Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Advanced Subsidiary

Friday 13 January 2012 – Morning

Time: 1 hour 30 minutes

Materials required for examination	**Items included with question papers**
Mathematical Formulae (Pink)	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 or integration, or have retrievable mathematical formulae 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.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
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 not gain full credit.

P40083A

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)

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2. A circle C has centre $(-1, 7)$ and passes through the point $(0, 0)$. Find an equation for C.

(4)

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3. (*a*) Find the first 4 terms of the binomial expansion, in ascending powers of x, of

$$\left(1+\frac{x}{4}\right)^8,$$

giving each term in its simplest form.

(4)

(*b*) Use your expansion to estimate the value of $(1.025)^8$, giving your answer to 4 decimal places.

(3)

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4. Given that $y = 3x^2$,

(*a*) show that $\log_3 y = 1 + 2\log_3 x$.

(3)

(*b*) Hence, or otherwise, solve the equation

$$1 + 2\log_3 x = \log_3 (28x - 9).$$

(3)

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

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)

6.

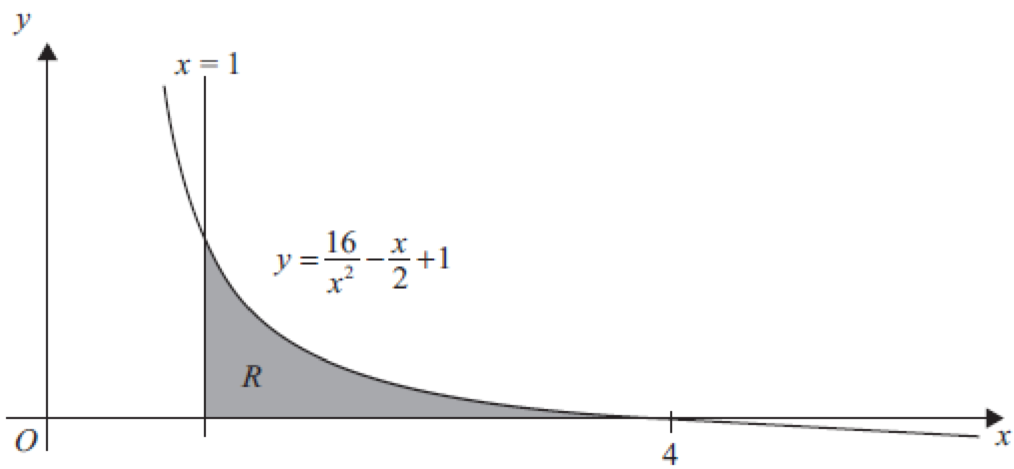

Figure 1

Figure 1 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 1. 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)

7.

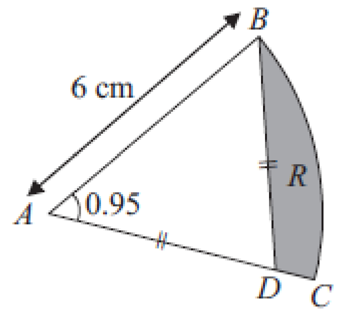

Figure 2

Figure 2 shows ABC, a sector of a circle of radius 6 cm with centre A. Given that the size of angle BAC is 0.95 radians, find

(a) the length of the arc BC,

(2)

(b) the area of the sector ABC.

(2)

The point D lies on the line AC and is such that $AD = BD$. The region R, shown shaded in Figure 2, is bounded by the lines CD, DB and the arc BC.

(c) Show that the length of AD is 5.16 cm to 3 significant figures.

(2)

Find

(d) the perimeter of R,

(2)

(e) the area of R, giving your answer to 2 significant figures.

(4)

8.

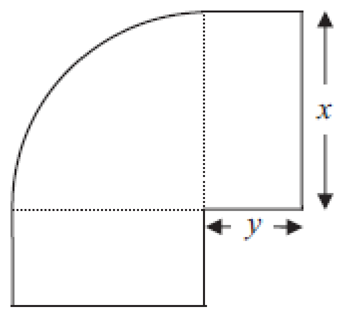

Figure 3

Figure 3 shows a flowerbed. Its shape is a quarter of a circle of radius x metres with two equal rectangles attached to it along its radii. Each rectangle has length equal to x metres and width equal to y metres.

Given that the area of the flowerbed is 4m^2,

(*a*) show that

$$y = \frac{16 - \pi x^2}{8x}.$$

(3)

(*b*) Hence show that the perimeter P metres of the flowerbed is given by the equation

$$P = \frac{8}{x} + 2x.$$

(3)

(*c*) Use calculus to find the minimum value of P.

(5)

(*d*) Find the width of each rectangle when the perimeter is a minimum.
Give your answer to the nearest centimetre.

(2)

9. (i) Find the solutions of the equation $\sin(3x - 15°) = \frac{1}{2}$, for which $0 \leq x \leq 180°$.

(6)

(ii)

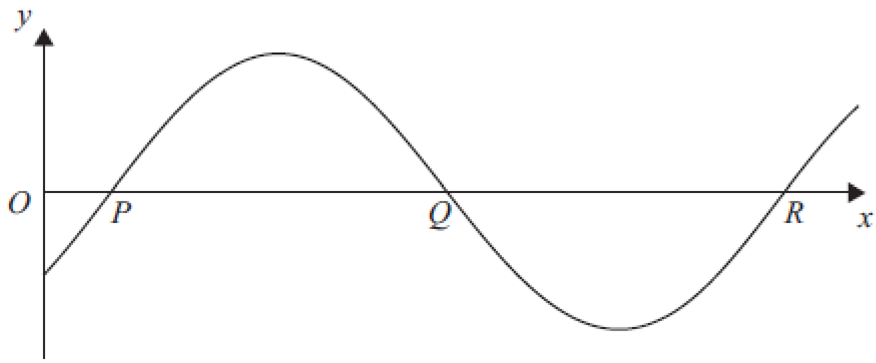

Figure 4

Figure 4 shows part of the curve with equation

$$y = \sin(ax - b), \text{ where } a > 0, \quad 0 < b < \pi.$$

The curve cuts the x-axis at the points P, Q and R as shown.

Given that the coordinates of P, Q and R are $\left(\frac{\pi}{10}, 0\right)$, $\left(\frac{3\pi}{5}, 0\right)$ and $\left(\frac{11\pi}{10}, 0\right)$ respectively, find the values of a and b.

(4)

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 marks
2.		The equation of the circle is $(x+1)^2+(y-7)^2=(r^2)$	M1 A1
		The radius of the circle is $\sqrt{(-1)^2+7^2}=\sqrt{50}$ or $5\sqrt{2}$ or $r^2=50$	M1
		So $(x+1)^2+(y-7)^2=50$ or equivalent	A1 (4)
			4 marks
3.	**(a)**	$(1+\frac{x}{4})^8=1+2x+..,$ ……	B1
		$+\dfrac{8\times 7}{2}(\frac{x}{4})^2+\dfrac{8\times 7\times 6}{2\times 3}(\frac{x}{4})^3,$	M1 A1
		$=$ $+\frac{7}{4}x^2+\frac{7}{8}x^3$ or $=$ $+1.75x^2+0.875x^3$	A1 (4)
	(b)	States or implies that $x = 0.1$	B1
		Substitutes their value of x (provided it is <1) into series obtained in (a)	M1
		i.e. 1 + 0.2 + 0.0175 + 0.000875, = 1.2184	A1 cao (3)
			7 marks
4.	**(a)**	$\log_3 3x^2=\log_3 3+\log_3 x^2$ or $\log y-\log x^2=\log 3$ or $\log y-\log 3=\log x^2$	B1
		$\log_3 x^2=2\log_3 x$	B1
		Using $\log_3 3=1$	B1 (3)
	(b)	$3x^2=28x-9$	M1
		Solves $3x^2-28x+9=0$ to give $x=\frac{1}{3}$ or $x = 9$	M1 A1 (3)
			6 marks

Question number	Scheme	Marks
5. **(a)**	$f(-2) = -8 + 4a - 2b + 3 = 7$	M1
	so $2a - b = 6$ *	A1 (2)
(b)	$f(1) = 1 + a + b + 3 = 4$	M1 A1
	Solve two linear equations to give $a = 2$ and $b = -2$	M1 A1 (4)
		6 marks

Question number	Scheme	Marks
6. **(a)**	(table below)	B1, B1 (2)
(b)	$\frac{1}{2} \times 0.5, \quad \{(16.5 + 0) + 2(7.361 + 4 + 2.31 + 1.278 + 0.556)\}$	B1, M1A1ft
	$= 11.88$ (or answers listed below in note)	A1 (4)
(c)	$\int_1^4 \frac{16}{x^2} - \frac{x}{2} + 1 \, dx = \left[-\frac{16}{x} - \frac{x^2}{4} + x\right]_1^4$	M1 A1 A1
	$= [-4 - 4 + 4] - [-16 - \frac{1}{4} + 1]$	M1
	$= 11\frac{1}{4}$ or equivalent	A1 (5)
		6 marks

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
7. **(a)**	$r\theta = 6 \times 0.95, = 5.7$ (cm)	M1, A1 (2)
(b)	$\frac{1}{2} r^2 \theta = \frac{1}{2} \times 6^2 \times 0.95, = 17.1 \; (\text{cm}^2)$	M1, A1 (2)
(c)	Let $AD = x$ then $\frac{x}{\sin 0.95} = \frac{6}{\sin 1.24}$ so $x = 5.16$ *	
	OR $x = 3 / \cos 0.95$ OR so $x = 3/ \sin 0.62$ so $x = 5.16$ *	M1 A1 (2)
	OR $x^2 = 6^2 + x^2 - 12x\cos 0.95$ leading to $x =$, so $x = 5.16$ *	
(d)	Perimeter = ‘5.7’+5.16 +6 – 5.16= “11.7” **or 6 + their 5.7**	M1A1 ft (2)
(e)	Area of triangle ABD = $\frac{1}{2} \times 6 \times 5.16 \times \sin 0.95 = 12.6$ or	

		$\frac{1}{2}\times 6\times 3\times \tan 0.95$ = 12.6 (½ base x height) or	
		$\frac{1}{2}\times 5.16\times 5.16\times \sin 1.24 = 12.6$	M1 A1
		So Area of R = '17.1' – '12.6' = 4.5	M1 A1 (4)
			12 marks
8.	**(a)**	$kr^2 + cxy = 4$ or $kr^2 + c[(x+y)^2 - x^2 - y^2] = 4$	M1
		$\frac{1}{4}\pi x^2 + 2xy = 4$	A1
		$y = \frac{4 - \frac{1}{4}\pi x^2}{2x} = \frac{16 - \pi x^2}{8x}$ *	B1 cso (3)
	(b)	$P = 2x + cy + k\pi r$ where c = 2 or 4 and k = ¼ or ½	M1
		$P = \frac{\pi x}{2} + 2x + 4\left(\frac{4 - \frac{1}{4}\pi x^2}{2x}\right)$ or $P = \frac{\pi x}{2} + 2x + 4\left(\frac{16 - \pi x^2}{8x}\right)$ o.e.	A1
		$P = \frac{\pi x}{2} + 2x + \frac{8}{x} - \frac{\pi x}{2}$ so $P = \frac{8}{x} + 2x$ *	A1 (3)
	(c)	$\left(\frac{dP}{dx} =\right) - \frac{8}{x^2} + 2$	M1 A1
		$-\frac{8}{x^2} + 2 = 0 \Rightarrow x^2 = ..$	M1
		and so x = 2 o.e. (ignore extra answer x = –2)	A1
		P = 4 + 4 = 8 (m)	B1 (5)
	(d)	$y = \frac{4 - \pi}{4}$, (and so width) = 21 (cm)	M1, A1 (2)
			13 marks

Question number	Scheme	Marks
9. (i)	$\sin(3x-15)=\frac{1}{2}$ so $3x-15=30$ (α) and $x = 15$	M1 A1
	Need $3x-15=180-\alpha$ or $3x-15=540-\alpha$	M1
	Need $3x-15=180-\alpha$ and $3x-15=360+\alpha$ and $3x-15=540-\alpha$	M1
	$x = 55$ or 175	A1
	$x = 55, 135, 175$	A1 (6)
(ii)	At least one of $(\frac{a\pi}{10}-b)=0$ (or $n\pi$) $(\frac{a3\pi}{5}-b)=\pi$ {or $(n+1)\pi$} or in degrees or $(\frac{a11\pi}{10}-b)=2\pi$ {or $(n+2)\pi$}	M1
	If two of **above equations** used eliminates a or b to find one or both of these or uses period property of curve to find a or uses other valid method to find either a or b (May see $\frac{5\pi}{10}a=\pi$ so $a=$)	M1
	Obtains $a = 2$	A1
	Obtains $b = \frac{\pi}{5}$ (must be in radians)	A1 (4)
		10 marks