Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2
Bronze Level B1

Time: 1 hour 30 minutes

Materials required for examination papers	**Items included with question**
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 11 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	68	62	56	50	44

1. A geometric series has first term $a = 360$ and common ratio $r = \frac{7}{8}$.

Giving your answers to 3 significant figures where appropriate, find

(*a*) the 20th term of the series,

(2)

(*b*) the sum of the first 20 terms of the series,

(2)

(*c*) the sum to infinity of the series.

(2)

January 2012

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2. $$f(x) = ax^3 + bx^2 - 4x - 3, \text{ where } a \text{ and } b \text{ are constants.}$$

Given that $(x - 1)$ is a factor of f(x),

(*a*) show that $a + b = 7$.

(2)

Given also that, when f(x) is divided by $(x + 2)$, the remainder is 9,

(*b*) find the value of a and the value of b, showing each step in your working.

(4)

January 2013

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3. $$y = \sqrt{(10x - x^2)}.$$

(*a*) Copy and complete the table below, giving the values of y to 2 decimal places.

x	1	1.4	1.8	2.2	2.6	3
y	3	3.47			4.39	

(2)

(*b*) Use the trapezium rule, with all the values of y from your table, to find an approximation for the value of $\int_1^3 \sqrt{(10x - x^2)}\ dx$.

(4)

January 2009

4.

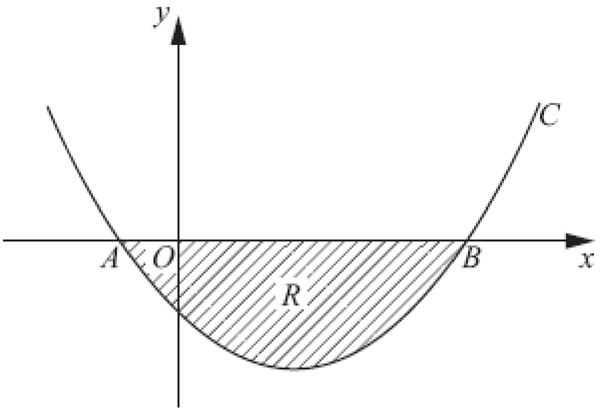


Figure 1

Figure 1 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 1, is bounded by *C* and the *x*-axis.

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

(6)

January 2011

5. $\mathrm{f}(x) = x^3 + ax^2 + bx + 3$, where *a* and *b* are constants.

Given that when f (*x*) is divided by ($x + 2$) the remainder is 7,

(*a*) show that $2a - b = 6$.

(2)

Given also that when f(*x*) is divided by ($x - 1$) the remainder is 4,

(*b*) find the value of *a* and the value of *b*.

(4)

January 2012

6.

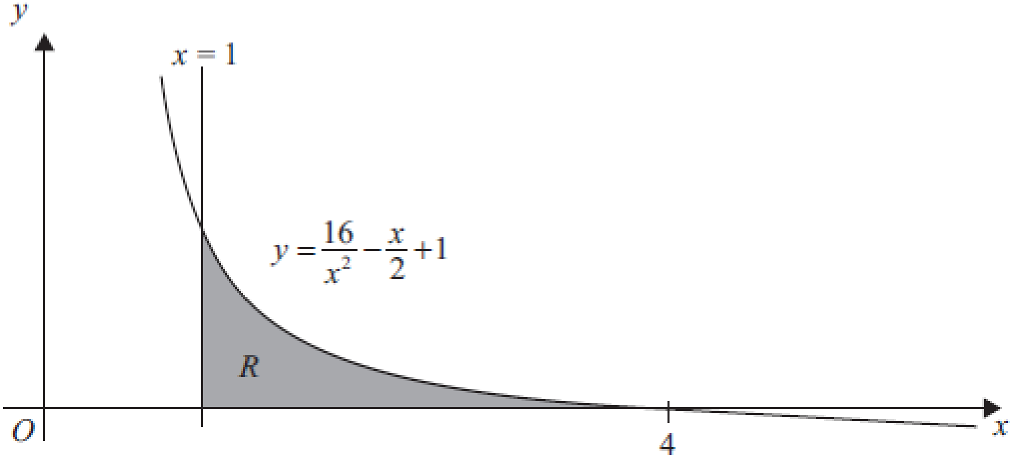


Figure 2

Figure 2 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 2. 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.

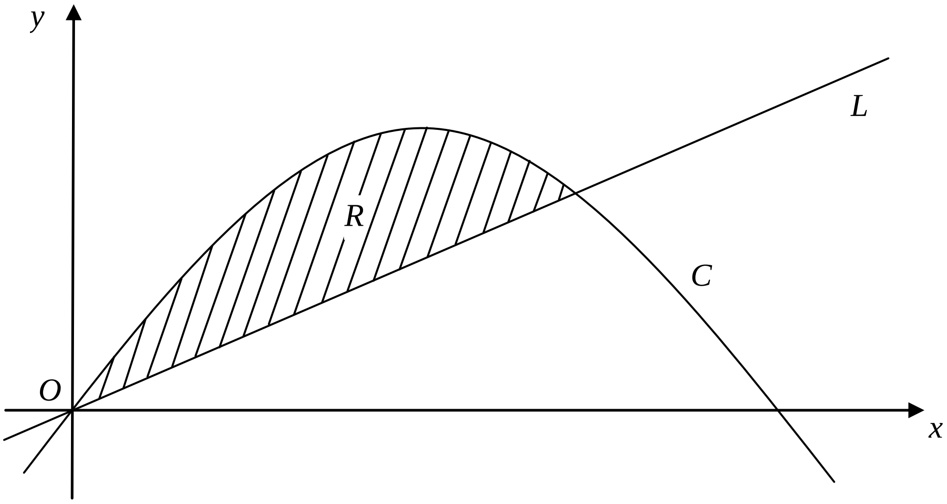
(4)

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

(5)

January 2012

7. **Figure 3**



In Figure 3 the curve C has equation $y = 6x - x^2$ and the line L has equation $y = 2x$.

(*a*) Show that the curve C intersects with the x-axis at $x = 0$ and $x = 6$.

(1)

(*b*) Show that the line L intersects the curve C at the points (0, 0) and (4, 8).

(3)

The region R, bounded by the curve C and the line L, is shown shaded in Figure 3.

(*c*) Use calculus to find the area of R.

(6)

January 2008

8.

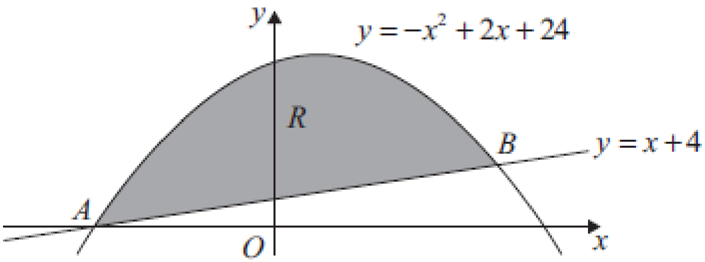


Figure 4

The straight line with equation $y = x + 4$ cuts the curve with equation $y = -x^2 + 2x + 24$ at the points A and B, as shown in Figure 4.

(*a*) Use algebra to find the coordinates of the points A and B.

(4)

The finite region R is bounded by the straight line and the curve and is shown shaded in Figure 4.

(*b*) Use calculus to find the exact area of R.

(7)

January 2010

9.

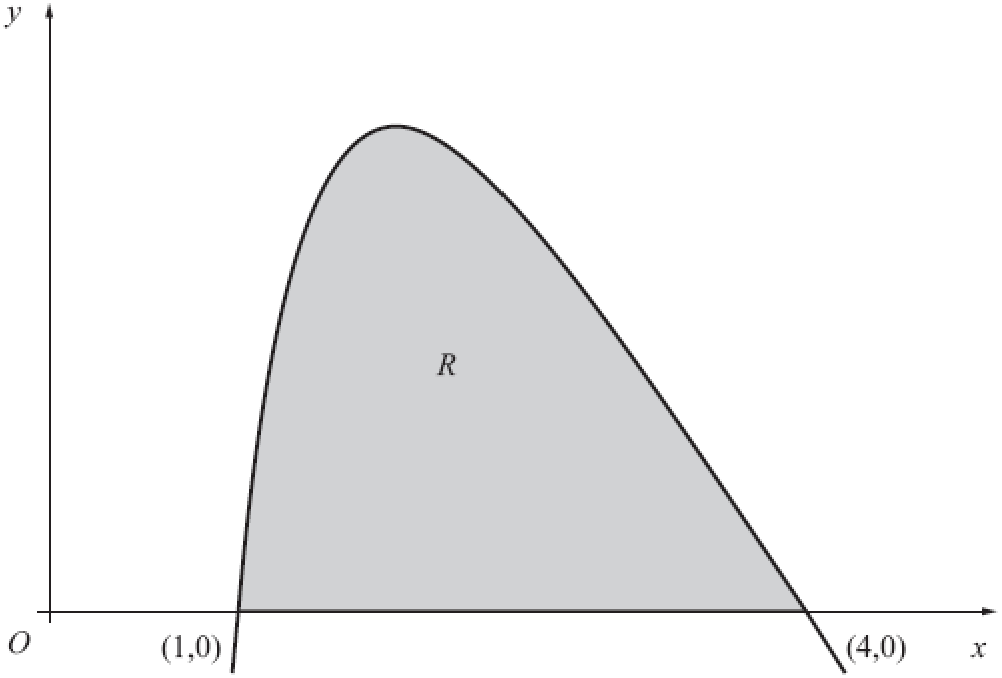


Figure 5

The finite region R, as shown in Figure 5, is bounded by the x-axis and the curve with equation

$$y = 27 - 2x - 9\sqrt{x} - \frac{16}{x^2}, \qquad x > 0.$$

The curve crosses the x-axis at the points (1, 0) and (4, 0).

(*a*) Copy and complete the table below, by giving your values of y to 3 decimal places.

x	1	1.5	2	2.5	3	3.5	4
y	0	5.866		5.210		1.856	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.

(6)

January 2013

TOTAL FOR PAPER: 75 MARKS

END

Question Number	**Scheme**	**Marks**
1. (a)	Uses $360\times\left(\frac{7}{8}\right)^{19}$, to obtain 28.5	M1, A1 (2)
(b)	Uses $S=\dfrac{360(1-(\frac{7}{8})^{20})}{1-\frac{7}{8}}$, or $S=\dfrac{360((\frac{7}{8})^{20}-1)}{\frac{7}{8}-1}$ to obtain 2680	M1, A1 (2)
(c)	Uses $S=\dfrac{360}{1-\frac{7}{8}}$, to obtain 2880	M1, A1 cao (2) **[6]**
2. (a)	$\text{f}(1)=a+b-4-3$ **=** 0 **or** $a + b - 7 = 0$	M1
	$a + b = 7$ *	A1 (2)
(b)	$\text{f}(-2)=a\left(-2\right)^3+b\left(-2\right)^2-4\left(-2\right)-3=9$	M1
	$-8a+4b+8-3=9$	A1
	$(-8a + 4b = 4)$	
	Solves the **given equation from part (a)** and their equation in a and b from part (b) as far as a =... or b = ...	M1
	$a = 2$ **and** $b = 5$	A1 (4) **[6]**
3. (a)	3.84, 4.14, 4.58	B1 B1 (2)
(b)	$\frac{1}{2}\times 0.4,\quad \left\{(3+4.58)+2\left(3.47+3.84+4.14+4.39\right)\right\}$	B1, M1 A1ft
	= 7.852 (awrt 7.9)	A1 (4) **[6]**

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>4. (a)</td><td>Seeing –1 and 5.</td><td>B1
(1)</td></tr>
<tr><td>(b)</td><td>$(x+1)(x-5)=x^2-4x-5$ or $x^2-5x+x-5$</td><td>B1</td></tr>
<tr><td></td><td>$\int(x^2-4x-5)\mathrm{d}x=\frac{x^3}{3}-\frac{4x^2}{2}-5x\{+c\}$</td><td>M1 A1ft
A1</td></tr>
<tr><td></td><td>$\left[\frac{x^3}{3}-\frac{4x^2}{2}-5x\right]_{-1}^{5}=(\ldots\ldots)-(\ldots\ldots)$</td><td>dM1</td></tr>
<tr><td></td><td>$\left\{\begin{array}{l}\left(\frac{125}{3}-\frac{100}{2}-25\right)-\left(-\frac{1}{3}-2+5\right)\\=\left(-\frac{100}{3}\right)-\left(\frac{8}{3}\right)=-36\end{array}\right\}$</td><td></td></tr>
<tr><td></td><td>Hence, Area = 36</td><td>A1
(6)
[7]</td></tr>
<tr><td>5. (a)</td><td>$\mathrm{f}(-2)=-8+4a-2b+3=7$</td><td>M1</td></tr>
<tr><td></td><td>so $2a-b=6$ *</td><td>A1
(2)</td></tr>
<tr><td>(b)</td><td>$\mathrm{f}(1)=1+a+b+3=4$</td><td>M1 A1</td></tr>
<tr><td></td><td>Solve two linear equations to give $a=2$ and $b=-2$</td><td>M1 A1
(4)
[6]</td></tr>
<tr><td>6. (a)</td><td><table>
<tr><td>x</td><td>1</td><td>1.5</td><td>2</td><td>2.5</td><td>3</td><td>3.5</td><td>4</td></tr>
<tr><td>y</td><td>16.5</td><td>7.361</td><td>4</td><td>2.31</td><td>1.278</td><td>0.556</td><td>0</td></tr>
</table></td><td>B1, B1
(2)</td></tr>
<tr><td>(b)</td><td>$\frac{1}{2}\times0.5,\ \{(16.5+0)+2(7.361+4+2.31+1.278+0.556)\}$</td><td>B1,
M1A1ft</td></tr>
<tr><td></td><td>= 11.88</td><td>A1
(4)</td></tr>
<tr><td>(c)</td><td>$\int_1^4\frac{16}{x^2}-\frac{x}{2}+1\,\mathrm{d}x=\left[-\frac{16}{x}-\frac{x^2}{4}+x\right]_1^4$</td><td>M1 A1
A1</td></tr>
<tr><td></td><td>$=[-4-4+4]-[-16-\frac{1}{4}+1]$</td><td>M1</td></tr>
<tr><td></td><td>$=11\frac{1}{4}$ oe</td><td>A1
(5)
[11]</td></tr>
</table>

Question Number	**Scheme**	**Marks**
7. (a)	Either solving 0 = $x(6 – x)$ and showing $x = 6$ (and $x = 0$) or showing (6, 0) (and $x = 0$) satisfies $y = 6x – x^2$	B1 (1)
(b)	Solving $2x = 6x – x^2$ ($x^2 = 4x$) to $x = \ldots$	M1
	$x = 4$ (and $x = 0$)	A1
	Conclusion: when $x = 4$, $y = 8$ and when $x = 0$, $y = 0$	A1 (3)
(c)	(Area =) $\int_{(0)}^{(4)}\left(6x-x^2\right)\mathrm{d}x$	M1
	Correct integration $3x^2-\frac{x^3}{3}(+c)$	A1
	Correct use of correct limits on their result above	M1
	$\left[3x^2-\frac{x^3}{3}\right]^4-\left[3x^2-\frac{x^3}{3}\right]_0$ with limits substituted $\left[=48-21\frac{1}{3}=26\frac{2}{3}\right]$	
	Area of triangle = 2 × 8 =16	A1
	Shaded area = ± (area under curve – area of triangle) applied correctly	M1
	$\left(=26\frac{2}{3}-16\right)$ $=10\frac{2}{3}$ (awrt 10.7)	A1 (6) **[10]**
8. (a)	Curve: $y=-x^2+2x+24$, Line: $y=x+4$	
	{Curve = Line} $\Rightarrow -x^2+2x+24=x+4$	B1
	$x^2-x-20\ \{=0\}\ \Rightarrow\ (x-5)(x+4)\ \{=0\} \Rightarrow\ x=.....$	M1
	So, $x=5,-4$	A1
	So corresponding y-values are $y=9$ and $y=0$.	B1ft (4)
(b)	$\left\{\int(-x^2+2x+24)\,\mathrm{d}x\right\}=\underline{-\frac{x^3}{3}+\frac{2x^2}{2}+24x}\ \{+c\}$	M1A1A1
	$\left[-\frac{x^3}{3}+\frac{2x^2}{2}+24x\right]_{-4}^{5}=(......)-(......)$	dM1
	$\left\{\left(-\frac{125}{3}+25+120\right)-\left(\frac{64}{3}+16-96\right)=\left(103\frac{1}{3}\right)-\left(-58\frac{2}{3}\right)=162\right\}$	
	Area of $\Delta=\frac{1}{2}(9)(9)=40.5$	M1
	So area of R is $162-40.5=121.5$	M1 A1 oe **cao** (7) **[11]**

Question Number	**Scheme**	**Marks**
9. (a)	$y = 27 - 2x - 9\sqrt{x} - \frac{16}{x^2}$	
	6.272 , 3.634	B1, B1 (2)
(b)	$\frac{1}{2}\times\frac{1}{2}$ or $\frac{1}{4}$	B1
	$....\{(0+0)+2(5.866+"6.272"+5.210+"3.634"+1.856)\}$	M1A1ft
	$\frac{1}{2}\times 0.5\{(0+0)+2(5.866+"6.272"+5.210+"3.634"+1.856)\}$	
	$= \frac{1}{4}\times 45.676$	
	= 11.42	A1 cao (4)
(c)	$\int y\,\mathrm{d}x = 27x - x^2 - 6x^{\frac{3}{2}} + 16x^{-1} (+c)$	M1 A1 A1 A1
	$\left(27(4)-(4)^2-6(4)^{\frac{3}{2}}+16(4)^{-1}\right)$ $-\left(27(1)-(1)^2-6(1)^{\frac{3}{2}}+16(1)^{-1}\right)$	dM1
	= (48 – 36)	
	12	A1 cao (6) **[12]**

Examiner reports

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

Candidates found this question accessible. In part (a) most candidates attempted f(1) and proceeded to establish the given equation. However it is worth pointing out that a significant number of candidates presented work along the lines of f(1) = $a + b - 7$ and concluded that $a + b = 7$ with no reference to f(1) = 0 thereby losing a mark in this “show that” question.

In part (b) the majority of candidates correctly attempted f(-2) with a minority using f(–2) = 0 rather than f(–2) = 9. Although many candidates with correct work so far could then go on to find *a* and *b*, there were many examples of errors in solving the simultaneous equations. Very few candidates used long division.

Question 3

On the whole this question was also well answered with most students gaining more than just the two marks for completion of the table in part (a).

As in previous sessions the most frequent error was in finding h, with 2/6 being the most usual wrong answer. Many candidates used h = (b – a)/n and put n as 6. It is clear that what this formula represents is not fully understood. It was rare to see the simple method of subtracting one x value from the next one to get h.

There were not as many bracketing errors in the application of the formula this time as in previous examinations. Errors in substituting values inside the curly brackets included putting (0 + 4.58) + 2(3 + 3.47 + . . . + 4.39) as well as several instances of the first bracket correct but 3 also appearing in the second bracket. There was also some use of x values instead of y values in the trapezium formula.

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 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 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.

Part (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.

Part (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

The first two parts were a good source of marks for most candidates. In part (c), the method of finding the area under the curve and subtracting the area under the line was the more favoured approach. In the majority of these cases the area under the line was found by calculating the area of the triangle rather than integrating, but in either case there was considerable success. Integration of the curve function was usually correct and the biggest source of error was confusion with the limits. It was surprisingly common to see $\int_0^6 (6x - x^2)dx - \int_0^6 2xdx$ (or equivalent), and $\int_0^6 (6x - x^2)dx$ [or $\int_0^8 (6x - x^2)dx$] – 16 used, and it may be that parts (a) and (b) had in some way contributed to the confusion. Candidates who subtracted the line function from the curve function before integrating often earned the marks quickly, but sign errors were not uncommon. Candidates who used longer strategies were sometimes successful but there was clearly more chance of making one of the errors noted above. Some candidates calculated the area under the curve using the trapezium rule; the mark scheme enabled them to gain a maximum of two marks.

Question 8

This question was generally well answered by the majority of candidates. In part (a), the vast majority of candidates eliminated y from $y = -x^2 + 2x + 24$ and $y = x + 4$, and solved the resulting equation to find correct x-coordinates of A and B. It was common, however, to see $x = -5$ and $x = 4$ which resulted from incorrect factorisation. Almost all of these candidates found the corresponding y-coordinates by using the equation $y = x + 4$. A less successful method used by a few candidates was to eliminate x. A significant number of candidates only deduced $A(-4, 0)$ by solving $0 = x + 4$. A popular misconception in this part was for candidates to believe that the coordinates were $A(-4, 0)$ and $B(6, 10)$ which were found by solving $0 = -x^2 + 2x + 24$. A small minority of candidates were penalised 2 marks by ignoring the instruction to “use algebra”. They usually used a graphical calculator or some form of trial and improvement to find the coordinates of A and B.

The most popular approach in part (b) was to find the area under the curve between $x = -4$ and $x = 5$ and subtract the area of the triangle. Integration and use of limits was usually carried out correctly and many correct solutions were seen. Many candidates stopped after gaining the first four marks in this part, not realising the need to subtract the area of the triangle. Some candidates lost the method mark for limits as they failed to use their x-values from part (a) and proceeded to use the x-intercepts which were calculated by the candidate in part (b).

Candidates either found the area of the triangle by using the formula $\frac{1}{2}$(base)(height) or by integrating $x + 4$ using the limits of $x = -4$ and $x = 5.$ Alternatively, in part (b), a significant number of candidates applied the strategy of $\int (-x^2 + 2x + 24) - (x + 4)\,\mathrm{d}x$, between their limits found from part (a). Common errors in this approach included subtracting the wrong way round or using incorrect limits or using a bracketing error on the linear expression when applying "curve" – "line".

Question 9

This question was a good source of marks for many candidates.

In part (a), the missing values in the table were usually calculated correctly, however the second value was sometimes given as 3.633 rather than 3.634.

The Trapezium Rule was usually dealt with appropriately but the strip length was sometimes incorrectly used as $\frac{3}{7}$. More frequently, the final answer was not given to the required accuracy.

In part (b) the integration was often well answered but there were errors on the third and fourth terms (which involved negative and fractional powers). The limits of 1 and 4 were usually used correctly although candidates are advised to show clearly the substitution and evaluation of the limits to avoid losing unnecessary marks.

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	6		92	5.54	5.80	5.83	5.73	5.58	5.37	5.24	4.25
2	6		86	5.17	5.92	5.75	5.44	5.09	4.82	4.30	3.34
3	6		81	4.88		5.68	5.24	4.69	4.09	3.60	2.74
4	7		87	6.12	6.93	6.73	6.40	6.09	5.77	5.33	3.90
5	6		89	5.35	5.92	5.86	5.69	5.38	4.91	4.52	3.21
6	11		83	9.09	10.92	10.50	9.70	8.96	8.02	7.05	4.87
7	10		83	8.29		9.84	9.22	8.39	7.50	6.15	3.68
8	11		72	7.97	10.77	10.39	9.63	8.68	7.39	5.70	2.40
9	12		85	10.14	11.85	11.46	10.83	10.14	9.32	8.34	5.88
	75		**83**	**62.55**		**72.04**	**67.88**	**63.00**	**57.19**	**50.23**	**34.27**