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Examiners' Report

Summer 2015

Pearson Edexcel Advanced Extension Award in Mathematics (9801/01)

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Mathematics Unit Advanced Extension Award

Specification 9801/01

General Introduction

The question paper proved accessible to all the students but questions 3, 4(c) and 7(c) provided plenty of challenge for those aspiring to the distinction grade.

Report on Individual Questions

Question 1

This proved to be a good starter and most made some progress here. There were many fully correct graphs but some were unsure over the behaviour for $x \leqslant -2$, and the curvature was incorrect, and a number simply just sketched $y = \ln(2x + 5)$. In part (b) most found the solution to $2x + 5 = 9$ but the equation $\ln(2x + 5) = -\ln(9)$ sometimes became $2x + 5 = -9$ however there were plenty of fully correct solutions seen.

Question 2

Part (a) was nearly always correct by using the factor theorem or using long division but some failed to give a suitable conclusion. Most were able to start part (b) too and many squared twice to obtain the correct cubic equation and then usually used part (a) to solve it finding answers of $x = -1$ and $x = \frac{1}{2}$. Only a few realised that squaring may have introduced extra solutions and suitable checks were only carried out by the better students. A small minority realised that some form of check was required but did not use the <u>original</u> equation and were therefore unable to establish that there was only one solution to the problem.

Question 3

This proved to be a challenging question with many students simply expanding $\cot 2x$ in terms of $\tan x$ and then getting lost in a mass of algebra which they could not simplify or factorise. Others made the more promising start of converting the left hand side to $\frac{\cos 2x}{\sin 2x} - \frac{\sin 78}{\cos 78}$. It is a general principle for solving trigonometric equations containing several ratios, to reduce everything to sin and cos but many seemed unfamiliar with this strategy. Those who set off in the right direction and then attempted to put their left hand side over the same denominator stood a good chance of identifying $\cos(2x + 78)$ on the numerator. This was the key to reducing the equation to $\cos(2x + 78) = \sin x$ and the first 4 marks . Most who got this far were able to obtain at least one solution by replacing $\sin x$ with $\cos(90 - x)$, or something equivalent, but only the very best students considered all the cases needed to find all 4 solutions.

Question 4

Part (a) was a fairly standard expansion and nearly all the students completed this correctly. Most then replaced their y with $5x + x^2$ and simplified correctly to the given expression. Some spotted that $4 + 5x + x^2 = (4 + x)(1 + x)$ and proceeded to multiply together the expansions of

$(4+x)^{\frac{1}{2}}$ and $(1+x)^{\frac{1}{2}}$ which, of course, also led to the same expression. Part (c) caused problems with many students either not knowing the conditions for convergence of a binomial expansion or failing to see how these could be used to establish the required result. Those who did consider $\left|5x+x^2\right|<4$ or, if they had multiplied the two expansions in part (b), $|x|<4$ and $|x|<1$ should then have been able to argue that the expansion would be valid in the interval $\left[-\frac{1}{2},\frac{1}{2}\right]$. Part (d) was done correctly by most students although only the more astute realised that because the interval of integration was of the form $\left[-a,a\right]$only the even powers of x in the expansion needed to be considered thus reducing the amount of arithmetic required.

Question 5

Parts (a) and (b) were answered very well by the majority of the students with some using the quotient rule in (a) and others reducing the function to $\mathrm{f}(x)=\frac{x}{3}+\frac{16}{3}x^{-1}$. Some of the sketches in part (c) had two branches for each of g and $\mathrm{g}^{-1}$and many lacked attention to detail: some curves bent away from the coordinate axes for large negative values and for others g did not have a domain of [−4, 0). Most students realised that the inverse function is a reflection in the line $y = x$ but many did not exploit this fact when answering part (e). Part (d) proved to be difficult for some students. They realised that they needed to make x the subject of $y=\frac{x^2+16}{3x}$ and often rearranged to $x^2-3xy+16=0$ but didn't realise that they could then use the quadratic formula. Those who did take this step rarely considered what to do with the $\pm$ and only the very best were able to give a convincing reason for choosing the + sign. These students usually have strong algebraic skills and many were able to reach a correct answer in part (e) from equating g(x) = $\mathrm{g}^{-1}(x)$ or even gg(x) = x but a number looked at their sketch to see that there was only one solution and used the simpler g(x) = x as intended.

Question 6

Although this was a long question the structure meant that all the students could make some progress here. Part (a) was answered very well using a scalar product but some students failed to give a conclusion explaining the significance of $\begin{pmatrix}2\\-5\\4\end{pmatrix}\bullet\begin{pmatrix}1\\2\\2\end{pmatrix}=0$. A sizeable minority of students claimed to be ignorant of the term "skew" to describe lines which are not parallel and do not intersect but most formed suitable equations in λ and μ, solved 2 of them and checked in the 3rd.

There was some shocking arithmetic here with errors like $9\lambda = 14$ leading to $\lambda = \frac{9}{14}$, or an equivalent error, appearing all too often. In part (c) most students wrote $\overrightarrow{AX}$ in terms of λ and then used a suitable scalar product to obtain a suitable linear equation in λ which was easily solved. Some students found $\left|\overrightarrow{OX}\right|$ in part (d) and some did not simplify their surd which would have made further work a little easier but there were many correct solutions here. In part (e) the most common approach was to write $\overrightarrow{OB}$ in terms of μ, then form $\overrightarrow{BX}$ and equate moduli to form a quadratic equation in μ. The alternative approach using the isosceles triangle *AXB* was rarely seen. The final part (f) was a straightforward application of the scalar product and those who had worked accurately throughout were usually able to obtain the correct answer.

Question 7

This question proved to be an effective discriminator with many making a good start but few able to complete the final part. Nearly all the students were able to use the given substitution to start part (a) and reached an integrand of $\frac{\sec\theta}{\tan^2\theta}$. Some turned this into $\frac{\cos\theta}{\sin^2\theta}$ and then used a further substitution of the form $t = \sin\theta$ whilst others identified that this was $\operatorname{cosec}\theta\cot\theta$ and were able to use a standard result to complete the integral. In part (b) the instruction to integrate by parts helped many get started but some chose to integrate $\operatorname{cosec}\theta$ and were rarely able to complete the integration. A few students did not identify the original integral when it appeared again and they struggled to provide a convincing demonstration of the result. In part (c) most were able to identify a correct integral and many tried the same substitution, as intended, and got as far as $\int \operatorname{cosec}\theta\cot^4\theta\,\mathrm{d}\theta$. At this point most attempts floundered: a further integration by parts, followed by use of the $\operatorname{cosec}^2\theta = 1 + \cot^2\theta$ identity (as in part (b)) would have helped them but some students worked with accuracy and persistence on alternative approaches and were sometimes able to reach the required 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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