Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Bronze Level B2

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 10 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
73	66	59	52	45	38

1. (a) Find the remainder when

$$x^3 - 2x^2 - 4x + 8$$

is divided by

(i) $x - 3$,

(ii) $x + 2$.

(3)

(*b*) Hence, or otherwise, find all the solutions to the equation

$$x^3 - 2x^2 - 4x + 8 = 0.$$

(4)

January 2008

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2. Find the first 3 terms, in ascending powers of x, in the binomial expansion of

$$(2 - 5x)^6.$$

Give each term in its simplest form.

(4)

January 2013

3.

$$f(x) = 3x^3 - 5x^2 - 16x + 12.$$

(*a*) Find the remainder when f(x) is divided by ($x - 2$).

(2)

Given that ($x + 2$) is a factor of f(x),

(*b*) factorise f(x) completely.

(4)

May 2007

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4. The second and fifth terms of a geometric series are 750 and –6 respectively.

Find

(*a*) the common ratio of the series,

(3)

(*b*) the first term of the series,

(2)

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

(2)

January 2011

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5. $$f(x) = 2x^3 - 7x^2 - 10x + 24.$$

(*a*) Use the factor theorem to show that $(x + 2)$ is a factor of $f(x)$.

(2)

(*b*) Factorise $f(x)$ completely.

(4)

May 2012

6.

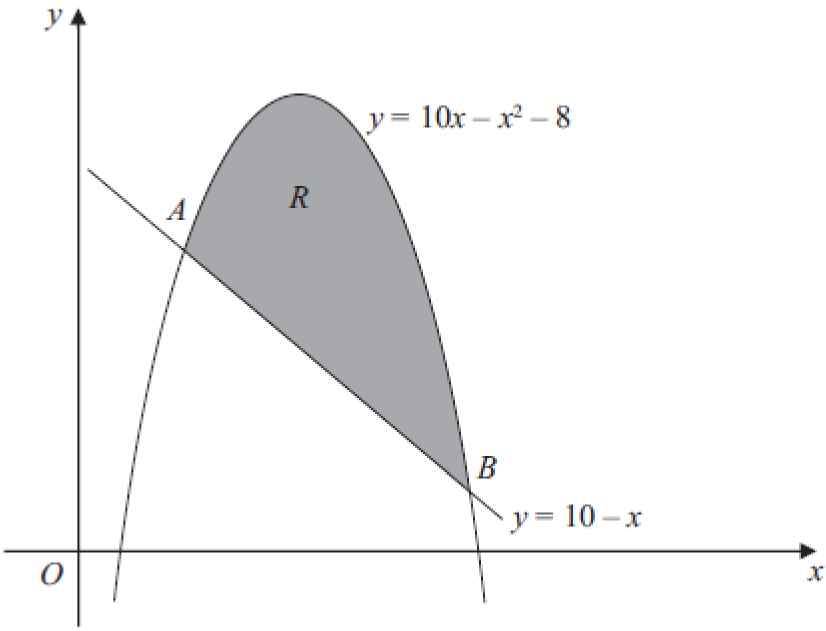

Figure 1

Figure 1 shows the line with equation $y = 10 - x$ and the curve with equation $y = 10x - x^2 - 8$.

The line and the curve intersect at the points A and B, and O is the origin.

(*a*) Calculate the coordinates of A and the coordinates of B.

(5)

The shaded area R is bounded by the line and the curve, as shown in Figure 1.

(*b*) Calculate the exact area of R.

(7)

May 2012

7.

$$y = \frac{5}{3x^2 - 2}$$

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

x	2	2.25	2.5	2.75	3
y	0.5	0.38			0.2

(2)

(*b*) Use the trapezium rule, with all the values of *y* from your table, to find an approximate value for $\int_2^3 \frac{5}{3x^2 - 2}\, dx$.

(4)

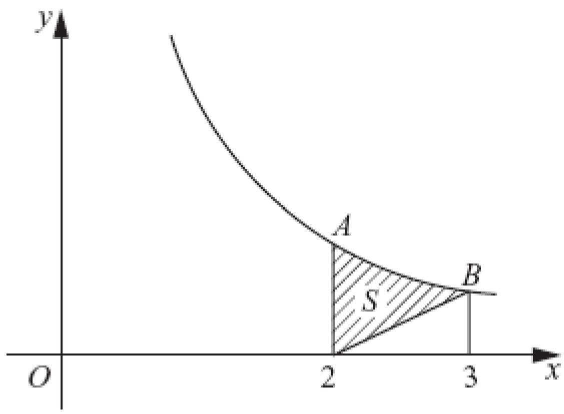

Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = \frac{5}{3x^2 - 2}$, $x > 1$.

At the points *A* and *B* on the curve, $x = 2$ and $x = 3$ respectively.

The region *S* is bounded by the curve, the straight line through *B* and (2, 0), and the line through *A* parallel to the *y*-axis. The region *S* is shown shaded in Figure 2.

(*c*) Use your answer to part (*b*) to find an approximate value for the area of *S*.

(3)

January 2011

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

(*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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9. (*a*) Show that the equation

$$4 \sin^2 x + 9 \cos x - 6 = 0$$

can be written as

$$4 \cos^2 x - 9 \cos x + 2 = 0.$$

(2)

(*b*) Hence solve, for $0 \leq x < 720°$,

$$4 \sin^2 x + 9 \cos x - 6 = 0,$$

giving your answers to 1 decimal place.

(6)

January 2009

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10. The points A and B have coordinates $(-2, 11)$ and $(8, 1)$ respectively.

Given that AB is a diameter of the circle C,

(*a*) show that the centre of C has coordinates $(3, 6)$,

(1)

(*b*) find an equation for C.

(4)

(*c*) Verify that the point $(10, 7)$ lies on C.

(1)

(*d*) Find an equation of the tangent to C at the point $(10, 7)$, giving your answer in the form $y = mx + c$, where m and c are constants.

(4)

January 2011

TOTAL FOR PAPER: 75 MARKS

END

Question Number	Scheme	Marks
1. (a)(i)	$f(3) = 3^3 - 2 \times 3^2 - 4 \times 3 + 8 \quad = 5$	M1 A1
(ii)	$f(-2) = (-8 - 8 + 8 + 8) = 0$	B1
		(3)
(b)	$[(x+2)](x^2 - 4x + 4) \quad (= 0)$	M1 A1
	$(x+2)(x-2)^2 \quad (= 0)$	M1
	Solutions: $x = 2$ or -2 or $(-2, 2, 2)$	A1
		(4)
		[7]
2.	$\left(2-5x\right)^6$	
	$\left(2^6 =\right)$ 64	B1
	$+6\times\left(2\right)^5(-5x)+\frac{6\times5}{2}\left(2\right)^4(-5x)^2$	M1
	$-960x$	A1
	$(+)6000x^2$	A1
		(4)
3. (a)	$f(2) = 24 - 20 - 32 + 12 = -16$	M1 A1
		(2)
(b)	$(x+2)(3x^2 - 11x + 6)$	M1 A1
	$(x+2)(3x-2)(x-3)$	M1 A1
		(4)
		[6]
4. (a)	$ar = 750$ and $ar^4 = -6$	B1
	$r^3 = \frac{-6}{750}$	M1
	$r = -\frac{1}{5}$	M1
		(3)
(b)	$a(-0.2) = 750$	M1
	$a\left\{=\frac{750}{-0.2}\right\} = -3750$	A1ft
		(2)
(c)	Applies $\frac{a}{1-r}$ correctly using both their a and their $\lvert r\rvert < 1$.	M1
	So, $S_\infty = -3125$	A1
		(2)
		[7]

Question Number	Scheme	Marks
5. (a)	$f\left(-2\right)=2.\left(-2\right)^{3}-7.\left(-2\right)^{2}-10.\left(-2\right)+24$	M1
	$=0$ so $(x+2)$ is a factor	A1
		(2)
(b)	$\mathrm{f}(x)=(x+2)(2x^{2}-11x+12)$	M1 A1
	$\mathrm{f}(x)=(x+2)(2x-3)(x-4)$	dM1 A1
		(4) **[6]**
6. (a)	Puts $10-x=10x-x^{2}-8$ and rearranges to give three term quadratic	M1
	Solves their "$x^{2}-11x+18=0$" to give $x=$	M1
	Obtains $x=2$, $x=9$	A1
	Substitutes their x into a given equation to give $y=$	M1
	$y=8, y=1$	A1
		(5)
(b)	$\int(10x-x^{2}-8)\,\mathrm{d}x=\dfrac{10x^{2}}{2}-\dfrac{x^{3}}{3}-8x\left\{+c\right\}$	M1 A1 A1
	$\left[\dfrac{10x^{2}}{2}-\dfrac{x^{3}}{3}-8x\right]_{2}^{9}=(......)-(......)$	dM1
	$=90-\dfrac{4}{3}=88\tfrac{2}{3}$ or $\tfrac{266}{3}$	
	Area of trapezium $=\tfrac{1}{2}(8+1)(9-2)=31.5$	B1
	So area of R is $88\tfrac{2}{3}-31.5=57\tfrac{1}{6}$ or $\tfrac{343}{6}$	M1 A1 cao
		(7) **[12]**
7. (a)	At $\{x=2.5,\}$ $y=0.30$	B1
	At $\{x=2.75,\}$ $y=0.24$	B1
		(2)
(b)	$\dfrac{1}{2}\times0.25;\times\left\{0.5+0.2+2(0.38+\text{their}0.30+\text{their}0.24)\right\}$	B1 M1 A1
	$\left\{=\dfrac{1}{8}\left(2.54\right)\right\}=$ awrt 0.32	A1
		(4)
(c)	Area of triangle $=\dfrac{1}{2}\times1\times0.2=0.1$	B1
	Area (S) = "0.3175" – 0.1	M1
	= 0.2175	A1ft
		(3) **[9]**

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>8. (a)

(b)</td><td>

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

$\frac{1}{2}\times 0.25,\ \left\{(1+2)+2\left(1.251+1.494+1.741\right)\right\}$ o.e.
$= 1.4965$</td><td>B1 B1

(2)
B1 M1 A1ft
A1
(4)
[6]</td></tr>
<tr><td>9. (a)

(b)</td><td>$4(1-\cos^2 x)+9\cos x-6=0$ $\quad\quad 4\cos^2 x-9\cos x+2=0$ (*)

$(4\cos x-1)(\cos x-2)=0$ $\quad \cos x = ...,\ \frac{1}{4}$
$x = 75.5$ $\quad (\alpha)$
$360-\alpha,$ $\quad 360+\alpha$ or $720 - \alpha$
284.5, 435.5, 644.5</td><td>M1 A1
(2)
M1 A1
B1
M1, M1
A1(6)
[8]</td></tr>
<tr><td>10. (a)

(b)

(c)
(d)</td><td>$C\left(\frac{-2+8}{2},\frac{11+1}{2}\right)=C\left(3,6\right)$

$(8-3)^2+(1-6)^2$ or $\sqrt{(8-3)^2+(1-6)^2}$ or
$(-2-3)^2+(11-6)^2$ or $\sqrt{(-2-3)^2+(11-6)^2}$
$(x-3)^2+(y-6)^2=50$ $\left(\text{or}\left(\sqrt{50}\right)^2 \text{or}\left(5\sqrt{2}\right)^2\right)$

{For (10, 7),} $(10-3)^2+(7-6)^2=50,$ {so the point lies on C.}
{Gradient of radius} $= \frac{7-6}{10-3}$ or $\frac{1}{7}$
Gradient of tangent $= \frac{-7}{1}$
$y-7=-7(x-10)$
$y=-7x+77$</td><td>B1*
(1)
M1
A1
M1 A1
(4)
(1)
B1
M1
M1
A1 cao
(4)
[10]</td></tr>
</table>

Examiner reports

Question 1

The fact that $(x + 2)$ and $(x - 2)$ were both factors of the cubic was unfortunate and examiners needed to be eagle-eyed in marking part (a); some candidates clearly evaluated f(2) in answering (a)(ii). There were often arithmetic errors in evaluating f(–2), with 16 being a common answer, and consequently many candidates had not found a factor in (a) and needed to start from scratch in part (b).

Of those candidates who chose to use long division in (a), there was a considerable number who produced $(x + 2)(x^2 - 4)$ in (ii) and then went on to use this in part (b). Although the solutions $x = 2$ and $x = -2$ were then often still found, this was fortuitous and M1A0M1A0 was a common outcome. The most frequent loss of the final mark, however, was for giving the factors, not the solutions, to the cubic equation.

Question 2

This question was well done by the vast majority of candidates. The most common method was to use the general expansion for $(a + b)^n$ and this was largely successful although there were some common errors. The most frequent error was the failure to square the –5 in the third term resulting in an expansion of $64 - 960x + 1200x^2$. It was also common to see an answer of $64 + 960x + 6\text{-}00x^2$. A minority of candidates attempted to take out a factor of 2 before using the expansion for $(1 + x)^n$. Some candidates took out the factor of 2, without realising that it needed to become 2^6.

Question 3

In part (a), many candidates unnecessarily used long division rather than the remainder theorem to find the remainder. The correct remainder –16 was often achieved, although mistakes in arithmetic or algebra were common.

There were many good solutions to the factorisation in part (b). Candidates usually found the quadratic factor by long division or by ‘inspection’ and went on to factorise this quadratic, obtaining the correct linear factors. Sometimes time was wasted in justifying the given fact that $(x + 2)$ was a factor. Some candidates were distracted by part (a) and assumed that $(x - 2)$ was one of the factors, using the quadratic they had obtained from their long division in part (a). A few attempted to use the formula to find the roots of the quadratic but did not always continue to find the factors. It was common for solutions of the equation $f(x) = 0$ to be given, but this ‘additional working’ was not penalised here.

Question 4

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 5

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 6

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 7

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 8

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 9

In part (a) most candidates correctly substituted for $(\sin x)^2$ but some lost the A mark through incorrect signs or a failure to put their expression equal to zero.

For part (b) most factorised or used the formula correctly and earned the B1. Unfortunately some who failed to achieve the given answer in a) carried on with their own version of the equation. There were many completely accurate solutions, but others stopped after 360 – 75.5 or did just 360 + 75.5 and some candidates tried combinations of 180 +/– 75.5 or 270 +/– 75.5. A few candidates mixed radians and degrees.

This question was answered well by a majority of candidates.

Question 10

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).

Statistics for C2 Practice Paper Bronze Level B2

Qu	Max score	Modal score	Mean %	Mean score for students achieving grade: ALL	A*	A	B	C	D	E	U
1	7		86	6.05		6.80	6.53	6.08	5.50	5.01	3.74
1	4		85	3.39	3.93	3.82	3.59	3.40	3.20	2.75	1.93
2	6		82	4.93		5.88	5.67	5.37	5.00	4.33	2.51
3	7		80	5.57	6.92	6.75	6.27	5.40	4.28	2.91	1.89
4	6		81	4.86	5.84	5.68	5.44	5.18	4.86	4.30	2.72
5	12		77	9.18	11.87	11.50	10.79	10.03	9.07	7.50	3.47
6	9		80	7.16	8.76	8.61	7.77	6.75	5.61	4.64	2.98
7	6		83	5.00	5.94	5.83	5.61	5.33	4.93	4.38	3.09
8	8		74	5.89		7.60	6.82	5.68	3.94	2.63	1.05
9	10		71	7.11	9.74	9.25	7.95	6.27	4.93	3.46	1.70
	75		**79**	**59.14**		**71.72**	**66.44**	**59.49**	**51.32**	**41.91**	**25.08**