Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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In Further Pure 1 (6667/01)

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Introduction

This paper proved to be a good test of student knowledge and understanding. It discriminated well between the different ability levels. There were many accessible marks available to candidates who were confident with topics such as complex numbers, matrices, conic sections, numerical methods, series summation and proof by induction.

Reports on Individual Questions

Question 1

The opening question on complex numbers saw a surprisingly mixed response. Most were able to identify the conjugate as a second root and the majority then proceeded to find the quadratic factor, usually via $(z - (3i - 2))(z - (-2 - 3i))$. Those who were able to spot that since the constant of the cubic was given, the remaining linear factor could be quickly identified, although some offered $z = -2$ or failed to specify this root by giving the factorised form of $f(z)$ as their final answer. Candidates who proceeded this way were then able to answer part (b) swiftly by expanding and comparing coefficients. A significant number evidently thought that a and b had to be found before $f(z) = 0$ could be solved. This usually led to long divisions which were often prone to error. Substituting $3i - 2$ or $-2 - 3i$ into $f(z) = 0$ and equating real and imaginary parts to get simultaneous equations in a and b was occasionally seen but not often successful. However, the more confident candidates picked up all eight marks with little fuss.

Question 2

In part (a), most candidates attempted an appropriate matrix multiplication with only a small number setting this up the wrong way round. Although a few succumbed to algebraic errors, the correct matrix in terms of k was widely seen.

Part (b) was a little more discriminating. The correct area of triangle T was commonly achieved as was a correct expression for det **M**. Some were unable to use the 770 correctly to achieve a correct equation in k. A particularly common error was to not include the modulus sign which led to only one value being found for the constant. A small but significant number of candidates were unfamiliar with the entire method here with some attempting to use their coordinates from part (a) with no success.

Question 3

This question on a rectangular hyperbola saw very good scoring in parts (a) and (b) but a correct answer for part (c) eluded most.

Differentiation in part (a) was almost always correct and usually done explicitly. The subsequent method was well known and the next three marks (for finding a value for m_t, then finding m_n and finally using m_n in a straight line equation) were widely scored. Very occasionally the straight line was not given in the required form.

The correct method in part (b) was also widely seen. Most eliminated a variable (usually y) by combining their normal and the hyperbola equation and then went on to correctly solve the resulting quadratic. Slips obtaining the coordinates of the intersection were rare.

The majority struggled to progress in (c). The few that did tended to have a realistic diagram of the situation. The most common misconception was to believe that triangle *OPQ* was right-angled at *O*. Way 1 in the mark scheme – finding an axis intercept to divide triangle *OPQ* into two triangles whose bases and perpendicular heights were easily determined – saw the most success. A few correct attempts using the Way 2 "shoelace" method were seen. Those opting for the more circuitous routes of Ways 3 to 5 tended to be unsuccessful.

Question 4

Good scoring was widely seen in question 4 on numerical methods although the linear interpolation task in part (ii) proved more demanding.

In (i) part (a), the method was widely known and only a few lost the second mark for either no conclusion or an inadequate one.

It was very rare to see errors with the differentiation in (i) part (b).

The Newton-Raphson method in (i) part (c) was also executed correctly by the majority with few slips seen.

In part (ii), a small number of candidates calculated in degrees but the first M was obtained by almost all. Forming a correct interpolation statement was more challenging with sign errors fairly common. Those who had a correct statement usually obtained a correct value for β although it was occasionally not given to the required degree of accuracy. Some equivalent variations were seen such as finding the x-axis intercept of the line joining (–3, g(–3)) and (–2, g(–2)).

Question 5

This question on series summation was generally well executed in part (a). Almost all candidates expanded the $r^2(4 + r)$ correctly and proceeded to use the standard results to get an expression in n which was invariably correct. Most went on via correct algebra to obtain the quadratic and few errors were seen.

Part (a) required the candidates to obtain a result. The "hence" in part (b) required them to use it to find a summation of a series whose algebraic expression for each term was r^2 less than that of the series in part (a). A significant number of candidates merely repeated the work in part (a) without using the result and could only score the second M mark for use of a sum of squares. The relatively small number who proceeded correctly tended to obtain the correct answer although a few used incorrect summation limits and some calculations went awry. A correct answer only was insufficient – appropriate working needed to be evident following the "hence" command word in the question.

Question 6

Question 6 on complex numbers was a good source of marks for most. In (a), the vast majority knew how to obtain z in the correct form so that its real part could be identified. Most formed an appropriate equation and very few made errors in solving it, so the correct value for a was widely seen.

The method for part (b) was also well known. A few candidates needlessly substituted their a into the original form of z and gave themselves unnecessary processing to do. The technique for obtaining an appropriate angle was recalled by most and only a small number made errors such as attempting $\arctan\left(\frac{c}{d}\right)$ instead of $\arctan\left(\frac{d}{c}\right)$ from $z = c + d\text{i}$. A small number did fail to use their angle correctly to get a correct value for $\arg(z)$ – most commonly missing out the minus sign.

Part (c) required the calculation of zz^*. Not many directly calculated $c^2 + d^2$ and instead multiplied it out in full, but both of the two marks proved easily accessible.

Question 7

Matrix transformations were assessed in this question and plenty of marks proved to be obtainable for most. In part (a), the question required the transformation given by the matrix to be described fully and so omitting to mention the origin lost the second mark of the two available. Almost all candidates identified that the matrix would cause a rotation and that this was of 45° although some thought it was anticlockwise rather than clockwise.

Part (b) was correctly dealt with by most. Some were able to write the answer straight down as the question expected but many considered the movement of unit vectors to obtain their solution.

Part (c) also saw good scoring and it was again quite rare to see the matrix multiplication attempted incorrectly such as having the matrices the wrong way round.

The final part was a little more discriminating with a range of wrong attempts seen to determine the constant of the invariant point. Those who could form the correct matrix equation usually obtained a correct equation in k. Errors in solving the equation were not common.

Question 8

The final question involved two proofs by induction. Part (a) involved the result of an nth power of a matrix and part (b) featured a series summation. Although there were some candidates who offered no response or just proved results for $n = 1$, the methods were generally well known on the whole and good scoring was seen.

In part (a), it was pleasingly rare to see a proof of the result for $n = 1$ that did not make evident substitution into both sides. Only a small number of attempts failed to use the correct induction step and the required matrix multiplication invariably went well. Slightly more common was the error of failing to express the resulting matrix in terms of $k + 1$.

In part (b), most obtained $\frac{1}{6}$ from both sides but many then proceeded to add the kth rather than the $(k + 1)$th term or thought this term required $k + 1$ to be substituted into the expression in n. A range of errors were seen with the resulting algebra and as with (a), some failed to put their final expression in terms of $k + 1$.

It was good to see a substantial number of fully correct solutions to both parts and few candidates lost the final mark for not making the required statements either throughout their proofs or as conclusions.

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