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Examiners' Report

Summer 2015

Pearson Edexcel International Advanced Level in Further Pure Mathematics F2 (WFM02/01)

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Mathematics Unit Further Mathematics 2
Specification WFM02/01

General Introduction

This was a reasonably straightforward paper which gave all students plenty of opportunity to show their knowledge of the specification. There were no obvious signs that students did not have sufficient time to complete all the work they were able to do.

Students should be advised to write down the formula that they are going to use.. Errors in substitution are then penalised by accuracy marks only; if the general formula is not shown then method marks are lost as well.

Some students are clearly spending a long time on relatively short questions. Time management is part of examination technique and students should move on if they feel they are not succeeding with a question; they can return at the end if they have time left.

Examiners reported several instances of poor handwriting which made it extremely difficult to determine the variable being used. This was particularly seen in question 3 with u, y and even x all looking very similar. Also it was sometimes difficult to distinguish between powers and multiples in some students' presentation.

Report on Individual Questions

Question 1

Most students were able to identify the four critical values either by expressing the inequality as a single fraction or by correctly cross-multiplying by positive quantities. Having identified the correct four critical values, two main methods were seen to extract the solution inequalities – drawing a sketch graph or drawing a number line.

An alternative solution approach was to spot the first pair of critical values and then to treat the inequality as an equation to find the next pair of critical values. From there graphs or number lines were used to complete the solution.

There were very few solutions, which gained no credit, where a graphical calculator was used from the outset and no algebra was shown.

Question 2

In part (a) almost all students obtained the correct partial fractions expression with any errors caused by numerical slips. In part (b) most students attempted to sum the given expression by the method of differences, and most also made the connection between (a) and (b) by multiplying their sum by 2 either at the beginning or at the end. Students who were unsuccessful tended to forget to multiply the series by 2, while some resorted to using known formulae to try to obtain the result, despite the question being specific about using the method of differences. Such attempts generally scored zero marks.

Question 3

Students were well prepared for the demands of the first part of this question and they were able to transform the original differential equation by a variety of valid methods.

It was the second part of the question that caused problems. The idea of how to use their integrating factor was understood by most but the integration of $-2x\mathrm{e}^{3x^2}$ caused problems. Students at this level should not just take the presence of a product in an integral to mean that integration by parts must be needed. The most common mark for this part was 3/5.

Of those who did obtain a final solution for *z*, most were able to get their answer in the form $y^2 = ...$although it was also disappointing to see how many students thought that taking the inverse of a sum of terms could be done by inverting the separate terms.

Question 4

In part (a) most students attempted to multiply either their expression for *z* or the one for *w* by the correct conjugate. Some students then incorrectly applied the given condition, which was applicable in the *z*-plane, to their expression for *w* in the *w*-plane and ended up with no further marks. Students who applied the condition correctly to *z* after rearranging and multiplying by the correct conjugate generally progressed to the correct solution. Some disappointing presentation was observed with several attempts and crossed out work adjacent to partial solutions making it more difficult to see where marks should be awarded. In part (b) it was common to see a correct sketch followed through from working in (a) but some students were still uncertain how to establish which region should be shaded when checking a simple value (eg the origin) would suffice.

Question 5

This again was a question that students were well prepared for. The main problems in parts (a) and (b) centred around incorrect signs in differentiation. However for the most part students could get to the correct answers by the most efficient means. There were few solutions where students reverted to sin and cos to work with.

The Taylor expansion in powers of (x – pi/3) was well known. It should be stressed to students the importance of writing down the formula before using it although they must be careful about the use of f(x) as in the formula rather than the correct y or cot x.

It was pleasing to see students working in exact fractions rather than resorting to decimals.

Question 6

This question was very well answered by the vast majority of students, with many fully correct solutions obtained in (a). Common errors were mainly down to students being unable to solve their set of linear equations correctly to get their constants for the particular integral. Students would be best advised to double check that the values they obtain do satisfy their original equations. It was relatively rare to see a student who did not know how to find the particular integral, although some poor responses were seen where only one trigonometric function was used. This showed a poor level of preparation by such students in what was a routine question. Some minor errors were also observed when finding the complementary function, with some students simply forgetting the form of the solution when two distinct roots are obtained from the auxiliary equation. In part (b) the most common errors were either in writing down the wrong set of linear equations, or solving them incorrectly, however such students nearly always benefitted from the follow through marks available to them after these errors.

Question 7

Students quite often did not appreciate the meaning of the word verify so that what was supposed to be a straightforward start to the question was made into something more complicated as students tried by a variety of means to solve an equation to find θ.

The formula for the area under a polar curve was well known with very few students not being able to express the area as a correct integral although there were occasional problems in getting the limits on to the correct integral.

The method of integrating the powers of sin and cos by expressing them in terms of double angles was well understood and correctly carried out by the majority of students.

Some students did subtract rather than add their integrals but of those who added and had the correct limits on the correct integrals most were able to reach the answer in the required form.

Question 8

In part (a) most students made a reasoned attempt at multiplying out the brackets separately and then collecting the like terms together. Such attempts usually led to at least 2/3 marks being awarded. Algebraic slips were the main reason for students not obtaining full marks here. The more aware students noticed that a difference of two squares could simplify the given result and make the algebra easier- those students almost always obtained full marks in (a). Moreover part (b) was very well answered by the vast majority of students, with most demonstrating that they knew, understood and could apply de Moivre's theorem correctly. Some students did not show enough working here, while some did not seem to know how to simplify z^{-n} which was disappointing and showed a lack of preparation.

Part (c) proved to be the most challenging part of this question, with many blank attempts seen. Many students made no connection between parts (a) (b) and (c) while of those who did, it was not unusual to see their $(2\mathrm{i}\sin\theta)^3$ term simplified incorrectly, or for them to omit the ‘i’ term. If students were able to utilise parts (a) and (b) correctly then a correct solution was frequently seen. Furthermore in part (d) it was good to see that even students who were not able to obtain the correct answer for (c) were not put off attempting the integration with considerable success. The most common error here was in applying the ‘0’ limit incorrectly, or for simple arithmetic slips. Some students differentiated their expression, which may have been because they were under time pressure at the end of the examination.

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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