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GCE Core Mathematics C2 (6664) Paper 1

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Introduction

The paper tested the specification thoroughly and provided reasonable discrimination throughout the ability range. The questions which discriminated particularly at the A boundary were questions 4, 7, 8, and 9 whilst questions 1, 2, 3 and 5 provided discrimination at the E grade boundary. There were some extremely good candidates who answered all of the questions, producing a concise proof in question 4 and a clearly considered answer to qu 9 (ii). Such candidates also indicated clearly which triangle they were referring to in question 7(e) and could explain their working and convert their units in question 8. Unfortunately however there were also examples of candidates who either did not read the questions carefully enough, or were very poor at writing answers to a given degree of accuracy. As usual, the standard of basic algebra and arithmetic was of serious concern in many of these cases. Too many candidates had no concept of BIDMAS, or of balancing equations. Clarity of expression, careful use of calculators, consistent algebra and precise concise solutions need to be emphasised as essential for good mathematics.

Question 1

This was a very straightforward first question on Geometric Progressions. Over 80% of candidates obtained full marks. Parts a) and c) were done exceptionally well with most of the problems arising in part b), where a sizeable group of candidates who had used the power $(n-1)$ or 19 in a) then used it again in b) instead of the correct $n=20$. Other loss of marks was usually as a result of calculator operation errors and rounding, some candidates offering 268 and 288 as answers to b) and c) respectively.

There were fewer candidates confusing geometric and arithmetic series formulae than in previous years, but the question did tell them what the series was. On the whole, the GCE series work seemed to be well applied by the majority but GCSE rounding caused more problems.

Question 2

This question was also well answered (71% with full marks). For those who did not obtain a completely correct solution, most began with $(x+1)^2+(y-7)^2=r^2$. However, errors were common, with incorrect signs within and between the brackets, missing indices, or 1 and −7 in the wrong bracket. Most were able to find the radius although a significant minority appeared to be confused between radius and diameter. Some candidates had difficulty with $(-1)^2$ and made $r=\sqrt{48}$ whilst others made $r^2=\frac{d^2}{2}$. Others substituted the correct radius into their equation without squaring it. Although not penalised, many candidates did not simplify their r^2 leaving it as $\left(\sqrt{50}\right)^2$ or $\left(2\sqrt{5}\right)^2$. Only very few candidates expanded the brackets to give the answer in the form $x^2+2x+y^2-14y=0$. (This expanded answer was not required by the question). There were a number of weaker candidates who did not use the circle formula at all and instead attempted some form of straight line equation, gaining no marks.

Question 3

There were many completely correct solutions (39.5%) but a sizeable minority of candidates who obtained a fully correct answer in (a) had little idea how to answer (b).

(a) The majority of candidates were able to obtain the binomial expansion. There were the usual mistakes with terms in just x rather than $\frac{x}{4}$ and omission of brackets around this fraction, which often meant incorrect powers of 4 were used. Many candidates failed to simplify all of their terms hence losing the final A mark and there were some who did not simplify their $\frac{8x}{4}$ losing the first B mark.

(b) Most candidate were able to use their expansion correctly and many were able to gain marks even from incorrect answers to (a). In general they used 0.1 and showed their results clearly. However some used 1.025, 3.1 or even 1, with no consideration as to whether their result was a sensible answer. A few restarted with 0.025 as in the special case and achieved the correct result. Those who just used their calculator to evaluate $(1.025)^8$ were not answering the question and gained no credit.

Question 4

As in previous examinations, logarithms continue to discriminate between candidates and a relatively small proportion (27.8%) of this paper's entrants emerged with full marks on what appeared to be a fairly standard logarithm question. In fact 24% of candidates gained no credit on this question. Particularly noteworthy was the fact that a substantial number of candidates who scored well in (a) made no progress in part (b).

(a) A significant minority made no real attempt at this part and for many candidates the general standard of setting out a proof was not good. The presence of "y" caused some confusion and a number of candidates omitted to mention it in their answer.

$\log_3 y=\log_3 3x^2$ = $\log_3 3+\log_3 x^2$ = 1 + $2\log_3 x$ was the neatest shortest method seen which could gain full marks. The jump from $\log_3 y=\log_3 3x^2$ to 1 + $2\log_3 x$ was frequently seen, without explanation, and the most common error was to replace $\log_3 3x^2$ by $2\log_3 3x$. Beginning with the answer was also common, and explanations leading to a statement such as 1 = 1. Many attempting this approach failed to draw the required conclusion at the end. Less confident candidates tended to write down log laws at random. $\log_3 3=1$ was often seen but not used.

Using $\frac{y}{3}=x^2$ or $\frac{y}{x^2}=3$ resulted in long methods, as did methods which involved changes of base, but candidates using these approaches frequently gained full marks even though their proof was not the most efficient.

(b) In some cases candidates who had shown a poor grasp of logarithms in part (a) gained full marks in part (b). A surprisingly small minority saw the connection between parts (a) and (b). Most started again and solved the equation successfully. It was very unusual to see candidates produce $y=28x-9$ with little effort. Those with little understanding of logarithms obviously floundered badly here and errors included $\log_3(28x-9)$ replaced by $\log_3 28x - \log_3 9$ or $\frac{\log_3 28x}{\log_3 9}$.

Once a quadratic equation had been formed it was usually solved correctly, particularly by those who factorised. A significant minority used an incorrect quadratic formula, or did not quote the formula and made algebraic errors.

Question 5

The vast majority of candidate used the remainder theorem correctly in this question and there were very few correct attempts at the alternative method of long division. 77% of candidates achieved full marks.
(a) Most candidates gained both marks for this part of the question. The main errors were with the minus signs and a few did not actually equate their expression to 7.

(b) The majority of candidates again used the remainder theorem correctly and then solved the simultaneous equations to obtain the correct answers. A common error was to use $f(-1)$ instead of $f(1)$. Some misread the question and put both remainders equal to 7. Many candidates found $a+b=0$ and then made a mistake and used this as $a=b$. Another common error occurred when solving the two equations by subtracting one from the other and making mistakes with the – signs. There were more errors than might be expected in the solution of the two relatively simple simultaneous equations.

Question 6

43% of candidates achieved full marks. In parts (a) and (b), many completely correct solutions were seen and there were far fewer bracketing errors than in previous sessions. The main error was to give an incorrect value for h, with 7 intervals used instead of 6. Candidates need to appreciate that the value of h can just be written down when the table of values is given. The majority used the trapezium rule correctly and most gave the answer to 2 decimal places as required. There was however a surprisingly sizeable minority who missed part (b) out completely or who wrote out the formula and then didn't know how to substitute values into it.

A few students tried to substitute in x-values and some students entered 16.5 into the incorrect place inside the brackets.

In part (c) the required area was a simpler one to find than usual and most candidates made a good attempt at this part of the question. Nearly all gained the first mark for attempting to integrate and most got the first accuracy mark for having 2 terms correct.

The $\frac{x}{2}$ term seemed to often cause the biggest problem in the integration. It was sometimes written as $2x^{-1}$ or $x^{-1/2}$ prior to integration and others integrated it as $\frac{x^2}{2/2}$ i.e. x^2

Some students incorrectly integrated 1 (often mixing it up with the fact it differentiates to 0) and a few students struggled with $\frac{16}{x^2}$, with some rewriting this as $16x^{-\frac{1}{2}}$.

Limits were used correctly in the majority of cases and there were only a few who used 0 as the lower limit, without realising that this would give them an undefined value. Use of calculators was disappointing however, with many losing the last accuracy mark in an otherwise perfect solution.

Some confused candidates went on to find another area to combine with the integrated value (e.g. triangle – integral = area of R), even though this was completely false reasoning.

Question 7

Most candidates were able to display their knowledge of trigonometry and circles here and a substantial group (44%) achieved full marks. Among the others, greater clarity in their responses would have helped their own working and not led to lost marks. A few were reluctant to work in radians, particularly in part (c), but generally worked correctly in degrees.

Parts (a) and (b) were almost always correct, though some candidates lost the $\frac{1}{2}$ in the formula for area.

Part (c) was attempted in a wide variety of ways. The most common approach was to use the Sine rule, having first found that the third angle of triangle ADB is 1.24 radians. This was generally successful. However there were a few cases seen of angle $(2\pi - 2x)\times 0.95$ and there was some confusion as to which were the equal angles of the isosceles triangle.
Others used trigonometry in the right-angled triangle which is half of triangle ADB, getting a successful result from $AD = \frac{3}{\cos 0.95}$. Those who attempted the Cosine rule in triangle ADB could achieve a correct answer

but sometimes attempted a verification method. Answers to part (c) were often disappointing, partly from poor algebra and from a lack of clarity in the symbols used and confusion about the equal sides. As this was a 'show that' question, there appeared to be a temptation for some to hope that the examiner would not notice incorrect working.

In part (d), where perimeter was needed, a few slips were seen, but most were able to achieve the required result. Many were able to find the correct area in part (e) by using the difference between the area of the sector and of the triangle ADB. Lack of clarity was a problem where errors occurred, since scripts mostly said 'the area of the triangle' and it was not always clear whether ADB or ABC was intended. Some approached the problem by using area of the segment + area of triangle BDC. This was usually successful. Errors sometimes occurred when finding angles in triangle BDC. Lack of clarity again caused difficulties. A minority of candidates assumed that this was a normal 'area of segment' question, without looking properly at the question, but this was fairly rare.

Question 8

About 25% of the candidates achieved full marks or lost just one mark. The lost mark was usually forgetting to evaluate the minimum perimeter, or making errors giving the final answer to the nearest centimetre

(a) Most candidates had some idea how to form an equation for the area although an incorrect fraction of the circle was often seen. The algebra that followed was not always reliable although those that multiplied all the terms by 4 to start with had greater success than the others. Several candidates were clearly uncomfortable with dealing with double fractions.

(b) This was the most challenging part of the question, with candidates frequently getting the wrong coefficients for at least one of x, y or x^2. Most knew they had to substitute the value of y from (a) but sometimes the expression had been changed before it was substituted. A common error was to multiply all terms by an integer (usually 2) to remove the fraction, but not apply this to P (on the left hand side of the equation). The algebraic rearrangement that followed the substitution was often laboured and frequently inaccurate.

(c) This part of the question was generally well done and there were many responses where it was the only part that was awarded marks. A large number of candidates failed to use their value of x to find P (this was sometimes the only mark lost on the paper). Candidates generally appeared to have little difficulty with the differentiation and the subsequent rearrangement of their equation to find x. There was some reluctance to include a statement indicating that $\frac{dP}{dx}=0$ in forming their equation for finding x.

(d) Some candidates thought that they had to find P here and failed to find y. Of those that did calculate y, most used the formula from part (a) and were generally successful in getting to 0.21..... It was not unusual for P and x to be substituted into the original expression for P, which was then rearranged, sometimes successfully, to find y.
However, there was great confusion with units and 0.21 cm (often rounded to 0 or 1) was probably the most commonly seen answer. Those who converted their answer to cm were usually successful with 21 cm, although 2.1 cm or 210 cm were occasionally seen as were 21.5 cm and 22 cm. The alternative correct answer of 0.21 m was relatively rare.

Question 9

Part (i) was attempted by most candidates and many scored full marks. Most correctly used inverse sine before addition and division, although a significant number manipulated the algebra incorrectly, solving $3x-15=30$ as $x=\frac{30}{3}+15=25$ or as $x=(30-15)/3=5$.
Many found 30 and 150 from their inverse sine leading to x = 15 and 55 but missed the later 390 and 510, thus failing to obtain the other two solutions in the range.
A large number did not keep to the order of operations required, applying $\sin(180-\theta)=\sin\theta$ to some angle they had obtained in the process of trying to solve $3x-15=30$. Regrettably a few candidates began with $\sin 3x-\sin 15=$, which gained them no marks.

In Part (ii) successful solutions were rare and were evenly split between the simultaneous equation and the translation and stretches approach. There were some excellent full mark solutions. Most, however, were unable to formulate the equations required to solve for a and b. Some began correctly with $\sin\left(\frac{a\pi}{10}-b\right)=0$, but proceeded no further. Those who continued frequently wrote $\left(\frac{a\pi}{10}-b\right)=0$ (worth the first Method mark) but followed it by $\left(\frac{3a\pi}{5}-b\right)=0$ from which they could only get $a=0$ and $b=0$ from correct algebra applied to their equations. The second equation should have been $\left(\frac{3a\pi}{5}-b\right)=\pi$. Some other candidates mixed degrees and radians e.g. with $\frac{a\pi}{10}-b=0$ and $\frac{a3\pi}{5}-b=180$ producing $a=\frac{360}{\pi}$. Some converted all angles into degrees, which could produce a correct value for a, but of course b = 36 was not acceptable.

There were some who apparently confused the value of x with that of $(ax-b)$, producing equations such as $a.0-b=n/10$, and $a\pi-b=\frac{3\pi}{5}$. In some cases, it was unclear, e.g. $\frac{\pi}{a}+b=108$ or similar, seen occasionally. This last expression (usually appearing with no explanation) might have been due to incorrect algebra, as $\frac{\pi+b}{a}=\frac{3\pi}{5}$ is correct.

Using the period of the graph was often a successful starting point, and many found $a=2$ quite easily, though some mistakenly gave $a=\frac{1}{2}$. The most common answer using this approach was $a=2$ and $b=\frac{n}{10}$ rather than the correct $a=2$ and $b=\frac{\pi}{5}$. Few appeared to have the time to check that their solution crossed the x-axis at the correct places.

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