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January 2013

GCE Further Pure Mathematics (6667)
Paper 01

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January 2013
Publications Code UA034508

General Introduction

This paper had a wide range of challenging questions. The questions enabled candidates in the lower ability range to show what they could do and it was rare that candidates felt unable to access at least some part of the paper. The paper also challenged the more able candidates.

Report on Individual Questions

Question 1

The majority of candidates made a good start to the paper and a large number of candidates scored full marks on this question. The common mistake was adding 3 instead of $3n$, which would often then be changed into $3n$ to get the given answer. Other errors included replacing Σr or Σr^2 with an incorrect expression and an inability to extract n as a common factor. A small number of candidates attempted to solve this problem using induction and, given the wording of the question, such attempts attracted no marks at all.

Question 2

This question was accessible to all and was usually very well attempted.

Q2(a), Q2(b) and Q2(c) were usually done well and sufficient working was generally shown. In Q2(b) some took the longer route of not using their answer from Q2(a) and had a lot of work to do before the method mark could be awarded. Q2(c) was usually answered correctly, but some mis-read the question and used z^2 instead of z and this error was sometimes repeated in Q2(d). The most common mistakes in Q2(d) were using radians instead of degrees or not getting the angle in the correct quadrant.

Question 3

Generally, this was a standard question on numerical methods with good outcomes for most candidates. In Q3(a) the differentiation was almost always done correctly. Most candidates knew the formula to use for Newton-Raphson and most attempts gained full marks. There were however some errors in the calculation of f(5) and f′(5). Those who did not show explicit substitution and / or accurate values of f(5) and f′(5) risked losing several marks if their final answer was incorrect.

Question 4

This question usually contained some errors from candidates. In Q4(a) the matrix was usually correct, but in Q4(b) the matrix attracted more errors. In Q4(c) and Q4(d) many candidates did not multiply their matrices in the correct order, however a large number of candidates made a reasonable attempt at the matrix multiplication and gained at least the method mark. Q4(e) could be answered without reference to the matrix obtained in Q4(d) and for many this was a useful approach. A single transformation was required in Q4(e) and most got at least one mark here. A common error was to choose the wrong axis.

Question 5

In Q5(a) many candidates gained all the marks using either the quadratic formula or completion of the square. Some candidates made an error when using the formula and gained no marks as it had not been quoted correctly or at all. Some candidates mistakenly obtained two real roots for this equation and these also lost a mark in Q5(b). Occasionally, candidates just wrote down the four roots with no working at all. Candidates need to be reminded that correct answers may not get full marks if insufficient working is shown.

Most candidates gained full marks in Q5(b). They demonstrated knowledge of some labelling on the Argand diagram. Errors made included plotting the pure imaginary roots on the real axis or not plotting the complex roots as a conjugate pair.

Question 6

Q6(a) was generally answered successfully. Candidates mostly know the property of a singular matrix and any errors were usually careless. In Q6(b) most appreciated that they needed to multiply by $\frac{1}{\det \mathbf{Y}}$, although there were some arithmetic mistakes made in evaluating $ad - bc$. Some used the wrong structure of the matrix and these obtained no marks here. In Q6(c) there were two approaches seen. When using the inverse of **Y** some made the error of 'multiplying on the wrong side'. In addition, there were a number of algebraic errors in multiplying the terms in $\mathbf{Y}^{-1}$ and the expressions in λ. More significantly, some used a 2×2 matrix combined with 2×1 matrix and arrived at a 2×2. The alternative method of using $\mathbf{YA} = \mathbf{B}$ and solving the equations was often completed successfully and meant that full marks could be obtained in Q6(c) even if their inverse matrix was incorrect.

Question 7

This was a challenging question that required good skills in algebraic manipulation which many candidates displayed, although some were more efficient than others at rearranging and simplifying. In Q7(a) most used $y = \frac{25}{x}$ to differentiate but several used implicit differentiation. Those who used parametric differentiation mostly lost marks because they used p or q as their initial parameter. Most candidates realised that they could just write down the answer to Q7(b) although there were candidates who thought they had to start again from scratch. There were some very pleasing solutions to Q7(c) with many gaining full marks. Q7(d) was where most differences in performance were seen. The given information could, in fact, be embodied in one line of algebra, equivalent to "gradient using points P and Q" multiplied by "gradient using points O and N" $= -1$. This could then be manipulated in very few steps to give the required result. Some did indeed produce a correct and efficient solution along these lines. Many candidates chose a much more complicated method and these attempts usually lost the last two marks. Another efficient way of tackling this part was to set the scalar product of vectors $\overrightarrow{PQ}$ and $\overrightarrow{ON}$ equal to zero.

Question 8

The proofs by induction given were generally of a good standard, with most candidates seeming to appreciate the overall structure of a proof by induction. In Q8(a) some candidates tried to use standard results and this resulted in a loss of a number of marks. Many candidates jumped from a cubic expression to the final answer and lost marks as a result. Q8(b) was also well attempted by most but only the more able candidates gained full marks. A common error was to prove the result for $n = 2$, not $n = 1$, thereby losing the first and last marks. Another common mistake was to add $(k + 1)\{3(k + 1)\}$ onto u_k.

Question 9

In Q9(a) most used differentiation after square rooting but some used implicit or parametric differentiation and the majority gained full marks here. Candidates using $y = mx + c$ to find the equation of the normal were more prone to errors than those using $y - y_1 = m\ (x - x_1)$. In Q9(b) the majority found S correctly and N for their line but finding the vertical height of the triangle seemed to be the biggest problem. Many misinterpreted the coordinates and gave the height as 4. Many found the area by subtracting the area of two triangles or by using a rectangle and triangles.

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