Examiners’ Report

Summer 2014

Pearson Edexcel GCE in Further Pure Mathematics FP2
(6668/01)

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Summer 2014
Publications Code UA038872

Mathematics Unit Further Mathematics 2

Specification 6668/01

General Introduction

This was a paper with some accessible and challenging questions thus every student was able to show what they had learnt.

Poor presentation can lead to a student miscopying their own work or making other errors and so achieving a lower score. It is good practice to quote formulae such as the series expansion in question 3 before substitution. When an error is made on substitution the examiner needs to be sure that the correct formula is being used before the method mark can be awarded.

If a student runs out of space in which to give their answer than they are advised to use a supplementary sheet – if extra paper is not available then it is crucial for the student to say whereabouts in the script the extra working is going to be done.

Report on Individual Questions

Question 1

This was an accesible testing of the method of differences to sum a simple finite series. The large majority of students scored full marks on this question. The terms of the series were usually clearly listed although some students listed terms from $r = 0$ or beyond $r = n$. Most students could identify the remaining four fractions that do not cancel. Some errors in working towards a single fraction were made and some students attempted the leap to the final given correct answer too quickly without showing the required working. It is important for students to remember the need to show all steps when an answer is given.

Question 2

The large majority tackled this inequalities question successfully. Several included a graph to illustrate their thinking. Those who did so could see that there were more than two intersection points. Most students identified the four critical values correctly and a small minority failed to combine them in the correct pair of inequalities. It was noted however that some students tried to find a solution by simply considering $3x^2 - 19x + 20$ on its own and getting $x = 5$ and $x = \frac{4}{3}$ as critical values.

There were a few cases where a quartic was obtained by squaring both sides of the given inequality. A number of those students who attempted this method were successful in identifying their four linear factors.

The large majority of students understood that algebra had to be used in this question and avoided using the calculator to give them a quick answer.

Question 3

This was a straightforward series expansion using Maclaurin's method. The large majority of students recognised that they had to differentiate twice, the second time using the product rule. This and the subsequent substitution were on the whole carried out correctly.

A small number of students attempted to use the series expansion of $e^x = 1 + x + x^2/2 + \dots$ Those who tried $(9 + x + x^2/2 + \dots)^{½}$ were on the whole, successful, but not those who tried $2\sqrt{2}(1 + e^x/8)^{½}$.

Question 4

Being a 'show that' question, detailed working was required to gain full marks and this was seen from most students.

Most students answered the first part of this question successfully navigating their way correctly through real and imaginary parts and the expansion of brackets involving $\left(1-\cos^2\theta\right)$. Some students used $\left(\cos^2\theta-1\right)$ by mistake compromising the last two marks of Q04(a). It was surprising to see that having expanded $\left(c+\mathrm{i}s\right)^6$ using the Binomial Expansion, most students then expanded $\left(1-\cos^2\theta\right)^3$ 'long hand'.

Some students began by expanding $\left(z+\frac{1}{z}\right)^n$ without giving any indication of what z might be representing. Most of those who did replace $z^n+\frac{1}{z^n}$ with $2\cos n\theta$ were successful in obtaining the desired result after some further work.

Most students reached the correct equation $\cos 6\theta=\frac{1}{2}$ and solved this correctly. Those who ended up with the wrong equation (eg $\cos 6\theta=1$ or $\cos 6\theta=0$) could still gain 2 out of the available 5 marks. Students were confident proceeding to obtain three correct solutions in the required range although a number left their final answer with only one or two angles.

Question 5

A large number of students tackled this question successfully. Some preferred to give the solution in terms of $A\mathrm{e}^{(-1+3\mathrm{i})x}+B\mathrm{e}^{(-1-3\mathrm{i})x}$ rather than $\mathrm{e}^{-x}\left(A\cos 3x+B\sin 3x\right)$. Some errors occurred in finding the Particular Integral by not using $y=k\mathrm{e}^{-x}$ and finding k. A small number of students lost the final accuracy mark in both Q05(a) and Q05(b) by not writing their solutions with “y = “.

Question 6

Students found this a challenging question. Several persisted in substituting $x + iy$ for z rather than $x + ix$ which involved complicated algebraic manipulations. Once $x = y$ was spotted most students proceeded to achieve the right answer for Q06(a). However, some students attempted to multiply through by a "conjugate" involving z, not realising that there was still an imaginary element to that conjugate, before making any substitution.

Q06(b) proved more challenging if the correct answer to Q06(a) had not been reached. Some students realised the importance of identifying the real and imaginary parts and scored the first method mark of Q06(b). Some proceeded by substituting into $(u - 3)^2 + v^2$; others by eliminating x to obtain an equation in terms of u and v which in some cases was simplified to that of a circle.

Some students ignored the instruction "Hence" in Q06(b) and started afresh by finding z in terms of w; these earning no marks for their efforts.

Question 7

Most students started this differential equation question by using $v = y^{-3}$ or $y = v^{-1/3}$. Since the correct answer had been given, most students navigated their way correctly to it. There was a small number of students who started with the given answer and ended showing that the given differential equation was correct. Common errors included writing y = v^3 instead of $y = v^{-1/3}$. Some differentiated y^{-3} to give $-3y^{-2}$ rather than $-3y^{-4}$.

In Q07(b) most students found the integrating factor correctly and proceeded to find a general solution in the form $y^3 = \mathrm{f}(x)$. Most mistakes occurred when students did not realise that they had to find $v \times \text{their IF} = \int \left(-6x^3 \times \text{their IF}\right)\mathrm{d}x$ for the method mark. Since the remaining marks depended on this mark, several students lost the last four marks for Q07(b). The absence of the integrating constant lost some students the last two marks. Another error was using the reciprocal incorrectly as $y^{-3} = cx^3 - 6x^4$ becomes $y^3 = \dfrac{1}{cx^3} - \dfrac{1}{6x^4}$.

Question 8

The polar coordinates question that concluded the paper was found to be an accessible one.

This question proved a valuable source of marks for most students. They demonstrated a sound understanding that they needed to start with x and proceed to $\frac{dx}{d\theta}$. Some students complicated the differentiation of $x = (1 + \tan\theta)\cos\theta$ by not noticing that this was $x = \cos\theta + \sin\theta$. A small number forgot to find their value of r having correctly identified the value of θ as $\frac{\pi}{4}$. The relatively few students who used $y = r\sin\theta$ and proceeded to differentiate ended up with no marks.

Q08(b) involved a simple substitution of $\tan^2\theta = \sec^2\theta - 1$. A sizeable majority of students spotted this and proceeded to integrate and substitute limits successfully. No instances of slipping into decimals were seen when moving towards the final answer.

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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