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Principal Examiner Feedback

Summer 2013

Advanced Extension Award
Mathematics (9801)

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AEA Mathematics (9801)

Introduction

The paper was accessible to all the candidates and the standard of work on calculus and vectors was again pretty good although there appeared to be a number of candidates entered for this paper whose numerical and algebraic skills were not as fluent as expected. Questions 2(a), 3(a)-(c), 4(a), 5(b)(d) and 7(a)(b) were all particularly accessible but the paper also gave plenty of opportunities for the better candidates to shine and questions 1(b), 2(b), 3(d), 5(a)(c) and 7(c)(d) proved to be quite discriminating.

Report on individual questions

Question 1

Most candidates secured the first mark in part (a) but a surprising number then chose to multiply out their coefficients and often lost accuracy in the ensuing “sea” of calculations. Efficient manipulation of expressions and keeping terms factorised where possible are key skills to success at this level. Those who did arrive at the correct quadratic expression in n could usually solve to find the two values of n although some were also considering $n = 0$ or 1 at this stage as they had not appreciated that the coefficients were non-zero. Part (b) proved more discriminating and a number of candidates seemed unaware of the $|x| < 1$ condition for the validity of a binomial expansion $(1+x)^n$ for $n \notin \mathbb{N}$. Those who did apply this condition often arrived at $|n| < \frac{5}{6}$ but did not always go on to specify which value of n they could use.

Question 2

Part (a) proved a straightforward starter which most candidates were able to answer successfully. Part (b) proved to be more difficult for many. Most candidates seemed to realise that the result from part (a) could be useful, but they could not always see at which stage to apply it. Some applied $\sin(A + B)$ and the $\cos(A + B)$ formulae and ended up with a page of impenetrable trigonometry which defied further progress. The key step was to identify the opportunity to use the $\sin 2A$ formula and then apply the result from part (a) and those who identified this were usually able to obtain at least one of the 4 answers. Achieving a second or 3rd equation was only mastered by the better candidates and some poor arithmetic here meant that only a few produced a fully correct solution.

Question 3

Parts (a) and (b) were answered very well. In part (c) the scalar product was familiar to most candidates and $\overrightarrow{CA}$ and $\overrightarrow{CB}$ (or occasionally $\overrightarrow{BC}$) were usually used but many candidates could not simplify their expression to $\frac{23}{39}$. Candidates who simplified the lengths of their vectors would have discovered that $\left|\overrightarrow{CA}\right| = 2\sqrt{13}$ and $\left|\overrightarrow{CB}\right| = 3\sqrt{13}$ and this would have helped them here in part (c) and given a hint as to the correct approach in part (d). Very few made progress with the final part. The commonest approach was to find the median of the triangle but some did realise that they needed to consider a rhombus but their explanations were not always very clear and it was sometimes difficult to give partial credit where an incorrect answer was obtained. A clear diagram and explicit definition of intermediate points would help both candidates and examiners.

Question 4

This was possibly the least well answered question on the paper. Part (a) was fine but in both parts (b) and (d) general proofs for all values of *r* were required and many candidates merely demonstrated that the results were true for some specific values. In part (c) a surprising number failed to identify the geometric series and some thought that $\sum 1 = \frac{n(n+1)}{2}$. In part (e) the candidates had to use the result in part (d) to show that $\frac{1}{a_4} < \frac{\frac{1}{2}}{a_3}, \frac{1}{a_5} < \frac{\frac{1}{2}}{a_4}$ and hence that $\frac{1}{a_5} < \frac{\frac{1}{2}\times\frac{1}{2}}{a_3}$. Some candidates were able to state 2 of these inequalities but few gave convincing arguments to establish all 3. In part (f) the lower limit from the first 3 terms was often overlooked but many recognised the geometric series and were able to establish the upper limit.

Question 5

Some candidates thought that part (a) could be established by integration and made no meaningful progress whereas those who realised that differentiation of the given result was required usually completed the proof successfully. Almost all the candidates knew what to do in part (b) though and this mark was usually scored. Part (c) caused some difficulties with some thinking that $\int \mathrm{u}\,\mathrm{d}x = \frac{\mathrm{u}^2}{2} + c$ but those that realised $\frac{\mathrm{d}}{\mathrm{d}x}\left(\int \mathrm{u}\,\mathrm{d}x\right) = \mathrm{u}$ and could use the product or quotient rule were usually able to establish the result. Solving the differential equation in part (d) was a more recognisable problem and the printed answer probably helped steer some candidates in the right direction but the quality of work on this part was generally very good. In the final part most could differentiate the given expression but some then struggled to deduce the expression for v preferring to repeat the work of (c) and (d). Questions on the AEA will frequently try and encourage the candidates to identify such connections.

Question 6

In part (a) most candidates could square the given result and then integrate between the limits to achieve the required inequality. The better candidates mentioned that if the function is non-negative then the area under the curve will also be non-negative and set themselves up for some possible S marks. Part (b) was not answered well and many candidates made no progress. Those who realised that the discriminant was required often tried to apply $b^2 - 4ac \geq 0$ and mysteriously fudged the signs to try and arrive at the printed result. Some looked ahead and realised that they needed to apply $b^2 - 4ac \leq 0$ but only a small minority justified this choice and secured all the marks. Part (c) most candidates were able to follow the lead and establish the inequality but part (d) caused many to stumble as integration by parts was attempted. In part (e) the candidates needed to select their own functions f(x) and g(x) and then use the results from parts (b) and (d) and many did spot the connections and establish the given inequality successfully.

Question 7

Almost all candidates could get started here and part (a) was answered well. Most were also able to answer part (b) too but the hint this was supposed to provide for part (c) was lost on the majority. In part (c) many gave an expression for the gradient of the normal when x = , but few realised this should equal to $\frac{1}{3}$, the gradient of the chord. Rather they attempted to form an equation for the normal at this point, set it equal to the equation of the curve and use the discriminant condition for one root to obtain an expression for . Most of these attempts faded into a “sea” of algebra. A few more perceptive candidates did solve a correct equation and were often able to score the marks in both parts (c) and (d). The sketch in part (e) was well done, except sometimes the asymptotes were not stated, and there were some good attempts at part (f). The usual approach was to form an equation based on the line intersecting the curve and then impose a condition on the discriminant . Some set < 0 and solved to find $m < \frac{5}{16}$, others chose the limiting case and solved = 0 and then argued that because the line does not touch or intersect the curve then $m < \frac{5}{16}$. Sometimes they forgot to complete the argument, by using the symmetry of the curve, but usually both inequalities were stated.

Grade Boundaries

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