Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5143809836

ADDITIONAL MATHEMATICS **4037/23**

Paper 2 **October/November 2015**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **16** printed pages.

DC (SLM) 115940/1

CAMBRIDGE International Examinations

[Turn over

Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\Delta = \frac{1}{2} bc \sin A$$

1 Find the equation of the tangent to the curve $y = x^3 + 3x^2 - 5x - 7$ at the point where $x = 2$. [5]

2 Find the values of k for which the line $y = 2x + k + 2$ cuts the curve $y = 2x^2 + (k + 2)x + 8$ in two distinct points. [6]

3 **(a)** Given that $y = \dfrac{x^3}{2 - x^2}$, find $\dfrac{dy}{dx}$. [3]

(b) Given that $y = x\sqrt{4x + 6}$, show that $\dfrac{dy}{dx} = \dfrac{k(x + 1)}{\sqrt{4x + 6}}$ and state the value of k. [3]

4 Solve the following simultaneous equations, giving your answers for both x and y in the form $a + b\sqrt{3}$, where a and b are integers.

$$2x + y = 9$$

$$\sqrt{3}x + 2y = 5$$

[5]

5 The roots of the equation $x^3 + ax^2 + bx + c = 0$ are 1, 3 and 3. Show that $c = -9$ and find the value of a and of b. [4]

6 Solve the following equation.

$$\log_2(29x - 15) = 3 + \frac{2}{\log_x 2}$$ [5]

7 The velocity, v ms^{-1}, of a particle travelling in a straight line, t seconds after passing through a fixed point O, is given by $v = \dfrac{10}{(2+t)^2}$.

(i) Find the acceleration of the particle when $t = 3$. [3]

(ii) Explain why the particle never comes to rest. [1]

(iii) Find an expression for the displacement of the particle from O after time t s. [3]

(iv) Find the distance travelled by the particle between $t = 3$ and $t = 8$. [2]

8 **(i)** Prove that $\sec^2 x + \operatorname{cosec}^2 x = \sec^2 x \operatorname{cosec}^2 x$. [4]

(ii) Hence, or otherwise, solve $\sec^2 x + \operatorname{cosec}^2 x = 4\tan^2 x$ for $90° < x < 270°$. [4]

9 Given that $f(x) = 3x^2 + 12x + 2$,

(i) find values of a, b and c such that $f(x) = a(x + b)^2 + c$, [3]

(ii) state the minimum value of $f(x)$ and the value of x at which it occurs, [2]

(iii) solve $f\left(\frac{1}{y}\right) = 0$, giving each answer for y correct to 2 decimal places. [3]

10 **(i)** Given that $\frac{\mathrm{d}}{\mathrm{d}x}\left(\mathrm{e}^{2-x^2}\right) = kx\mathrm{e}^{2-x^2}$, state the value of k. [1]

(ii) Using your result from part **(i)**, find $\int 3x\mathrm{e}^{2-x^2}\,\mathrm{d}x$. [2]

(iii) Hence find the area enclosed by the curve $y = 3x\mathrm{e}^{2-x^2}$, the x-axis and the lines $x = 1$ and $x = \sqrt{2}$. [2]

(iv) Find the coordinates of the stationary points on the curve $y = 3x\mathrm{e}^{2-x^2}$. [4]

11 The trees in a certain forest are dying because of an unknown virus.

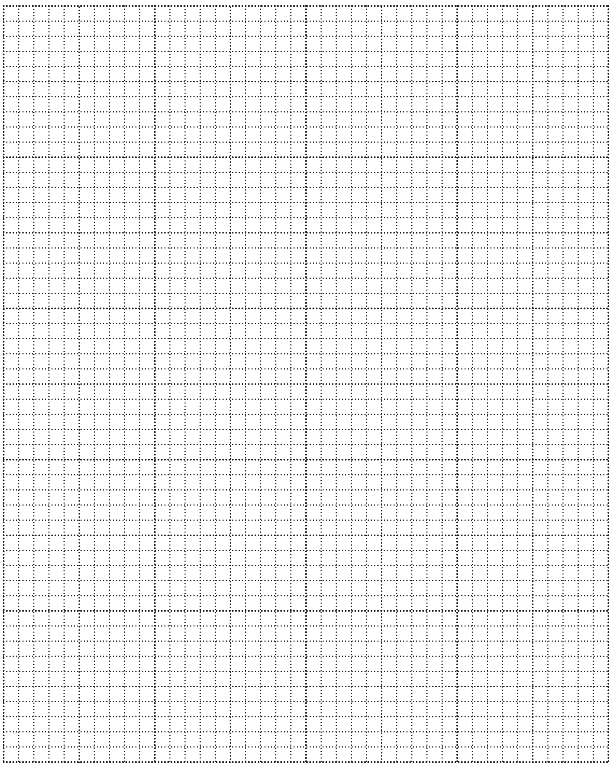
The number of trees, N, surviving t years after the onset of the virus is shown in the table below.

t	1	2	3	4	5	6
N	2000	1300	890	590	395	260

The relationship between N and t is thought to be of the form $N = Ab^{-t}$.

(i) Transform this relationship into straight line form. [1]

(ii) Using the given data, draw this straight line on the grid below. [3]



(iii) Use your graph to estimate the value of A and of b. [3]

If the trees continue to die in the same way, find

(iv) the number of trees surviving after 10 years, [1]

(v) the number of years taken until there are only 10 trees surviving. [2]

Question 12 is printed on the next page.

12 A plane that can travel at $250\,\text{kmh}^{-1}$ in still air sets off on a bearing of 070°. A wind with speed $w\,\text{kmh}^{-1}$ from the south blows the plane off course so that the plane actually travels on a bearing of 060°.

Find, in kmh^{-1}, the resultant speed V of the plane and the windspeed w. [5]