Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Bronze Level B1

Time: 1 hour 30 minutes

Materials required for examination	**Items included with question papers**
Mathematical Formulae (Green)	Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulas stored in them.

Instructions to Candidates

Write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Core Mathematics C2), the paper reference (6664), your surname, initials and signature.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
There are 9 questions in this question paper. The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may gain no credit.

Suggested grade boundaries for this paper:

A*	A	B	C	D	E
74	69	64	59	53	47

1. A geometric series has first term a and common ratio $r = \frac{3}{4}$.

The sum of the first 4 terms of this series is 175.

(a) Show that $a = 64$.

(2)

(b) Find the sum to infinity of the series.

(2)

(c) Find the difference between the 9th and 10th terms of the series.
Give your answer to 3 decimal places.

(3)

May 2016

2.

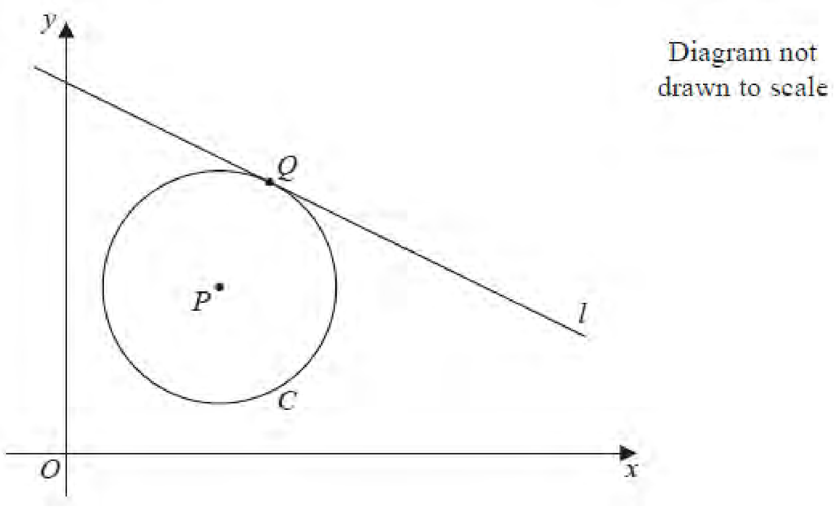

Figure 1

The circle C has centre $P(7, 8)$ and passes through the point $Q(10, 13)$, as shown in Figure 1.

(a) Find the length PQ, giving your answer as an exact value.

(2)

(b) Hence write down an equation for C.

(2)

The line l is a tangent to C at the point Q, as shown in Figure 1.

(c) Find an equation for l, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

May 2016

3.

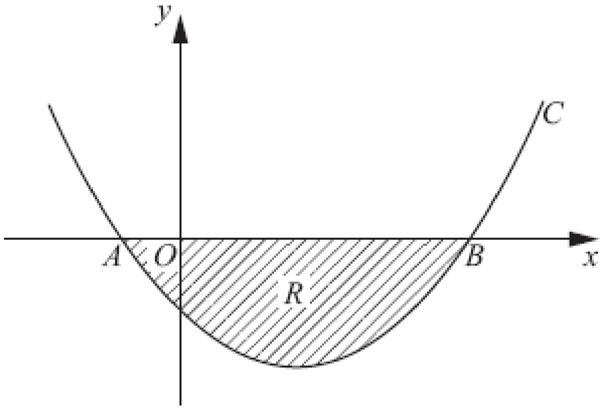

Figure 2

Figure 2 shows a sketch of part of the curve C with equation

$$y = (x + 1)(x - 5).$$

The curve crosses the x-axis at the points A and B.

(a) Write down the x-coordinates of A and B.

(1)

The finite region R, shown shaded in Figure 2, is bounded by C and the x-axis.

(b) Use integration to find the area of R.

(6)

January 2011

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4. $$\text{f}(x) = -4x^3 + ax^2 + 9x - 18, \quad \text{where } a \text{ is a constant.}$$

Given that $(x - 2)$ is a factor of $\text{f}(x)$,

(a) find the value of a,

(2)

(b) factorise $\text{f}(x)$ completely,

(3)

(c) find the remainder when $\text{f}(x)$ is divided by $(2x - 1)$.

(2)

May 2014

5.

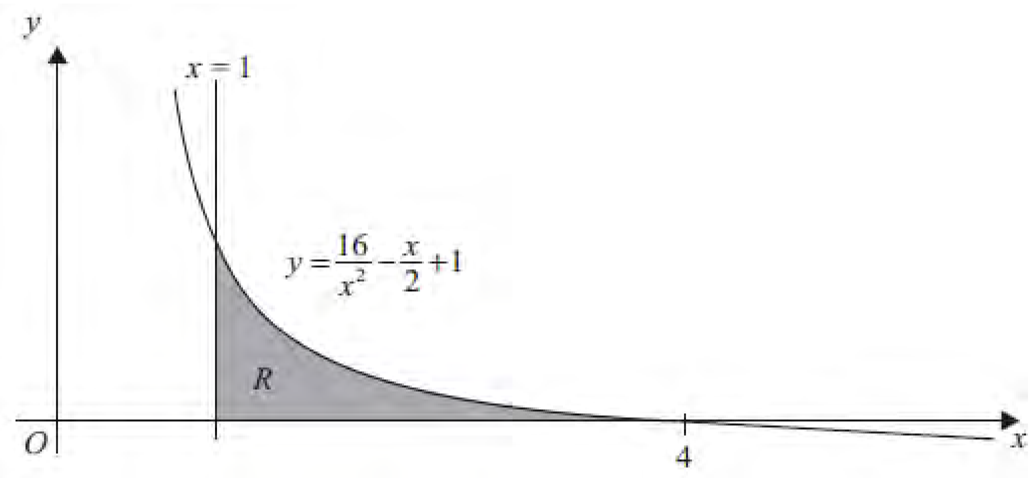

Figure 3

Figure 3 shows the graph of the curve with equation

$$y = \frac{16}{x^2} - \frac{x}{2} + 1, \qquad x > 0.$$

The finite region R, bounded by the lines $x = 1$, the x-axis and the curve, is shown shaded in Figure 3. The curve crosses the x-axis at the point (4, 0).

(*a*) Complete the table with the values of y corresponding to $x = 2$ and 2.5.

x	1	1.5	2	2.5	3	3.5	4
y	16.5	7.361			1.278	0.556	0

(2)

(*b*) Use the trapezium rule with all the values in the completed table to find an approximate value for the area of R, giving your answer to 2 decimal places.

(4)

(*c*) Use integration to find the exact value for the area of R.

(5)

January 2012

6. Given that $\log_3 x = a$, find in terms of a,

(*a*) $\log_3 (9x)$

(2)

(*b*) $\log_3 \left(\dfrac{x^5}{81}\right)$

(3)

giving each answer in its simplest form.

(*c*) Solve, for x,

$$\log_3 (9x) + \log_3 \left(\frac{x^5}{81}\right) = 3$$

giving your answer to 4 significant figures.

(4)

May 2013 (R)

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7. $$y = \sqrt{(3^x + x)}$$

(*a*) Complete the table below, giving the values of y to 3 decimal places.

x	0	0.25	0.5	0.75	1
y	1	1.251			2

(2)

(*b*) Use the trapezium rule with all the values of y from your table to find an approximation for the value of

$$\int_0^1 \sqrt{(3^x + x)}\ \ \mathrm{d}x.$$

You must show clearly how you obtained your answer.

(4)

May 2012

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8. (i) Solve

$$5^y = 8$$

giving your answers to 3 significant figures.

(2)

(ii) Use algebra to find the values of *x* for which

$$\log_2(x+15) - 4 = \frac{1}{2}\log_2 x$$

(6)

May 2014 (R)

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9. (i) Solve, for $0 \le \theta < 180°$

$$\sin(2\theta - 30°) + 1 = 0.4$$

giving your answers to 1 decimal place.

(5)

(ii) Find all the values of *x*, in the interval $0 \le \theta < 360°$, for which

$$9\cos^2 x - 11\cos x + 3\sin^2 x = 0$$

giving your answers to 1 decimal place.

(7)

You must show clearly how you obtained your answers.

May 2013 (R)

TOTAL FOR PAPER: 75 MARKS

END

Question number	Scheme	Marks
1 (a)	$\dfrac{a\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}}$ or $\dfrac{a\left(1-\frac{3}{4}^4\right)}{1-\frac{3}{4}}$ or $\dfrac{a\left(1-0.75^4\right)}{1-0.75}$	M1
	$175 = \dfrac{a\left(1-\left(\frac{3}{4}\right)^4\right)}{1-\frac{3}{4}} \Rightarrow a = \dfrac{175\left(1-\frac{3}{4}\right)}{\left(1-\left(\frac{3}{4}\right)^4\right)} \left\{\Rightarrow a = \dfrac{\left(\frac{175}{4}\right)}{\left(\frac{175}{256}\right)} \Rightarrow\right\} \underline{a = 64}$ *	A1*
		(2)
	$\{S_\infty\} = \dfrac{64}{\left(1-\dfrac{3}{4}\right)}$; $= 256$	M1
		A1 cao
		(2)
	$\{D = T_9 - T_{10} = \}\ 64\left(\dfrac{3}{4}\right)^8 - 64\left(\dfrac{3}{4}\right)^9$	M1
		dM1
	$\left\{= 64\left(\dfrac{3}{4}\right)^8\left(\dfrac{1}{4}\right) = 1.6018066...\right\} = \underline{1.602}$ (3dp)	A1 cao
		(3)
		[7]

Question number	Scheme		Marks
2 (a)	$\{PQ =\}\ \sqrt{(7-10)^2 + (8-13)^2}$ or $\sqrt{(10-7)^2 + (13-8)^2}$		M1
	$\{PQ\} = \sqrt{34}$		A1
			(2)
(b)	$(x-7)^2 + (y-8)^2 = 34\ \left(\text{or } \left(\sqrt{34}\right)^2\right)$		M1
			A1 oe
			(2)
(c)	$\{\text{Gradient of radius}\} = \frac{13-8}{10-7}$ or $\frac{5}{3}$		B1
	Gradient of tangent $= -\frac{1}{m}\left(= -\frac{3}{5}\right)$		M1
	$y - 13 = -\frac{3}{5}(x-10)$		M1
	$3x + 5y - 95 = 0$		A1
			(4)
			[8]
3 (a)	Seeing −1 and 5. (See note below)		B1
			(1)
(b)	$(x+1)(x-5) = \underline{x^2 - 4x - 5}$ or $\underline{x^2 - 5x + x - 5}$		B1
		M: $x^n \rightarrow x^{n+1}$ for any one term.	M1
	$\int (x^2 - 4x - 5)\,dx = \frac{x^3}{3} - \frac{4x^2}{2} - 5x\ \{+c\}$	1st A1 at least two out of three terms correctly ft.	A1ftA1
	$\left[\frac{x^3}{3} - \frac{4x^2}{2} - 5x\right]_{-1}^{5} = (......) - (......)$	Substitutes 5 and −1 (or limits from part(a)) into an "integrated function" and subtracts, either way round.	dM1
	$\left\{\begin{array}{l}\left(\frac{125}{3} - \frac{100}{2} - 25\right) - \left(-\frac{1}{3} - 2 + 5\right) \\ = \left(-\frac{100}{3}\right) - \left(\frac{8}{3}\right) = -36\end{array}\right\}$		
	Hence, Area = 36	Final answer must be 36, not −36	A1
			(6)
			[7]

Question number	Scheme	Marks
4 (a)	$f(x) = -4x^3 + ax^2 + 9x - 18$ $f(2) = -32 + 4a + 18 - 18 = 0$ $\Rightarrow\ 4a = 32 \Rightarrow\ a = 8$	M1 A1 **(2)**
(b)	$f(x) = (x-2)(-4x^2 + 9)$ $= (x-2)(3-2x)(3+2x)$ or equivalent e.g. $= -(x-2)(2x-3)(2x+3)$ or $= (x-2)(2x-3)(-2x-3)$	M1 **d**M1A1 **(3)**
(c)	$f\left(\frac{1}{2}\right) = -4\left(\frac{1}{8}\right) + 8\left(\frac{1}{4}\right) + 9\left(\frac{1}{2}\right) - 18 = -12$	M1A1ft **(2)** **[7]**
5 (a)	*(table below)*	B1 B1 **(2)**
(b)	$\frac{1}{2}\times 0.5,\quad \{(16.5+0)+2(7.361+4+2.31+1.278+0.556)\}$ $= 11.88$ (or answers listed below in note)	B1M1A1ft A1 **(4)**
(c)	$\int_1^4 \frac{16}{x^2} - \frac{x}{2} + 1\,dx = \left[-\frac{16}{x} - \frac{x^2}{4} + x\right]_1^4$ $= [-4-4+4] - [-16 - \frac{1}{4} + 1]$ $= 11\frac{1}{4}$ or equivalent	M1A1A1 M1 A1 **(5)** **[11]**

Table for 5 (a):

x	1	1.5	2	2.5	3	3.5	4
y	16.5	7.361	**4**	**2.31**	1.278	0.556	0

Question number	Scheme	Marks
6 (a)	Way 1: $\log_3(9x) = \log_3 9 + \log_3 x$ $= 2 + a$ or Way 2: $\log_3(9x) = \log_3 3^{a+2}$ $= 2 + a$	M1 A1 **(2)**
(b)	Way 1: $\log_3\left(\frac{x^5}{81}\right) = \log_3 x^5 - \log_3 81$ $\log x^5 = 5\log x$ or log81=4log3 or log81=4 or Way 2 $= \log_3 \frac{3^{5a}}{3^4}$ $= \log_3 3^{5a-4}$ $= 5a - 4$	M1 M1 A1 cso **(3)**
(c)	$\log_3(9x) + \log_3\left(\frac{x^5}{81}\right) = 3$ Method 1 $\Rightarrow 2 + a + 5a - 4 = 3$ $\Rightarrow a = \frac{5}{6}$ $\Rightarrow x = 3^{\frac{5}{6}}$ or $\log_{10} x = a \log_{10} 3$ so $x =$ Method 2 $\log_3\left(9x.\frac{x^5}{81}\right)$ = (3 or log27) $\log_3\left(\frac{x^6}{9}\right) = 3$ or log 27 $\Rightarrow \frac{x^6}{9} = 3^3 \Rightarrow x^6 = 3^5 \Rightarrow x =$ $x = 2.498$ **or awrt** If x = -2.498 appears as well or instead this is A0	M1 A1 M1 A1 **(4)** **[9]**
7 (a)	see table below	B1B1 **(2)**
(b)	$\frac{1}{2} \times 0.25$, $\{(1+2) + 2(1.251 + 1.494 + 1.741)\}$ o.e. =1.4965	B1M1A1ft A1 **(4)** **[6]**

x	0	0.25	0.5	0.75	1
y	1	1.251	**1.494**	**1.741**	2

Question number	Scheme	Marks
8 (i)	$y\log 5 = \log 8$	M1
	awrt 1.29	A1
		(2)
	$\log_2(x+15) - 4 = \frac{1}{2}\log_2 x$	
	$\log_2(x+15) - 4 = \log_2 x^{\frac{1}{2}}$	M1
	$\log_2\left(\dfrac{x+15}{x^{\frac{1}{2}}}\right) = 4$	M1
	$\left(\dfrac{x+15}{x^{\frac{1}{2}}}\right) = 2^4$	M1
(ii)	$x - 16x^{\frac{1}{2}} + 15 = 0$	
	or e.g.	A1
	$x^2 + 225 = 226x$	
	$(\sqrt{x}-1)(\sqrt{x}-15) = 0 \Rightarrow \sqrt{x} = ...$	dddM1
	$\{\sqrt{x} = 1, 15\}$	
	$x = 1, 225$	A1
		(6)
		[8]

Question number	Scheme	Marks
9 (a)	$\sin(2\theta - 30) = -0.6$ or $2\theta - 30 = -36.9$ or implied by 216.9	B1
	$2\theta - 30 = 216.87$ = (180 + 36.9)	M1
	$\theta = \dfrac{216.87 + 30}{2} = 123.4$ or 123.5	A1
	$2\theta - 30 = 360 - 36.9$ or 323.1	M1
	$\theta = \dfrac{323.1 + 30}{2} = 176.6$	A1
		(5)
(b)	$9\cos^2 x - 11\cos x + 3(1 - \cos^2 x) = 0$ or	M1
	$6\cos^2 x - 11\cos x + 3(\sin^2 x + \cos^2 x) = 0$	
	$6\cos^2 x - 11\cos x + 3 = 0$ {as $(\sin^2 x + \cos^2 x) = 1$}	A1
	$(3\cos x - 1)(2\cos x - 3) = 0$ implies $\cos x =$	M1
	$\cos x = \dfrac{1}{3}, \left(\dfrac{3}{2}\right)$	A1
	$x = 70.5$	B1
	$x = 360 - "70.5"$	M1
	$x = 289.5$	A1cao
		(7)
		[12]

Examiner reports

Question 1

This proved to be an accessible start to the paper with a majority of candidates gaining the full seven marks and only a small number losing just one mark. Only a very small minority gained less than half of the marks.

Part (a) was a "show that" question. Full marks were obtained by most candidates, but the final mark was lost by some because they showed insufficient working and jumped straight from an initial equation for the sum of four terms, to $a = 64$ with no simplification or rearrangement. A few lost the final mark for using rounded decimals and hence not obtaining $a = 64$ exactly, as required. The alternative method of adding terms in a was usually completed successfully. Many candidates who used the reverse method of substituting $a = 64$ failed to write a conclusion and so lost the final mark.

In part (b) the S_n formula was used correctly by almost all candidates, with only a very few arithmetic errors. A very small minority of candidates worked with a value of a other than 64 and these were able to pick up the method mark.

Part (c) was completed correctly by the majority of candidates, with the most common error being to round their answer to 2, rather than the required 3 decimal places. Some candidates found the 10th and 11th terms difference as they used the wrong formula, $u_n = ar^n$, for the nth term. A small minority divided rather than subtracted terms. A significant proportion found the difference between the **sum** of the first 9 terms and the first 10 terms.

Question 2

Overall this circle question was well attempted by the majority of candidates. Errors were generally due to slips rather than misunderstandings.

In part (a) most candidates used the distance formula or Pythagoras theorem correctly to find the length of PQ, and wrote it exactly, as $\sqrt{34}$. However, a number of candidates went on to write this, unnecessarily, as a rounded decimal, while some lost the second mark by writing their answer as a rounded decimal only. Only a minority of candidates had neither, having made arithmetic errors, with the most common error being the answer of 6 (coming incorrectly from $\sqrt{(25 + 9)} = \sqrt{36}$).

In part (b) the correct equation for the circle was given by the majority of candidates who had part (a) right, and at least the method mark was available for those who did not achieve the correct radius.

Part (c) was also very well attempted with many candidates achieving full marks. Way 1 on the mark scheme, the expected route, was used by the vast majority. Attempts at Way 2 were uncommon, and usually involved invalid attempts at differentiation, though the very small minority who used implicit differentiation did evaluate the gradients correctly and gain full marks. Way 3, or other unusual methods, were rare.

The common errors in this part were twofold: some miscalculated the gradient, usually having $\frac{\text{change in } x}{\text{change in } y}$, while for others the algebraic rearrangement to the required form was omitted or incorrect with $3x + 5y - 35 = 0$ being a common answer. Occasionally the wrong point on the line would be used, taking the centre rather than point P.

However, most demonstrated correct knowledge of the need to reciprocate and negate their radial gradient (wherever it came from) to give the gradient of the tangent and formed a correct line equation. The $y - y_1 = m(x - x_1)$ equation for a line was by far the most common method and usually gave a correct answer.

Question 3

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 lost 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 4

For part (a) the majority could obtain the correct value for a by solving f(2) = 0. There were very few students who chose long division or comparison of coefficients.

Many students could at least make a start in part (b) and used inspection or long division to establish the quadratic factor $-4x^2 + 9$. Interestingly, many students stopped at $(x - 2)(-4x^2 + 9)$ for the factorised form of f(x), presumably not spotting the difference of two squares. Of those who did attempt to factorise $-4x^2 + 9$, a significant number of students chose to change the sign and obtained $(2x + 3)(2x - 3)$ without subsequently compensating for the change of sign.

The method in part (c) was well known and most chose to evaluate $\text{f}\left(\frac{1}{2}\right)$, with a few students opting for long division. The scheme allowed for a follow through accuracy mark for those with an incorrect value for a in part (a).

Question 5

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 6

This question was well answered by most candidates. In part (a), almost all candidates used the addition rule of logs to separate the terms and were able then to write the given expression in terms of a. Candidates who tried to change base introduced extra complications. There were some weaker candidates who did not know the log laws well. Some did not know how to deal with the 9 or 81 and some simply replaced x with a giving common incorrect answers of $9a$ and $\frac{a^5}{81}$.

In part (b), again, most candidates used the subtraction law correctly and spotted that the power law was the next step; almost all achieved the correct answer. In parts (a) and (b), almost all candidates used the first method, “way 1” on the mark scheme.

Unusually, part (c) was answered by some candidates who had not been able to answer parts (a) and (b). Most answered part (c) using the first method on the scheme, although it was disappointing how many achieved the value for a, without going on to find a value for x. Those who used the alternative method tended to be less successful, making errors in ‘undoing’ the log and in multiplying and dividing by powers of 3 correctly. Those using method 2 sometimes gave the "extra false solution" of –2.498 losing the last mark.

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

Very few errors were seen in part (i). The majority took logs base 10 and divided but some took logs base 5 to give the correct answer directly.

Success in part (ii) was very varied. Those with a clear understanding of the properties of logs could make significant progress although the resulting quadratic in $\sqrt{x}$ confused many.

The most common error was from those whose understanding of logs was weak, wrote $\log(x+15)$ as $\log x + \log 15$. Some credit was given for any evidence of understanding of either the power law or addition/subtraction laws and some students could gain at least one or two marks. Solving the quadratic involving $\sqrt{x}$ was challenging for many and of those who chose to square $x + 15$, sometimes produced $x^2 + 225$. More successful students substituted $y = \sqrt{x}$ to help with the factorising and solving of the equation.

Question 9

The majority of candidates were able to make a good attempt at this question and many gained full marks. Where candidates were less successful, part (a) was less well done that part (b).

Several candidates did not realise that they needed to obtain sin $(2\theta - 30) = -\frac{0}{6}$ to start this question. Some candidates expanded the bracket in (a) and others solved to find θ as –3.4 but then made no further progress. Occasionally candidates who had correct values for $(2\theta - 30)$ made the common error of dividing by 2 before adding 30. Of those who only found one of the two solutions, it was most common for them to find 176.6, often not using the method on the mark scheme, but obtaining the –3.4 before using the sine graph or a CAST diagram.

In part (b) candidates regularly obtained the correct quadratic but there were some errors is factorising and solving, with cos $x = \frac{2}{3}$ and $\frac{1}{3}$ being the most common incorrect answer. A few candidates gave just one value of x as 70.5 without calculating the second value, whilst a few gave extra answers of $180 - x$ and $180 + x$, or of $270 + x$ and $270 - x$. It was interestingly very rare for candidates to work in radians in this question.

Statistics for C2 Practice Paper Bronze Level B1

Qu	Max score	Modal score	Mean %	Mean score for students achieving grade: ALL	A*	A	B	C	D	E	U
1	7	7	92	6.41	6.84	6.76	6.67	6.56	6.45	6.26	5.46
2	8	8	86	6.85	7.89	7.80	7.53	7.24	6.84	6.27	4.20
3	7		87	6.12	6.93	6.73	6.40	6.09	5.77	5.33	3.90
4	7		88.3	6.18	6.96	6.76	6.39	6.10	5.91	5.39	4.19
5	11		83	9.09	10.92	10.50	9.70	8.96	8.02	7.05	4.87
6	9		80	7.19	8.78	8.60	7.29	6.34	6.29	4.25	3.05
7	6		83	5.00	5.94	5.83	5.61	5.33	4.93	4.38	3.09
8	8		75.6	6.05	7.72	7.22	6.20	5.72	4.98	4.53	2.45
9	12		80	9.61	11.93	11.52	10.54	8.98	7.36	4.56	2.21
	75		**83.33**	**62.50**	**73.91**	**71.72**	**66.33**	**61.32**	**56.55**	**48.02**	**33.42**