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

Wednesday 9 June 2010 – 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	
10	
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, 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.
You must write your answer to 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 10 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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1. $$y = 3^x + 2x$$

(a) Complete the table below, giving the values of y to 2 decimal places.

x	0	0.2	0.4	0.6	0.8	1
y	1	1.65	2.35	3.13	4.01	5

(2)

(b) Use the trapezium rule, with all the values of y from your table, to find an approximate value for $\int_0^1 (3^x + 2x)\,dx$.

(4)

b/ $0.2\left(\frac{1}{2} + 1.65 + 2.35 + 3.13 + 4.01 + \frac{5}{2}\right)$

$= 2.828$ units^2

Leave blank

2. $$f(x) = 3x^3 - 5x^2 - 58x + 40$$

(a) Find the remainder when $f(x)$ is divided by $(x-3)$.

(2)

Given that $(x-5)$ is a factor of $f(x)$,

(b) find all the solutions of $f(x) = 0$.

(5)

a) $f(3) = 3(3)^3 - 5(3)^2 - 58(3) + 40$

$= -98$

b)
$$\begin{array}{r|l} & 3x^2 + 10x - 8 \\ \hline x - 5 & 3x^3 - 5x^2 - 58x + 40 \\ & 3x^3 - 15x^2 \\ & \quad 10x^2 - 58x \\ & \quad 10x^2 - 50x \\ & \qquad -8x + 40 \\ & \qquad -8x + 40 \\ & \qquad\qquad 0 \end{array}$$

$(x-5)(3x^2 + 10x - 8)$

$(x-5)(3x-2)(x+4) = 0$

$x = 5 \quad x = 2/3 \quad x = -4$

Leave blank

3.

$$y = x^2 - k\sqrt{x}, \quad \text{where } k \text{ is a constant.}$$

(a) Find $\frac{dy}{dx}$. **(2)**

(b) Given that y is decreasing at $x = 4$, find the set of possible values of k. **(2)**

a) $y = x^2 - kx^{1/2}$

$\frac{dy}{dx} = 2x - \frac{1}{2}kx^{-1/2}$

b) when $x = 4$ $\quad \frac{dy}{dx} < 0$

$2(4) - \frac{1}{2}k(4)^{-1/2} < 0$

$8 - \frac{1}{2}k\left(\frac{1}{2}\right) < 0$

$8 - \frac{1}{4}k < 0$

$8 < \frac{1}{4}k$

$\underline{\underline{32 < k}}$

$\underline{\underline{k > 32}}$

Leave blank

4. (a) Find the first 4 terms, in ascending powers of x, of the binomial expansion of $(1+ax)^7$, where a is a constant. Give each term in its simplest form.

(4)

Given that the coefficient of x^2 in this expansion is 525,

(b) find the possible values of a.

(2)

$1 \quad 7 \quad 21$

a/ $(1)^7 + 7(1)^6(ax) + 21(1)^5(ax)^2$

$1 + 7ax + 21a^2x^2$

b/ $21a^2 = 525$

$a^2 = 25$

$\underline{a = \pm 5}$

Leave blank

5. (a) Given that $5\sin\theta = 2\cos\theta$, find the value of $\tan\theta$.

(1)

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

$$5\sin 2x = 2\cos 2x,$$

giving your answers to 1 decimal place.

(5)

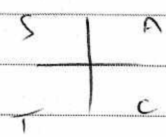
a/ $5\sin\theta = 2\cos\theta$

$5\tan\theta = 2$

$\underline{\tan\theta = 2/5}$

b/ $\tan(2x) = 2/5$

$2x = 21.80140949,\ 201.8014095,$
$381.8014095,\ 561.8014095$



$x = \underline{10.9,\ 100.9,\ 190.9,\ 280.9}$

Leave blank

6.

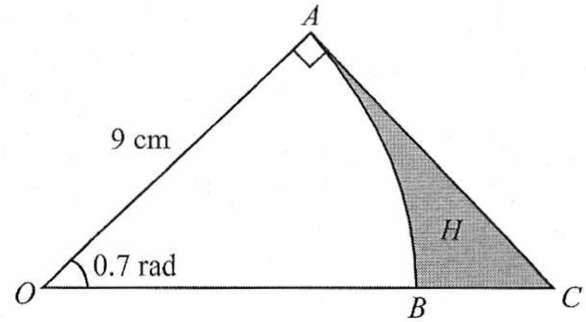


Figure 1

Figure 1 shows the sector OAB of a circle with centre O, radius 9 cm and angle 0.7 radians.

(a) Find the length of the arc AB.
(2)

(b) Find the area of the sector OAB.
(2)

The line AC shown in Figure 1 is perpendicular to OA, and OBC is a straight line.

(c) Find the length of AC, giving your answer to 2 decimal places.
(2)

The region H is bounded by the arc AB and the lines AC and CB.

(d) Find the area of H, giving your answer to 2 decimal places.
(3)

a) Arc Length $= \theta r$

$= 0.7 \times 9$

$= \underline{\underline{6.3 \text{cm}}}$

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

$= \frac{0.7}{2} \times 9^2$

$= 28.35 \text{ cm}^2$

c) $\tan(\theta) = \frac{o}{a}$

$\tan(0.7) = x/9$

$9 \tan(0.7) = x$

$x = 7.58$ cm (2dp)

Leave blank

Question 6 continued

d/ Area of triangle $= \frac{1}{2} \times 9 \times 7.58$

$= 34.1\ cm^2$ (3sf)

$34.1 - 28.35 = \underline{5.76\ cm^2}$

Leave blank

7. (a) Given that

$$2\log_3(x-5) - \log_3(2x-13) = 1,$$

show that $x^2 - 16x + 64 = 0$.

(5)

(b) Hence, or otherwise, solve $2\log_3(x-5) - \log_3(2x-13) = 1$.

(2)

a) $2\log_3(x-5) - \log_3(2x-13) = 1$

$\log_3(x-5)^2 - \log_3(2x-13) = 1$

$\log_3\left(\frac{(x-5)^2}{2x+13}\right) = 1$

$\frac{(x-5)^2}{2x-13} = 3$

$(x-5)^2 = 3(2x-13)$

$x^2 - 5x - 5x + 25 = 6x - 39$

$x^2 - 10x + 25 = 6x - 39$

$\underline{x^2 - 16x + 64 = 0}$

b) $(x-8)(x-8) = 0$

$\underline{\underline{x = 8}}$

Leave blank

8.

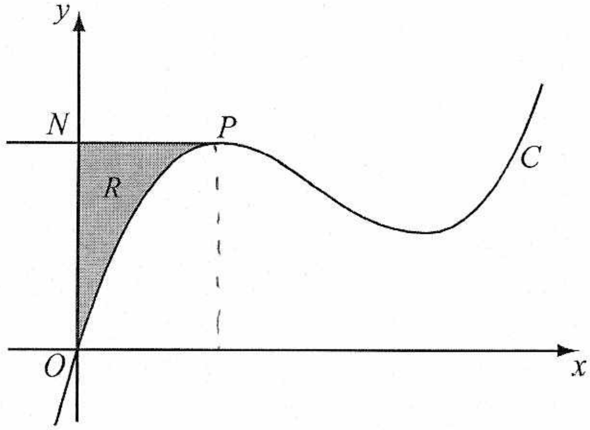


Figure 2

Figure 2 shows a sketch of part of the curve C with equation

$$y = x^3 - 10x^2 + kx,$$

where k is a constant.

The point P on C is the maximum turning point.

Given that the x-coordinate of P is 2,

(a) show that $k = 28$.

(3)

The line through P parallel to the x-axis cuts the y-axis at the point N.
The region R is bounded by C, the y-axis and PN, as shown shaded in Figure 2.

(b) Use calculus to find the exact area of R.

(6)

a) turning point is where $\frac{dy}{dx} = 0$

$\frac{dy}{dx} = 3x^2 - 20x + k$

$\frac{dy}{dx} = 0$ when $x = 2$

$0 = 3(2)^2 - 20(2) + k$

$0 = 12 - 40 + k$

$\underline{\underline{k = 28}}$

Leave blank

Question 8 continued

$$y = x^3 - 10x^2 + 28x$$

when $x = 2$

$$y = (2)^3 - 10(2)^2 + 28(2)$$
$$= 24$$

Area of rectangle $= 2 \times 24 = 48$ units^2

$$\int_0^2 x^3 - 10x^2 + 28x \quad dx$$

$$\left[\frac{x^4}{4} - \frac{10x^3}{3} + 14x^2 + c \right]_0^2$$

$$\left[\frac{(2)^4}{4} - \frac{10(2)^3}{3} + 14(2)^2 \right] - \left[0 \right]$$

$$= \frac{100}{3} \text{ units}^2$$

$$R = 48 - \frac{100}{3} = \underline{\underline{\frac{44}{3} \text{ units}^2}}$$

Leave blank

9. The adult population of a town is 25 000 at the end of Year 1.

A model predicts that the adult population of the town will increase by 3% each year, forming a geometric sequence.

(a) Show that the predicted adult population at the end of Year 2 is 25 750.
(1)

(b) Write down the common ratio of the geometric sequence.
(1)

The model predicts that Year N will be the first year in which the adult population of the town exceeds 40 000.

(c) Show that

$$(N-1)\log 1.03 > \log 1.6$$
(3)

(d) Find the value of N.
(2)

At the end of each year, each member of the adult population of the town will give £1 to a charity fund.

Assuming the population model,

(e) find the total amount that will be given to the charity fund for the 10 years from the end of Year 1 to the end of Year 10, giving your answer to the nearest £1000.
(3)

a/ $a = 25000$ $r = 1.03$

$25000 \times 1.03 = \underline{\underline{25750}}$

b/ 1.03

c/ ~~$40000 < \frac{N}{2}(2(25000) + (N-1)$~~

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

~~$40000 < \frac{25000(1-1.03^N)}{1-1.03}$~~

~~$-1200 < 25000(1-1.03^N)$~~

Leave blank

Question 9 continued

$\cancel{\frac{-1200}{25000} < 1 - 1.03^N}$

$\cancel{1.03^N - \frac{1200}{25000} < 1}$

$\cancel{1.03^N <}$

$U_n = ar^{n-1}$

$40000 < 25000(1.03)^{N-1}$

$1.6 < 1.03^{N-1}$

$\log 1.6 < \log 1.03^{N-1}$

$\log 1.6 < (N-1)\log 1.03$

$15.9\ldots < N-1$

$16.9\ldots < N$

$N = 17$

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

$S_{10} = \frac{25000(1-1.03^{10})}{1-1.03}$

$= £286596.98$

$£287000$

Leave blank

10. The circle C has centre $A(2, 1)$ and passes through the point $B(10, 7)$.

(a) Find an equation for C.

(4)

The line l_1 is the tangent to C at the point B.

(b) Find an equation for l_1.

(4)

The line l_2 is parallel to l_1 and passes through the mid-point of AB.

Given that l_2 intersects C at the points P and Q,

(c) find the length of PQ, giving your answer in its simplest surd form.

(3)

a) $(x-2)^2 + (y-1)^2 = r^2$ $\quad (10,7)$

$(10-2)^2 + (7-1)^2 = r^2$

$8^2 + 6^2 = r^2$

$100 = r^2$

$\underline{(x-2)^2 + (y-1)^2 = 100}$

b) gradient of AB: $\quad \overset{x_1\ y_1}{(2,1)} \quad \overset{x_2\ y_1}{(10,7)}$

$m = \dfrac{7-1}{10-2} = \dfrac{6}{8} = \dfrac{3}{4}$

l_1 is perpendicular $\therefore$ $m = -4/3$

$y = -4/3\, x + c$ $\quad (10,7)$

$7 = -\frac{4}{3}(10) + c$

$7 = \dfrac{-40}{3} + c$

$21 = -40 + 3c$

$61 = 3c$

$c = 61/3$

$y = -\frac{4}{3}x + \frac{61}{3}$

c/ l_2 $m = -\frac{4}{3}$

Mid point of AB $\left(\frac{2+10}{2}, \frac{1+7}{2}\right)$

$(\underset{x}{6}, \underset{y}{4})$

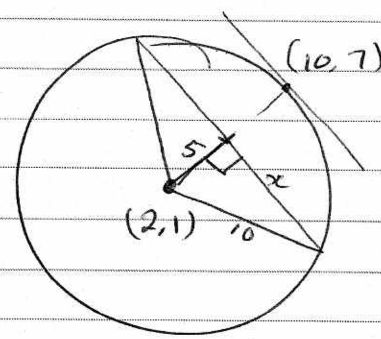
$y = -\frac{4}{3}x + c$

$4 = -\frac{4}{3}(6) + c$

$4 = -8 + c$

$12 = c$

$y = -\frac{4}{3}x + 12$



$5^2 + x^2 = 10^2$

$25 + x^2 = 100$

$x^2 = 75$

$x = \sqrt{75}$

$= \sqrt{3}\sqrt{25}$

$= 5\sqrt{3}$

$2 \times 5\sqrt{3} = 10\sqrt{3}$

Leave blank