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Examiners' Report
Principal Examiner Feedback

Summer 2017

Pearson Edexcel GCE
In Further Pure Mathematics FP1 (6667/01)

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Introduction

This paper was accessible to most candidates and the great majority could make some attempt at all questions. Calculus techniques when required were well understood and, in general, the standard of presentation was satisfactory. Most candidates used calculators appropriately, but problems arose when candidates gave exact answers to some questions derived from calculators without any working to support them. The rubric on the front of the paper advises candidates that they should show sufficient working to make your methods clear to the examiner.

Report on individual questions

Question 1

Most candidates scored very well. There was a roughly equal split between those working with decimal values and those with fractions. In part (a) a few candidates correctly calculated f(6) and f(7), with negative and positive signs respectively, but then failed to comment on the sign change and/or draw a conclusion, therefore losing the accuracy mark. Almost all obtained the correct three differentiated terms in part (b) and went on to apply Newton-Raphson correctly, though, the formula was not always quoted before applying it. This proved to be a costly if an error was made with the substitution.

Question 2

In part (a) it was rare to see an error. However part (b) proved to challenge a substantial minority, who multiplied their matrices in the wrong order. Most candidates spotted that they could use their inverse matrix to quickly find matrix ***B***, but some did use the much longer method; pre-multiplying by ***A***, then solving simultaneous equations.

Question 3

Many candidates gained full marks in part (a), with only occasional sign errors, or mistakes in the final equation. The rectangular hyperbola equation in part (b) was almost always correct, though some took several lines of working to derive it. Most candidates determined the x coordinates first in part (c). Use of the parametric form was rare. Occasionally, the final two marks were lost when the y coordinates were omitted. Almost all candidates had the correct simplified surds with $\sqrt{32}$ only rarely seen. Those who did find the y coordinates mostly substituted for x in the $xy=16$ equation, rather than using the much simpler $2y=x$.

Question 4

Almost all candidates knew to multiply top and bottom by the complex conjugate of the denominator, and most did this correctly, though there were occasional errors in both numerator and denominator. The final mark in part (i)(a) was sometimes lost due to failure to separate the real and imaginary parts, as the question required. In part (b), relatively few candidates were able to immediately equate the numerators of the real and imaginary parts. Most used $\tan \pi/4 = 1$ involving them in extra work. In part (ii) it was very rare to see use of the modulus of the product as the product of the moduli. Instead candidates worked out the product of the two complex numbers, sometimes incorrectly, and then attempted to obtain the modulus of that product, usually successfully. Most were then able to progress to a correct conclusion, though a worrying minority thought that $\sqrt{(25 + \lambda^2)} = (5 + \lambda)$.

Question 5

Candidates appear well drilled in multiplying two 2x2 matrices, so errors in part (i)(a) were very rare with just the occasional arithmetic slip. The majority could complete part (b) correctly though a substantial minority showed their confusion in various ways, at worst multiplying rather than adding **AB** and 2**A**. It was common for $p=3/2$ to be calculated twice from both $4p-6=0$ and $-9+6p=0$. Calculation of the value of k then generally followed correctly. Only a minority of candidates scored full marks in part (ii) as many omitted the possibility that the determinant of **M** could be negative and scored only 3 out of 5 marks for just applying $2a + 9 = + 18$. Just a few candidates erroneously had det**M** $= 2a - 9$.

Question 6

Many candidates were confused by the root 2i - 3, written with the imaginary part first, and therefore wrote down 2i + 3 as their third root. They could then score, at best, only 2 marks out of 5. Of those with the correct third root many then scored full marks. Most firstly multiplied out the two brackets containing the complex roots, followed by $(x - 4)$. Others found the correct quadratic factor by using –(sum) and product of roots and just a few used $(x + 3)^2 = -4$. The latter two approaches were less error prone than multiplying out the brackets. It was not uncommon to see pairs of brackets with the wrong signs, due to using (x + root). Other approaches were rarely seen.

Question 7

The standard bookwork of part (a) was well known and the vast majority of candidates scored the first four marks. Various approaches were used to obtain $\mathrm{d}y/\mathrm{d}x = 1/q$, as indicated in the mark scheme, and additionally finding $\mathrm{d}x/\mathrm{d}y$, then inverting. The most popular option was to differentiate $y = 2\sqrt{a}x^{½}$. Full marks in part (b) were scored by only about half the candidates. This was due to the failure to use $X\,(-a/4,0)$ to obtain $q = ½$. This was an expensive omission in terms of marks, losing three here, and also the two marks in part (c). Those with the correct coordinates for D, were frequently then able to obtain the correct triangle area. Many simply used ½ base x height for the required triangle, and others subtracted right angled triangles. A surprising minority correctly obtained ½(3a/2)(5a/4), but then gave their answer as 15a/16 omitting that "a" is squared. A few produced prolonged and complicated working when attempting to use DF as their base, therefore having to calculate the perpendicular distance from DF to X.

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Question 8

Almost all candidates gained full marks in part (a), helped by knowing what they were trying to achieve. In some cases, this involved more than one attempt. A good proportion initially extracted $n/2$ as a common factor so that the six terms in the brackets were easy to simplify. Those who chose 1/6 or $n/6$ as their factor made a lot of work for themselves, which sometimes led to errors. Part (b) proved to be a good discriminator. Whilst many candidates successfully used $n=12$ in the result from part (a), recognition of the geometric progression frequently challenged candidates, many of whom ignored the summation. It was quite rare to see use of the geometric sum formula, with a fair number listing and then summing the twelve terms, for which they could score full marks, but wasted time, and sometimes caused errors. A few candidates apparently realised they should use a sum formula but chose that of an arithmetic progression.

Question 9

As ever, proof by induction also proved to be an excellent discriminator, especially in this case with two proofs. In some cases, candidates performed similarly on both parts but with interesting exceptions, such as a handful who scored 0/6 in part (a) followed by 6/6 in part (b). In part (a) failure to demonstrate the result for $n=2$ lost many candidates the first and last marks, who were nonetheless able to correctly complete the algebra for the formal proof. An able minority used the two terms, from the definition, to extract the factor $3k+2$ initially, producing the most concise proof. Many other rambling proofs were eventually successful, often using $3k$, throughout and only finally achieving k+2, as the index. A few candidates combined working forwards and backwards, mostly with success. Many could complete the final conclusion, but some struggled to include the key elements here. Most candidates scored the first two marks in part (b), but only a minority went on to complete the formal proof successfully. The most popular starting point was to use f(k+1) - f(k), but a substantial minority used just f(k+1). Fewer candidates added or subtracted multiples of f(k), often successfully, with +11f(k) seen several times to good effect. Many candidates who scored only the first two marks were unable to progress due to an inability to deal correctly with indices, for example sometimes $3^{3k}+1$ was replaced with 27k+1. Again, the quality of the conclusion was variable.

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