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 5 June 2009 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

Materials required for examination
Mathematical Formulae
(Orange or Green)

Items included with question papers
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 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. Write your answers in the spaces provided in this question paper.
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 24 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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1. Use calculus to find the value of

$$\int_1^4 (2x + 3\sqrt{x})\,dx.$$

(5)

$= \left[\frac{2x^2}{2} + \frac{3x^{\frac{3}{2}}}{\frac{3}{2}}\right]_1^4 = \left[x^2 + 2x^{\frac{3}{2}}\right]_1^4$

$= (16+16) - (1+2) = 29$

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

$$(2 + kx)^7$$

where k is a constant. Give each term in its simplest form.

(4)

Given that the coefficient of x^2 is 6 times the coefficient of x,

(b) find the value of k.

(2)

$= 2^7\left(1 + \frac{k}{2}x\right)^7 = 128\left(1 + \frac{k}{2}x\right)^7$

$= 128\left(1 + 7\left(\frac{k}{2}x\right) + \frac{7\times 6}{2}\left(\frac{k}{2}x\right)^2\right)$

$= 128\left(1 + \frac{7k}{2}x + \frac{21}{4}k^2x^2\right)$

$= 128 + 448kx + 672k^2x^2$

b) $6 \times 448\cancel{k} = 672k^{\cancel{2}}$ $\quad k = \frac{448\times 6}{672} = \frac{448}{112}$

$\Rightarrow k = 4$

(assuming $k \neq 0$)

Leave blank

3.

$$f(x) = (3x - 2)(x - k) - 8$$

where k is a constant.

(a) Write down the value of $f(k)$.

(1)

When $f(x)$ is divided by $(x - 2)$ the remainder is 4

(b) Find the value of k.

(2)

(c) Factorise $f(x)$ completely.

(3)

a) $f(k) = (3k-2)(\underbrace{k-k}_{=0}) - 8 \Rightarrow f(k) = -8$

b) $f(2) = 4 \Rightarrow (6-2)(2-k) - 8 = 4$

$\Rightarrow 4(2-k) = 12 \Rightarrow 2 - k = 3 \Rightarrow k = -1$

c) $f(x) = (3x-2)(x+1) - 8 = 3x^2 + x - 2 - 8$

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

Leave blank

4. (a) Complete the table below, giving values of $\sqrt{(2^x + 1)}$ to 3 decimal places.

x	0	0.5	1	1.5	2	2.5	3
$\sqrt{(2^x + 1)}$	1.414	1.554	1.732	1.957	2.236	2.58	3

(2)

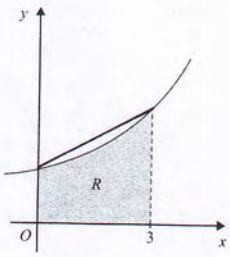

Figure 1

Figure 1 shows the region R which is bounded by the curve with equation $y = \sqrt{(2^x + 1)}$, the x-axis and the lines $x = 0$ and $x = 3$

(b) Use the trapezium rule, with all the values from your table, to find an approximation for the area of R.

(4)

(c) By reference to the curve in Figure 1 state, giving a reason, whether your approximation in part (b) is an overestimate or an underestimate for the area of R.

(2)

b) Area $\simeq \frac{1}{2}\left(\frac{1}{2}\right)\left(1.414 + 3 + 2\left(1.732 + 1.554 + 1.957 + 2.236 + 2.58\right)\right)$

Area $\simeq 6.133$

c) Over estimate as curve is concave so trapezia would be bigger than curve.

Leave blank

5. The third term of a geometric sequence is 324 and the sixth term is 96

(a) Show that the common ratio of the sequence is $\frac{2}{3}$ **(2)**

(b) Find the first term of the sequence. **(2)**

(c) Find the sum of the first 15 terms of the sequence. **(3)**

(d) Find the sum to infinity of the sequence. **(2)**

a) $\frac{ar^5}{ar^2} = \frac{96}{324} \Rightarrow r^3 = \frac{8}{27} \Rightarrow r = \frac{2}{3}$

b) $ar^2 = 324 \Rightarrow a = \frac{324}{\left(\frac{2}{3}\right)^2} \Rightarrow a = 729$

c) $S_{15} = \frac{729\left(1-\left(\frac{2}{3}\right)^{15}\right)}{1-\frac{2}{3}} = 2182.006$

d) $S_\infty = \frac{a}{1-r} = \frac{729}{\left(\frac{1}{3}\right)} = 2187$

Leave blank

6. The circle C has equation

$$x^2 + y^2 - 6x + 4y = 12$$

(a) Find the centre and the radius of C. **(5)**

The point $P(-1, 1)$ and the point $Q(7, -5)$ both lie on C.

(b) Show that PQ is a diameter of C. **(2)**

The point R lies on the positive y-axis and the angle $PRQ = 90°$.

(c) Find the coordinates of R. **(4)**

a) $(x^2 - 6x) + (y^2 + 4y) = 12$

$(x-3)^2 + (y+2)^2 - 9 - 4 = 12$

$(x-3)^2 + (y+2)^2 = 25 = 5^2$

Centre $(3, -2)$ radius $= 5$

b) PQ is a diameter if Midpoint = Centre

$\left(\frac{-1+7}{2}, \frac{1-5}{2}\right) = (3, -2) =$ centre ✓

c) $x = 0 \Rightarrow (-3)^2 + (y+2)^2 = 25$

$\Rightarrow (y+2)^2 = 16 \Rightarrow y + 2 = \pm 4$

$y = -6, y = 2$

$\Rightarrow y = 2$

Leave blank

7. (i) Solve, for $-180° \leqslant \theta < 180°$,

$$(1 + \tan\theta)(5\sin\theta - 2) = 0.$$

(4)

$\Rightarrow 1 + \tan\theta = 0$ $\quad$ $5\sin\theta - 2 = 0$

$\tan\theta = -1$ $\quad$ $\sin\theta = \frac{2}{5}$

$\theta = \tan^{-1}(-1)$ $\quad$ $\theta = \sin^{-1}\left(\frac{2}{5}\right)$

$\theta = -45°, 135°$ $\quad$ $\theta = 23.6°, 156.4°$

$(\tan \pm 180°)$ $\quad$ $(\sin \quad 180 - \text{angle})$

(ii) Solve, for $0 \leqslant x < 360°$,

$$4\sin x = 3\tan x.$$

(6)

$4\sin x = 3\frac{\sin x}{\cos x}$

$4\sin x - \frac{3\sin x}{\cos x} = 0$

$4\sin x\cos x - 3\sin x = 0$

$\sin x(4\cos x - 3) = 0$

$\sin x = 0$ $\quad$ $4\cos x = 3$

$x = \sin^{-1}(0)$ $\quad$ $x = \cos^{-1}\left(\frac{3}{4}\right)$

$x = 0, 180, \cancel{360}, \ldots$ $\quad$ $x = 41.4°, 318.6°$

Leave blank

8. (a) Find the value of y such that

$$\log_2 y = -3$$

(2)

(b) Find the values of x such that

$$\frac{\log_2 32 + \log_2 16}{\log_2 x} = \log_2 x$$

(5)

a) $y = 2^{-3} \Rightarrow y = \frac{1}{8}$

b) $\log_2 2^5 + \log_2 2^4 = 5\log_2 2 + 4\log_2 2$

$= 9.$

$\Rightarrow \frac{9}{\log_2 x} = \log_2 x \Rightarrow 9 = (\log_2 x)^2$

$\Rightarrow \log_2 x = 3$ or -3

$x = 2^3$ or 2^{-3}

$x = 8$ or $\frac{1}{8}$

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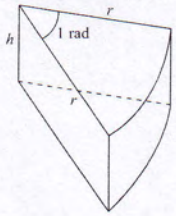
9.



$arc = r\theta$
$= r$

$area = \frac{1}{2}r^2\theta$
$= \frac{1}{2}r^2$

Figure 2

Figure 2 shows a closed box used by a shop for packing pieces of cake. The box is a right prism of height h cm. The cross section is a sector of a circle. The sector has radius r cm and angle 1 radian.

The volume of the box is 300 cm^3.

(a) Show that the surface area of the box, S cm^2, is given by

$$S = r^2 + \frac{1800}{r}$$

(5)

(b) Use calculus to find the value of r for which S is stationary.

(4)

(c) Prove that this value of r gives a minimum value of S.

(2)

(d) Find, to the nearest cm^2, this minimum value of S.

(2)

$SA = \frac{1}{2}r^2 + \frac{1}{2}r^2 + rh + rh + rh = r^2 + 3hr$

$Volume = area \times h \Rightarrow \frac{1}{2}r^2h = 300 \Rightarrow h = \frac{600}{r^2}$

$\Rightarrow SA = r^2 + 3r\left(\frac{600}{r^2}\right) \Rightarrow SA = r^2 + \frac{1800}{r}$ qed.

b) $\frac{dSA}{dr} = 0 \Rightarrow 2r - \frac{1800}{r^2} = 0 \Rightarrow r^3 = 900$
$\Rightarrow r = \sqrt{900}$
$r = 9.654$ cm

Leave blank

Question 9 continued

c) $\frac{d^2SA}{dr^2} = 2 + \frac{3600}{r^3}$ when $r = 9.65...$

$\frac{d^2SA}{dr^2} > 0$ ∪ minima

d) $SA = \left(\sqrt[3]{900}\right)^2 + \left(\frac{1800}{\sqrt[3]{900}}\right) = 279.5...$
$= 280$ cm^2