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GCE

GCE Core Mathematics C2 (6664) Paper 1

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Introduction

This paper proved to be very accessible to many of the candidature and there was little evidence of candidates being short of time. The paper afforded a typical E grade candidate plenty of opportunity to gain marks across the majority of questions.

The standard of algebra seen was good, although a number of candidates made basic sign or manipulation errors. The design of the question booklet continues to help candidates to present their solutions well and an overwhelming majority of them were able to give their solutions to all questions in the spaces provided.

In question 2 there were a significant number of candidates who worked in degrees and converted their final answers to radians. Some candidates, however, worked completely in degrees.

In summary, questions 1, 3, 4, 6(a), 6(b), 7(a) and 10 were a good source of marks for the average candidate, mainly testing standard ideas and techniques; and questions 5, 7(b), 9(d) and especially question 8 were discriminating questions at the higher grades.
In question 10(b), a number of stronger candidates stopped after finding $x = \frac{5}{3}$.
The majority of them did not realise (or forgot) that the question required them to find the maximum volume, but a minority of them, however, did in fact believe that $\frac{5}{3}$ was the maximum volume.

Report on individual questions

Question 1

This question was accessible to the nearly all the candidates with the majority of them attempting to use the remainder theorem. In part (a), many candidates substituted $x = 1$ into the $\mathrm{f}(x)$ expression and were able to achieve the required $a + b = 3$. A few candidates, however, substituted $x = -1$ into $\mathrm{f}(x)$.

In part (b), most candidates attempted to find $\mathrm{f}(-2)$ and applied $\mathrm{f}(-2) = -8$ to give $16 - 8 + 8 - 2a + b = -8$. A significant minority of candidates incorrectly simplified $(-2)^4$ as -16 and a few candidates incorrectly set their $\mathrm{f}(-2)$ equal to 8 or even 0. Poor manipulation was also a common feature, with some candidates simplifying $16 - 8 + 8 - 2a + b = -8$ incorrectly to give $-2a + b = 8$. The need to solve the two equations simultaneously was clearly understood and generally correctly applied, although those candidates who had made sign or manipulation slips earlier were unable to access the final two marks for finding both a and b.

A small minority of candidates attempted to use a method of long division in parts (a) and (b). The majority of these candidates usually failed to achieve a remainder in *a* and *b* which was independent of *x*. Some able candidates, however, handled long division with confidence and gained full marks in both parts of the question.

Question 2

This question was well answered with a considerable number of candidates gaining full marks. It was rare to see a solution assuming that the triangle was right-angled, although there were a few candidates who did not proceed beyond using right-angled trigonometric ratios.

In part (a), the majority of candidates were able to correctly state or apply the correct cosine rule formula. In rearranging to make $\cos C$ the subject a significant minority of candidates incorrectly deduced that $\cos C = \frac{1}{14}$. A negative sign leading to an obtuse angle appeared to upset these candidates. The more usual error, however, was to use the formula to calculate one of the other two angles. This was often in spite of a diagram with correctly assigned values being drawn by candidates, thus indicating a lack of understanding of how the labeling of edges and angles on a diagram relates to the application of the cosine rule formula. Although the question clearly stated that the answer should be given in radians, it was not unusual to see an otherwise completely correct solution losing just one mark due to candidates giving the answer to part (a) in degrees. It was also fairly common to see evidence of candidates preferring to have their calculator mode in degrees, by evaluating their answer in degrees and then converting their answer to radians.

Part (b) was a good source of marks, with most candidates showing competence in using $\frac{1}{2}ab\sin C$ correctly. Of those candidates who "really" found angle *A* or *B* in part (a), most assumed it was angle *C* and applied $\frac{1}{2}(7)(8)\sin(\text{their } C)$, thus gaining 2 out of the possible 3 marks available. A few candidates correctly found the height of the triangle and applied $\frac{1}{2}(\text{base})(\text{height})$ to give the correct answer.

Question 3

The vast majority of candidates found this question to be accessible and problems seen were usually concerning signs.

In part (a), a majority candidates were able to write down both $ar = 750$ and $ar^4 = -6$ and proceed to correctly find the value of *r*. A minority of candidates displayed poor algebraic skills, giving incorrect results such as $ar^3 = -\frac{6}{750}$ or $r^4 - r = -\frac{6}{750}$ or $r^3 = 756$. A significant minority of candidates were unhappy with a negative value for r^3 and thus *r* and this problem with signs would then persist in parts (b) and (c). A very small number of candidates confused geometric series with arithmetic series.

In part (b), most candidates were able to substitute their value for *r* into a correct equation that they had written down in part (a) in order to find the first term of the series.

In part (c), many candidates were able to write down the correct formula for S_∞. Some candidates who had correctly found *r* as $-\frac{1}{5}$, incorrectly interpreted the condition of $|r| < 1$ to mean that their *r* in part (c) should then be $\frac{1}{5}$. Some candidates believed that a sum to infinity can only be positive and so arrived at an incorrect answer of 3125. Some candidates who had earlier found a value of *r* whose modulus was not less than 1, were happy with substituting this into the correct sum to infinity formula, and did not then deduce or were aware that their value for *r* found in part (a) must then be incorrect.

Question 4

This question was very well attempted by the majority of candidates. It was rare to see errors in part (a). In part (b), most candidates expanded correctly and went on to integrate successfully, gaining the first four marks, although a few candidates differentiated instead of integrating. Some candidates could not cope with the negative result and tried a range of ingenious tricks to create a positive result. A common error was to take $-\frac{100}{3}$ to be positive and then subtract $\frac{8}{3}$. This incorrect use of limits meant some candidates were to lose the final two marks. There were a significant number of errors in evaluating the definite integral. Disappointing calculator use and inability to deal with a negative lower limit meant that a significant minority of candidates lost the final accuracy mark. Some candidates used 1 as their lower limit instead of -1, and lost the final two marks for part (b). A few candidates correctly dealt with a negative result by reversing their limits whilst others multiplied their expression by -1 before integration to end up with a “positive area”.

Question 5

A significant number of candidates failed to answer part (a) correctly, due to the unfamiliarity with the formula for $\binom{n}{r}$. Common incorrect answers for *b* included either $1,\ 4,\ 10,\ 36!$ or 91390.

In part (b), most candidates were able to write down the binomial expansion of $(1+x)^n$. Although a minority of candidates picked out wrong terms, most commonly terms in x^3 and x^4 rather than x^4 and x^5, the majority of candidates were able to to give $\frac{q}{p}$ as $\frac{36}{5}$. Other common errors included finding $\frac{p}{q}$ or giving $\frac{q}{p}$ as $7.2x$ which is not independent of *x*.

Question 6

In part (a), the vast majority of candidates correctly evaluated both *y*-values to 2 decimal places, although a significant minority of candidates lost marks due to incorrect rounding or truncating, with the most common error being either writing 0.3 or 0.29 instead of 0.30.

In part (b), some candidates incorrectly used the formula $h = \frac{b-a}{n}$, with $n = 5$ instead of $n = 4$ to give the width of each trapezium as $\frac{1}{5}$. Many candidates, however, were able to look at the given table and deduce the value of *h*. The correct structure of the trapezium rule inside the brackets was usually evident, although as usual there were the inevitable 'invisible brackets' and bracketing errors.

In part (c), most candidates identified the correct triangle and correctly found its area. A significant number of candidates did not realise that the 'height' of the triangle was given in the table and re-calculated it. A small minority of candidates found the equation of the straight line segment between $(2,\ 0)$ and $(3,\ 0.2)$ and used integration to find the area of the triangle. Candidates should be encouraged to look at the available marks for a question before embarking on such a long and complicated method. Almost all candidates who correctly found the area of the triangle applied the correct method of subtracting this from their answer to part (b). Some candidates used elaborate incorrect methods for finding the area of the triangle and so gained no credit in part (c).

Those candidates who gave the incorrect answer in part (b) could gain full credit in part (c) if they correctly applied "their part (b) answer" – 0.1.

Question 7

Most candidates were able to score both marks in part (a). Most candidates proceeded by replacing $1 - \sin^2 x$ for $\cos^2 x$. A few candidates, however, made algebraic errors or slips in rearranging the equation correctly into the result given.

The need to use the alternative form was understood in part (b) and most candidates made a valid attempt at factorisation, with correct factors being seen much more frequently than incorrect ones. Some candidates correctly wrote $(4\sin x + 3)(\sin x + 1) = 0$ and solved this incorrectly to give one of their solutions as $\sin x = \frac{3}{4}$. Of those candidates achieving the correct two values for $\sin x$ many only gave two correct solutions, usually 228.6 and 270 or 311.4 and 270. Sometimes extra incorrect solutions were given, usually 131.4 and/or 90. A small number of candidates found $\left(270 + \text{or} - \text{ their } |\alpha|\right)$ rather than $\left(180 + |\alpha|\right)$ and $\left(360 - |\alpha|\right)$. Some candidates incorrectly stated that $\sin x = -1$ had no solutions and a few gave their answers to the nearest degree. A significant number of candidates used a sketch of $\sin x$ to help them to correctly identify their answers.

Question 8

Many good sketches were seen in part (a), with a significant number of candidates constructing a table of *x* and *y*-values in order to help them sketch the correct curve. Some candidates had little idea of the shape of the curve, whilst others omitted this part completely and a significant number failed to show the curve for $x < 0$. For $x < 0$, some candidates believed the curve levelled off to give $y = 1$, whilst others showed the curve cutting through the *x*-axis. Many candidates were able to state the correct *y*-intercept of $(0, 1)$, but a few believed the intercept occurred at $(0, 7)$.

Responses to part (b) varied considerably with a number of more able candidates unable to produce work worthy of any credit. A significant number of candidates incorrectly took logs of each term to give the incorrect result of $2x\log 7 - x\log 28 + \log 3 = 0$. Some candidates provided many attempts at this part with many of them failing to appreciate that 7^{2x} is equivalent to $(7^x)^2$ and so they were not able to spot the quadratic equation in 7^x. Those candidates who wrote down the correct quadratic equation of $y^2 - 4y + 3 = 0$ proceeded to gain full marks with ease, but sometimes final answers were left as 3 and 1. Some candidates wrote down incorrect quadratic equations such as $7y^2 - 4y + 3 = 0$ or $7y^2 - 28y + 3 = 0$. Notation was confusing at times, especially where the substitution $x = 7^x$ appeared.

Question 9

This question was answered more successfully by candidates than similar ones in the past. It was pleasing to see that a significant number of candidates used diagrams to help them to answer this question.

In part (a), most candidates were able to verify that $(3, 6)$ was the centre of the circle, usually by finding the midpoint of *A* and *B*, although other acceptable methods were seen.

In part (b), most candidates were able to write down an expression for the radius of the circle (or the square of the radius). A significant number of candidates found the length of the diameter AB and halved their result to find the radius correctly. Most candidates were also familiar with the form of the equation of a circle, although some weaker candidates gave equations of straight lines. The most common error in this part was confusion between the diameter and radius of a circle leading to the incorrect result of $(x-3)^2 + (y-6)^2 = 50$.

In part (c), the majority of those candidates who had found a correct equation in part (b) were able to substitute both $x = 10$ and $y = 7$ into the left-hand side of their circle equation and show that this gave a result of 50. Other candidates successfully substituted $x = 10$ (or $y = 7$) into the circle equation, solved the resulting quadratic and showed that one resulting *y* (or *x*) value was correct. Those candidates who gave an incorrect answer in part (b) were usually unable to gain any credit in part (c).

In part (d), many candidates knew the method for finding the equation of the tangent at $(10, 7)$. Typical mistakes here included candidates finding the gradient of the radius *AB* or finding a line parallel to the radius or finding a line through the centre of the circle. A few candidates attempted to find the gradient of the line by differentiating their circle equation. This method was rarely successful, as most candidates were not able to apply the method of implicit differentiation correctly.

Question 10

In part (a), most candidates expanded V to obtain a cubic equation of the correct form and then differentiated this to give the correct result. Occasional slips, usually with signs, appeared as did the loss of a term when squaring $(5 - x)^2$. A few candidates attempted to use the product rule but most of them made slips.

In part (b), nearly all candidates were able to put their answer from part (a) equal to 0 and many candidates obtained $x = \frac{5}{3}$ with most of them realising that $x = 5$ was outside the range. Unfortunately a significant number of candidates did not substitute their x-value into an expression for V in order to find the maximum volume. A significant minority of candidates tried to find the value of x which satisfied $\frac{\mathrm{d}^2V}{\mathrm{d}x^2} = 0$.

In part (c), most candidates knew an appropriate method with almost all opting to find $\frac{\mathrm{d}^2V}{\mathrm{d}x^2}$. The final mark was often lost, however, due to candidates differentiating an incorrect $\frac{\mathrm{d}V}{\mathrm{d}x}$ or equating their second differential to zero or failing to evaluate the second differential, and then stating that this was negative which meant that the volume found in part (b) was maximum.

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