Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Bronze Level B4

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 C1), the paper reference (6663), 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
72	65	59	52	46	40

1. Find

$$\int\left(2x^4 - \frac{4}{\sqrt{x}} + 3\right)\mathrm{d}x$$

giving each term in its simplest form.

(4)

May 2016

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2. (*a*) Simplify

$$\sqrt{50} - \sqrt{18}$$

giving your answer in the form $a\sqrt{2}$, where a is an integer.

(2)

(*b*) Hence, or otherwise, simplify

$$\frac{12\sqrt{3}}{\sqrt{50} - \sqrt{18}}$$

giving your answer in the form $b\sqrt{c}$, where b and c are integers and $b \neq 1$.

(3)

May 2016

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3. $$\mathrm{f}(x) = 3x + x^3, \qquad x > 0.$$

(*a*) Differentiate to find $\mathrm{f}'(x)$.

(2)

Given that $\mathrm{f}'(x) = 15$,

(*b*) find the value of x.

(3)

June 2008

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4. Solve

(*a*) $2^y = 8$,

(1)

(*b*) $2^x \times 4^{x+1} = 8$.

(4)

May 2013 (R)

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5. Solve the equation

$$10 + x\sqrt{8} = \frac{6x}{\sqrt{2}}$$

Give your answer in the form $a\sqrt{b}$ where a and b are integers.

(4)

May 2014 (R)

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6. A sequence $x_1, x_2, x_3, \ldots$ is defined by

$$x_1 = 1,$$

$$x_{n+1} = (x_n)^2 - kx_n, \qquad n \geq 1,$$

where k is a constant.

(*a*) Find an expression for x_2 in terms of k.

(1)

(*b*) Show that $x_3 = 1 - 3k + 2k^2$.

(2)

Given also that $x_3 = 1$,

(*c*) calculate the value of k.

(3)

(*d*) Hence find the value of $\sum_{n=1}^{100} x_n$.

(3)

May 2013 (R)

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7. Given that

$$y = 3x^2 + 6x^{\frac{1}{3}} + \frac{2x^3 - 7}{3\sqrt{x}}, \quad x > 0,$$

find $\frac{\mathrm{d}y}{\mathrm{d}x}$. Give each term in your answer in its simplified form.

(6)

May 2016

8.

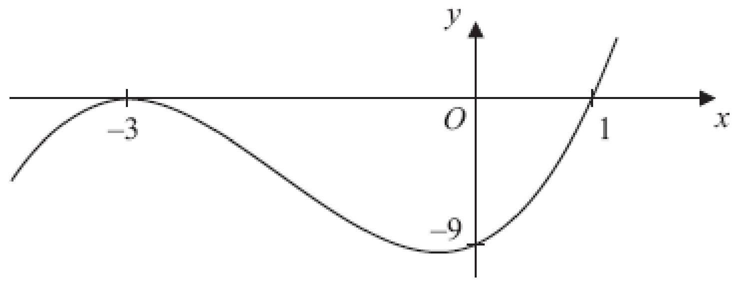

Figure 1

Figure 1 shows a sketch of the curve with equation $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = (x + 3)^2(x - 1), \qquad x \in \mathbb{R}.$$

The curve crosses the x-axis at (1, 0), touches it at (–3, 0) and crosses the y-axis at (0, –9).

(*a*) Sketch the curve C with equation $y = \mathrm{f}(x + 2)$ and state the coordinates of the points where the curve C meets the x-axis.

(3)

(*b*) Write down an equation of the curve C.

(1)

(*c*) Use your answer to part (*b*) to find the coordinates of the point where the curve C meets the y-axis.

(2)

May 2013

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9. The curve C with equation $y = \mathrm{f}(x)$ passes through the point (5, 65).

Given that $\mathrm{f}'(x) = 6x^2 - 10x - 12$,

(*a*) use integration to find $\mathrm{f}(x)$.

(4)

(*b*) Hence show that $\mathrm{f}(x) = x(2x + 3)(x - 4)$.

(2)

(*c*) Sketch C, showing the coordinates of the points where C crosses the x-axis.

(3)

May 2007

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10. A curve with equation $y = f(x)$ passes through the point (4, 25).

Given that $f'(x) = \frac{3}{8}x^2 - 10x^{-\frac{1}{2}} + 1, \quad x > 0,$

(*a*) find f(*x*), simplifying each term.

(5)

(*b*) Find an equation of the normal to the curve at the point (4, 25). Give your answer in the form $ax + by + c = 0$, where *a*, *b* and *c* are integers to be found.

(5)

May 2014

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11. The curve *C* has equation

$$y = \frac{1}{2}x^3 - 9x^{\frac{3}{2}} + \frac{8}{x} + 30, \qquad x > 0.$$

(*a*) Find $\frac{dy}{dx}$.

(4)

(*b*) Show that the point *P*(4, –8) lies on *C*.

(2)

(*c*) Find an equation of the normal to *C* at the point *P*, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(6)

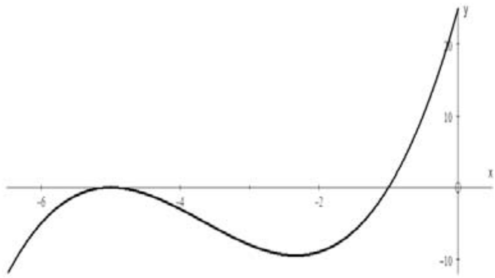
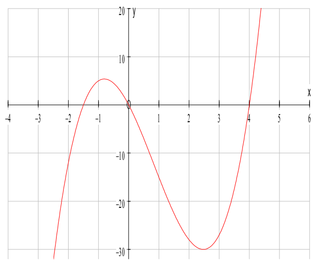
January 2011

TOTAL FOR PAPER: 75 MARKS

END

Question Number	Scheme	Marks
1	$\frac{2}{5}x^5 - \frac{4}{\frac{1}{2}}x^{\frac{1}{2}} + 3x$	M1 A1 A1
	$= \frac{2}{5}x^5 - 8x^{\frac{1}{2}} + 3x + c$	A1
		[4]
2 (a)	$\sqrt{50} - \sqrt{18} = 5\sqrt{2} - 3\sqrt{2}$	M1
	$= 2\sqrt{2}$	A1
		(2)
(b)	$\frac{12\sqrt{3}}{\sqrt{50}-\sqrt{18}} = \frac{12\sqrt{3}}{"2"\sqrt{2}}$	M1
	$= \frac{12\sqrt{3}}{"2"\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{12\sqrt{6}}{4}$	dM1
	$= 3\sqrt{6}$ or $b = 3$, $c = 6$	A1
		(3)
		[5]
3 (a)	$f'(x) = 3 + 3x^2$	M1 A1
		(2)
(b)	$3 + 3x^2 = 15$ and start to try and simplify	M1
	$x^2 = k \rightarrow x = \sqrt{k}$ (ignore $\pm$)	M1
	$x = 2$ (ignore $x = -2$)	A1
		(3)
		[5]
4 (a)	$2^y = 8 \Rightarrow y = 3$	B1 cao
		(1)
	$8 = 2^3$	M1
	$4^{x+1} = (2^2)^{x+1}$ or $(2^{x+1})^2$	M1
	$2^{3x+2} = 2^3 \Rightarrow 3x + 2 = 3 \Rightarrow x = \frac{1}{3}$	M1A1
		(4)
		[5]

Question Number	Scheme	Marks
5	$x\sqrt{8}+10=\dfrac{6x}{\sqrt{2}}$ $\times\sqrt{2}\Rightarrow x\sqrt{16}+10\sqrt{2}=6x$ $4x+10\sqrt{2}=6x\Rightarrow 2x=10\sqrt{2}$ $x=5\sqrt{2}$ or $a=5$ and $b=2$	M1A1 M1A1 **[4]**
6 (a)	$x_2=1-k$	B1 **(1)**
(b)	$x_3=(1-k)^2-k(1-k)$ $=1-3k+2k^2$ *	M1 A1 **(2)**
(c)	$1-3k+2k^2=1$ $\left(2k^2-3k=0\right)$ $k(2k-3)=0\Rightarrow k=..$ $k=\dfrac{3}{2}$	M1 dM1 A1 cao cso **(3)**
(d)	$\sum_{n=1}^{100}x_n=1+\left(-\dfrac{1}{2}\right)+1+......$ Or $=1+\left(1-'k'\right)+1+........$ $50\times\dfrac{1}{2}$ or $50\times1-50\times\dfrac{1}{2}$ or $\dfrac{1}{2}\times50\times(1-\dfrac{1}{2})$ $=25$	M1 M1 A1 **(3)** **[9]**
7	$\dfrac{2x^3-7}{3\sqrt{x}}=\dfrac{2x^3}{3\sqrt{x}}-\dfrac{7}{3\sqrt{x}}=\dfrac{2}{3}x^{\frac{5}{2}}-\dfrac{7}{3}x^{-\frac{1}{2}}$ $x^n\to x^{n-1}$ $\left(\dfrac{dy}{dx}=\right)6x+2x^{-\frac{2}{3}}+\dfrac{5}{3}x^{\frac{3}{2}}+\dfrac{7}{6}x^{-\frac{3}{2}}$	M1 M1 A1 A1 A1 A1 **[6]**

Question Number	Scheme		Marks
8 (a)		Horizontal translation	B1
		Touching at (–5, 0).	B1
		The right hand tail of their cubic shape crossing at (–1, 0).	B1
			(3)
(b)	$(x+5)^2(x+1)$		B1
			(1)
(c)	When $x = 0$, $y = 25$		M1 A1
			(2)
			[6]
9 (a)	$\text{f}(x) = \dfrac{6x^3}{3} - \dfrac{10x^2}{2} - 12x \ (+C)$		M1 A1
	$x = 5$: $\quad 250 - 125 - 60 + C = 65 \qquad C = 0$		M1 A1
			(4)
(b)	$x(2x^2 - 5x - 12)$ or $(2x^2 + 3x)(x - 4)$ or $(2x + 3)(x^2 - 4x)$		M1
	$= x(2x + 3)(x - 4)$ (*)		A1 cso
			(2)
(c)		Shape	B1
		Through origin	B1
		$\left(-\dfrac{3}{2}, 0\right)$ and (4,0)	B1
			(3)
			[9]

Question Number	Scheme	Marks
10 (a)	$f(x)=\int\left(\frac{3}{8}x^2-10x^{-\frac{1}{2}}+1\right)dx$	
	$x^n \to x^{n+1} \Rightarrow f(x)=\frac{3}{8}\times\frac{x^3}{3}-10\frac{x^{\frac{1}{2}}}{\frac{1}{2}}+x(+c)$	M1A1A1
	Substitute $x=4, y=25 \Rightarrow 25=8-40+4+c \Rightarrow c=$	M1
	$(f(x))=\frac{x^3}{8}-20x^{\frac{1}{2}}+x+53$	A1
		(5)
(b)	Sub x=4 into $f'(x)=\frac{3}{8}x^2-10x^{-\frac{1}{2}}+1$	M1
	$\Rightarrow f'(4)=\frac{3}{8}\times4^2-10\times4^{-\frac{1}{2}}+1$	
	$\Rightarrow f'(4)=2$	A1
	Gradient of tangent $=2 \Rightarrow$ Gradient of normal is $-1/2$	dM1
	Substitute $x=4, y=25$ into line equation with their changed gradient e.g. $y-25=-\frac{1}{2}(x-4)$	dM1
	$\pm k(2y+x-54)=0$ o.e. (but must have integer coefficients)	A1cso
		(5) [10]
11 (a)	$\left(\frac{dy}{dx}=\right)\frac{3}{2}x^2-\frac{27}{2}x^{\frac{1}{2}}-8x^{-2}$	M1A1A1 A1
		(4)
(b)	$x=4 \Rightarrow y=\frac{1}{2}\times64-9\times2^3+\frac{8}{4}+30$	M1
	$=32-72+2+30 \qquad = \underline{-8}$ *	A1 cso
		(2)
(c)	$x=4 \Rightarrow y'=\frac{3}{2}\times4^2-\frac{27}{2}\times2-\frac{8}{16}$	M1
	$=24-27-\frac{1}{2}= \qquad -\frac{7}{2}$	A1
	Gradient of the normal = $-1\div"\frac{7}{2}"$	M1
	Equation of the normal: $y--8=\frac{2}{7}(x-4)$	M1A1ft
	$\underline{7y-2x+64=0}$	A1
		(6) [12]

Examiner reports

Question 1

This was completed very well by the majority of candidates. Very few differentiated and almost all candidates included a constant of integration. The term which caused the most difficulty was $\frac{-4}{\sqrt{x}}$ where the most common errors were $\frac{-4}{\sqrt{x}}$ re-written as $-4x^{\frac{1}{2}}$ or $-4x^{\frac{-1}{2}}$ but then integrated to either $-2x^{\frac{1}{2}}$ or $+8x^{\frac{1}{2}}$.

Question 2

Part (a) was generally well answered with the vast majority of candidates arriving at $2\sqrt{2}$. Only a very small proportion mistakenly thought $\sqrt{50} - \sqrt{18} = \sqrt{32}$.

In part (b) a frequent error in execution was writing $\sqrt{2}\sqrt{3} = \sqrt{5}$. By far the easiest simplification was to replace $\sqrt{50} - \sqrt{18}$ in the denominator by $2\sqrt{2}$. In addition, many candidates rationalised the denominator by multiplying top and bottom by $k\sqrt{2}$, whereas it would have been far simpler to rationalise using just $\sqrt{2}$. There was, of course, nothing wrong in multiplying numerator and denominator by the conjugate of $\sqrt{50} - \sqrt{18}$, but it was unnecessary and long winded, and therefore more error prone.

There was a significant number of candidates who left their answer as $\frac{6\sqrt{3}}{\sqrt{2}}$.

Question 3

Most candidates differentiated in part (a) and usually scored both marks. Sometimes the coefficient of the second term was incorrect (values of 2, $\frac{1}{2}$ or $\frac{1}{3}$ re seen). In part (b) most candidates were able to form a suitable equation and start to collect terms but a few simply evaluated f '(15). There were a number of instances of poor algebraic processing from a correct equation with steps such as $3x^2 = 12 \Rightarrow 3x = \sqrt{12}$ or $3x^2 = 12 \Rightarrow x^2 = 9 \Rightarrow x = 3$ appearing far too often.

Question 4

In part (a) almost all candidates obtained the correct answer. Performance in part (b) was more variable and discriminated to some extent. By far the most common error was to write 4^{x+1} as 2^{2x+1} in attempt to achieve a common base. Some candidates also multiplied their powers of 2 instead of adding them.

Question 5

This question was well answered. Some however found it challenging to get beyond $\sqrt{2}x = 10$ or $x = \frac{10}{\sqrt{2}}$. Other errors were, for example, replacing 20 by $\sqrt{4}\sqrt{5}$ and then by $2\sqrt{5}$, or replacing 10 by $5\sqrt{2}$.

Some rationalised the denominator $\left(6-\sqrt{16}\right)$ creating extra work instead of simplifying it to 2. Others thought they could remove the roots by squaring, which creates a second, invalid, solution.

Question 6

Part (a) was almost always correct. In (b) most could obtain the third term correctly although there was the very occasional mistake in expanding $(1 - k)^2$. In part (c) most could solve the quadratic correctly although many resorted to using the quadratic formula rather than factorising the two terms. Part (d) was for many, the first challenge of the paper. The most common mistake was to assume an AP, to then attempt a value for *d* and then substitute in the sum formula. Some did this even when they had identified a recurring sequence.

Question 7

Apart from a few candidates who integrated, the majority obtained the 6x term and so gained two marks. Some candidates had issues with subtracting 1 from indices that were fractions.

The main problem seemed to be with splitting up the algebraic fraction part of '*y*' correctly. Many candidates wrote the 3 in the numerator and expanded the expression $(2x^3 - 7)(3x^{\frac{1}{2}})$ or $(2x^3 - 7)(3x^{-\frac{1}{2}})$, or else had issues with the laws of indices but they often still managed to gain the method mark.

Even candidates who split up the fraction correctly and differentiated correctly often left the third term as $\frac{10}{6}x^{\frac{3}{2}}$, despite the question stating that each term in the answer was required in its simplest form. Other common errors were, working out $\frac{1}{3} - 1 = -\frac{1}{3}$ for the power of the second term, the fourth term being negative, and having $2\frac{1}{2}$ for the last term when a candidate could not cope with the 3 in the denominator of the algebraic fraction part of '*y*'.

A very small number of candidates used the product rule to differentiate $(2x^3 - 7)(3x^{\frac{1}{2}})^{-1}$ rather than simplifying the fraction; a few used the quotient rule. Both techniques were applied with mixed success.

Question 8

In part (a) nearly all candidates produced a horizontal translation in the right direction with the required coordinates marked on the graph. Errors mainly consisted of translating horizontally in the wrong direction or attempting $f(x) + 2$.

In part (b) a large number of candidates successfully wrote down $y = (x + 5)^2(x + 1)$; however it was quite common to see $y = (x + 1)^2(x - 3)$. Some candidates chose to expand $f(x)$ correctly as $x^3 + 5x^2 + 3x - 9$ but then incorrectly deduced $f(x + 2) = x^3 + 5x^2 + 3x - 7$.

In part (c), most knew to substitute $x = 0$ in their answer to (b). Some used the original equation, writing $f(2) = (2 + 3)^2(2 - 1)$. Common errors or misconceptions included, putting $y = 0$ giving $(-5, 0)$ and $(-1, 0)$, expanding the brackets incorrectly before substituting and evaluating $(0 + 5)^2(0 + 1)$ as $25 + 1 = 26$.

Question 9
Most candidates were able to integrate correctly to obtain $2x^3 - 5x^2 - 12x$ but many forgot to include a +C and never used the point (5, 65) to establish that C = 0. The majority of those who did attempt to find C went on to complete part (b) correctly but a few, who made arithmetic slips and had a non-zero C, were clearly stuck in part (b) although some did try and multiply out the given expression and gained some credit.

The sketch in part (c) was answered well. Few tried plotting points and there were many correct answers. Sometimes a "negative" cubic was drawn and occasionally the curve passed through (1.5, 0) instead of (−1.5, 0). There were very few quadratic or linear graphs drawn.

Question 10
26.2% gained full marks and a further 28% lost one or two marks.

In part (a) the first three marks were obtained relatively easily by most candidates, but simplifying the fractional coefficients often proved to be a challenge, in particular $\frac{3}{8} \div 3$ which often became $\frac{9}{8}$, and dividing by $\frac{1}{2}$ in the second term also caused problems. Many candidates failed to go on and find c. Those that did often made arithmetical mistakes and so did not get the correct answer of 53. Those that did manage to achieve c = 53 failed to get the final mark as they did not simplify their coefficients, $\frac{3}{24}$ being seen frequently in the final answer or simplified incorrectly.

In part (b) some candidates substituted (4, 25) into their f(x) rather than f′(x) which resulted in no marks for this part. Most, however, did substitute into the correct f′(x). Many errors were made in the calculation and a significant minority die not achieve the correct gradient. Most were able to continue to find the gradient of the normal and then use (4, 25) to write down an equation of the normal with a few using $y = mx + c$ to find c. A minority tried to find the equation of the tangent. Many candidates did not read this question properly with regard to integer coefficients being required, giving their final answer as $y + 0.5x - 27 = 0$. There were common mistakes made when re-arranging from $y = -\frac{1}{2}x + 27$ to the form of the equation required.

Question 11
As a last question this enabled good candidates to demonstrate an understanding of the techniques of gradients, applying problem solving and logical skills to achieve the final equation. 26% achieved full marks in this question. There were very few blank scripts or evidence of candidates who did not have time to complete the question. Usually if candidates did have difficulty, it was because they had made a mistake in answering the early part of the question. In part (a) most candidates were able to differentiate the equation correctly, although there were some problems with coefficients. Most mistakes occurred when differentiating $\frac{8}{x}$ with candidates being unable to rewrite it as $8x^{-1}$ prior to differentiation, or losing the term completely on differentiation. This term also caused candidates problems in the subsequent substitution of numbers which resulted in many strange results. Again, as in question 2, an inability to deal with fractions was seen.

In part (b), the usual approach was to substitute (4, –8) into the equation and show that –8 = –8. Cases where candidates substituted $x = 4$ mistakenly into their gradient instead of the equation of the curve C were frequent, although sometimes corrected. Substituting into fractional items proved to be too much for some candidates and consequently elementary mistakes were made. Simplification of the third term to −72 caused the most problems (many getting 54).

In part (c) there was again the occasional mistake of substitution into the wrong expression. Those candidates who correctly found the gradient of the curve, at the point P, usually went on and found the equation of the normal without any trouble.

Arithmetic was often poor and it was common to see $24-27-\frac{1}{2}=-\frac{5}{2}$ and other numerical slips. However even those candidates who had made an error initially then attempted to find a perpendicular gradient and went on to use it successfully in finding the equation of their normal. Very few used the gradient of the tangent in error. Where candidates used $y = mx + c$ the calculations for c were often numerically incorrect and followed long, complex (often messy) workings.

Presentation in this question varied from some excellent easily followed solutions to some with little coherence.

Statistics for C1 Practice Paper Bronze Level B4

				Mean score for students achieving grade:							
Qu	**Max score**	**Modal score**	**Mean %**	**ALL**	**A***	**A**	**B**	**C**	**D**	**E**	**U**
1	4	4	94	3.76	3.96	3.94	3.89	3.85	3.80	3.71	3.26
2	5	5	90	4.48	4.91	4.85	4.69	4.56	4.42	4.25	3.69
3	5		90	4.49		4.90	4.83	4.75	4.63	4.47	3.39
4	5		86	4.32	4.99	4.91	4.55	4.15	3.97	3.55	2.62
5	4		87.0	3.48	4.00	3.90	3.59	3.39	3.46	2.77	2.09
6	9		80	7.24	8.66	8.17	7.18	6.89	6.47	5.99	4.37
7	6	6	83	5.00	5.79	5.65	5.37	5.14	4.91	4.60	3.59
8	6	6	79	4.74	5.96	5.82	5.53	5.21	4.80	4.34	3.13
9	9		74	6.66		8.68	7.96	7.26	6.39	5.44	3.43
10	10		69	6.93	9.59	9.26	8.41	7.58	6.56	5.29	2.75
11	12		67	8.03	11.72	11.43	10.51	9.29	7.89	6.47	3.90
	75		**78.84**	**59.13**	**59.58**	**71.51**	**66.51**	**62.07**	**57.30**	**50.88**	**36.22**