Examiners' Report/
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GCE

GCE Core Mathematics C4 (6666) Paper 1

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Introduction

The majority of candidates who took this paper found it straightforward and many correct solutions were seen to all questions on the paper. The quality of algebraic manipulation was generally good and the work seen in the question on the binomial theorem was particularly impressive. The standard of presentation was good and almost all candidates now recognise that, when a question asks for an exact answer, a decimal approximation is not acceptable.

Problems did arise, however, with candidates giving exact answers to questions, presumably derived from calculators with functions that gave such answers, without any supporting working. The rubric on the front of the paper advises candidates that they "should show sufficient working to make your methods clear to the examiner". When, for example, a questions states, as question 2 does on this paper, "Use differentiation to find the value of …" then, if the process of differentiation is not shown, the conditions of the question have not been complied with and little or no credit can be awarded.

Report on individual questions

Question 1

This proved a good starting question and full marks were common. A few candidates differentiated the expression, using the product rule. However, the great majority realised that integration by parts was necessary and such errors as were seen usually arose from integrating $\sin 2x$ and $\cos 2x$ incorrectly. Both errors of sign and multiplying (rather than dividing) by 2 were not uncommon. Most knew how to use the limits and complete the question. In some cases the numerically correct answer, $\frac{\pi}{4}$, was obtained after incorrect working. In these cases, the final A mark was not awarded.

Question 2

Those who knew, and often quoted, a formula of the form $\frac{\mathrm{d}}{\mathrm{d}x}\left(a^x\right) = a^x \ln a$ usually found this question straightforward. Those who did not, tried a number of methods and these were frequently incorrect. Errors seen included $-16t\left(0.5\right)^{t-1}$, $-16\left(0.5\right)\ln t$ and $8^t \ln t$. Nearly all candidates substituted $t = 3$ into their $\frac{\mathrm{d}I}{\mathrm{d}t}$ but a significant number of candidates failed to give their answer in the form $\ln a$, as required by the question, leaving their answer in the form $n \ln a$.

Question 3

Partial fractions are well understood and part (a) was usually fully correct. The majority used substitution to find the constants and comparing constants was rare, as was the use of the cover up rule. One error that was seen from time to time was $5A = 5 \Rightarrow A = 5$.

Part (b) was also well done and the common error $\int \frac{3}{3x+2} \mathrm{d}x = 3\ln(3x+2)$ was seen less often than in some recent examinations.

Part (c) proved more difficult. Many could not separate the variables correctly and some did not even realise that this was necessary. Some kept the 5 with the *y* and this caused problems in applying the result of part (b) correctly. Those who established the appropriate method usually included a constant of integration and were able to obtain an equation to find its value. Making *y* the subject of the formula proved difficult and moving from an expression of the form $\ln y = \ln(\mathrm{f}(x)) + \ln k$ to $y = \mathrm{f}(x) + k$ was a common error.

Question 4

This question was well done and full marks were common. Part (a) was almost always correct and such errors as were seen were errors of arithmetic. Even at this level $2 - -3 = 1$ is seen from time to time. For (b), the majority knew the form of a straight line. A few got the vectors the wrong way round or produced an answer of the form $\mathbf{r} = \mathbf{a} + \lambda\mathbf{b}$. The commonest error was to give an answer of the form $\begin{pmatrix} 1 \\ -3 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} -3 \\ 5 \\ -3 \end{pmatrix}$, not recognising that, as the question asks for an equation, this expression must be preceded by $\mathbf{r} = \ldots$.

Part (c) was more demanding and many were unable to choose vectors in the appropriate directions. Almost all knew that they had to form an equation by equating a scalar product to zero. However, often one of the position vectors was used; finding the scalar product of $\overrightarrow{OC}$ with $\overrightarrow{AB}$ being a common choice. Some formed the scalar product of $\overrightarrow{AB}$ with the vector equation of $\overrightarrow{AC}$ obtaining equations involving parameters as well as *p*. Almost all knew the appropriate method for part (d).

Question 5

Part (a) was well done. Those who could write $(2-3x)^{-2}$ as $2^{-2}\left(1 - \frac{3}{2}x\right)^{-2}$ nearly always expanded correctly and those who could not were usually able to gain 2 or 3 marks by showing that they knew how to expand binomial expressions. The distribution of marks for part (b) was bimodal; the majority of candidates obtaining either 0 or 5 marks. Those who knew how to proceed were able to obtain two linear equations by comparing coefficients and solve them for *a* and *b*. Apart from occasional algebraic slips, these candidates usually obtained full marks. Those who did not know the appropriate method often gave up very quickly and, wisely, went on to the next question. Those who were able to solve part (b) almost always completed the question.

Question 6

Although there were many correct solutions to part (a), a surprising number of candidates made mistakes in establishing $\frac{\mathrm{d}y}{\mathrm{d}x}$ from their $\frac{\mathrm{d}y}{\mathrm{d}t}$ and their $\frac{\mathrm{d}x}{\mathrm{d}t}$. Both 2 and $2t^3$ were seen and, in many cases, the method used was not clearly shown and this resulted in the loss of both the method and the accuracy marks. If $\frac{\mathrm{d}y}{\mathrm{d}x}$ was correctly found, the majority were able to complete this part correctly. A significant number, however, failed to read the question and gave the equation of the tangent rather than that of the normal. Part (b) was well done and nearly all could eliminate the parameter. Quite a number of candidates thought that $\left(\mathrm{e}^x\right)^2$ was e^{x^2} and this often caused a major loss of marks in part (c).

In part (c), the majority of candidates knew the volume formula but the attempts at integration were of a very variable quality. Many used the lead given in part (b) but the resulting squaring out of the brackets was often incorrect. Examples of errors seen are $\left(\mathrm{e}^{2x}\right)^2 = \mathrm{e}^{4x^2}$ and $\left(\mathrm{e}^{2x} - 2\right)^2 = \mathrm{e}^{4x} + 4$ or $\mathrm{e}^{4x} - 4$. There were also attempts at direct integration, for example $\int \left(\mathrm{e}^{2x} - 2\right)^2 \mathrm{d}x = \frac{\left(\mathrm{e}^{2x} - 2\right)^3}{3}$. Those who used parameters often made similar mistakes and sometimes the $\frac{\mathrm{d}x}{\mathrm{d}t}$ was omitted. The choice of limits also gave some difficulty; those who integrated using the variable x using the t limits and vice versa. Despite these frequent mistakes, there were many completely correct solutions.

Question 7

Parts (a) and (b) were usually fully correct and few lost marks through failing to work to the accuracy specified in the question. The trapezium rule is well known and the only error commonly seen was obtaining an incorrect width of an individual trapezium.

Part (c) proved more demanding. Many got off to a bad start. The substitution was deliberately given in the form $x=(u-4)^2+1$ so that the essential $\frac{\mathrm{d}x}{\mathrm{d}u}=2(u-4)$ could be found easily. Many, however, rearranged the substitution and obtained $\frac{\mathrm{d}x}{\mathrm{d}u}=\frac{1}{2}(x-1)^{-\frac{1}{2}}$ and the resulting algebraic manipulations often proved beyond candidates. Those who did complete the substitution often failed to complete the definite integral. An unexpected difficulty was that a number of candidates failed, in the context, to simplify $4+(u-4)$ to *u*. Many did not see that $\frac{2u-8}{u}$ reduced to $2-\frac{8}{u}$ and embarked upon complicated solutions using integration by parts which, although theoretically possible, were rarely completed. The choice of limits also gave some difficulties. The convention is used that a surd is taken as the positive square root. If this were not the case the expression given at the head of the question would be ambiguous. Some however produce limits resulting from negative square roots, 3 and 2, as well as the correct 5 and 6, and did not know which to choose. As in question 6, there was also some confusion in choosing the limits, some choosing the *x* limits when the *u* limits were appropriate and vice versa. Despite these difficulties, nearly 34% of the candidates gained full marks for this question.

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