c* but there was clear evidence that some of the learners were unclear of the definition of a sheaf and thus made little progress in their solution.

Question 11

Solutions to this question usually showed an appreciation of the techniques required thus gaining the method marks but failed to gain accuracy marks because of mistakes in algebraic manipulation.

The sum of roots and the product of roots were obtained correctly with very few having sign errors in the signs of the sum and of the product.

Most then appreciated the need to eliminate one of α or β from the pair of simultaneous equations that they had formed. The more straightforward substitution of $\alpha = 7 - 3\beta$ was seen almost as often as the more awkward $\beta = \frac{7-\alpha}{3}$

Attempts to simplify the resulting equation saw algebraic errors or insufficient simplification so that a correct simplified quadratic was not achieved. Often a cubic resulted which was solved via a calculator which was acceptable here, although previous errors led to incorrect values for α or β being obtained.

With the value of α or β, most followed a correct method to achieve the three roots. There were cases where the values obtained deterred learners from proceeding to three roots so losing the final method and accuracy mark.

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