Surname	
Other Names	
Candidate Signature	

Centre Number						Candidate Number				

Examiner Comments	Total Marks

MATHEMATICS

A LEVEL PAPER 2

CM

Bronze Set B (Edexcel Version)

Time allowed: 2 hours

Instructions to candidates:

- In the boxes above, write your centre number, candidate number, your surname, other names and signature.
- Answer ALL of the questions.
- You must write your answer for each question in the spaces provided.
- You may use a calculator.

Information to candidates:

- Full marks may only be obtained for answers to ALL of the questions.
- The marks for individual questions and parts of the questions are shown in round brackets.
- There are 13 questions in this question paper. The total mark for this paper is 100.

Advice to candidates:

- You should ensure your answers to parts of the question are clearly labelled.
- You should show sufficient working to make your workings clear to the Examiner.
- Answers without working may not gain full credit.

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1 Giving your answers in the form $a + b\sqrt{3}$, where a and b are rational numbers, find

(a) $(4 - \sqrt{3})^2$ **(2)**

(b) $\dfrac{3 - \sqrt{3}}{2 + \sqrt{3}}$ **(4)**

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Question 1 continued

TOTAL 6 MARKS

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2 Relative to a fixed origin O, A and B have position vectors $\mathbf{i} - 2\mathbf{j} + p\mathbf{k}$ and $5\mathbf{i} + \mathbf{j} - \mathbf{k}$ respectively, where p is a positive constant.

(a) Find, in terms of p, $\overrightarrow{AB}$. **(2)**

Given that $\left|\overrightarrow{AB}\right| = 5\sqrt{2}$,

(b) find the value of p. **(4)**

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Question 2 continued

TOTAL 6 MARKS

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3

$$f(x) = 2 - \frac{5}{x+5} + \frac{5}{(x+5)^2},\ x \neq -5$$

(a) Show that $f(x) = \dfrac{2x^2 + 15x + 30}{(x+5)^2},\ x \neq -5$. **(3)**

(b) Prove that $2x^2 + 15x + 30 > 0$ for all x. **(3)**

(c) Hence, show that $f(x) > 0$ for all $x, x \neq -5$. **(1)**

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Question 3 continued

TOTAL 7 MARKS

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4 (a) Sketch the graph with equation $y = |3x+1|$.

On your sketch, show clearly the coordinates of any points where the graph crosses or meets the coordinate axes. **(3)**

(b) Hence, or otherwise, solve the equation $|3x+1| = 3 - x$. **(3)**

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Question 4 continued

TOTAL 6 MARKS

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5 Using the substitution $y = 2^x$, or otherwise, solve the equation

$$2(2^{2x}) - 7(2^x) + 3 = 0$$

(4)

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Question 5 continued

TOTAL 4 MARKS

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6 Using logarithmic differentiation, or otherwise, show that if $y = (\sin x)^x$, then

$$\frac{dy}{dx} = (x \cot x + \ln \sin x)(\sin x)^x$$

(5)

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Question 6 continued

TOTAL 5 MARKS

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7 $A(4, 5)$ and $B(8, 2)$.

The line AB is a diameter of the circle C.

(a) (i) Show that the circle C has centre $\left(6, \frac{7}{2}\right)$ and radius $\frac{5}{2}$. **(3)**

(ii) Hence, express the equation of the circle C in the form

$$(x - a)^2 + (y - b)^2 = k$$

where a, b and k are constants to be found. **(2)**

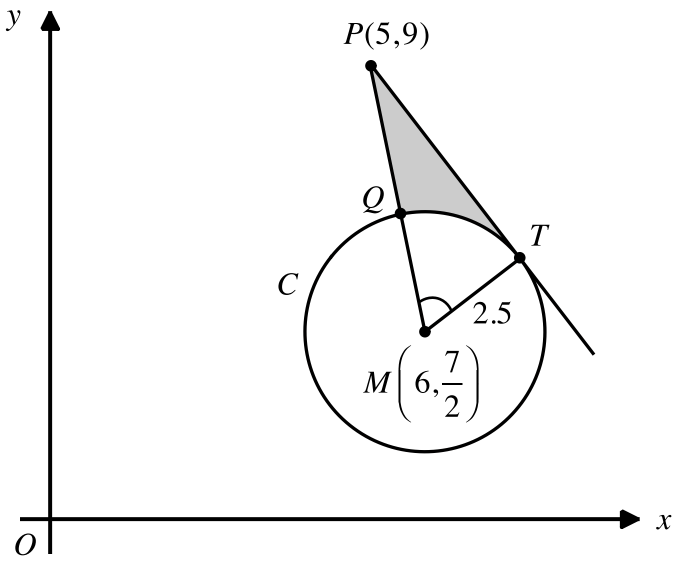

Figure 1

Figure 1 above shows a sketch of the circle C. The point T lies on the circle C and the tangent to C at T passes through the point $P(5, 9)$. The line MP cuts the circle C at the point Q, where M is the centre of C.

(b) Show that the angle TMQ is 1.1071 to 4 decimal places. **(3)**

The shaded region TPQ is bounded by the straight lines TP, QP and the arc TQ, as shown in Figure 1.

(c) Find the area of the shaded region. **(5)**

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Question 7 continued

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Question 7 continued

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Question 7 continued

TOTAL 13 MARKS

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8

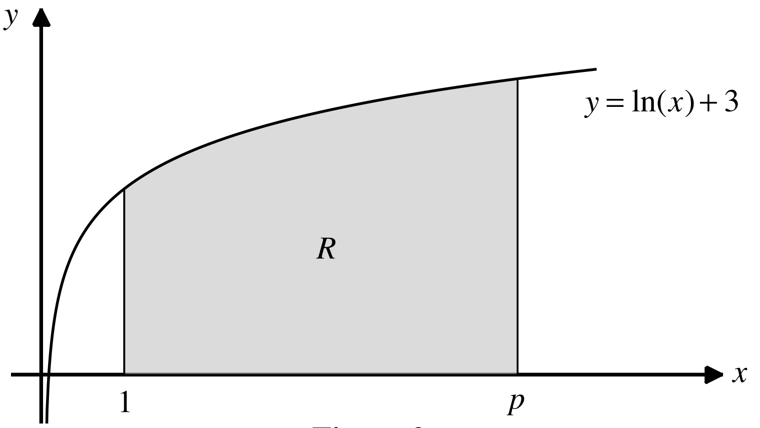

Figure 2

Figure 2 above shows a sketch of the curve with equation $y = \ln(x) + 3, x > 0$. The region R, shown shaded in Figure 2, is bounded by the curve, the x-axis and the lines $x = 1$ and $x = p$, where p is a constant.

Given that the area of the shaded region R is 12 units^2,

(a) show that

$$2p + p\ln(p) - 14 = 0$$

(5)

The equation $2p + p\ln(p) - 14 = 0$ has one root α.

A student uses the iteration formula

$$p_{n+1} = \frac{14}{2 + \ln(p_n)}, \quad n \in \mathbb{N}$$

in an attempt to find an approximation for α.

(b) Starting with $p_0 = 4$, use the student's iteration formula a suitable number times to find the value of α to two decimal places. Give the result of each iteration to four decimal places. **(3)**

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Question 8 continued

Do not write outside the box

Question 8 continued

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Question 8 continued

TOTAL 8 MARKS

Do not write outside the box

9 (a) Show that the equation

$$3\cot x + 1 = 2\operatorname{cosec} x$$

can be written in the form

$$a\cos x + b\sin x = c$$

where a, b and c are constants to be found. **(2)**

(b) Hence, or otherwise, solve, for $0 < x < 360°$, the equation

$$3\cot x + 1 = 2\operatorname{cosec} x$$

(6)

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Question 9 continued

TOTAL 8 MARKS

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10 The number of individuals, N individuals, in a finite population at time t weeks after a disease outbreak is modelled by

$$N = 120\,e^{-0.9t} + e^{2t}, \quad t \geq 0$$

(a) Find the number of individuals in the population before the outbreak. **(1)**

(b) Use the model to determine the range of values of t for which the size of the population is decreasing. **(5)**

(c) Calculate the long-term behaviour of the population according to the model. **(1)**

(d) Determine whether, according to the model, the population survives the disease outbreak. Explain your reasoning. **(1)**

(e) Give a limitation of the model. **(1)**

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Question 10 continued

TOTAL 9 MARKS

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11 Two curves C_1 and C_2 are defined parametrically such that

$$C_1: \quad x = s^2, \; y = 2s$$

$$C_2: \quad x = 7t + 1, \; y = -3t^2$$

The point P with parameter p lies on C_1.

(a) Show that the normal to C_1 at P can be given by

$$y + px = p^3 + 2p$$

(5)

The point Q with parameter 2 lies on C_2.

The normal to C_1 at P passes through the point Q.

(b) (i) Show that $p^3 - 13p + 12 = 0$.

(ii) Show that p could equal 3 **and** hence find all the possible coordinates of P.

(6)

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Question 11 continued

Do not write outside the box

Question 11 continued

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Question 11 continued

TOTAL 11 MARKS

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

(a) Prove that the sum of the first n terms of the series can be given by

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

(3)

(b) Find $\sum_{k=1}^{8} 10(2^k)$. **(2)**

(c) (i) State the condition for an infinite geometric series to converge. **(1)**

(ii) Hence, show that the series $\frac{4}{3} + \frac{8}{9} + \frac{16}{27} + \ldots$ converges and find its value. **(3)**

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Question 12 continued

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Question 12 continued

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Question 12 continued

TOTAL 9 MARKS

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13

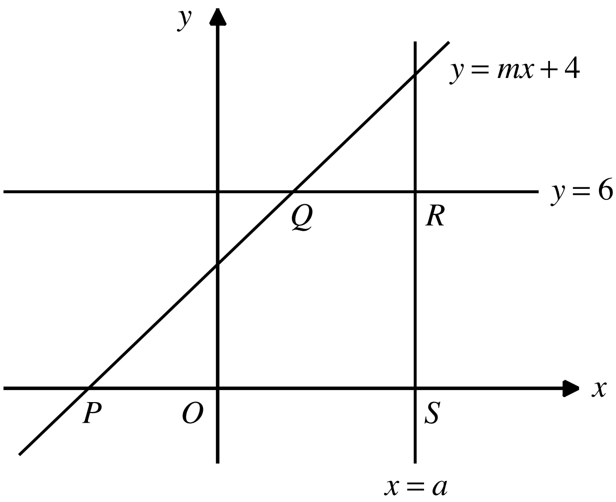

Figure 3

The straight line l has the equation $y = mx + 4$, where m is a constant.

The line l is perpendicular to the line with equation $4y + 2x - 10 = 0$.

(a) Find the value of m. **(2)**

The line l intersects the x-axis at the point P.

(b) Find the coordinates of the point P. **(1)**

The line $y = 6$ intersects l at the point Q and the line $x = a$ at the point R.

(c) Find the coordinates of the point Q. **(1)**

The point S is where the line $x = a$ crosses the x-axis.

Given that the area of the quadrilateral $PQRS$ is $7a$ units^2,

(d) find the value of the constant a. **(4)**

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Question 13 continued

END OF PAPER

TOTAL 8 MARKS

TOTAL FOR PAPER IS 100 MARKS

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