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Summer 2012

GCE Core Mathematics C2 (6664)
Paper 01

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Summer 2012
Publications Code UA031952

Introduction

Most candidates were well prepared and found the paper accessible and reasonably straightforward. There was no shortage of time. Weaker candidates faced particular difficulties on the trigonometry, the logarithms, and on proving the formula for the sum of a geometric series. Candidates should be encouraged to practice proving given results and should be advised to show all their working and not just write down numerical answers without justification. This particularly applied in questions 5, 6 and 8(c).

Question 1

This was a straightforward starter question allowing candidates to settle into the paper, with 59% of candidates achieving full marks and only 14% failing to gain at least half marks. Students confidently applied the binomial series and had no problem with binomial coefficients which were usually found using a formula though some candidates simply quoted the 5th line of Pascal's triangle. The most common error was in missing out the brackets around the term in x^2, leading to an incorrect coefficient for this term. Some did not simplify $+-240x$, and a small proportion of candidates complicated the expansion by taking out a factor of 2^5, which introduced fractions and then involved further simplification at the end. This latter method frequently led to errors. A few wrote the expansion in descending order but most of these gave all the terms and so managed to score full marks.

Question 2

50% of the candidates achieved full marks on this logarithm question. Most had no difficulty in applying the power rule on $2\log x$, followed by the subtraction rule to produce a single log equated to 2. A common error was then to "remove the logs" incorrectly by using 2^3 instead of 3^2, but those candidates who did "remove the logs" correctly usually went on to reach the correct solutions.

Of the candidates who were not able to achieve a fully correct solution, a large proportion were able to apply the power rule, but then made no further progress – a particularly common mistake was to "expand" the brackets wrongly and change log $(x - 2)$ to $\log x - \log 2$. There were disappointingly 22% of candidates who scored no marks on this question, showing that the topic of logs remains a problem for many candidates.

Question 3

36.5% achieved full marks and 13.4% achieved no marks on this circle question.
In part (a), good candidates easily produced $(x - a)^2 + (y - b)^2 = r^2$ from the equation given, leading to $(x - 10)^2 + (y - 8)^2 = 25$ and therefore giving the co-ordinates of the centre correctly as *(10, 8)*. Weaker candidates either could not rearrange the equation or gave the centre of the circle as *(20,16)*. A few obtained the equation of the circle but then failed to state the coordinates of the centre.

Most candidates then took the equation of the circle and showed that $r^2 = 25$ and therefore $r = 5$. Some just stated that the root of 25 was 5 with no reference to r^2 or r and a few even stated wrongly that r = √-25 = 5 so achieving the printed answer but not gaining the marks.

In part (c) numerous candidates substituted 13 into the equation of the circle and found the co-ordinates of *P* and *Q*. For a number of candidates, this was the only part of the question that they could answer. A few candidates successfully used geometry and the 3, 4, 5 triangle to find these points.

Part (d) asked for the perimeter of the sector *PTQ* but many candidates found the perimeter of a triangle making 18 rather than 19.275. A few tried to use $\frac{1}{2}r^2\theta$ and found the area of the sector instead of the perimeter.

Question 4

This question was very well done and almost 75% of candidates achieved full marks or lost just one mark.

Use of the factor theorem was well understood in part (a). Many, having shown $f(-2) = 0$, lost the accuracy mark by not giving a conclusion such as 'therefore $(x+2)$ is a factor'. A few used long division in part (a) and gained no marks, as the question explicitly asked for the use of the factor theorem.

In part (b), achieving the full factorised expression for $f(x)$ was very well done, but a few slipped up on the $(2x-3)$ factor, or thought $x = -2$, $x = 4$, $x = 1.5$ was the answer to the question. The distinction between solve and factorise should be understood by candidates at this level, but frequently is not.

Question 5

In part (a) most candidates recognized that they needed to equate the line and curve equations and in most cases a correct quadratic equation and correct x-values were found. A few lost the next 2 marks by not deriving the corresponding y-values. Poor algebra was seen however and the incorrect $x^2 - 9x + 18 = 0$ appeared regularly.

Part (b) saw separate integration of the curve and line equations, with use of the limits 2 and 9, proved a more successful approach than trying to combine the curve and line equations first, though stronger candidates had no problem. Sign errors were not uncommon by others who attempted to combine. Integration overall was very good, though some stopped after finding the area under the curve, not realizing that the area of the trapezium had to be subtracted. Geometric attempts at splitting the trapezium to obtain its area were often flawed, with the wrong formulae used. Others only subtracted a triangle instead of a trapezium. A sizeable minority found the points where the curve crossed the x- axis and used these values in their limits. This was unnecessary and frequently led to errors. The most common error was in not appreciating what an exact answer means, and rounded decimal answers were often seen and lost the final mark. Overall however this was an accessible question, and while 37% achieved full marks, 72% achieved 9 or more marks out of 12.

Question 6

Many candidates showed little or no skill in trigonometry. 48.4% of candidates achieved zero or only one mark on this question.

In part (a) some appeared to lack the basic knowledge that *tan2x = sin2x/cos2x* (or even that *tanx = sinx/cosx* or equivalent), there was also badly devised notation such as $\tan = \frac{\sin}{\cos} 2x$, as if the trig "words" were separate variables unconnected to the ($2x$). Some gained the first mark and multiplied throughout by cos2x to obtain *sin2x = 5sin2x cos2x,* but couldn't make the link from there to the required answer.

In part (b) candidates demonstrated an inability to recognize that two expressions multiplied together to equal zero mean that either or both must be zero. There were many instances of trying to draw trig curves without knowing how to interpret them into solving the equations. Very few candidates gained any B marks as they failed to solve *sin2x = 0*, and of those who did this even fewer obtained all 3 solutions. More candidates did achieve *cos2x =1/5*, and those who then reached 2x =78.5 usually proceeded to obtain one or both required solutions for x. Overall performance on this question was extremely disappointing with only 11% achieving full marks.

Question 7

Overall this trapezium rule question was answered successfully by most candidates and 63.3% achieved full marks.

In part (a) the majority of candidates found the two required values although not all entered them in the table and in exceptional cases the only sign of these values was in the working for part (b). A few candidates did not give their values to the required accuracy often stating answers to two decimal places rather than the requested three. Another common error was to give the second value as 1.740 earning B1 B0 in part (a) but having the possibility of follow through in part (b).

There were many fully correct answers in part (b), some with very little working. Not all were aware of the trapezium rule however. Some left this part blank and a few tried integration. A minority used the separate trapezia method, which was clearly given credit. There were the usual common errors of incorrect values for h (the common one being 0.2), and missing brackets. For the missing brackets full marks were awarded if it was clear from their final correct answer that they knew what they were doing and had recovered. Correct use of brackets should always be encouraged however, as bracketing errors usually lead to logical errors and to wrong answers. Very few candidates entered extra values in the brackets but of those who did, the error was often including 1 and/or 2 in both parts of the formula. It was also very rare to see values of x used instead of y, an error which has occurred in the past. It was necessary to see some evidence of the use of the trapezium rule and answers with no working were awarded no marks in part (b).

Question 8

Numerous candidates found this question difficult but 18% achieved full marks. Weaker candidates sometimes managed no more than 2 marks (for differentiation). 28% achieved only zero, one or two marks out of the thirteen available.

In part (a) most candidates knew the formula for the volume of a cylinder but some were unable to make h the subject.

In part (b), those candidates who were able to write down an expression for the surface area in terms of two circles and a rectangle (of length equal to the circumference) were usually able to go on to gain all 3 marks. However, many candidates did not realise that this was the way to approach this part of the question, often seemingly trying to work back from the answer, but then showing insufficient working to convince that they were using the area of the two circles and the rectangle as required. The formula $S = 2\pi r^2 + 2V/r$ was sometimes seen, but this was only accepted if it had been properly derived as the $2V/r$ is not obvious and the answer was printed, and some also started from an incorrect formula, $S = 2\pi x^2 + (2)\pi x^2 h$ being seen quite frequently, followed by mistakes in cancellations to achieve the required result. Presentation was sometimes a problem, especially for those who confused a multiplication sign with the letter x.

Part (c) required the use of calculus and no marks were available for correct answers obtained by trial and error or by graphical means. Given the formula for the surface area, most candidates were able to differentiate it and equate it to zero. The negative power in the resulting equation caused some candidates problems but many were able to end with an equation in x cubed which they cube- rooted to obtain x, the radius. Two common errors at this stage were to find the cube root of 30π instead of $\frac{30}{\pi}$ and to square root rather than cube root. Some candidates used inequalities as their condition for a stationary value rather than equating their derivative to zero, and could only score two of the marks available for part (c). Other candidates differentiated twice and solved $d^2A/dx^2 = 0$, which was also an incorrect method.

Part (d) was omitted by quite a few candidates. A high number of candidates however successfully substituted their value for x into their equation for the surface area although a number lost the final mark because they did not give the correct value as an integer. For some candidates, this was the only mark they lost on this question. Almost all candidates attempted part (e), with most sensibly choosing to demonstrate that the second differential was positive, rather than other acceptable methods such as considering the gradient. Of the candidates using the second derivative method, those who lost marks on this part had usually differentiated the second term incorrectly although there was sometimes confusion over exactly what had to be positive for a minimum. Some weaker candidates considered the sign of A here, "85 > 0, therefore minimum" being quite often seen. Others confused the 85 with the value for x and substituted $x = 85$ into their second derivative. Some stronger candidates could see that the second derivative was positive for all values of x and made a clear conclusion to show the minimum.

Question 9

Most students should have learned a proof of the sum to n terms of a geometric progression, but only a minority were able to construct a complete proof in part (a). Unfortunately a significant proportion of candidates were unable to deal with a finite series of unknown length. The majority of students attempted the traditional method of subtracting expressions for S_n and rS_n and then factorising and dividing. Marks were not given here for factorisation that clearly did not follow from their own series. Some students attempted a proof by induction (from the FP1 specification) but this was rare. Some even tried to use the method for proving the sum of an arithmetic series. Teachers need to emphasise that these are easy marks and students must learn how to present and reproduce these formal proofs.

In part (b) most students were able to find the common ratio but there were some serious errors such as subtracting the 1.944 from the 5.4 instead of finding their ratio, or using $r = 0.36$ instead of 0.6. Most then went on successfully to find the first term in part (c) and the sum to infinity in part (d). Those who struggled with part (b) generally went on to gain a follow through mark in part (c), and a method mark in part (d) although this mark was not given if $|r| > 1$. Once again, a few treated this as an arithmetic series.

The most common score was 0 in part (a) and full marks in the rest of the question. About 20% achieved full marks and about 40% achieved 7 out of the 11 marks while about 15% achieved no marks at all.

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