Examiners' Report/
Principal Examiner Feedback

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GCE Core Mathematics C3 (6665)
Paper 01

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General Introduction

The paper appeared well structured and allowed for differentiation at all levels as it contained a combination of straight forward and more challenging questions. Parts of certain questions were only completed correctly by the most able, yet nearly every candidate was able to gain some marks on every question. The length of the paper seemed to allow all candidates time to attempt every question.

The "show that" questions were sometimes completed really well with very direct and succinct arguments used, however there were many candidates who took circuitous routes, usually including errors which lost marks.

Overall the standard of algebra was good. Errors included incorrect cancelling of algebraic fractions, incorrectly removing factors from brackets, incorrectly simplifying expressions and brackets either being omitted or incorrectly inserted.

Formulae are often not quoted causing method marks to be lost unnecessarily.

Accuracy was generally good but rounding twice in Q8(c) led to lost marks. Angles were usually given in the correct units. A number of candidates were unable to distinguish between the notation for an inverse function and a first differential.

Presentation of work was varied as was the sketching of graphs with many candidates interpreting ‘sketch’ as ‘rough sketch’. Overall the paper allowed candidates to demonstrate their abilities.

Report on Individual Questions

Question 1

This was an accessible question for candidates with many gaining all 7 marks.

Q1(a) was very well done and usually correct. Occasionally +32 was used instead of –32 giving $w = \frac{5}{2}$. Some candidates reached $w = \frac{5}{2}$ as a result of writing $(-32)^{-\frac{1}{5}} = 2$.

For Q1(b) the correct expression for $\frac{dy}{dx}$ was usually achieved with nearly all candidates recognising the need to apply the chain rule. The substitution of $w = \frac{1}{2}$ occasionally produced –160 instead of +160. Some candidates mistakenly set $\frac{dy}{dx} = 0$, leading to $x = \frac{3}{2}$ and proceeded to use this as their gradient. A few used the result $m_1m_2 = -1$ and went on to find the gradient of the normal. The method mark for finding the equation of a line was gained by almost all candidates but a number of candidates lost the final accuracy mark as a result of errors made in arranging the answer in the form $y = mx + c$. An example of this was $y + 32 = 160x - 80$ followed by $y = 160x - 48$.

Question 2

Many candidates achieved full marks on this question.

In Q2(a) some candidates did not set $g(x) = 0$ at the start. Candidates who set $g(x) = 0$ generally proceeded correctly to the required solution. The 'ln' work was mostly well done, and very few made errors such as $\ln 6 - \ln x = \ln(6 - x)$. Very few candidates started with the given expression, and attempted to work backwards to $g(x) = 0$. A small number of candidates failed to put the correct brackets around their 'ln' work.

In Q2(b) the majority of candidates gained full marks. There were very few errors, with marks being generally lost for incorrect rounding or rounding to an incorrect number of decimal places.

In Q2(c) almost all candidates chose a suitable interval, usually [2.3065, 2.3075], and proceeded to the correct answer. Errors were seen where candidates substituted incorrectly, into the wrong function, or omitted the $\times 10^{-3}$ or $\times 10^{-4}$ when expressing answers in standard form. A smaller number of candidates tried further iterations. Candidates mostly provided appropriate reasons and minimal conclusions, although a few failed to do this, omitting to mention "change in sign" or "hence root" or equivalent.

Question 3

Most candidates found this question accessible and a good number of completely correct solutions were seen.

Q3(a) seemed to be the most challenging part of the question for many candidates. Some were confused by the fact that they were not told $f(x)$ as a function of x was and therefore did not realise they could find the answer by using the given sketch. A proportion of these candidates attempted to find a function (usually linear) that passed through $(-3, 0)$ and $(0, 2)$. Some responses showed confusion over how to calculate the value of a composite function, with $ff(-3) = f(-3) \times f(-3)$ or $ff(-3) = f(-3) \times f(0)$ being common errors.

In Q3(b) the sketch was done well by the majority of candidates, nearly all knowing to reflect the graph of $f(x)$ in the line $y = x$. A few candidates lost the mark for the shape of the graph due to an obvious minimum point drawn in the third quadrant or the curve bending back on itself in the first quadrant. However, the most common error on this part was confusion with the coordinates on the axes.

In Q3(c) most candidates scored both mark. Some responses did lose the first mark due to the presence of an obvious maximum point, poor symmetry or the wrong shape.

Q3(d) was done well by most candidates with nearly all scoring 2 or 3 marks. It was rare for the shape of the graph to be drawn incorrectly, the most common errors made when finding the coordinates, with $(-1.5, 0)$ instead of $(-6, 0)$ being the mistake most often seen.

Question 4

In Q4(a) candidates demonstrated knowledge of using the $R \cos(\theta - \alpha)$ identity and were generally successful in finding both R and α. Most candidates were finding R and α independently of each other using division and Pythagoras' theorem. Most candidates gave α to the required number of decimal places; it was rare to see answers rounded to 2 decimal places or more. Most candidates also gave their answer for α in radians, but 53.1 was also seen. Candidates who found α first were more likely to then use the numbers 3 and 4 (incorrectly, instead of 6 and 8) in Pythagoras' theorem to determine R.

In Q4(b) very few realised that the maximum value of p was achieved using the minimum value of the denominator. However those who did realise this, gained the marks in Q4(b)(i) and generally went on to achieve full marks in Q4(b)(ii) as well. The majority of candidates thought they were looking for the maximum value of the denominator, setting $\cos(\theta - \alpha) = 1$, leading to $\frac{2}{11}$. Calculus could have, and was occasionally, used but almost invariably led to incorrect solutions.

Question 5

Q5(i)(a) was generally answered well, with the vast majority using the product rule. Many candidates started the question by quoting the rule. There were some errors in differentiating $\ln 2x$, obtaining either $\frac{1}{2x}$ or $\frac{2}{x}$.

In Q5(i)(b) most candidates recognised the need for the chain rule. However a considerable number obtained only $2 \cos 2x$ when differentiating $x + \sin 2x$. Of those who performed this differentiation correctly, a significant number lost marks because of incorrect bracketing in their answer. Another common error was to omit the factor 2 when differentiating $\sin 2x$. Common incorrect answers were $3(x + \sin 2x)^2 \times 2 \cos 2x$, $3(x + \sin 2x)^2 \times 1 + 2 \cos 2x$ or $3(x + \sin 2x)^2 \times (1 + \cos 2x) \times 2$.

Candidates' responses in Q5(ii) showed many concise and clear solutions. A majority expressed $\frac{dx}{dy}$ in terms of y, although many did not know, or use the formula sheet, to state that the differential of $\cot y$ is $-\text{cosec}^2 y$. These candidates generally differentiated either $\frac{1}{\tan y}$ or $\frac{\cos y}{\sin y}$, often correctly. A number of able candidates proceeded more directly by using implicit differentiation. Most candidates knew that they then had to invert their result to find $\frac{dy}{dx}$, although there were many instances of negative signs appearing or disappearing without any justification. Candidates who used the identity $\text{cosec}^2 y = 1 + \cot^2 y$ could usually reach the correct result quite efficiently, although some failed to bracket the terms and hence obtained $-\text{cosec}^2 y = -1 + \cot^2 y$. However some correct use of other trig identities was also seen. At this stage some candidates confused the x and y so could not reach the stated result.

Question 6

This question was accessible to most candidates with many achieving full marks in Q6(a) and Q6(b).

Q6(i) produced a range of responses. Most candidates expanded the brackets with many spotting identities such as 2 sin 22.5 cos 22.5 = sin45 and sin 222.5 + cos 222.5 = 1.

Common errors seen were the appearance of terms such as $\frac{\cos 45}{2}$ and sin 2506.25. Variations on the method shown in the mark scheme were examples such as cos 222.5 + sin 222.5 = cos [22.5 – 22.5] = cos 0 = 1 and various versions of the factor formulae for trigonometrically functions.

For Q6(ii)(a) most responses were correct, with the correct substitution of cos 2θ. There were some incorrect double angle formulae quoted, e.g. $1 + \sin^2 \theta$ or $1 - \sin \theta$ but these were rare. The most common mistake was the failure to rearrange the equation into the required format, thus stating k as –2 rather than 2.

Q6(ii)(b) was generally well done with many fully correct solutions. Errors were seen when candidates re-wrote the question to this part as $2 \sin^2 \theta - \sin \theta = 1$ resulting in a three term quadratic. Others divided $2 \sin^2 \theta - \sin \theta = 0$ through by sin hence losing two of the four solutions.

Question 7

Q7(a) was usually completed well and most candidates were able to score full marks. A few candidates found forming the single fraction challenging as they failed to recognise the lowest common denominator at the outset.

In Q7(b) the majority of candidates were able to use the quotient rule correctly and a number of candidates started by quoting the rule. A number of candidates used an incorrect form of the quotient rule, usually reversing the terms in the numerator. Some candidates failed to fully simplify their answer and a larger number who cancelled incorrectly which resulted in the final mark being lost. The common error seen was to change –2 × 2 + 10 to –2(× 2 + 5). It was also common to see responses where candidates misunderstood the notation and tried to find the inverse function. Some of these did however proceed to find h′(x) in Q7(c) and then went on to complete Q7(c) successfully.

Q7(c) was the most demanding part of this question. Those candidates who had cancelled incorrectly in Q7(b) found they had an unsolvable equation and tried to rearrange their equation in an attempt to form an equation that they could solve. Some candidates set their h′(x) = 0 but then set the denominator of their derivative = 0. A number of candidates failed to recognise that the maximum value of h(x) would be at the turning point and tried evaluating h(x) = 0 or h′(0). It was common to see candidates forming inequalities for the range using their x values instead of evaluating h(x). Of those with otherwise correct solutions, some lost the final mark by omitting the lower boundary for the range or by incorrectly using a strict inequality.

Question 8

Q8(a) was usually correct, although a few candidates thought that e^0 was 0.

Q8(b) proved to be the most challenging part of the paper. Most candidates knew how to start, correctly equating to 9500 but the majority did not collect the terms together on one side and applied the laws of logs incorrectly resulting in incorrect equations, gaining no marks at all. Those that managed to get the correct quadratic usually went on to gain full marks.

Q8(c) had many correct responses. Many realised that differentiation was required, although a number of candidates substituted 8 into the original equation and some tried to differentiate after making this substitution. There were errors in differentiating with an extra t appearing. A common incorrect method was to calculate the value for 2 consecutive years, usually 8 and 9 or 7 and 8, then subtract to find the yearly rate.

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