Examiners’ Report

Summer 2014

Pearson Edexcel International Advanced Level in Further Pure Mathematics F3 (WFM03/01)

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General Introduction

This paper proved a good test of students' knowledge and students' understanding of F3 material. In general, the standard of work was very high with many students scoring full marks on some questions. Presentation was also good but there were some cases where students showed insufficient working, particularly in places where the answer was given in the question. Students should be aware that in these cases, sufficient working must be shown to fully justify the printed answer.

Report on Individual Questions

Question 1

In Q01(a) most students managed to get the correct answer but many failed to put the answer in a simple enough form, as required in the question. It was at least expected that students would eliminate fractions over fractions. So whilst $\frac{6}{9+4x^2}$ was acceptable as a final answer, $\frac{\frac{2}{3}}{1+\frac{4}{9}x^2}$ was not. Some students began with $\tan y = \frac{2x}{3}$ and then differentiated implicitly to obtain the required result. A minority of students did not use the chain rule and differentiated to obtain $\frac{1}{1+\frac{4}{9}x^2}$ and a few students used the result for artanh rather than artctan.

Q01(b) was usually approached correctly by the majority of students. This was helped by the instruction to use parts. Even those with an incorrect result in Q01(a) could integrate to obtain an expression of the required form involving a natural logarithm.

Question 2

Most used the correct equations for the directrix and the eccentricity and were then able to proceed to eliminate either a or e to obtain a quadratic in one variable. Most then succeeded in finding the two values of a although there were a number of students who multiplied their value of e by 81 and not 9.

Question 3

Although most students followed the instructions given in the question to use the exponential forms of sinh x and cosh x to establish the identity in Q03(a) and to solve the equation in Q03(b), many penalised themselves by not following the instructions carefully and did not use exponential functions in Q03(b).

In Q03(a) most succeeded in proving this standard equality although some students did not show sufficient working to justify the accuracy mark. Examiners expected to see at least one line of working in between the substitution of exponentials and the “$=\ 1$”.

In Q03(b) those who used the exponential form of the hyperbolic functions, as instructed, quickly managed to collect the terms and form a 3 term quadratic in e^x. The quadratic was solved by either using the formula or less frequently, by factorisation. Once the values for e were found very few made errors in finding the values of x. A significant number of students chose to make a rearrangement of the given equation and square both sides and solve their resulting equation without reference to exponential functions.

Question 4

In Q04(a) most succeeded in finding the determinant correctly although the sign error of $6 + k^2$ was seen occasionally. There were very few students who did not know the full method for finding an inverse.

In Q04(b) most succeeded by pre-multiplying the column vector by the inverse of the matrix, (having substituted $k = 1$) to give the correct answer. The main error was in multiplying the vector by the matrix itself. Some students took the more laborious approach of setting up three simultaneous equations to establish the coordinates of A. Given the location of the three zero elements of **M,** this essentially meant solving **e**quations in two unknowns and students were largely successful with this approach.

Question 5

In Q05(a) many students realised how to start the integration by parts and followed the main method on the mark scheme, although quite a few did not identify the second step to write $\sin^2\theta$ as $1-\cos^2\theta$ or showed insufficient working to justify that this result was being used. There were some students who wrote $\cos^n\theta$ as $\cos^{n-2}\theta\cos^2\theta$ and then as $\cos^{n-2}\theta\left(1-\sin^2\theta\right)$ and then proceeded correctly to obtain the printed result.

In Q05(b) the majority of students realised that they needed to use the reduction formula to obtain I_5 in terms of I_3 and I_3 in terms of I_1 and then to find I_1 by integration. However there were some who thought they needed to find I_0 and this of course did not work. There were also others who did not simplify their answers and left their result with fractions containing $\sqrt{2}$ in the numerator and denominator.

Question 6

Most tried to find the equation for the tangent to the hyperbola by using the parametric form of x and y. This proved to be easier than differentiating implicitly or explicitly. In establishing the printed result, some students jumped from

$(y - 2\sinh\alpha) = \dfrac{\cosh\alpha}{2\sinh\alpha}(x - 4\cosh\alpha)$ to $2y\sinh\alpha - x\cosh\alpha + 4 = 0$

with no intermediate work and thereby lost the final accuracy mark in this part.

Q06(b) was very straightforward for the majority of students although there were a few who found where the tangent crossed the x-axis instead of the y-axis

For Q06(c), provided that the student used the correct eccentricity equation, it was relatively straightforward to find the correct value for ae although some multiplied e by 16 rather than 8. It was then straightforward to find the gradients of AS and BS and prove these lines were perpendicular or to use vector **AS** and **BS** and prove the scalar product to be zero. The only problem was that some forgot to give a conclusion.

Question 7

In Q07(a) the majority of students succeeded in getting the correct derivatives for $\dfrac{\mathrm{d}x}{\mathrm{d}t}$ and $\dfrac{\mathrm{d}y}{\mathrm{d}t}$ and then used the correct formula for the surface area and attempted to integrate either by using a substitution $t = \tan\theta$ or by recognising they could reverse the chain rule. The limits were generally attempted correctly but errors occurred when trying to simplify their integral and some failed to give their answer in the form required.

In Q07(b) it was rare not to see a correct integral for the arc length.

As the question gave the substitution for Q07(c), most then found the derivative and completed the substitution. Many students then identified the need to use the double angle formula for cosh – and could then use the correct limits to establish the answer as given in the question.

Question 8

In Q08(a), once the student realised that they need to insert the equation of the line into the equation of the plane then they could achieve the correct value for λ and could find the coordinates of the point where the line and plane intersected.

Q08(b) could either be solved in a similar way to Q08(a) by finding where the line intersected the plane Π_2 or by showing that AB was perpendicular to the plane Π_2 and that the point B was on the second plane Π_2.

In Q08(c) there were many ways of finding the point A' and most used a correct strategy which quite often involved the property of a mid-point.

In Q08(d) it was important for students to realise that the line required, passed through A' and B. It is often useful in cases like these for students to draw a diagram the help them visualise the scenario. Students were seen to start with a wrong direction and were thus unlikely to make any progress in Q08(d). Of those students who used an appropriate method for the vectors **a** and **b**, a significant number failed to give the equation of the line in the required form.

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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