Examiners' Report

Summer 2014

Pearson Edexcel GCE in Further Pure Mathematics FP3R (6669/01R)

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2014
Publications Code UA038880

Mathematics Unit Further Pure Mathematics FP3

Specification 6669/01R

General Introduction

This paper proved a good test of students' knowledge and students' understanding of FP3 material. There were plenty of accessible marks available for all students. 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

The majority of students substituted the exponential forms of $\tanh x$ and $\operatorname{sech} x$ and went on to establish the correct quadratic in e^x and solve it correctly to find the correct values of x. A significant number of students multiplied through by $\cosh x$ and then substituted for exponentials and were equally successful. A minority of students opted to rearrange the given equation and square to obtain a quadratic in $\sinh x$ or tanh and then went on to introduce exponential functions and again were very successful.

Question 2

In Q02(a) almost all students could obtain the correct values for *a*, *b* and *c* although a small number found the algebra challenging. In Q02(b) and Q02(c), students needed to identify the correct forms to be able to deal with the integration. Although the majority recognised the arctan form for Q02(b) and the arsinh form for Q02(c), many students did not obtain the correct coefficients in one case and/or the other. Students are advised to consider carefully situations like these where the coefficient of x^2 in the quadratic is something other than unity.

Question 3

In Q03(a) the majority of students used the chain rule successfully to establish the printed result. However, there were some cases where insufficient working was shown and some students wrote $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{2} \times \frac{1}{\coth x} \times -\operatorname{cosech}^2 x$ followed by $\frac{\mathrm{d}y}{\mathrm{d}x} = -\operatorname{cosech} 2x$. Examiners would expect some intermediate working to justify this given answer. Some students wrote the equation as $e^{2y} = \coth x$ and used implicit differentiation and were largely successful with this approach. For the arc length in Q03(b), the majority could make a start by using the correct formula. Most then opted to use the identity $1 + \operatorname{cosech}^2 2x = \coth^2 2x$ although a surprising number of students used $1 + \operatorname{cosech}^2 2x = \coth^2 x$ which would potentially lose them 3 marks. Those who reached an expression involving coth then often spotted the need for a natural logarithm although those with $\coth 2x$ sometimes missed the $\frac{1}{2}$.

Question 4

Students found it challenging to establish the reduction formula in Q04(a). Of those who made progress, the majority took u as $\left(3 - x^2\right)^n$ and $\frac{\mathrm{d}v}{\mathrm{d}x}$ as 1. The alternative of writing $\left(3 - x^2\right)^n$ as $\left(3 - x^2\right)^{n-1}\left(3 - x^2\right)$ and then multiplying out to obtain 2 integrals was seen occasionally. However, many students were unable to make a start. Q04(b) was accessible to students of all abilities and apart from a few errors, many students obtained the correct answer although some did not leave it in exact form.

Question 5

This coordinate geometry question proved to be a good source of marks for many students with Q05(d) discriminating at the top end.

Q05(a) was a write down and students invariably gave the correct values for *a* and *b*. Q05(b) involved routine work to find the equation of a tangent. Although the work was often sound, a significant number of students did not show enough working to establish the printed result. Some students correctly reached $y - \sin\theta = -\dfrac{\cos\theta}{3\sin\theta}(x - 3\cos\theta)$ and then just wrote down $3y\sin\theta + x\cos\theta = 3$. Students are expected to show enough working to establish a given answer and this would be regarded as insufficient. Q05(c) was a straightforward demand to find the area of a triangle although a surprising number of students missed off the $\dfrac{1}{2}$ .In Q05(d), many students found the mid-point correctly although some got them the wrong way round. Most could then at least make a start establishing the cartesian equation of the mid-point but a significant number of students struggled to make y^2 the subject and there were sometimes some basic algebraic misconceptions such as $\dfrac{9}{4x^2} + \dfrac{1}{4y^2} = 1 \Rightarrow \dfrac{4x^2}{9} + \dfrac{4y^2}{1} = 1$.

Question 6

In Q06(a) students usually wrote down a matrix of eigenvectors for **P** but not always of unit length. Often the matrix **D** was not attempted but those who did, usually knew it needed to have the eigenvalues on the leading diagonal and were usually consistent with their matrix **P**. Q06(b) was accessible to the majority of students and many showed clearly each step of their working to establish the given result. Those students who had matrices for **P** and **D** could make further progress in Q06(c) and those with correct matrices often proceeded to obtain the correct matrix **M**.

Question 7

In Q07(a) nearly all students could establish the printed result for the surface area. Some students did, however, fail to show enough working. Students must be clear that a solution along the lines of $\dfrac{\mathrm{d}y}{\mathrm{d}x} = -\mathrm{e}^{-x} \therefore S = 2\pi\int \mathrm{e}^{-x}\sqrt{1+\mathrm{e}^{-2x}}\,\mathrm{d}x$ is not enough to score the 3 marks. It was expected that students should at least quote the general formula for surface area and then substitute their derivative. In Q07(b) the majority of students knew how to use the substitution but a few failed to replace the $\mathrm{d}x$ correctly and could make little progress. Those who did substitute correctly were confused by the minus when correctly obtaining $\mathrm{d}x = -\dfrac{\cosh u}{\mathrm{e}^{-x}}\mathrm{d}u$ and sometimes crossed it out in an attempt to establish the printed answer. The better students realised that the minus sign could be eliminated by swapping the limits. Students were helped with the subsequent integration required and the majority could establish the result Q07(c) by using the correct hyperbolic identity. Correct answers to Q07(d) were rare and students often forgot to reintroduce π or omitted the 2 in the $\sinh 2u$.

Question 8

In Q08(a), students used a variety of methods to find an equation for the line of intersection of the two planes. Perhaps the most common approach was to attempt the cartesian equation of the line by expressing one of x or y or z in terms of the other variables from the Cartesian equations of the two planes. This was met with varying degrees of success but largely the method was sound with some occasional algebraic slips. From the Cartesian equation, most could identify the position and direction of the line correctly. A significant number of students correctly used a vector product to find the direction of the line.

In Q08(b) students with a vector equation from Q08(a) could proceed correctly and substituted into the third plane to identify the intersection of the 3 planes. Some students chose to solve 3 simultaneous equations to find the required point and were, in many cases, successful.

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

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE