Surname	
Other Names	
Candidate Signature	

Centre Number						Candidate Number				

Examiner Comments	Total Marks

MATHEMATICS

A LEVEL PAPER 1

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.

A2/M/P1

1 0 3 3 1 3 1 2 8 0 0 0 4

1

$$y = x^2 + \frac{1}{x} - e^{3x} + 3, \quad x \neq 0$$

Find $\frac{dy}{dx}$, giving each term in its simplest form. **(4)**

Do not write outside the box

Question 1 continued

TOTAL 4 MARKS

2 The sequence $x_1, x_2, x_3, ...$ is defined such that

$$x_{n+1} = px_n + 2, \quad x_1 = 3, \quad n \geq 1$$

where p is a constant.

Given that $x_2 = 14$,

(a) find the value of p. **(2)**

(b) Find $\sum_{n=1}^{4} x_n$. **(4)**

Do not write outside the box

Question 2 continued

TOTAL 6 MARKS

3 Given that the acute angle θ is such that

$$\sin\theta = p, \text{ where } p \text{ is a constant}, -1 < p < 1$$

use standard trigonometric identities to find, in terms of p,

(a) $\cos\theta$ **(2)**

(b) $\operatorname{cosec} 2\theta$ **(2)**

(c) $\sin(\theta - 45)$ **(2)**

Give each answer in its simplest form.

Question 3 continued

TOTAL 6 MARKS

4 The line l_1 has the equation $2x + 3y = -2$.

The line l_2 passes through the points $(-2, -1)$ and $(0, 2)$.

Determine whether the lines l_1 and l_2 are parallel, perpendicular or neither.
Show your working clearly. **(4)**

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Question 4 continued

TOTAL 4 MARKS

5 The functions f and g are defined such that

$$\mathrm{f}: x \mapsto 2\mathrm{e}^{x} + 3, \quad x \in \mathbb{R}$$

$$\mathrm{g}: x \mapsto \ln(4x), \quad x > 0$$

(a) Write down the range of f. **(1)**

(b) Solve the equation $\mathrm{fg}(x) = 5$. **(3)**

(c) Find a simplified expression for $\mathrm{f}^{-1}(x)$ and state its domain. **(3)**

Question 5 continued

TOTAL 7 MARKS

6

$$f(x) = \sqrt{x} - 2x^2 + 3, \quad x > 0$$

(a) Show that $f(x) = 0$ has a root α in the interval $[1, 2]$. **(2)**

A student takes 1.5 as the first approximation to α.

(b) Apply the Newton-Raphson procedure once to obtain a second approximation for α.
Give your answer to three significant figures. **(5)**

(c) Show that α is the only root of $f(x) = 0$. **(2)**

Question 6 continued

TOTAL 9 MARKS

7

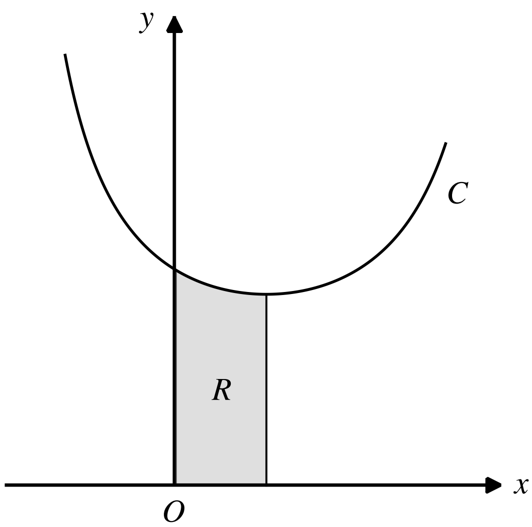

Figure 1

Figure 1 above shows a sketch of the curve C with the equation $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = \frac{2}{(2-x)(x+1)}, \quad 0 < x < \frac{3}{2}$$

(a) Express f(x) in the form $\dfrac{A}{2-x} + \dfrac{B}{x+1}$, where A and B are constants to be found. **(3)**

(b) Find the coordinates of the minimum point on the curve C. **(5)**

The finite region R, shown shaded in Figure 1, is bounded by the curve C, the y-axis, the x-axis and the vertical line passing through the minimum point on C.

(c) Find the exact area of the shaded region R, giving your answer in the form $a\ln(2)$, where a is a constant to be determined. **(4)**

Question 7 continued

Question 7 continued

Question 7 continued

TOTAL 12 MARKS

8 Given that θ is measured in radians, prove, from first principles, that the derivative of $\sin\theta$ is $\cos\theta$.

You may assume the formula for $\sin(A \pm B)$ and that as $h \to 0$, $\frac{\sin h}{h} \to 1$ and $\frac{\cos h - 1}{h} \to 0$.

(5)

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Question 8 continued

TOTAL 5 MARKS

9 (a) "If p and q are prime numbers with $p > 2$ and $q > 2$, then $p^2 + q^2$ is always even."

Determine if the statement is true or false.

If it is true, provide a proof or if it is false, provide a counter-example. **(3)**

(b) Prove that there are an infinite number of primes. **(3)**

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Question 9 continued

TOTAL 6 MARKS

10 The curve C has the equation $y = -2x^2 + 6x + 8$.

(a) (i) Express the equation of the curve C in the form $y = a(x + b)^2 + c$, where a, b and c are constants to be found. **(3)**

(ii) Hence, or otherwise, write down the coordinates of the turning point on C **and** state whether the turning point is a maximum or a minimum point. **(2)**

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

The line l has the equation $y = k(x + 2)$, where k is a constant.

(c) Show that x coordinates of the points of intersection between C and l satisfy

$$2x^2 + (k - 6)x + (2k - 8) = 0$$

(2)

(d) Find the values of k for which l is tangent to C. **(4)**

Question 10 continued

Question 10 continued

Question 10 continued

TOTAL 14 MARKS

11 (i) An arithmetic sequence has first term a and common difference d.

The second term in the sequence is 6.
The seventh term in the sequence is –7.

Find the values of a and d.
Show your working clearly. **(5)**

(ii) Alice decides to donate a small proportion of her weekly savings to charity. She saves £150 each week. In the first week, Alice donates £1.05 to charity. In the second week, Alice donates £1.15 to charity. In the third week, Alice donates £1.25 to charity, and so on, such that her donations each week follow an arithmetic progression.

In the nth week, Alice donates 2.5% of her savings to charity.

Calculate the total amount of money Alice has donated to charity over the n weeks. **(6)**

Question 11 continued

Do not write outside the box

Question 11 continued

Question 11 continued

TOTAL 11 MARKS

Do not write outside the box

12 Show clearly that

$$\int_{-1}^{1} 5x\sqrt{2-x}\ dx = \frac{1}{3}\left(6\sqrt{3}-14\right)$$

(7)

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Question 12 continued

TOTAL 7 MARKS

13

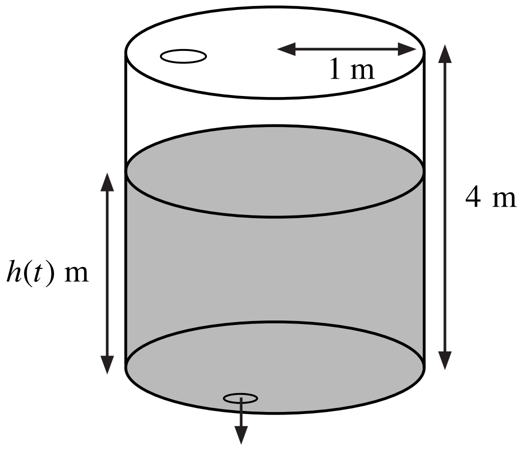

Figure 2

Figure 2 above shows a cylindrical tank of radius 1 m which contains some liquid. The tank is vented at the top and contains an outlet at the bottom through which the liquid can drain. At time $t = 0$, the outlet is opened and liquid begins to drain.

The depth of the liquid in the tank h m at time t s is modelled by the equation

$$A\frac{dh}{dt} = -0.016\pi\sqrt{h}$$

where A is the area of the liquid's **surface**.

(a) Explain why $A = \pi$. **(1)**

Initially, the tank is filled completely with liquid to a depth of 4 m.

(b) Solve the differential equation to show that $h = (2 - 0.008t)^2$. **(4)**

(c) Hence, find the time taken, in minutes, for the tank to empty. **(3)**

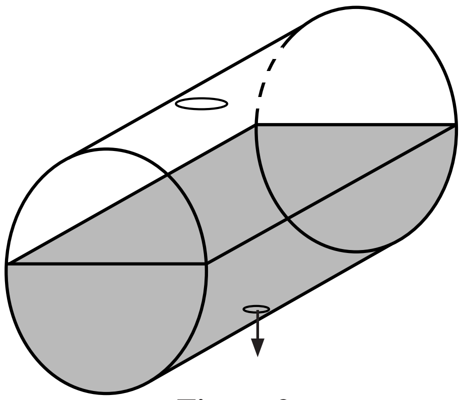

Figure 3

Figure 3 above shows another cylindrical tank, which is vented at the top and contains an outlet at the bottom through which liquid can drain. A model similar to the one used for the first cylinder is used to model the depth of liquid in this tank at time t.

(d) Explain why the value of A in the model for this tank will no longer be constant. **(1)**

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Question 13 continued

Do not write outside the box

Question 13 continued

Question 13 continued

END OF PAPER

TOTAL 9 MARKS

TOTAL FOR PAPER IS 100 MARKS