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 24 May 2013 – 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 or symbolic differentiation/integration, or have retrievable mathematical formulae stored in them.

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

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 10 questions in this question paper. The total mark for this paper is 75.
There are 32 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. The first three terms of a geometric series are

$$18, 12 \text{ and } p$$

respectively, where p is a constant.

Find

(a) the value of the common ratio of the series,
(1)

(b) the value of p,
(1)

(c) the sum of the first 15 terms of the series, giving your answer to 3 decimal places.
(2)

a) $a = 18$

$12 = 18r$

$r = \frac{12}{18} = \underline{\underline{\frac{2}{3}}}$

b) $12 \times \frac{2}{3} = \underline{\underline{8}}$

c) $S_{15} = \frac{a(1-r^n)}{1-r}$

$= \frac{18\left(1-\left(\frac{2}{3}\right)^{15}\right)}{1-\left(\frac{2}{3}\right)}$

$= \underline{\underline{53.877}}$

Leave blank

2. (a) Use the binomial theorem to find all the terms of the expansion of

$$(2 + 3x)^4$$

Give each term in its simplest form.

(4)

(b) Write down the expansion of

$$(2 - 3x)^4$$

in ascending powers of x, giving each term in its simplest form.

(1)

1 4 6 4 1

a) $(2)^4 + 4(2)^3(3x) + 6(2)^2(3x)^2 + 4(2)(3x)^3 + (3x)^4$

$16 + 96x + 216x^2 + 216x^3 + 81x^4$

b) $16 - 96x + 216x^2 - 216x^3 + 81x^4$

Leave blank

3. $$f(x) = 2x^3 - 5x^2 + ax + 18$$

where a is a constant.

Given that $(x - 3)$ is a factor of $f(x)$,

(a) show that $a = -9$

(2)

(b) factorise $f(x)$ completely.

(4)

Given that

$$g(y) = 2(3^{3y}) - 5(3^{2y}) - 9(3^{y}) + 18$$

(c) find the values of y that satisfy $g(y) = 0$, giving your answers to 2 decimal places where appropriate.

(3)

a/ $(x-3)$ is a factor $\therefore f(3) = 0$

$2(3)^3 - 5(3)^2 + a(3) + 18 = 0$

$54 - 45 + 3a + 18 = 0$

$3a + 27 = 0$

$3a = -27$

$\underline{a = -9}$

b/
$$\begin{array}{r} 2x^2 + x - 6 \\ x-3 \,\big)\, \overline{2x^3 - 5x^2 - 9x + 18} \\ 2x^3 - 6x^2 \\ x^2 - 9x \\ x^2 - 3x \\ -6x + 18 \\ -6x + 18 \\ \hline 0 \end{array}$$

$(x-3)(2x^2 + x - 6)$

$(x-3)(2x-3)(x+2)$

c/ $x = 3$ $\quad x = 3/2$ $\quad x = -2$

$3^y = 3$ $\quad 3^y = 3/2$ $\quad 3^y = -2$

(no solution)

Leave blank

Question 3 continued

$y = 1$ $\quad y = \log_3 {}^{3/2}$

$= 0.37$

Leave blank

4. $$y = \frac{5}{(x^2+1)}$$

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

x	0	0.5	1	1.5	2	2.5	3
y	5	4	2.5	1.538	1	0.690	0.5

(1)

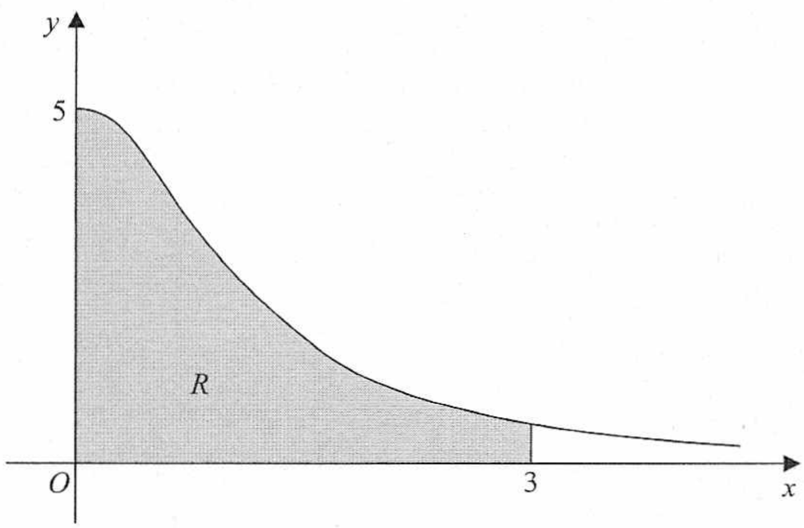

Figure 1

Figure 1 shows the region R which is bounded by the curve with equation $y = \frac{5}{(x^2+1)}$, the x-axis and the lines $x = 0$ and $x = 3$

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

(4)

(c) Use your answer to part (b) to find an approximate value for

$$\int_0^3 \left(4 + \frac{5}{(x^2+1)}\right) dx$$

giving your answer to 2 decimal places.

(2)

b) $0.5\left(\frac{5}{2} + 4 + 2.5 + 1.538 + 1 + 0.69 + \frac{0.5}{2}\right)$

$= 6.239$ units^2

Leave blank

Question 4 continued

c/ translated vertically upwards 4 spaces

$6.239 + 4 \times 3$

$6.239 + 12$

18.239 units^2

18.24 (2dp) units^2

Q4

(Total 7 marks)

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5.

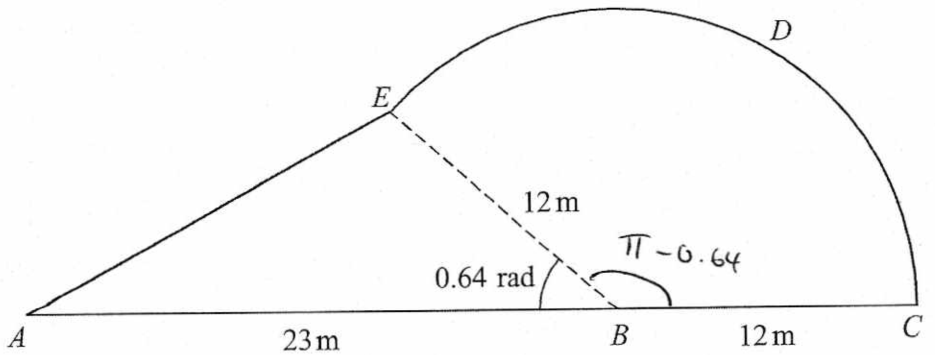

Figure 2

Figure 2 shows a plan view of a garden.
The plan of the garden $ABCDEA$ consists of a triangle ABE joined to a sector $BCDE$ of a circle with radius 12 m and centre B.
The points A, B and C lie on a straight line with $AB = 23$ m and $BC = 12$ m.

Given that the size of angle ABE is exactly 0.64 radians, find

(a) the area of the garden, giving your answer in m^2, to 1 decimal place,

(4)

(b) the perimeter of the garden, giving your answer in metres, to 1 decimal place.

(5)

a) Area of triangle $= \frac{1}{2}ab \sin C$

$= \frac{1}{2}(23)(12) \sin(0.64)$

$= 82.41297091 \, m^2$

Area of sector $= \frac{\theta}{2\pi} \times \pi r^2$

$= \frac{\pi - 0.64}{2} \times 12^2$

$= 180.1146711 \, m^2$

Total Area $= \underline{262.5 \, m^2}$

b/ AE: $a^2 = b^2 + c^2 - 2bc \cos A$

$a^2 = (23)^2 + (12)^2 - 2(23)(12) \cos(0.64)$

$= 230.24\ldots$

$a = 15.17376491$

Leave blank

Question 5 continued

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

$= \theta r$

$= (\pi - 0.64)\, 12$

$= 30.01911184$

Total Perimeter $= 23 + 12 + AE + CE$

$= \underline{80.2\text{m } 1dp}$

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6.

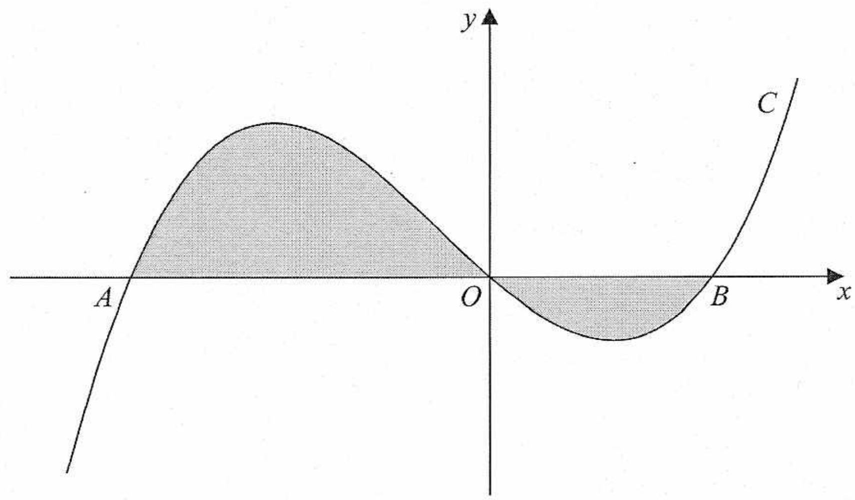


Figure 3

Figure 3 shows a sketch of part of the curve C with equation

$$y = x(x + 4)(x - 2)$$

The curve C crosses the x-axis at the origin O and at the points A and B.

(a) Write down the x-coordinates of the points A and B.

(1)

The finite region, shown shaded in Figure 3, is bounded by the curve C and the x-axis.

(b) Use integration to find the total area of the finite region shown shaded in Figure 3.

(7)

a) $A: (-4,0) \qquad B: (2,0)$

b) $y = x(x^2 - 2x + 4x - 8)$

$= x(x^2 + 2x - 8)$

$= x^3 + 2x^2 - 8x$

$$\int_0^2 x^3 + 2x^2 - 8x \, dx + \int_{-4}^0 x^3 + 2x^2 - 8x \, dx$$

$$\left[\frac{x^4}{4} + \frac{2x^3}{3} - 4x^2 + c\right]_0^2 + \left[\frac{x^4}{4} + \frac{2}{3}x^3 - 4x^2 + c\right]_{-4}^0$$

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

$$\frac{26}{3} + \frac{128}{3} = \underline{\frac{148}{3}} \text{ units}^2$$

Leave blank

7. (i) Find the exact value of x for which

$$\log_2(2x) = \log_2(5x + 4) - 3$$

(4)

(ii) Given that

$$\log_a y + 3\log_a 2 = 5$$

express y in terms of a.
Give your answer in its simplest form.

(3)

i/ $\log_2 2x - \log_2(5x+4) = -3$

$\log_2\left(\frac{2x}{5x+4}\right) = -3$

$2^{-3} = \frac{2x}{5x+4}$

$\frac{1}{8} = \frac{2x}{5x+4}$

$\frac{5x+4}{8} = 2x$

$5x+4 = 16x$

$4 = 11x$

$\underline{\underline{x = 4/11}}$

ii/ $\log_a y + \log_a 2^3 = 5$

$\log_a y + \log_a 8 = 5$

$\log_a 8y = 5$

$a^5 = 8y$

$\underline{\underline{y = \frac{1}{8}a^5}}$

Leave blank

8. (i) Solve, for $-180° \leqslant x < 180°$,

$$\tan(x - 40°) = 1.5$$

giving your answers to 1 decimal place.

(3)

(ii) (a) Show that the equation

$$\sin\theta \tan\theta = 3\cos\theta + 2$$

can be written in the form

$$4\cos^2\theta + 2\cos\theta - 1 = 0$$

(3)

(b) Hence solve, for $0 \leqslant \theta < 360°$,

$$\sin\theta \tan\theta = 3\cos\theta + 2$$

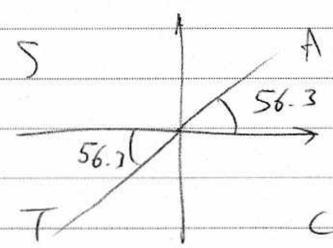
showing each stage of your working.

(5)

i/ $\tan(x-40) = 1.5$

$x - 40 = \tan^{-1}(1.5)$

$x - 40 = 56.3, -123.7$



$x = 96.3°, -83.7°$

ii/ $\sin\theta \tan\theta = 3\cos\theta + 2$

$\sin\theta \dfrac{\sin\theta}{\cos\theta} = 3\cos\theta + 2$

$\sin^2\theta = 3\cos^2\theta + 2\cos\theta$

$1 - \cos^2\theta = 3\cos^2\theta + 2\cos\theta$

$= 4\cos^2\theta + 2\cos\theta - 1$

Leave blank

Question 8 continued

b) $4\cos^2\theta + 2\cos\theta - 1 = 0$

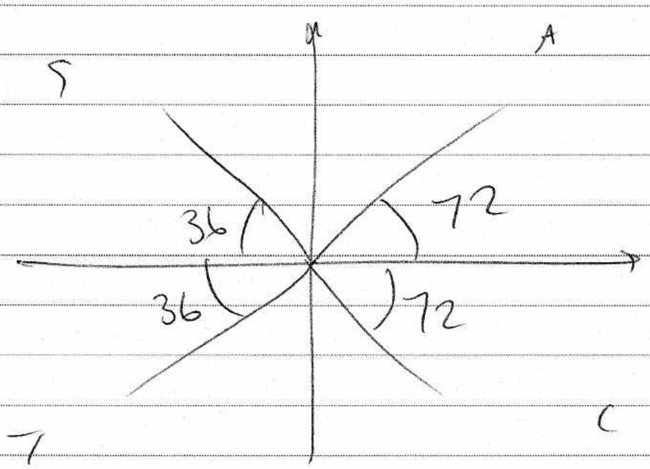
($a=4 \quad b=2 \quad c=-1$

$$\cos\theta = \frac{-(2) \pm \sqrt{(2)^2 - 4(4)(-1)}}{2(4)}$$

$$= \frac{-1+\sqrt{5}}{4}, \quad \frac{-1-\sqrt{5}}{4}$$

$\cos\theta = \frac{-1+\sqrt{5}}{4}$ $\qquad$ $\cos\theta = \frac{-1+\sqrt{5}}{4}$

$= 72$ $\qquad$ $= 144$



$\theta = 72°, 144°, 216°, 288°$

Leave blank

9. The curve with equation

$$y = x^2 - 32\sqrt{(x)} + 20, \qquad x > 0$$

has a stationary point P.

Use calculus

(a) to find the coordinates of P,

(6)

(b) to determine the nature of the stationary point P.

(3)

$y = x^2 - 32x^{1/2} + 20$

$\frac{dy}{dx} = 2x - 16x^{-1/2}$

stationary point is where $\frac{dy}{dx} = 0$

$2x - 16x^{-1/2} = 0$

$2x - \frac{16}{x^{1/2}} = 0$

$2x = \frac{16}{x^{1/2}}$

$2x^{3/2} = 16$

$x^{3/2} = 8$

$x^{1/2} = 2$

$x = 4$

when $x = 4$

$y = (4)^2 - 32(4)^{1/2} + 20$

$= 16 - 64 + 20$

$= -28$

$(4, -28)$

Leave blank

Question 9 continued

b) $\frac{d^2y}{dx^2} = 2 + 8x^{-3/2}$

when $x = 4$

$\frac{d^2y}{dx^2} = 2 + 8(4)^{-3/2}$

$= 3$

$\frac{d^2y}{dx^2}$ is positive $\therefore$ it is a minimum point.

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10.

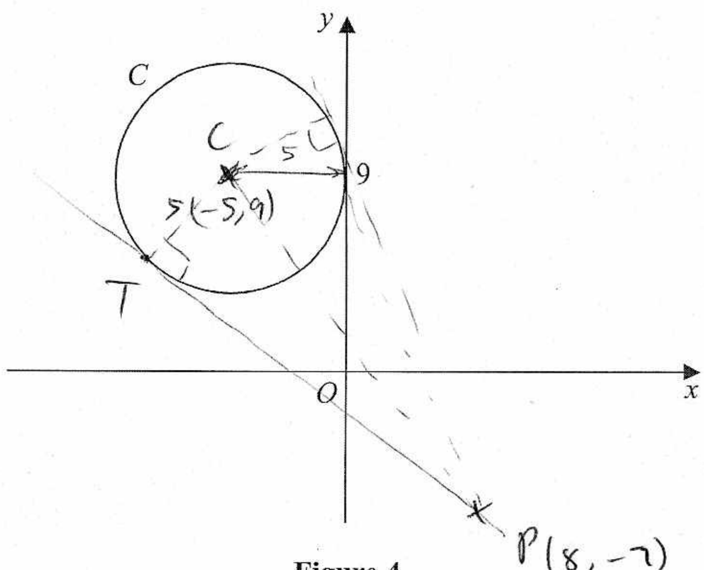

Figure 4

The circle C has radius 5 and touches the y-axis at the point (0, 9), as shown in Figure 4.

(a) Write down an equation for the circle C, that is shown in Figure 4.

(3)

A line through the point $P(8, -7)$ is a tangent to the circle C at the point T.

(b) Find the length of PT.

(3)

a) $(x+5)^2 + (y-9)^2 = 25$

b) Length of CP:

$x^2 = 13^2 + 16^2$

$x^2 = 425$

$x = \sqrt{425}$

Length of PT:

$x^2 + 5^2 = (\sqrt{425})^2$

$x^2 + 25 = 425$

$x^2 = 400$

$x = 20$