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

Monday 14 January 2013 – 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 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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1. Find the first 3 terms, in ascending powers of x, in the binomial expansion of

$$(2-5x)^6$$

Give each term in its simplest form.

(4)

1 6 15

$1(2)^6 + 6(2)^5(-5x) + 15(2)^4(-5x)^2$

$64 \cancel{\ast} - 960x + 6000x^2$

Q1

(Total 4 marks)

Turn over

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2. $f(x) = ax^3 + bx^2 - 4x - 3$, where a and b are constants.

Given that $(x - 1)$ is a factor of $f(x)$,

(a) show that

$$a + b = 7$$

(2)

Given also that, when $f(x)$ is divided by $(x + 2)$, the remainder is 9,

(b) find the value of a and the value of b, showing each step in your working.

(4)

a) $f(1) = 0$

$a(1)^3 + b(1)^2 - 4(1) - 3 = 0$

$a + b - 4 - 3 = 0$

$a + b = 7$ (1)

b/ $f(-2) = 9$

$a(-2)^3 + b(-2)^2 - 4(-2) - 3 = 9$

$-8a + 4b + 8 - 3 = 9$

$-8a + 4b = 4$

$-2a + b = 1$ (2)

(1) − (2) $3a = 6$

$\underline{a = 2}$

$\underline{b = 5}$

Leave blank

3. A company predicts a yearly profit of £120 000 in the year 2013. The company predicts that the yearly profit will rise each year by 5%. The predicted yearly profit forms a geometric sequence with common ratio 1.05

(a) Show that the predicted profit in the year 2016 is £138 915

(1)

(b) Find the first year in which the yearly predicted profit exceeds £200 000

(5)

(c) Find the total predicted profit for the years 2013 to 2023 inclusive, giving your answer to the nearest pound.

(3)

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

2016 = term 4

$u_4 = 120000(1.05)^3$
$= £138915$

b) $ar^{n-1} > 200000$
$120000(1.05)^{n-1} > 200000$
$(1.05)^{n-1} > 5/3$
$(n-1)\log 1.05 > \log(5/3)$
$n-1 > \frac{\log(5/3)}{\log(1.05)}$
$n-1 > 10.4698...$
$n > 11.4698$
The 12^{th} term exceeds £200 000

2024

c/ $S_{11} = \frac{a(1-r^n)}{1-r}$
$= \frac{120000(1-1.05^{11})}{1-1.05}$
$= 1704814.46$
$= £1704814$

4. Solve, for $0 \leqslant x < 180°$,

$$\cos(3x - 10°) = -0.4$$

giving your answers to 1 decimal place. You should show each step in your working.
(7)

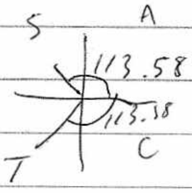
$\cos(3x - 10) = -0.4$

$3x - 10 = \cos^{-1}(-0.4)$

$3x - 10 = 113.5781785°,$

$246.4218215°,$

$473.5781785°$



$x = 41.2°, 85.5°, 161.2°$

Leave blank

5. The circle C has equation

$$x^2 + y^2 - 20x - 24y + 195 = 0$$

The centre of C is at the point M.

(a) Find

(i) the coordinates of the point M,

(ii) the radius of the circle C.

(5)

N is the point with coordinates (25, 32).

(b) Find the length of the line MN.

(2)

The tangent to C at a point P on the circle passes through point N.

(c) Find the length of the line NP.

(2)

a) i) $x^2 - 20x + y^2 - 24y + 195 = 0$

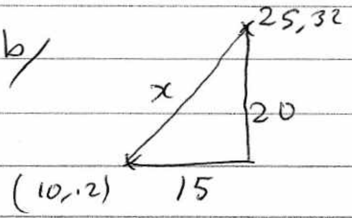
$(x-10)^2 - 100 + (y-12)^2 - 144 + 195 = 0$

$(x-10)^2 + (y-12)^2 = 49$

centre (10, 12)

ii) radius $\sqrt{49} = \underline{\underline{7}}$

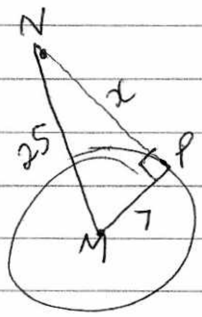
b/



$x^2 = 20^2 + 15^2$

$\underline{\underline{x = 25}}$

c/



$x^2 = 25^2 - 7^2$

$\underline{\underline{x = 24}}$

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6. Given that

$$2\log_2(x+15)-\log_2 x=6$$

(a) Show that

$$x^2-34x+225=0$$

(5)

(b) Hence, or otherwise, solve the equation

$$2\log_2(x+15)-\log_2 x=6$$

(2)

a) $2\log_2(x+15)-\log_2 x=6$

$\log_2(x+15)^2-\log_2 x=6$

$\log_2\left(\frac{(x+15)^2}{x}\right)=6$

$\frac{(x+15)^2}{x}=2^6$

$\frac{(x+15)^2}{x}=64$

$(x+15)^2=64x$

$x^2+30x+225=64x$

$x^2-34x+225=0$

b) $(x-25)(x-9)=0$

$x=25$ $x=9$

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7.

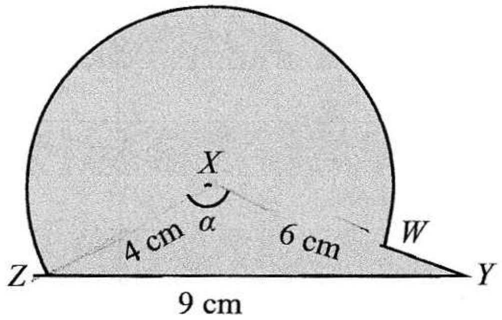

Figure 1

The triangle XYZ in Figure 1 has $XY = 6$ cm, $YZ = 9$ cm, $ZX = 4$ cm and angle $ZXY = \alpha$. The point W lies on the line XY.

The circular arc ZW, in Figure 1 is a major arc of the circle with centre X and radius 4 cm.

(a) Show that, to 3 significant figures, $\alpha = 2.22$ radians. **(2)**

(b) Find the area, in cm^2, of the major sector $XZWX$. **(3)**

The region enclosed by the major arc ZW of the circle and the lines WY and YZ is shown shaded in Figure 1.

Calculate

(c) the area of this shaded region, **(3)**

(d) the perimeter $ZWYZ$ of this shaded region. **(4)**

a) $\cos\alpha = \dfrac{b^2 + c^2 - a^2}{2bc}$

$= \dfrac{(4)^2 + (6)^2 - (9)^2}{2(4)(6)}$

$= \dfrac{-29}{48}$

$\alpha = 2.219516005^c$

$= 2.22^c$ (3sf)

b/ Area of sector $= \dfrac{\theta}{2} r^2$

$= \dfrac{2\pi - 2.22}{2}(4)^2$

$= 32.5054824 6\ cm^2$

Leave blank

Question 7 continued

c/ Area of triangle = $\frac{1}{2} ab \sin C$

$= \frac{1}{2}(4)(6) \sin(2.22)$

$= 9.558785667 \text{ cm}^2$

Total Area = sector + triangle

$= 42.0642812 \text{ cm}^2$

$= 42.1 \text{ cm}^2$ (3sf)

d/ Arc length $= \theta r$

$= (2\pi - 2.22) 4$

$= 16.25274123$ cm

perimeter = arc length + 9 + 2

$= 27.25274123$

$= 27.3$ cm (3sf)

8. The curve C has equation $y = 6 - 3x - \dfrac{4}{x^3}$, $x \neq 0$

(a) Use calculus to show that the curve has a turning point P when $x = \sqrt{2}$

(4)

(b) Find the x-coordinate of the other turning point Q on the curve.

(1)

(c) Find $\dfrac{d^2y}{dx^2}$.

(1)

(d) Hence or otherwise, state with justification, the nature of each of these turning points P and Q.

(3)

a/ $y = 6 - 3x - 4x^{-3}$

$\dfrac{dy}{dx} = -3 + 12x^{-4}$

Turning points where $\dfrac{dy}{dx} = 0$

$-3 + \dfrac{12}{x^4} = 0$

$\dfrac{12}{x^4} = 3$

$12 = 3x^4$

$4 = x^4$

$x = \pm\sqrt{2}$

b/ $-\sqrt{2}$

c/ $\dfrac{d^2y}{dx^2} = -48x^{-5}$

when $x = \sqrt{2}$ $\dfrac{d^2y}{dx^2} = -8.48528\ldots$

negative $\therefore$ maximum

when $x = -\sqrt{2}$ $\dfrac{d^2y}{dx^2} = 8.48528\ldots$

positive $\therefore$ minimum.

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9.

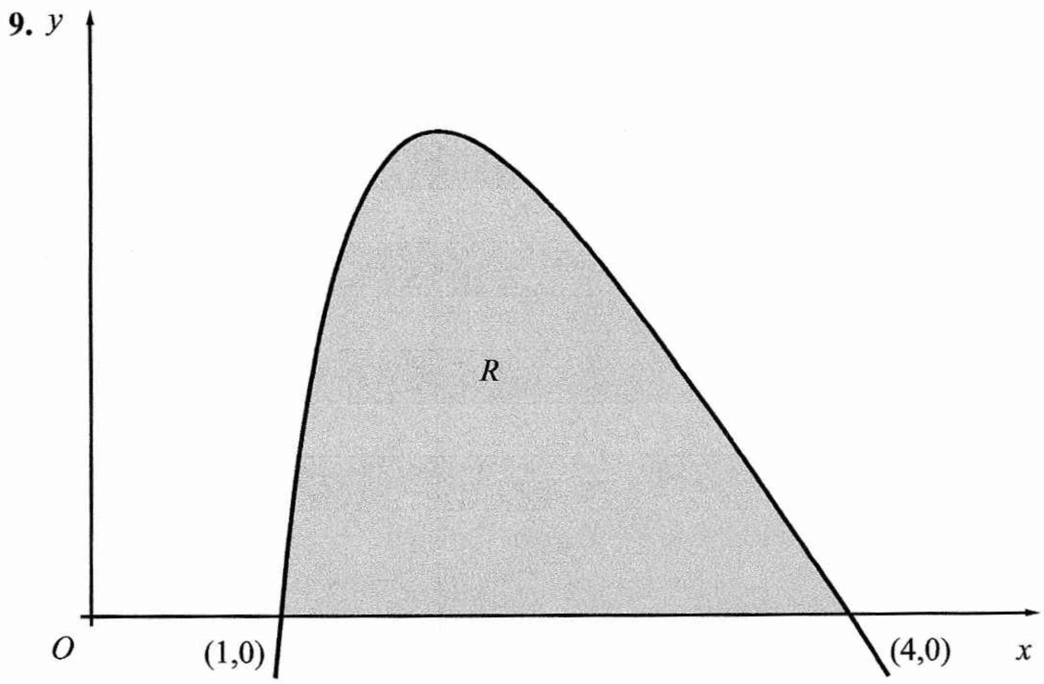

Figure 2

The finite region R, as shown in Figure 2, is bounded by the x-axis and the curve with equation

$$y = 27 - 2x - 9\sqrt{x} - \frac{16}{x^2}, \qquad x > 0$$

The curve crosses the x-axis at the points (1, 0) and (4, 0).

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

x	1	1.5	2	2.5	3	3.5	4
y	0	5.866	6.272	5.210	3.634	1.856	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.

(6)

b/ $0.5(5.866 + 6.272 + 5.210 + 3.634 + 1.856)$

$= 11.419$ units^2

Leave blank

Question 9 continued

$$\int_1^4 27 - 2x - 9x^{1/2} - 16x^{-2} \, dx$$

$$\left[27x - \frac{2x^2}{2} - \frac{9x^{3/2}}{3/2} - \frac{16x^{-1}}{-1} + c \right]_1^4$$

$$\left[27x - x^2 - 6x^{3/2} + 16x^{-1} \right]_1^4$$

$$\left[27(4) - (4)^2 - 6(4)^{3/2} + \frac{16}{4} \right] - \left[27(1) - (1)^2 - 6(1)^{3/2} + \frac{16}{1} \right]$$

$$[48] - [36]$$

$$\underline{\underline{12 \text{ units}^2}}$$

P 4 1 4 8 7 A 0 2 9 3 2

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