



## Cambridge O Level

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
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**ADDITIONAL MATHEMATICS**

**4037/23**

Paper 2

**October/November 2020**

**2 hours**

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

### INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Blank pages are indicated.

**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*

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

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

*Arithmetic series*      $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

*Geometric series*      $u_n = ar^{n-1}$

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

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

**2. TRIGONOMETRY***Identities*

$$\begin{aligned} \sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A \end{aligned}$$

*Formulae for  $\triangle ABC$* 

$$\begin{aligned} \frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A \end{aligned}$$

1 Solve  $|3x-2|=4+x$ .

[3]

2 Solve the simultaneous equations.

$$x^2 + 3xy = 4$$

$$2x + 5y = 4$$

[5]

3 Find the values of  $k$  for which the equation  $x^2 + (k+9)x + 9 = 0$  has two distinct real roots. [4]

4 It is given that  $y = \ln(1 + \sin x)$  for  $0 < x < \pi$ .

(a) Find  $\frac{dy}{dx}$ . [2]

(b) Find the value of  $\frac{dy}{dx}$  when  $x = \frac{\pi}{6}$ , giving your answer in the form  $\frac{1}{\sqrt{a}}$ , where  $a$  is an integer. [2]

(c) Find the values of  $x$  for which  $\frac{dy}{dx} = \tan x$ . [5]

5 Solve the following simultaneous equations.

$$3^x \times 9^{y-1} = 243$$

$$8 \times 2^{y-\frac{1}{2}} = \frac{2^{2x+1}}{4\sqrt{2}}$$

[5]

6 A 4-digit code is to be formed using 4 different numbers selected from 1, 2, 3, 4, 5, 6, 7, 8 and 9. Find how many different codes can be formed if

(a) there are no restrictions, [1]

(b) only prime numbers are used, [1]

(c) two even numbers are followed by two odd numbers, [2]

(d) the code forms an even number. [2]

7 A curve has equation  $y = x \cos x$ .

(a) Find  $\frac{dy}{dx}$ .

[2]

(b) Find the equation of the normal to the curve at the point where  $x = \pi$ , giving your answer in the form  $y = mx + c$ . [4]

- (c) Using your answer to **part (a)**, find the exact value of  $\int_0^{\frac{\pi}{6}} x \sin x \, dx$ . [5]

**8 DO NOT USE A CALCULATOR IN THIS QUESTION.**

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

$$\log_2(x+2) = 2 + \log_2 y$$

(a) Show that  $x^3 + 6x^2 - 32 = 0$ .

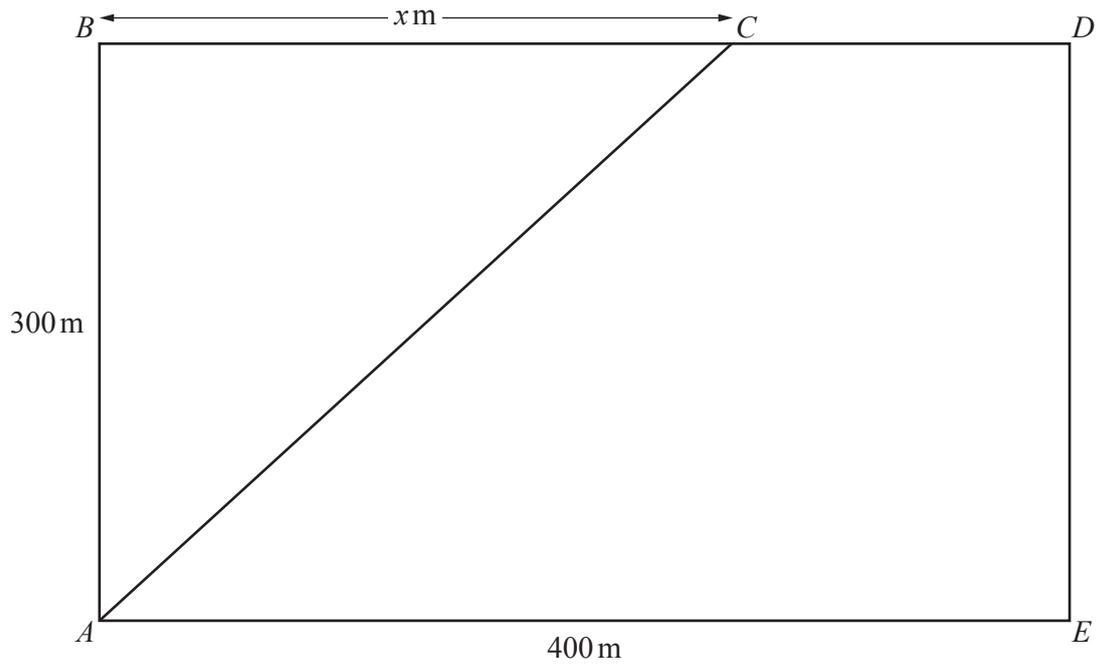
[4]

(b) Find the roots of  $x^3 + 6x^2 - 32 = 0$ .

[4]

(c) Give a reason why only one root is a valid solution of the logarithmic equations. Find the value of  $y$  corresponding to this root. [2]

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The rectangle  $ABCDE$  represents a ploughed field where  $AB = 300$  m and  $AE = 400$  m. Joseph needs to walk from  $A$  to  $D$  in the least possible time. He can walk at  $0.9 \text{ ms}^{-1}$  on the ploughed field and at  $1.5 \text{ ms}^{-1}$  on any part of the path  $BCD$  along the edge of the field. He walks from  $A$  to  $C$  and then from  $C$  to  $D$ . The distance  $BC = x$  m.

(a) Find, in terms of  $x$ , the total time,  $T$ s, Joseph takes for the journey.

[3]

- (b) Given that  $x$  can vary, find the value of  $x$  for which  $T$  is a minimum and hence find the minimum value of  $T$ . [6]

- 10 (a) The sum of the first 4 terms of an arithmetic progression is 38 and the sum of the next 4 terms is 86. Find the first term and the common difference. [5]

- (b) The third term of a geometric progression is 12 and the sixth term is  $-96$ . Find the sum of the first 10 terms of this progression. [6]

**Question 11 is printed on the next page.**

**11 DO NOT USE A CALCULATOR IN THIS QUESTION.**

Solve the quadratic equation  $(\sqrt{7}-2)x^2 - 4x + (\sqrt{7}+2) = 0$ , giving each of your answers in the form  $a + b\sqrt{7}$ , where  $a$  and  $b$  are constants. [7]

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