# Examiners' Report

# Summer 2014

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

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# Mathematics Unit Further Pure Mathematics 1

# Specification 6667/01

## General Introduction

The general standard of work was high with a lot of well organised clear solutions. Diagrams would have helped students make better progress in Q06 and Q07 .

## Report on Individual Questions

### Question 1

The majority of students made a successful start to this paper and multiplied the numerator and denominator by the conjugate of the denominator in Q01(a). There were common algebraic errors e.g. $(2\mathrm{i})^2 = 2\mathrm{i}^2$. Some students wrote 3 rather than 5 for their simplified denominator, but still gained the method mark for showing use of $\mathrm{i}^2 = -1$ in the numerator. A number of students failed to write the final answer as real and imaginary parts.

In Q01(b) many solutions included i incorrectly in the calculation of the modulus, thereby losing marks. This often occurred with students who did not factor out the i in the final solution of Q01(a).There were some mistakes in expanding and simplifying, leading to a 3 term quadratic.  Common errors were not squaring the 5, or equating the modulus to 13 rather than $13^2$.

### Question 2

There were a number of arithmetic mistakes in this question with students unable to correctly evaluate $x^{-\frac{3}{2}}$ and $x^{-\frac{5}{2}}$. Some students failed to make an adequate conclusion, or drew no conclusion, in respect of the ‘sign change’ and ‘hence the root’.

In Q02(b) there were many fully accurate attempts at differentiation although a significant number made an error with the middle term, having issues with both the coefficient and the power. Those who made errors in Q02(b) typically lost marks in Q02(c) for insufficient working. On a number of occasions, students gave an answer with no indication that a correct Newton-Raphson formula was used and no evidence of substitution into their derivative. A number of students with accurate solutions failed to give the final answer to 3 decimal places as required in the question.

### Question 3

Almost all students achieved full marks in Q03(a) and Q03(c) and labelling was clear on most Argand diagrams. Generally Q03(b) was also done well with many students obtaining full marks. Students who approached this question by attempting to write the cubic as a product of three factors and expand had the most success, with only a small number failing to do so correctly. Some students used the sum and product of the complex roots to find the quadratic factor. Of those who chose to substitute the root into the original equation, students who substituted the real root, $x = 2$, often made no further progress. Those who did substitute two of the roots into the equation generally did so correctly, however they then failed to separate out into real and imaginary parts to solve for $p$ and $q$. Some students opted to use long division for Q03(b), but this method was almost always unsuccessful.

## Question 4

In Q04(i)(a) there were a lot of correct answers with almost all students gaining at least one mark, although there were some who made two arithmetic mistakes which lost both accuracy marks. A few students failed to get the correct dimensional order of the answer.

In Q04(b) explanations for why **AB** and **BA** are not equal were many and varied and often correct. There were lots of references to transformations and matrix multiplication not being commutative, but these attempts were not usually sufficient for this mark. The most common approach was a discussion about the dimensions of the resulting matrices.

Q04(c) was generally very well done, with the majority of answers gaining full marks. There were some errors in the calculation of the determinant and also some errors in the positions and signs of the elements within the inverse matrix. A significant number of students took the time to either factorise the determinant or to multiply the determinant into the matrix, neither of which were necessary to get all the available marks.

## Question 5

Most students made a good start to this question and correctly expanded the quadratic expression. The majority of students also used the standard results for $\sum r$ and $\sum r^2$ correctly. Very few students failed to appreciate that $\sum 1 = n$, and those who did then tried to falsely manipulate the algebra to achieve the printed result. Those who correctly used $\sum 1 = n$ were usually successful in obtaining the printed results. Algebraic manipulation was excellent in a lot of cases and students generally attempted to factor out $\frac{n}{3}$ early on in their solution.

Q05(b) was slightly less well answered although many students realised they needed to use $4n$ and $2n$, but poor substitution and use of brackets led to incorrect answers, losing the last accuracy mark.

## Question 6

Students used a variety of methods to find the gradient and then the equation of the normal to obtain the given result in Q06(a). Most students wrote $y$ in terms of $x$ and were able to differentiate and find the gradient in terms of $t$ correctly. Some students used implicit differentiation or the chain rule with the parametric equations. All these methods were usually very well done. Some students did not show their method for finding the gradient and lost marks in Q06(a).

In Q06(b) the vast majority were able to find the coordinates where the tangent and normal met the $x$-axis by using the given equations although there were a number of students who incorrectly used the tangent for $A$ and the normal for $B$. A few students found the intersection of both lines with the $y$-axis and unfortunately lost marks in Q06(b) and Q06(c) for this misinterpretation of the question.

In Q06(c) the majority of students made a good attempt to subtract the $x$-coordinates of $A$ and $B$. For some attempts this resulted in a negative length and consequently a negative area. Full marks were available however for those who went on to give the positive value for the area. There were algebraic manipulation errors and sign errors seen.

## Question 7

Many students in Q07(i) could not find the matrices securely to represent the basic transformations in Q07(a) and Q07(b). The correct order of composite transformation in Q07(c) was found to be challenging with many students attempting to multiply in the wrong order. Some students in Q07(b) and Q07(c) left the matrix in terms of the trigonometrical ratios. In Q07(ii) the majority of students successfully calculated the value of the determinant. Of those who went on to calculate an area for the triangle many used 364 and their determinant and were successful in finding a value for $k$. Those who attempted to find the area of the transformed triangle in terms of $k$ usually made no further progress.

## Question 8

Many students approached this question well. In Q08(a) they were able to find the gradient in terms of $k$ and hence go on to obtain the given equation of the straight line. A small minority tried to use calculus to find the gradient which was an incorrect interpretation of the question. Some responses left the gradient in an unsimplified form which complicated the calculation of the equation of the line. Some of the algebraic manipulation seen in this question was very inefficient with a lot of students multiplying by the gradient in its fractional form rather than removing fractions early on. In Q08(b) the majority found the perpendicular gradient, stated the focus and the directrix and used them to find the equation of the line. Some students made errors with signs and algebra when expanding brackets.

## Question 9

Students typically showed an understanding of the principal of mathematical induction and were able to obtain the first two marks in this question. Almost all students showed the function was divisible by 6 for $k = 1$. The majority of students then considered $f(k+1) - mf(k)$. Those who used $m = 1$ or $m = 2$ were the most successful. In a significant number of cases the students incorrectly manipulated the algebra to write their expression as a multiple of 6. Many got stuck after forming $f(k+1) - f(k)$, only gaining the first two marks. A significant minority of students lost accuracy marks by not explicitly expressing $f(k+1)$ explicitly as a multiple of 6. The majority of those who correctly manipulated the algebra, in general, followed through to produce a complete solution.

**Grade Boundaries**

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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