Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6664/01	Signature	

Paper Reference(s)

6664/01

Edexcel GCE

Core Mathematics C2

Advanced Subsidiary

Thursday 24 May 2012 – Morning

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	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. Find the first 3 terms, in ascending powers of x, of the binomial expansion of

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

giving each term in its simplest form.

(4)

1) 1 5 10

$1(2)^5 + 5(2)^4(-3x) + 10(2)^3(-3x)^2$

$32 - 240x + 720x^2$

Q1

(Total 4 marks)

P 4 0 6 8 5 A 0 3 2 8

Turn over

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2. Find the values of x such that

$$2\log_3 x - \log_3(x-2) = 2$$

(5)

2) $2\log_3 x - \log_3(x-2) = 2$

$\log_3 x^2 - \log_3(x-2) = 2$

$\log_3\left(\frac{x^2}{x-2}\right) = 2$

$\frac{x^2}{x-2} = 3^2$

$\frac{x^2}{x-2} = 9$

$x^2 = 9(x-2)$

$x^2 = 9x - 18$

$x^2 - 9x + 18 = 0$

$(x-3)(x-6) = 0$

$x = 3 \quad x = 6$

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Question 2 continued

Q2

(Total 5 marks)

P 4 0 6 8 5 A 0 5 2 8

Turn over

3.

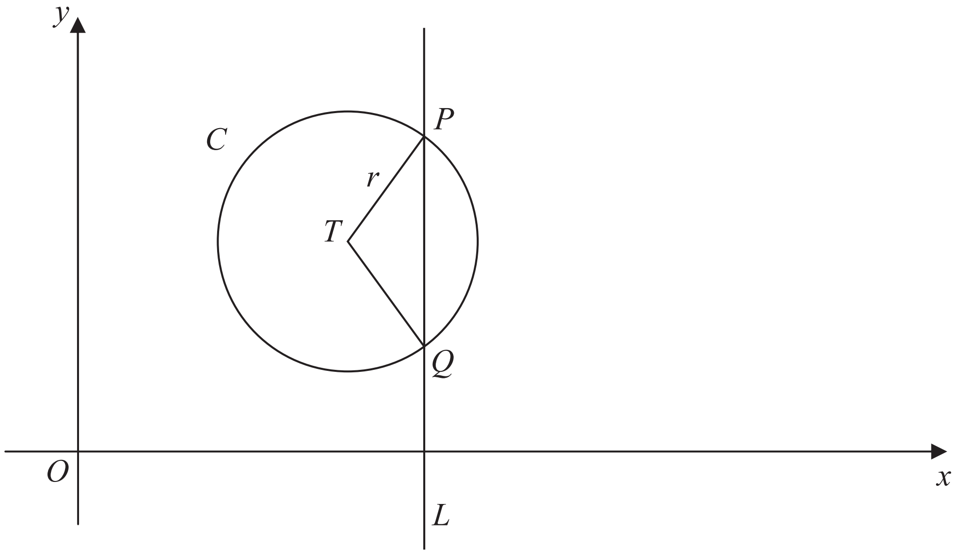

Figure 1

The circle C with centre T and radius r has equation

$$x^2 + y^2 - 20x - 16y + 139 = 0$$

(a) Find the coordinates of the centre of C.

(3)

(b) Show that $r = 5$

(2)

The line L has equation $x = 13$ and crosses C at the points P and Q as shown in Figure 1.

(c) Find the y coordinate of P and the y coordinate of Q.

(3)

Given that, to 3 decimal places, the angle PTQ is 1.855 radians,

(d) find the perimeter of the sector PTQ.

(3)

3a) $x^2 + y^2 - 20x - 16y + 139 = 0$

$x^2 - 20x + y^2 - 16y + 139 = 0$

$(x-10)^2 - 100 + (y-8)^2 - 64 + 139 = 0$

$(x-10)^2 + (y-8)^2 = 25$

centre $(10, 8)$

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Question 3 continued

b) $r = \sqrt{25} = 5$

c) $x = 13$

$(x-10)^2 + (y-8)^2 = 25$

$(13-10)^2 + (y-8)^2 = 25$

$9 + (y-8)^2 = 25$

$(y-8)^2 = 16$

$y - 8 = \pm 4$

$y = +4+8$ or $y = -4+8$

$= 12$ $\quad = 4$

d) Arc Length $= \frac{\theta}{\cancel{2\pi}} \times \cancel{2\pi} r$

$= 1.855 \times 5$

$= 9.275$

Perimeter $= 5 + 5 + 9.275$

$= 19.275$

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Question 3 continued

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Question 3 continued

Q3

(Total 11 marks)

P 4 0 6 8 5 A 0 9 2 8

Turn over

4. $$f(x) = 2x^3 - 7x^2 - 10x + 24$$

(a) Use the factor theorem to show that $(x + 2)$ is a factor of $f(x)$.
(2)

(b) Factorise $f(x)$ completely.
(4)

4a) if $(x+2)$ is a factor : $f(-2) = 0$

$f(-2) = 2(-2)^3 - 7(-2)^2 - 10(-2) + 24$

$= 0$

b)

$$\begin{array}{r} 2x^2 - 11x + 12 \\ x+2 \,\big)\, 2x^3 - 7x^2 - 10x + 24 \\ 2x^3 + 4x^2 \\ \hline -11x^2 - 10x \\ -11x^2 - 22x \\ \hline 12x + 24 \\ 12x + 24 \\ \hline 0 \end{array}$$

$f(x) = (x+2)(2x^2 - 11x + 12)$

$f(x) = (x+2)(2x-3)(x-4)$

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Question 4 continued

Q4

(Total 6 marks)

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5.

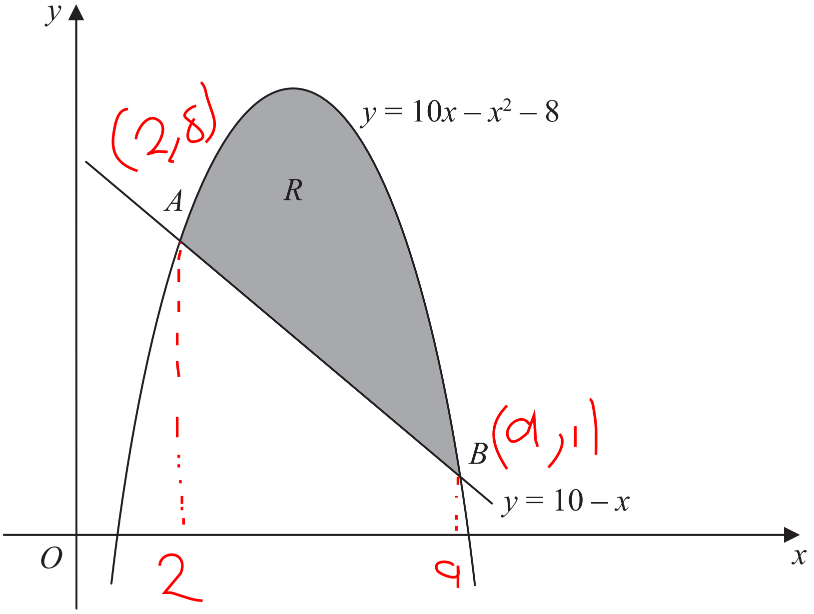


Figure 2

Figure 2 shows the line with equation $y = 10 - x$ and the curve with equation $y = 10x - x^2 - 8$

The line and the curve intersect at the points A and B, and O is the origin.

(a) Calculate the coordinates of A and the coordinates of B.

(5)

The shaded area R is bounded by the line and the curve, as shown in Figure 2.

(b) Calculate the exact area of R.

(7)

a) $y = 10 - x$

$y = 10x - x2 - 8$

$10 - x = 10x - x^2 - 8$

$x^2 - 11x + 18 = 0$

$(x - 9)(x - 2) = 0$

$x = 9 \quad x = 2$

$y = 1 \quad y = 8$

$(9, 1)$ and $(2, 8)$

P 4 0 6 8 5 A 0 1 2 2 8

Question 5 continued

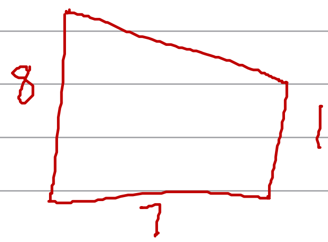
b) $\int_2^9 10x - x^2 - 8 \ dx$

$\left[\frac{10x^2}{2} - \frac{x^3}{3} - 8x\right]_2^9$

$\left[5(9)^2 - \frac{(9)^3}{3} - 8(9)\right] - \left[5(2)^2 - \frac{(2)^3}{3} - 8(2)\right]$

$90 - \frac{4}{3}$

$\frac{266}{3}$ units^2



$= 31.5$ units^2

$\frac{266}{3} - 31.5 = \frac{343}{6}$ units^2

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Question 5 continued

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Question 5 continued

Q5

(Total 12 marks)

P 4 0 6 8 5 A 0 1 5 2 8

Turn over

6. (a) Show that the equation

$$\tan 2x = 5 \sin 2x$$

can be written in the form

$$(1 - 5 \cos 2x) \sin 2x = 0$$

(2)

(b) Hence solve, for $0 \leqslant x \leqslant 180°$,

$$\tan 2x = 5 \sin 2x$$

giving your answers to 1 decimal place where appropriate.
You must show clearly how you obtained your answers.

(5)

6a) $\dfrac{\sin 2x}{\cos 2x} = 5 \sin 2x$

$\sin 2x = (5 \sin 2x)(\cos 2x)$

$\sin 2x - (5 \sin 2x)(\cos 2x) = 0$

$\sin 2x(1 - 5 \cos 2x) = 0$

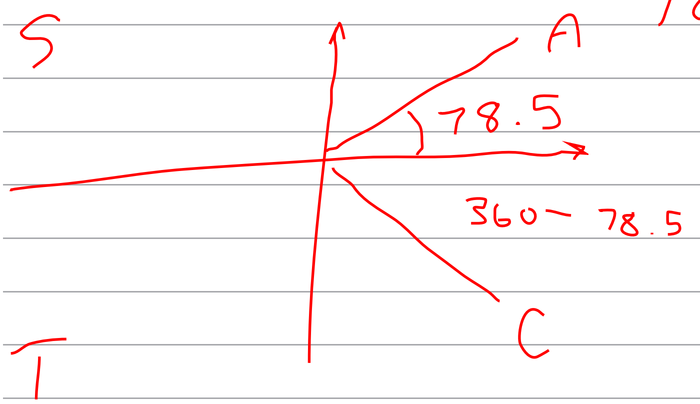
$(1 - 5\cos 2x) \sin 2x = 0$

$1 - 5\cos 2x = 0$ $\qquad$ $\sin 2x = 0$

$\cos 2x = 1/5$ $\qquad$ $2x = 0, 180, 360$

$2x = 78.5$

78.46304097



Question 6 continued

$2x = 0, 78.5, 180, 281.5, 360$

$x = 0, 39.2, 90.140.8, 180$

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Question 6 continued

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Question 6 continued

Q6

(Total 7 marks)

P 4 0 6 8 5 A 0 1 9 2 8

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7. $$y = \sqrt{(3^x + x)}$$

(a) Complete the table below, giving the values of y to 3 decimal places.

x	0	0.25	0.5	0.75	1
y	1	1.251	1.494	1.741	2

(2)

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

You must show clearly how you obtained your answer.

(4)

b) $0.25\left(\frac{1}{2} + 1.251 + 1.494 + 1.741 + \frac{2}{2}\right)$

$= \underline{\underline{1.4965}}$

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Question 7 continued

Q7

(Total 6 marks)

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8.

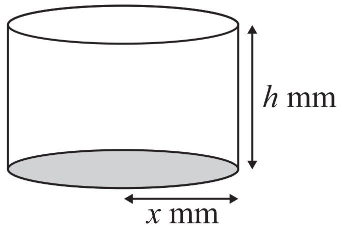

Figure 3

A manufacturer produces pain relieving tablets. Each tablet is in the shape of a solid circular cylinder with base radius x mm and height h mm, as shown in Figure 3.

Given that the volume of each tablet has to be 60 mm^3,

(a) express h in terms of x,
(1)

(b) show that the surface area, A mm^2, of a tablet is given by $A = 2\pi x^2 + \dfrac{120}{x}$
(3)

The manufacturer needs to minimise the surface area A mm^2, of a tablet.

(c) Use calculus to find the value of x for which A is a minimum.
(5)

(d) Calculate the minimum value of A, giving your answer to the nearest integer.
(2)

(e) Show that this value of A is a minimum.
(2)

a) $V = \pi r^2 h$

$60 = \pi x^2 h$

$h = \dfrac{60}{\pi x^2}$

b) surface area $= 2\pi r^2 + 2\pi r h$

$= 2\pi x^2 + 2\pi x\left(\dfrac{60}{\pi x^2}\right)$

P 4 0 6 8 5 A 0 2 2 2 8

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Question 8 continued

$$2\pi x^2 + \frac{120}{x}$$

c) Min surface area is where

$$\frac{dA}{dx} = 0$$

$$A = 2\pi x^2 + 120x^{-1}$$

$$\frac{dA}{dx} = 4\pi x - 120x^{-2}$$

$$4\pi x - \frac{120}{x^2} = 0$$

$$4\pi x^3 - 120 = 0$$

$$4\pi x^3 = 120$$

$$\pi x^3 = 30$$

$$x^3 = \frac{30}{\pi}$$

$$x = \sqrt[3]{\frac{30}{\pi}}$$

$$x = 2.121568836$$

d) $$s.a = 2\pi(2.12)^2 + \frac{120}{2.12}$$

$$= 84.84287521$$

Question 8 continued

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$$s\,a_{min} = 85 \text{ mm}^2$$

e) $$\frac{dA}{dx} = 4\pi x - \frac{120}{x^2}$$

$$\frac{d^2A}{dx^2} = 4\pi + 240x^{-3}$$

when $x = 2.12$

$$\frac{d^2A}{dx^2} = 4\pi + \frac{240}{2.12^3}$$

positive $\therefore$ it is a minimum

Leave blank

Question 8 continued

(Total 13 marks)

Q8

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9. A geometric series is $a + ar + ar^2 + \ldots$

(a) Prove that the sum of the first n terms of this series is given by

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

(4)

The third and fifth terms of a geometric series are 5.4 and 1.944 respectively and all the terms in the series are positive.

For this series find,

(b) the common ratio,

(2)

(c) the first term,

(2)

(d) the sum to infinity.

(3)

a) $S_n = a + ar + ar^2 + \ldots ar^{n-2} + ar^{n-1}$

$rS_n = ar + ar^2 + ar^3 \ldots ar^{n-1} + ar^n$

$S_n - rS_n = a - ar^n$

$S_n(1-r) = a(1-r^n)$

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

b) $U_3 = 5.4$

$U_5 = 1.944$

$5.4 = ar^2$

$1.944 = ar^4$

$r^2 = \dfrac{1.944}{5.4}$

$r = 3/5$

P 4 0 6 8 5 A 0 2 6 2 8

Question 9 continued

c) $5.4 = a\left(\frac{3}{5}\right)^2$

$a = 15$

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

$= \frac{15}{2/5}$

$= 37.5$

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Question 9 continued

Q9

(Total 11 marks)

TOTAL FOR PAPER: 75 MARKS

END

P 4 0 6 8 5 A 0 2 8 2 8