Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 6 6 4 / 0 1	Signature	

Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Advanced Subsidiary

Friday 13 January 2012 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
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8	
9	
Total	

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 or symbolic differentiation/integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer for each question in the space following the question.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

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 individual questions and 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.
There are 28 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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PEARSON

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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)**

a) $U_n = ar^{n-1}$

$U_{20} = ar^{19}$

$= (360)\left(\frac{7}{8}\right)^{19}$

$= 28.5$ (3sf)

b) $S_n = \frac{a(1-r^n)}{1-r}$

$S_{20} = \frac{(360)\left(1-\left(\frac{7}{8}\right)^{20}\right)}{1-\frac{7}{8}}$

$= 2680$ (3sf)

c) $S_\infty = \frac{a}{1-r}$

$= \frac{360}{1-\frac{7}{8}}$

$= 2880$

Leave blank

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

(4)

$$(x-a)^2 + (y-b)^2 = r^2$$

$$(x+1)^2 + (y-7)^2 = r^2$$

$$(0+1)^2 + (0-7)^2 = r^2$$

$$1 + 49 = r^2$$

$$50 = r^2$$

$$(x+1)^2 + (y-7)^2 = 50$$

P 4 0 0 8 3 A 0 4 2 8

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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)

a) 1 8 28 56

$1(1)^8 + 8(1)^7\left(\frac{x}{4}\right) + 28(1)^6\left(\frac{x}{4}\right)^2 + 56(1)^5\left(\frac{x}{4}\right)^3$

$1 + 2x + \frac{7}{4}x^2 + \frac{7}{8}x^3$

b) $1 + \frac{x}{4} = 1.025$

$x = 0.1$

$1 + 2(0.1) + \frac{7}{4}(0.1)^2 + \frac{7}{8}(0.1)^3$

$= 1.218375$

$= 1.2184$ (4dp)

Leave blank

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)

a) $y = 3x^2$

$\log_3 y = \log_3 3x^2$

$\log_3 y = \log_3 3 + \log_3 x^2$

$\log_3 y = 1 + 2\log_3 x$

b)

$\log_3 y = \log_3(28x - 9)$

$y = 28x - 9$

$y = 3x^2$

$3x^2 = 28x - 9$

$3x^2 - 28x + 9 = 0$

$(3x - 1)(x - 9) = 0$

$\underline{\underline{x = 1/3}}$ $\underline{\underline{x = 9}}$

Leave blank

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

Given that when $\mathrm{f}(x)$ is divided by $(x+2)$ the remainder is 7,

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

(2)

Given also that when $\mathrm{f}(x)$ is divided by $(x-1)$ the remainder is 4,

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

(4)

a/ $f(-2) = 7$

$(-2)^3 + a(-2)^2 + b(-2) + 3 = 7$

$-8 + 4a - 2b + 3 = 7$

$4a - 2b = 12$

$2a - b = 6$

b/ $f(1) = 4$

$(1)^3 + a(1)^2 + b(1) + 3 = 4$

$1 + a + b + 3 = 4$

$a + b = 0$

$2a - b = 6$

$+ \quad + \quad +$

$a + b = 0$

$3a = 6$

$a = 2$

$b = -2$

Leave blank

6.

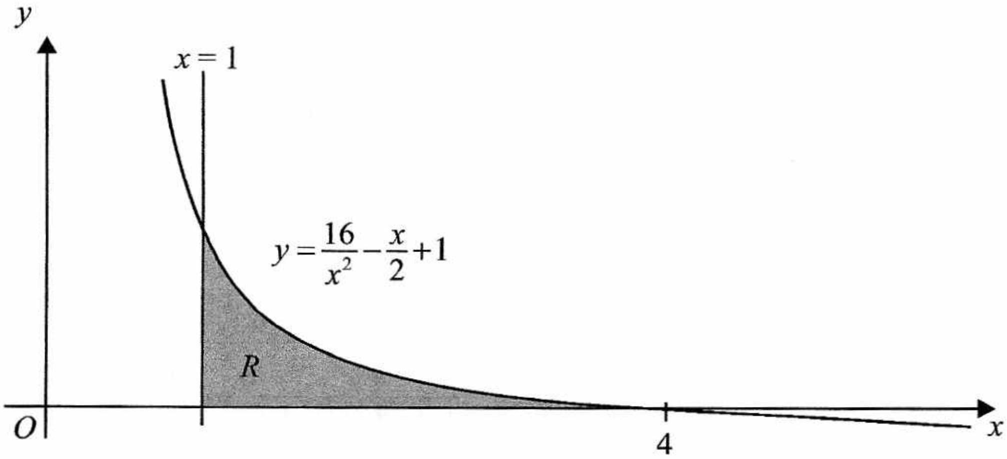

Figure 1

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	4	2.31	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)

b/ $0.5\left(\frac{16.5}{2}+7.361+4+2.31+1.278+0.556\right)$

$= 11.88$ (2dp)

c/ $y=16x^{-2}-\frac{1}{2}x+1$

$\int y\,dx = \frac{16x^{-1}}{-1}-\frac{\frac{1}{2}x^2}{2}+x+C$

Leave blank

Question 6 continued

$$\left[-16x^{-1} - \frac{1}{4}x^2 + x + c\right]_1^4$$

$$\left[-4\right] - \left[-\frac{61}{4}\right)$$

$$= \frac{45}{4} \text{ units}^2$$

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7.

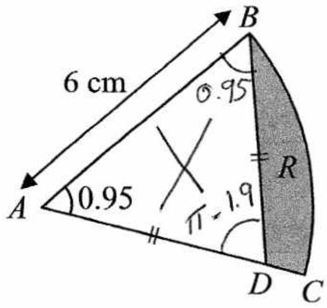

Figure 2

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)**

a) Arc Length $= \theta \times r$
$= 0.95 \times 6$
$= \underline{5.7 \text{ cm}}$

b) Sector Area $= \frac{\theta}{2} \times r^2$

$= \frac{0.95}{2} \times 6^2$

$= \underline{17.1 \text{ cm}^2}$

Leave blank

Question 7 continued

c/ $\dfrac{a}{\sin(0.95)} = \dfrac{6}{\sin(\pi-1.9)}$

$a = \dfrac{6}{\sin(\pi-1.9)} \times \sin(0.95)$

$= 5.157447508$

$= 5.16$ cm (3sf)

d/ perimeter $= 5.7 + (6-5.16) + 5.16$

$= \underline{\underline{11.7 \text{ cm}}}$

e/ area $= 17.1 - \left(\frac{1}{2}(6)(5.16)\sin(0.95)\right)$

$= 4.5$ cm^2 (2sf)

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8.

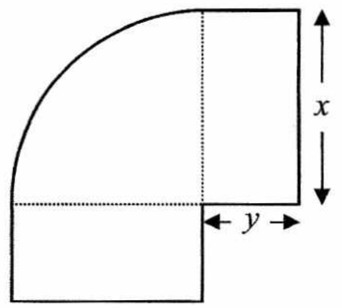

Figure 3

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 4 m^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)

$A = 2xy + \frac{1}{4}\pi x^2$

$4 = 2xy + \frac{1}{4}\pi x^2$

$16 = 8xy + \pi x^2$

$16 - \pi x^2 = 8xy$

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

Question 8 continued

$$P = 2x + 4y + \frac{1}{4}2\pi x$$

$$P = 2x + \cancel{4}\left(\frac{16-\pi x^2}{\cancel{8}^2 x}\right) + \frac{1}{4}2\pi x$$

$$= 2x + \frac{16-\pi x^2}{2x} + \frac{1}{2}\pi x$$

$$= 2x + \frac{8}{x} - \frac{1}{2}\pi x + \frac{1}{2}\pi x$$

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

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

c/ $P = 8x^{-1} + 2x$

$$\frac{dP}{dx} = -8x^{-2} + 2$$

Min value where $\frac{dP}{dx} = 0$

$$-8x^{-2} + 2 = 0$$

$$2 = 8x^{-2}$$

$$2 = \frac{8}{x^2}$$

$$2x^2 = 8$$

$$x^2 = 4$$

$$x = 2$$ (not -2, length cannot be negative)

$$P = 8(2)^{-1} + 2(2)$$

$$= \underline{\underline{8\ m}}$$

d/ $y = \frac{16-\pi(2)^2}{8(2)}$

$$= 0.2146018366\ m$$

$$= 21cm$$ (nearest cm)

Leave blank

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

(6)

(ii)

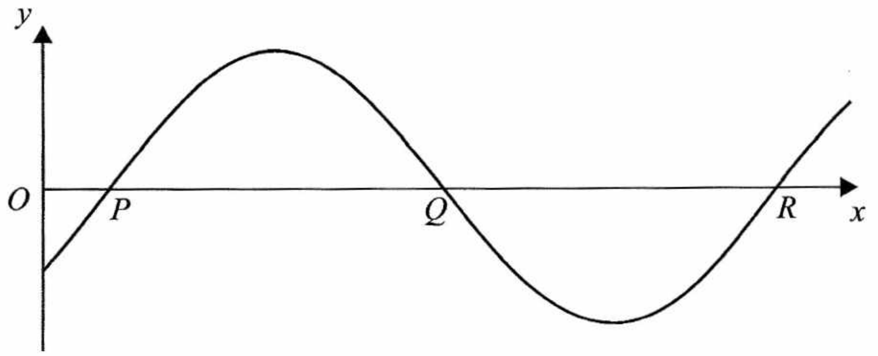

Figure 4

Figure 4 shows part of the curve with equation

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

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)

i) $\sin(3x-15) = \frac{1}{2}$

$3x - 15 = \sin^{-1}(\frac{1}{2})$

$3x - 15 = 30, 150, 390, 510$

$x = 15°, 55°, 135°, 175°$

ii) original interceptions $0, \pi, 2\pi$

$\frac{0+b}{a} = \frac{\pi}{10}$ (1)

$\frac{\pi+b}{a} = \frac{3\pi}{5}$ (2)

$\frac{2\pi+b}{a} = \frac{11\pi}{16}$

Leave blank

Question 9 continued

(1) $b = \frac{\pi}{10} a$

(2) $\pi + b = \frac{3\pi}{5} a$

(2) $b = \frac{3\pi}{5} a - \pi$

$\frac{\pi}{10} a = \frac{3\pi}{5} a - \pi$

$-\frac{1}{2}\pi a = -\pi$

$a = 2$

$b = \frac{\pi}{5}$

Turn over