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Examiners' Report

January 2010

GCE

Further Pure Mathematics FP1 (6667)

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Publications Code UA023031

Further Pure Mathematics FP1
Specification 6667

Introduction

There was a similar standard of responses to previous FP1 papers and although candidates showed which techniques to select and also how to use them, they found some parts of this paper challenging, notably the induction questions.

Report on individual questions

Question 1

This question was well answered with many candidates gaining full marks.

In part (a) there were very few candidates who were unaware of the technique of multiplying numerator and denominator by (1+i). Careless mistakes with arithmetic were the main reason that candidates lost marks on this part of the question e.g. dividing by 2 to give -6+5i or -3+10i. These were rare however. Part (b) was also well answered with most candidates following the method outlined in the mark scheme although some candidates correctly answered the question by calculating mod z_1 divided by mod z_2. Unfortunately $\sqrt{(-3^2 + 5i^2)}$ was occasionally seen.

Candidates who were successful in part (c) employed a variety of methods including $\pi/2 + \arctan(3/5)$, $\pi - \arctan(5/3)$, $\pi + \arctan(5/-3)$ and $\arg z_1 - \arg z_2$

Question 2

Part (a) was usually correct, though the required interval was not always stated. A small number of candidates failed to follow the requested method in part (b), in general trying to use linear interpolation. For most, however, the correct method was used, but it was surprising to see how many candidates failed to give an interval in their final answer. Newton-Raphson was usually attempted correctly in part (c), though sometimes a few candidates had problems differentiating the negative index.

Question 3

There were many successful attempts at this question. However many candidates considered both u_1 and u_2, which is not necessary, or worse, only considered u_2. There was then no evidence that the statement was true for $n = 1$, and hence for all positive integers. There needed to be some indication that the statement for u_{k+1} was true if u_k was true. An absence of words like "if … then", or "implied", meant that the final mark was lost. A related common error was to say that the truth for k+1 implied the truth for k. Some evidence was needed that the expression for $n = k+1$ had been legitimately obtained; simply to assert that something is true is not enough.

Question 4

This question was well done. In part (a) nearly all candidates found the coordinates of the focus correctly.

In part (b) a majority were correct but there were quite a few errors. A number of candidates carelessly obtained $y = 4$ at P. Many failed to realise that $PB = PS$ as a property of a parabola and so used Pythagoras to find PS, leading to a few careless errors. Some candidates thought that perimeter is the same as area. It is essential, at this level that candidates do know the basic terminology used in Mathematics and read questions with care.

Question 5

In part (a) some candidates gave the reciprocal of the determinant as their answer rather than the determinant itself. The successful attempts at part (b) employed methods involving the discriminant of the equation det $A = 0$; completing the square on the determinant; and a calculus/graphical approach. Some candidates lost the final mark in this part through not being able to fully justify their answer. The discriminant approach was most common with calculus rarely used. A number of candidates seemed confused about the precise meaning of the terms in use - singular, non-singular, real, complex. Whether the roots of the quadratic were real, complex, non-zero or positive was not clear to some. Part (c) was well answered by the vast majority of candidates, but some candidates did not spot the given value of a.

Question 6

This question was generally very well done. Nearly every candidate achieved the complex conjugate in part (a). In part (b) most candidates chose the method of expanding brackets, then equating coefficients to achieve c and d. This was generally very well attempted. Most mistakes were algebraic ones, with methods clearly understood. More confusion reigned amongst those who chose the alternative method. Some substituted 2 and found themselves with one equation in 2 unknowns. Those who substituted a complex root often made mistakes with powers of i or did not use the concept of equating real and imaginary parts.

The Argand diagrams in part (c) were good, and most found some way of introducing scale to their diagram, usually by "vectors", co-ordinates, or labelling the axes.

Question 7

This proved to be a challenging question for some, but many candidates were quite competent at handling the algebra involved. In part (a) most candidates differentiated the Cartesian equation although there were successful attempts at both parametric and implicit differentiation. A majority of candidates received full marks for part (a), although those who used $y=mx+c$ as the equation of a line were more likely to make algebraic slips. Part (b) was more problematic. Many substituted (15c, -c) and nearly all of them the right way round. However, there was confusion about the quadratic having two letters in it and too many failed to just divide through by the constant c, to produce a very friendly quadratic equation. Once -5 and 3 were obtained as roots, the candidates generally proceeded successfully to obtain the co-ordinates of the 2 points. Some lost the final mark for an errant t, or two, in the statement of the co-ordinates.

Question 8

As seen in Q3, the induction process was often proved to be a challenge for candidates. Some assumed both $n=k$ and $n=k+1$, many could not identify the three necessary steps. Several gained the first mark but then multiplied out rather than factorising. Some successfully factorised the resulting quartic, and some worked backwards to show it was correct, but many just produced the factorisation from nowhere. Those who factorised out the $(k+1)^2$ from their initial expression generally did so successfully. Part (b) was often correct, with only a few rarer examples of +2 rather than $+2n$. Part (c) was usually correct with only a few incorrect methods such as S(25) – S(15) or simply S(25) and a few examples of substituting 25 into $r^3 + 3r + 2$.

Question 9

In general this question was answered very well, and a high proportion of candidates gained full marks. There was, in some cases, uncertainty about the order needed to perform the matrix multiplication. A common error in part (a) was to omit the centre of rotation, but the correct angle and direction were almost always present. There were 2 popular approaches to part (b), either involving the formation of a pair of linear simultaneous equations, or finding the inverse of matrix **M**. Slips with signs produced the most common errors. The marks in (c) were almost always gained, with the simplified version of the surd being easily obtained. If slips were seen in part (d), these were mainly due to errors with signs. Provided that $\mathbf{M}^2$ had been found correctly, the coordinates in part (e) were normally obtained correctly. Some candidates did not use the coordinates of point *B*, thereby losing the marks. In part (d) and part (e), other candidates referred back to the geometry of the situation, obtaining their correct answers with some ease.

Grade Boundaries

The table below gives the lowest raw marks for the award of the stated uniform marks (UMS).

Module	80	70	60	50	40
6663 Core Mathematics C1	63	54	46	38	30
6664 Core Mathematics C2	54	47	40	33	27
6665 Core Mathematics C3	59	52	45	39	33
6666 Core Mathematics C4	61	53	46	39	32
6667 Further Pure Mathematics FP1	64	56	49	42	35
6674 Further Pure Mathematics FP1 (legacy)	62	54	46	39	32
6675 Further Pure Mathematics FP2 (legacy)	52	46	40	35	30
6676 Further Pure Mathematics FP3 (legacy)	59	52	45	38	32
6677 Mechanics M1	61	53	45	38	31
6678 Mechanics M2	53	46	39	33	27
6679 Mechanics M3	57	51	45	40	35
6683 Statistics S1	65	58	51	45	39
6684 Statistics S2	65	57	50	43	36
6689 Decision Maths D1	67	61	55	49	44

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Order Code UA023031 January 2010

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