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Summer 2012

Advanced Extension Award
Mathematics (9801)

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Introduction

The paper was accessible to all the candidates and the standard of work on calculus, functions and vectors was high. Some of the trigonometry proved challenging (notably in questions 2 and 3) and many found the sketch in 7(b) quite tricky. The paper also gave plenty of opportunities for the better candidates to shine and questions 3(b), 4(c), 5(a), 7(d) and 7(f) proved to be quite discriminating.

Comments on individual questions

Question 1

This proved to be a friendly starter to the paper. Most answered part (a) correctly with many both completing the square and using calculus to establish the minimum. Only a small minority found $\text{fg}(x)$ in part (b) and many correct expressions were seen. Part (c) proved a little more challenging and very few could write down the domain of gf with " $x \in \mathbb{R}$" or "$x \geq 2$" being common errors. More made progress with the range but an answer of $\text{gf} \geq 3+\sqrt{10}$ was quite common.

Question 2

Part (a) was usually correct with most using $sin(x + 2x)$ and then the double angle formulae although a few successful solutions used DeMoivre's theorem. Most could see how to use this result in part (b) but there were a number of numerical slips, lost factors of 2, and many could not see how to write down the answer to $\int 4\sin^2 x \cos x \, \mathrm{d}x$. Some tried integrating by substitution and others used integration by parts with varied degrees of success. Part (c) was a little more difficult but a good number saw that using the given result and the formula for sin2x simplified their integrand. Many though either couldn't simplify $8^{\frac{1}{3}}$ correctly or failed to spot the derivative of $\cos^{\frac{4}{3}} x$ to complete the question successfully.

Question 3

This question was the least well answered on the paper with candidates often giving a page or more of trigonometric ramblings without making progress towards a solution.

Those who did make some progress usually identified the geometric series and used the sum to infinity formula. Seeing that a solution in $\tan\theta$ was required led many to use the $\tan 2\theta$ formula too but few managed to arrive at an equation in $\tan\theta$. A few stumbled on a correct quartic in $\sin\theta$ and often they did eventually achieve a correct solution. Those who did arrive at $\tan\theta = 3^{-\frac{1}{4}}$ usually produced a sound argument in part (b) and an observation that tan$x$ was a continuous, increasing function confirmed that they had a sound understanding of the topic.

Question 4

There were some mixed responses to this question.
In part (a) many set about finding vectors $\overrightarrow{AB}, \overrightarrow{AC}$ and $\overrightarrow{BC}$ and then calculating their lengths. Those who related these lengths to the 3 vertex-vertex distances in a cube easily identified the length of a side and found the correct volume, a number though simply found the product of the lengths of their 3 vectors. Some candidates incorrectly assumed that the origin was also a vertex of the cube and simply found the lengths of **a, b** and **c** and others used a scalar triple product.

Part (b) was answered very well by most candidates with only a few thinking $\cos 60^o = \frac{\sqrt{3}}{2}$ or forgetting to square *a* when calculating the length of $\overrightarrow{PQ}$. Part (c), by contrast, was not answered well with few candidates linking this to the 7, $7\sqrt{2}$ and $7\sqrt{3}$ answers they found in part (a). A common mistake was to write down the length $\left|\overrightarrow{PQ}\right|$ failing to realise that this was the length of the diagonal of a face of the cube and not the length of a diagonal of the cube itself.

Question 5

In part (a) most used the power rule correctly to form an equation in $\log_a x$. Many then divided by $\log_a x$ but then used the power rule incorrectly, rather than taking the (n – 1)th root.

Better progress was made with part (b) with many using the given statement to obtain a quadratic in $\log_a x$. There were some poor attempts to factorise but most used the formula correctly and identified x_1 and x_2 and then frequently went on to answer part (ii) successfully.

Part (c) required the use of the sum formulae for an arithmetic and a geometric series along with some careful and sustained algebra to arrive at the printed result but there were some succinct solutions seen.

Question 6

This proved to be a fairly straightforward question but good candidates could (and did) earn S marks for more stylish and less laborious approaches.

Nearly all the candidates answered part (a) correctly and they knew that they had to integrate between – a and b. Most proceeded to multiply out their expressions and embark on several lines of complicated algebra to reach the given result. Only a few better candidates used integration by parts and arrived at the answer in a couple of lines. In the final part some thought that the point *S* was on the y-axis and they made no progress but many did proceed to differentiate (again few using the product rule) and attempt to find the coordinates of *S* and hence the area of the rectangle and the value of k. Some failed to find the y coordinate of *S* and simply multiplied the x coordinate b (a + b) and others had such complicated (and incorrect) expressions for the area of the rectangle that were clearly never going to give a value of k that was independent of a and b.

Question 7

Most could find the turning points in part (a) but often they had to use differentiation to achieve this. The graph in part (b) caused some problems. Many did not have a minimum below the x-axis and some failed to show that $\cos(1) < \sin(1) < 1$ by their point on the y- axis. Part (c) was answered well and most could find the *y* coordinate of *S* and *T* but few gave the correct *x* coordinate with many thinking it was $\arccos(\frac{5\pi}{4})$ or $\arccos(\frac{7\pi}{4})$. Most realised that they needed to differentiate in part (e) but evaluating $\sin\alpha$ proved a stumbling block for some. Those who proceeded to part (f) could usually differentiate and often showed that the gradient of C_2 was $-\tan\beta$, but only a very distinguished minority were able to explain clearly how to obtain the obtuse angle between the two tangents.

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