Examiners' Report/
Principal Examiner Feedback

Summer 2010

AEA

Mathematics (9801)

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Introduction

Unfortunately this paper was not as discriminating as usual and there were rather too many questions of an accessible nature which led to unusually high grade boundaries. Nevertheless Q6, Q3(c), Q4(b) and to some extent Q2 did provide some opportunity for distinction candidates to shine.

Report on individual questions

Question 1

This proved to be a successful starter with most candidates realising that they needed to square both sides to get started and very few getting 9 + x + 1 on the right hand side. Some rearranging and a second squaring usually yielded the solutions x = 0 and 3 but most candidates did not seem to appreciate that squaring could yield spurious solutions and a check of the validity of their solutions in this part was rare.

In part (b) most could use the log rules successfully to arrive at a quadratic equation in $\sqrt{x}$. Those who solved this quadratic were usually successful but many candidates squared their equation and then, unable to factorise the resulting quadratic resorted to the formula but the numbers were so large that they were often unable to reach a solution.

There were more cases where the validity of their solutions was checked here (they realised $x > 7$ from the original equation) and the $x = 4$ case was often rejected by these candidates.

Question 2

This question exposed the weaknesses in algebraic processing of many students.

A little thought at the start might have encouraged them to try and exploit the symmetry of the problem and the good practice of simplifying at each stage would have made their lives considerably simpler.

Most started off with two correct equations using the sum of an arithmetic series. Those who used a symmetrical approach to eliminate a such as $\frac{2p}{q}-(q-1)d=\frac{2q}{p}-(p-1)d$ seemed to be more successful than those who tried substitution such as $q=\frac{p}{2}\left[\frac{2p}{q}-(q-1)d+(p-1)d\right]$. It was disappointing to see many try and simplify $\frac{q^2-p^2}{p-q}$ and end up with $(q + p)$, losing the minus sign.

Many demonstrated correct intent in (b) and (c) but fully correct answers were not very common. A number of candidates showed a considerable misunderstanding in (c) by assuming that $\mathrm{S}_{p+q}=\mathrm{S}_p+\mathrm{S}_q$.

Question 3

Part (a) was answered very well with most scoring full marks.

Part (b) caused few problems too although few mentioned the significance of the conditions $f < 2$ and $f \neq 2$ in their solutions.

Part (c) though stumped many candidates who simply drew a circle of radius g. Some did complete the square to show that $(x-y)^2 = g^2$ (or use part (a) to show that m = 1) but they did not always deduce that $y = x \pm g$ and draw two parallel lines and this was one place where the better candidates could shine.

Question 4

For those candidates who had a fluency in vector methods this question presented few problems but many others struggled especially in part (b).

Part (a) provided a straightforward start with the scalar product or the cosine rule yielding answers quite readily. Some using the scalar product approach had $\overrightarrow{AF}$ and $\overrightarrow{CA}$ and therefore found the obtuse angle at A.

Part (b) generated a variety of approaches. A traditional vector solution found a general $\overrightarrow{FX}$, used a scalar product with $\overrightarrow{AC}$ and then found the length of FX and position vector of X. Difficulties arose though when their expression for $\overrightarrow{FX}$ was in terms of 2 or 3 unknowns and they were unable to find enough equations to determine the relevant values. Those who preferred a more geometric approach often used trigonometry to find AX (using the angle found in (a)) and then Pythagoras' theorem to obtain FX and the ratio AX:AC to find the position of X .

In part (c) most candidates had a correct strategy but their equation for l_2 was commonly wrong having direction 2.5**i** +10**j** +20**k** rather than -2.5**i** +10**j** +20**k**. Many candidates did confirm that their solution was a genuine point of intersection but a number missed out this important check.

Question 5

Part (a) began well but many had difficulty in handling both negative and fractional indices and so were unable to transform the integrand correctly. Those who did reach $\int \frac{-\mathrm{d}u}{\sqrt{1+2u}}$ were usually able to complete the proof.

In part (b) most saw the connection with part (a) and they were able to score the first mark. The rest of the proof required 3 steps which were quite simple in themselves but proved more challenging in combination. Plenty of correct solutions were seen, some more concise than others, but many candidates tried to jump over critical steps or simply gave up.

Question 6

This was the most challenging question on the paper. Although the question concerned the maximum and minimum of the expression $x^2 + y^2$ (subject to a constraint on x and y) most candidates investigated $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ and occasionally the sign of $\frac{\mathrm{d}^2 y}{\mathrm{d}x^2}$, implicitly assuming (wrongly) that the question concerned the turning points of y. A few students however did provide correct solutions and a variety of methods were employed. Some used a purely algebraic method, often starting with $\left(x^2 - y^2\right) \geq 0$, others formed an expression for $A = x^2 + y^2$ in terms of x and then used a traditional calculus approach.

In part (b) most could sketch the circle centre (0, 0) and radius 1 but the other curve was rarely seen correctly drawn.

Answers to part (c) were occasionally seen and correct ones were rare with $x^2 + y^2 = 1$ being a common offering.

Question 7

This question was greeted enthusiastically by most candidates who showed great stamina in successfully producing good answers.

Part (a) presented them with few difficulties although some seemed not to know the exact values of $\sin\frac{\pi}{4}$ and $\cos\frac{\pi}{4}$. In part (b) most were able to find the maximum value of the function but some failed to realise that the minimum value of the function was 0 and gave $\frac{3}{2} - \sqrt{2}$ instead.

In part (c) some just found the x coordinates of the maximum and minimum points and the local maximum at $x = \pi$ was often missed.

Most had a correct strategy for answering part (d) but fell at one or more of the hurdles involved. Some struggled to solve f(x) = 2 and so failed to calculate the correct limits. The majority of candidates knew how to prepare the integrand for integration (a few just thought the answer was $\frac{\left(\frac{1}{\sqrt{2}} + \cos x\right)^3}{\sin x}$) and were able to carry it out successfully. Many candidates though made sign errors in substituting the limits and a correct final answer was not that common.

Grade Boundaries

	Distinction	Merit
9801 AEA Mathematics	81	63

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