Examiners' Report

Summer 2016

Pearson Edexcel IAL in Further Pure Mathematics 2 (WFM02/01)

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IAL Mathematics Further Pure 2

Specification WFM02/01

Introduction

Generally students found this paper accessible and the range of the questions provided an opportunity for students at all levels to demonstrate their mathematical ability. Presentation was sometimes very good with the work easy for examiners to follow. There were no indications that students were unable to complete the paper in the time available.
Students should be encouraged to show all their working. For example, showing the substituting of limits following integration so that students can earn the associated method mark if appropriate.

Report on Individual Questions

Question 1

The students found this an accessible start to the paper. There were very few errors in determining the numerators of the partial fractions. The method of differences was well known and enough work was presented to be convincing as to how the terms cancelled. Sufficient intermediate steps were seen to lead to the printed result.
Q01(c) was usually well done but there were cases where the 5 was omitted, where $n = 9$ was used rather than $n = 8$ and where the original fraction was used rather than its sum.

Question 2

The majority of students used the most efficient way of solving this inequality by finding first the roots of $\left(x^2 - 9\right) = \pm\left(1 - 2x\right)$. There were some who only looked at one of these two equations because they looked at $\pm$ of both sides and ended up with the same equations twice (or in some cases different equations). Of those students who chose the much more difficult route of squaring both sides few could proceed from their quartic to the four required roots.
Having achieved the roots, students adopted a variety of methods all usually with success. Methods included sketching graphs, number lines and substituting values in between the roots to determine the sign changes.
The writing of the final inequalities was good but a few students introduced spurious equals signs.

Question 3

Students were usually well prepared for the demands of this question with the majority of students obtaining one of the versions of the correct answer. It was perhaps surprising seeing students integrating $x^{\frac{1}{2}}\left(1 + x\right)$ using parts rather than, more simply, expanding the brackets. However this longer method was executed successfully in most cases.
The constant of integration was introduced at the correct stage by nearly all students.

Question 4

This was another question where students clearly understood what was required of them. The requisite derivatives and their evaluation at $\frac{\pi}{3}$ were correctly done by the majority although there were some poor attempts at the differentiation in some cases.
There were some attempts at Maclaurin series rather than the required Taylor series.
Weaker solutions to Q04(b) substitute $\frac{1}{2}$ rather than $\frac{1}{3}$ into their expansion.

Question 5

Students who followed the route of re-arranging to make z the subject and then using Pythagoras' Theorem and the given condition often achieved the required centre and radius with ease. There were only a few solutions where the Pythagoras attempt included i and some students struggled with the required squaring of expressions. A significant number of students, having made z the subject, did not know how to proceed and could only score 2 out of the 7 marks available in this question.
Some students who, having made z the subject, replaced w with $u+iv$ and then attempted to multiply the numerator and denominator by the complex conjugate of the denominator. This was then followed by an attempt to split the resulting expression into its real and imaginary parts and then apply $x^2+y^2=1$. Students taking this approach were then unable to make any progress with the algebra required.

Question 6

The presentation of work in this question was often of a high standard and solutions were clear and easy to follow.
The method of obtaining the complementary function was well understood with only a relatively few errors. Similarly, the correct quadratic form of the particular integral was well known and the method of obtaining the coefficients of that quadratic by substitution was well executed.
Students knew how to take the general solution and apply the boundary conditions in order to obtain the remaining two constants.
There were only few students who lost marks by not writing their answer in the correct form.
Generally the only errors were errors in solving simultaneous equations and students are advised, if they have time, to check their answers.

Question 7

This question proved more demanding for students although there were many correct solutions.
Q07(a) proved accessible with most students achieving full marks although a significant number of students, having found θ, forgot to find r.
In Q07(b) the formula for the area enclosed by a polar curve was well known as was the idea that a sum of two areas was required. A common error was to use π rather than $\frac{\pi}{2}$ as the upper limit of the area bounded by the circle and some students correctly found the area of a segment for the relevant part of the area.
It was pleasing to see how many students could manage to take the quadratic function of $\cos\theta$ and change it into a function involving $\cos 2\theta$ and successfully integrate the resulting function.
The majority of the final answers did involve $\sqrt{3}$ and π rather than using decimals.
Students should be reminded that it is advisable to show how the limits are being substituted into the results of their integration rather than just produce a numerical result with no working.

Question 8

In Q08(a) the most popular method was to use the expansion of $\left(z+\frac{1}{z}\right)^5$ and the use of $\frac{z^n+1}{z^n}=2\cos n\theta$ to achieve the required result. Errors in the expansion were rare but the omission of the factor of 2 in $2\cos n\theta$ was seen more often. An alternative method was to expand $\left(\cos\theta+i\sin\theta\right)^5$ and then compare the real part with $\cos 5\theta$. Although the expansion was usually completed successfully the method often failed when students were unable to deal with the resulting $\cos^3\theta$ term.
In Q08(b) the integration was well attempted, even by those with wrong values for p, q and r. A correct final exact answer was seen frequently but students are advised to show the substitution of the limits into the result of integration rather than just writing down an answer.

Question 9

Students found this question demanding. Solutions were seen where there was no attempt at the locus at all. Students who had not met this locus before or could not appreciate the geometry required, resorted to attempting to investigate the locus algebraically, with mixed results.
In Q09(b), those students who appreciated the circular nature of the locus appreciated what was required to obtain the maximum value of the modulus of z and could make some progress. The centre was found by methods including finding the Cartesian equation of the circle and basic geometry. Understandably, students who did not appreciate the nature of the locus in Q09(a) were largely unable to make any progress in Q09(b).

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