AEA

Examiner's Report

Advanced Extension Award (AEA) Mathematics (9801)

June 2003

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Mathematics Advanced Extension Award
Specification 9801

(Maximum mark: 100)
(Mean mark: 40.6; **Standard deviation:** 20.4**)**

Introduction

There was a mixed standard of entry again this year and the examiners saw scripts with marks ranging from 0 to 100. Questions 3 and 4 were accessible to most candidates as were the first couple of parts in questions 5, 7 and sometimes 6. There were plenty of discriminators in questions 5(c), 6(c) and 7(e) and some excellent solutions were seen to these by candidates gaining distinction. The first two questions revealed weaknesses across all abilities. Those who failed to draw a diagram and use some simple geometry usually failed to produce a convincing argument in question 1 and many got lost in a sea of trigonometric formulae in question 2 because they lacked a suitable strategy.

Report on individual questions

Question 1

The key to this question was to observe that *OA* was equal in length to *AB* and therefore triangle *OAB* was isosceles. Those who realized this were usually able to establish that angle *BOX* was $\frac{3\pi}{8}$ and complete the question. A large number of candidates could show that the tan of angle *BOX* was $1+\sqrt{2}$, but they were unable to convincingly explain why the angle was $\frac{3\pi}{8}$ by using the given diagram. Some candidates used the midpoint *M* of *OB* and tried to find tan(*BAM*) but they were rarely successful, as few could establish the correct length of *AM*. Other attempts involved scalar products or the use of tan(*A*+*B*) formulae but these rarely considered triangle *OAB* and so were worthless as solutions to this question. A salutary lesson for all here is to look carefully at a given diagram and see what information it gives before wading in with lots of calculations.

Question 2

The "think before you leap" warning applied equally well to this question. Candidates who realized that they were seeking values of $\tan\theta$, and set about trying to convert the terms in the equation into tangents, usually made quick progress. Many realized that $\sin\theta\sec\theta = \tan\theta$ but the key step was then to divide throughout by $\cos^2\theta$. Those who did this were usually able to form a simple cubic equation in $\tan\theta$ and complete the question. Far too many scripts contained a page or more of work, using all conceivable trigonometric identities but with no clear strategy. There were several other neat solutions to this question. They usually led to a line such as $\sin\theta(\sin 2\theta - 1) = 2\cos\theta(\sin 2\theta - 1)$ or $2\sin\theta\cos\theta(\sin\theta - 2\cos\theta) = \sin\theta - 2\cos\theta$.
It was disappointing though when the candidates cancelled the common factor instead of collecting terms on one side, factorizing and therefore finding both solutions to the equation.

Question 3

This was a popular question and a good source of marks for most candidates. The vast majority found a correct equation for the tangent but it was disappointing at this level to see some answers being left with variable gradient. Weaker candidates could not find the coordinates of Q but many achieved this successfully either using an equation in terms of t or sometimes in terms of x or y. A large number found the area of the trapezium by integration, though many others wrote its area down directly. The integration to find the area under the curve was carried out correctly by many candidates. A common arithmetic error was to obtain this area as $\frac{96}{5}-\frac{3}{5}$, rather than $+\frac{3}{5}$ but there were a number of fully correct solutions to this question that also warranted 2 S marks as well.

Question 4

Nearly all the candidates knew the correct method and attempted to apply it and a good number selected $x = 1$ to find D immediately. Others made careless errors at the start and $(1-x^2)$ or $(1-x)^3$ as the multiplier of $(Ax+B)$ were sometimes seen. Often those who started correctly indulged themselves in excessive algebraic manipulation which often led to errors and wasted time. Fully correct solutions to part (a) were not as frequent as one might have expected. In part (b) it was disappointing to see a number of students using Maclaurin's theorem, rarely with much success, but those who did use the binomial expansions were usually able to obtain a series expansion for f(x) although completely accurate answers were less common. Many candidates did not appreciate that the series expansion could be used to find $\mathrm{f}(0)$ and $\mathrm{f}'(0)$ and only a handful appreciated that the equation of the tangent was obtained from the first two terms of their expansion. Some differentiated the original expression for f(x) whilst others used their expression found from the partial fractions but neither approach was particularly neat and did not qualify for an S mark.

Question 5

The sketch was well done here and most candidates went on to differentiate the function correctly and found the minima at $x^2 = \frac{29}{2}$ and many obtained the minimum of $\frac{-441}{4\lambda}$ or equivalent. Some then gave the range as $\mathrm{f} > \frac{-110.25}{\lambda}$ or $\frac{-110.25}{\lambda} < \mathrm{f} < \frac{100}{\lambda}$. A few weaker candidates simply thought that the minimum was at $x = \pm 3\frac{1}{2}$ (midway between 2 and 5). Part (c) proved beyond all but the best candidates and completely correct solutions were rare; it was disappointing to see so few attempting to sketch |f(x)| for this should have enabled them to see how to get started. Unfortunately some promising attempts failed because the candidates did not notice that λ was an integer or they failed to consider the cases where the horizontal line is a tangent to the curve.

Question 6

There were many good responses to parts (a) and (b). Some unusual methods were sometimes seen in part (a) where candidates observed that $2+\sqrt{3} = \frac{(1+\sqrt{3})^2}{2}$. In part (c) a good number of candidates was able to show that $n = 2[a-\sqrt{a^2-15}]$ and often these candidates saw that the pairs (a, n) = (4, 6) and (8, 2) satisfied this condition. What they found difficult was establishing that there were no other values. Some candidates chose to square the above expression for n and obtained $a = \frac{n^2+60}{4n}$. A systematic search usually gave them the correct solution pairs plus $a = 4$ with $n = 10$ and $a= 8$ with $n = 30$ but they usually failed to check whether or not all their solutions were valid.

Question 7

The first two parts were answered well by the majority of candidates although a few weaker ones had $\frac{\pi}{2}, \pi$ and $\frac{3\pi}{2}$ and some did not realize that they needed to integrate by parts a second time in part (b). In part (c) some used their result from part (b) with limits of $(2n-2)\pi$ and $(2n-1)\pi$ whilst others evaluated the first few terms of the sequence and tried to spot a pattern. In part (d) a general proof that the sequence formed a geometric series was required, and only the very best candidates provided this. However many were able to use the S_∞ formula and, provided they simplified their formula for *r,* they usually went on to obtain the printed result. Part (e) was answered well in many cases and there were several excellent convincing arguments. The candidates who considered the sequence of areas below the *x*-axis and related this sum to their answer in part (d) and the given result were usually able to secure the answer in a few lines. Others never saw this connection and made little progress.

Grade Boundaries and Pass Rate Statistics
June 2003
Mathematics Advanced Extension Award Examination

Subject Number	Subject Max Raw	Grade Boundaries		
		Distinction	Merit	Ungraded
9801	100	70	50	0

Subject Number	Number Sat	Number of Passes and Pass %	Cumulative Percentages of Candidates at Specified Grades		
			Distinction	Merit	Ungraded
9801	1007	32.2	9.6	32.3	100.0

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