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 11 January 2010 – 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 or Green)	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 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. Find the first 3 terms, in ascending powers of x, of the binomial expansion of

$$(3-x)^6$$

and simplify each term.

(4)

1 6 15

$(3)^6 + 6(3)^5(-x) + 15(3)^4(-x)^2$

$729 - 1458x + 1215x^2$

Q1

(Total 4 marks)

Leave blank

2. (a) Show that the equation

$$5\sin x = 1 + 2\cos^2 x$$

can be written in the form

$$2\sin^2 x + 5\sin x - 3 = 0$$

(2)

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

$$2\sin^2 x + 5\sin x - 3 = 0$$

(4)

a) $\cos^2 x + \sin^2 x = 1$

$\cos^2 x = 1 - \sin^2 x$

$5\sin x = 1 + 2(1 - \sin^2 x)$

$5\sin x = 1 + 2 - 2\sin^2 x$

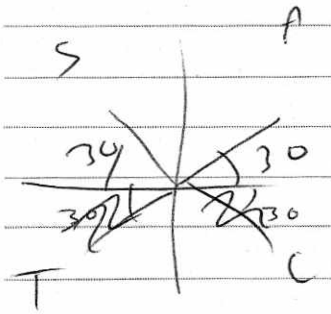
$2\sin^2 x + 5\sin x = 3$

$2\sin^2 x + 5\sin x - 3 = 0$

b) $(2\sin x - 1)(\sin x + 3) = 0$

$\sin x = \cancel{2}\,1/2$ $\qquad$ $\sin x = 3$

$x = 30,$ $\qquad$ NO SOLUTION



~~$x = 210°, 330°$~~

$x = 30°, 150°$

Q2

(Total 6 marks)

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3. $$f(x) = 2x^3 + ax^2 + bx - 6$$

where a and b are constants.

When f(x) is divided by $(2x - 1)$ the remainder is -5.

When f(x) is divided by $(x + 2)$ there is no remainder.

(a) Find the value of a and the value of b.

(6)

(b) Factorise f(x) completely.

(3)

a/ $f(\tfrac{1}{2}) = -5$

$f(-2) = 0$

$2(\tfrac{1}{2})^3 + a(\tfrac{1}{2})^2 + \tfrac{1}{2}b - 6 = -5$

$\tfrac{1}{4} + \tfrac{1}{4}a + \tfrac{1}{2}b = 1$

$\tfrac{1}{4}a + \tfrac{1}{2}b = 3/4$

$a + 2b = 3$

$2(-2)^3 + a(-2)^2 + (-2)b - 6 = 0$

$-16 + 4a - 2b - 6 = 0$

$4a - 2b = 22$

$a + 2b = 3$

$4a - 2b = 22$

$5a = 25$

$\underline{a = 5}$

$(5) + 2b = 3$

$2b = -2$

$\underline{b = -1}$

b/ $f(x) = 2x^3 + 5x^2 - x - 6$

Leave blank

Question 3 continued

$$\begin{array}{r|l} & 2x^2 + x - 3 \\ \hline x+2 & 2x^3 + 5x^2 - x - 6 \\ & 2x^3 + 4x^2 \\ & \quad\quad x^2 - x \\ & \quad\quad x^2 + 2x \\ & \quad\quad\quad -3x - 6 \\ & \quad\quad\quad -3x - 6 \\ \hline & \quad\quad\quad\quad 0 \end{array}$$

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

$(x+2)(2x+3)(x-1)$

Q3

(Total 9 marks)

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4.

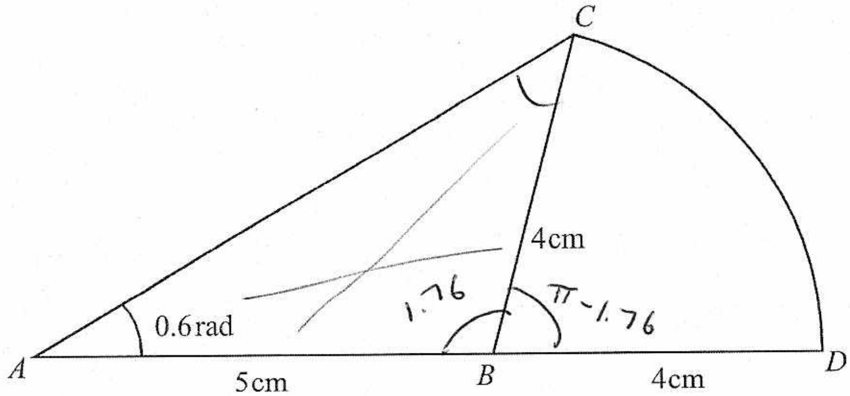

Figure 1

An emblem, as shown in Figure 1, consists of a triangle ABC joined to a sector CBD of a circle with radius 4 cm and centre B. The points A, B and D lie on a straight line with $AB = 5$ cm and $BD = 4$ cm. Angle $BAC = 0.6$ radians and AC is the longest side of the triangle ABC.

(a) Show that angle $ABC = 1.76$ radians, correct to 3 significant figures. **(4)**

(b) Find the area of the emblem. **(3)**

a) Angle $A\hat{C}B$:

$$\frac{\sin(x)}{5} = \frac{\sin(0.6)}{4}$$

$$\sin(x) = \frac{5\sin(0.6)}{4}$$

$$\sin(x) = 0.7058\ldots$$

$$x = 0.7835561635$$

$$ABC = \pi - 0.6 - 0.7835561635$$

$$= 1.75803649$$

$$= 1.76^c \ (3sf)$$

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

$$= \frac{1}{2}(4)(5)\sin(1.76)$$

$$= 9.825217144 \text{ cm}^2$$

Question 4 continued

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

$= \left(\frac{\pi - 1.76...}{2}\right) \times 4^2$

$= 11.06844931 \text{ cm}^2$

Total Area $= 20.9 \text{ cm}^2$ (3sf)

Q4

(Total 7 marks)

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5. (a) Find the positive value of x such that

$$\log_x 64 = 2$$

(2)

(b) Solve for x

$$\log_2(11 - 6x) = 2\log_2(x - 1) + 3$$

(6)

a) $\log_x 64 = 2$

$x^2 = 64$

$x = 8$ (positive value)

b/ $\log_2(11-6x) = 2\log_2(x-1) + 3$

$\log_2(11-6x) = \log_2(x-1)^2 + 3$

$\log_2(11-6x) - \log_2(x-1)^2 = 3$

$\log_2\left(\frac{11-6x}{(x-1)^2}\right) = 3$

$\frac{11-6x}{(x-1)^2} = 2^3$

$11-6x = 8(x-1)^2$

$11-6x = 8(x^2-2x+1)$

$11-6x = 8x^2-16x+8$

$0 = 8x^2-10x-3$

$0 = (4x+1)(2x-3)$

$x = -1/4 \quad x = 3/2$

Leave blank

6. A car was purchased for £18 000 on 1st January.
On 1st January each following year, the value of the car is 80% of its value on 1st January in the previous year.

(a) Show that the value of the car exactly 3 years after it was purchased is £9216.
(1)

The value of the car falls below £1000 for the first time n years after it was purchased.

(b) Find the value of n.
(3)

An insurance company has a scheme to cover the maintenance of the car.
The cost is £200 for the first year, and for every following year the cost increases by 12% so that for the 3rd year the cost of the scheme is £250.88

(c) Find the cost of the scheme for the 5th year, giving your answer to the nearest penny.
(2)

(d) Find the total cost of the insurance scheme for the first 15 years.
(3)

a) $a = 18000 \qquad r = 0.8$

$U_4 = ar^3$

$= 18000(0.8)^3$

$= £9216$

b) $1000 > 18000(0.8)^n$

$\frac{1000}{18000} > 0.8^n$

$\log_{0.8} \frac{1}{18} > n$

$n = 12.95 \quad \therefore \quad n = 13$ years

c) $U_5 = ar^4$

$= 200(1.12)^4$

$= £314.70$

Leave blank

Question 6 continued

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

$= \frac{200(1-1.12^{15})}{1-1.12}$

$= £7455.94$

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7.

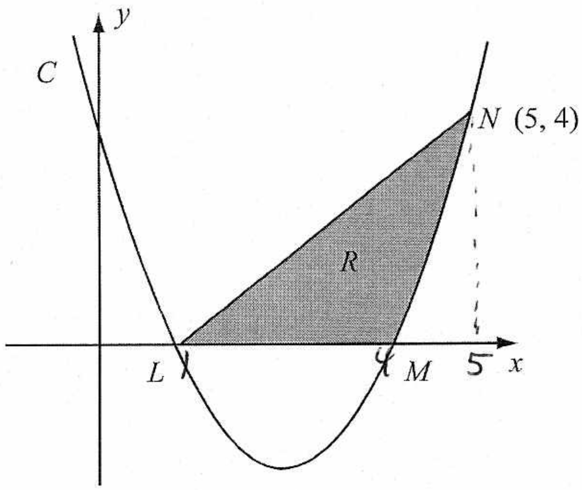

Figure 2

The curve C has equation $y = x^2 - 5x + 4$. It cuts the x-axis at the points L and M as shown in Figure 2.

(a) Find the coordinates of the point L and the point M.
(2)

(b) Show that the point N (5, 4) lies on C.
(1)

(c) Find $\int (x^2 - 5x + 4)\, dx$.
(2)

The finite region R is bounded by LN, LM and the curve C as shown in Figure 2.

(d) Use your answer to part (c) to find the exact value of the area of R.
(5)

a/ Crosses x when $y=0$

$x^2 - 5x + 4 = 0$

$(x-4)(x-1) = 0$

$x = 4 \quad x = 1$

~~L 4,0~~

$L: (1,0) \qquad M: (4,0)$

b/ $y = x^2 - 5x + 4$

$4 = (5)^2 - 5(5) + 4$

$4 = 25 - 25 + 4$

$4 = 4$ Shown

Leave blank

Question 7 continued

c/ $\int x^2 - 5x + 4 \, dx$

$\cancel{8}\ \frac{x^3}{3} - \frac{5x^2}{2} + 4x + c$

d/ Area of triangle = ½ base × height

= ½ × 4 × 4

= 8 units²

$\int_4^5 x^2 - 5x + 4 \, dx$

$\left[\frac{x^3}{3} - \frac{5x^2}{2} + 4x\right]_4^5$

$\cancel{\left[\frac{x^3}{3} - \frac{5x^2}{2} + 4x\right]_4^5}$

$\left[\frac{(5)^3}{3} - \frac{5(5)^2}{2} + 4(5)\right] - \left[\frac{(4)^3}{3} - \frac{5(4)^2}{2} + 4(4)\right]$

$\frac{11}{6}$ units²

$8 - \frac{11}{6} = \frac{37}{6}$ units²

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8.

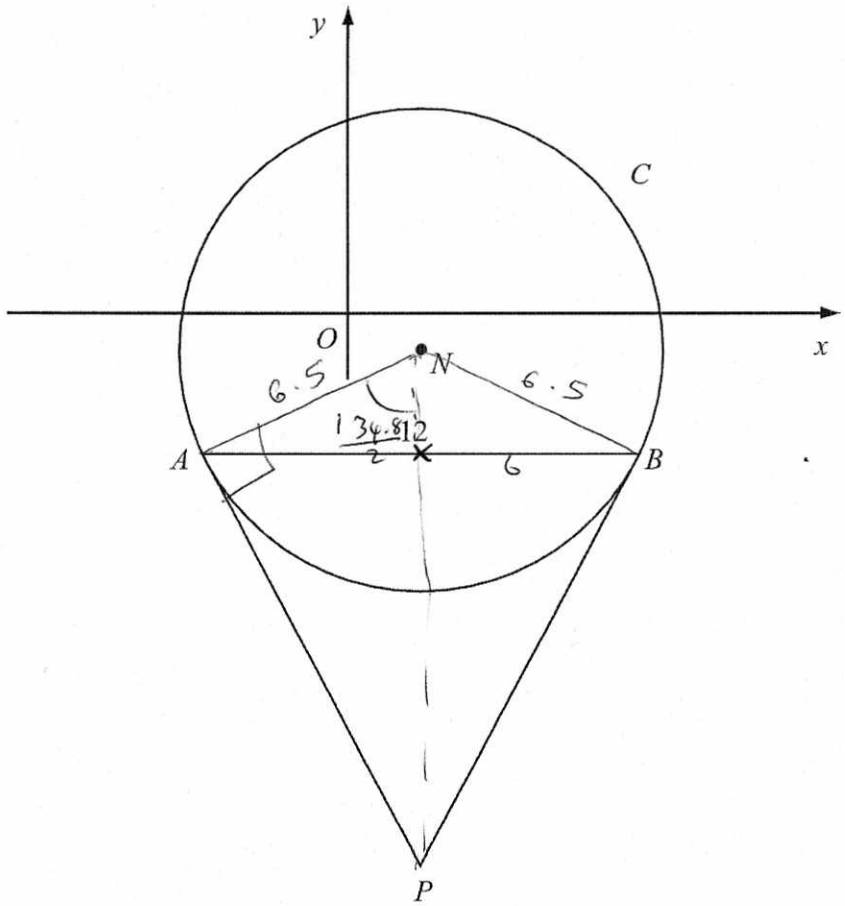


Figure 3

Figure 3 shows a sketch of the circle C with centre N and equation

$$(x-2)^2+(y+1)^2=\frac{169}{4}$$

(a) Write down the coordinates of N.
(2)

(b) Find the radius of C.
(1)

The chord AB of C is parallel to the x-axis, lies below the x-axis and is of length 12 units as shown in Figure 3.

(c) Find the coordinates of A and the coordinates of B.
(5)

(d) Show that angle $ANB = 134.8°$, to the nearest 0.1 of a degree.
(2)

The tangents to C at the points A and B meet at the point P.

(e) Find the length AP, giving your answer to 3 significant figures.
(2)

Leave blank

Question 8 continued

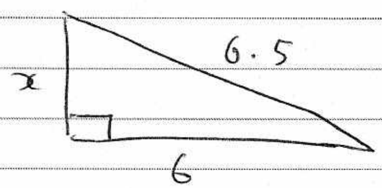
a) $(2, -1)$

b) $r^2 = \frac{169}{4}$

$r = \sqrt{\frac{169}{4}}$

$= \frac{13}{2} = \underline{\underline{6.5}}$

c)



$x^2 = 6.5^2 - 6^2$

$x^2 = \frac{25}{4}$

$x = 2.5$

Midpoint of AB $(2, -3.5)$

$\therefore$ A : $(-4, -3.5)$

B : $(8, -3.5)$

d) $\cos A = \frac{b^2 + c^2 - a^2 \; \cancel{a^2 + b^2 - c^2}}{2\cancel{ab}bc}$

$= \frac{(6.5)^2 + (6.5)^2 - (12)^2}{2(6.5)(6.5)}$

$= -\frac{119}{169}$

$A = 134.7602701$

$= \underline{\underline{134.8^\circ}}$ (1dp)

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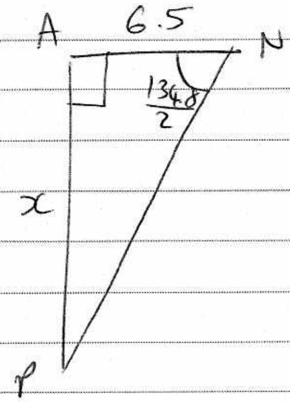
Question 8 continued



$$\tan\theta = \frac{o}{a}$$

$$\tan\left(\frac{134.8}{2}\right) = \frac{x}{6.5}$$

$$x = 6.5\tan\left(\frac{134.8}{2}\right)$$

$x = \underline{\underline{15.6}}$ units

Leave blank

9. The curve C has equation $y = 12\sqrt{(x)} - x^{\frac{3}{2}} - 10, \quad x > 0$

(a) Use calculus to find the coordinates of the turning point on C. **(7)**

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

(c) State the nature of the turning point. **(1)**

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

$y = 12x^{1/2} - x^{3/2} - 10$

$\frac{dy}{dx} = 6x^{-1/2} - \frac{3}{2}x^{1/2}$

$6x^{-1/2} - \frac{3}{2}x^{1/2} = 0 \qquad [\times x^{1/2}]$

$6 - \frac{3}{2}x = 0$

$6 = \frac{3}{2}x$

$x = 4$

$y = 12(4)^{1/2} - (4)^{3/2} - 10$

$= 6$

$(4, 6)$

b) $\frac{d^2y}{dx^2} = -3x^{-3/2} - \frac{3}{4}x^{-1/2}$

c) when $x = 4$

$\frac{d^2y}{dx^2} = -3(4)^{-3/2} - \frac{3}{4}(4)^{-1/2}$

$= -3/4$

$\frac{d^2y}{dx^2}$ is negative $\therefore$ the turning point is a MAXIMUM