Cambridge Assessment International Education

# Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*5865736663*

**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.

DC (MB) 207030

***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 $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

*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*

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\text{cosec}^2 A = 1 + \cot^2 A$$

*Formulae for $\Delta ABC$*

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

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

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

**1** 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 $\dfrac{dy}{dx}$. [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]

  **[Turn over**

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

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

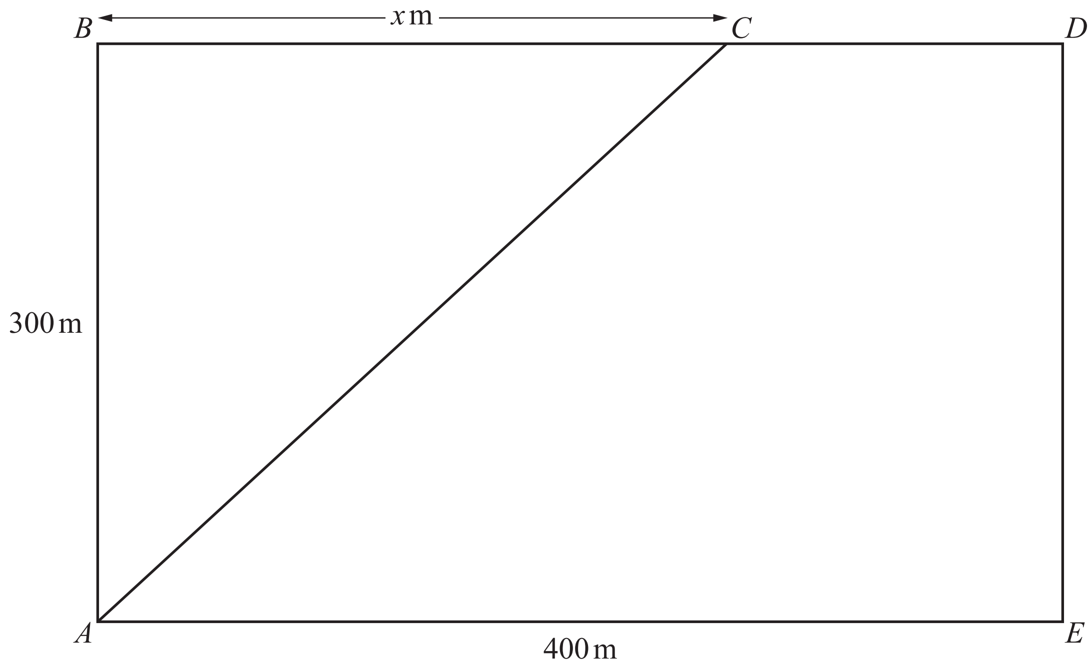
**(a)** Show that $x^3 + 6x^2 - 32 = 0$. [4]

**(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]

**9**




The rectangle $ABCDE$ represents a ploughed field where $AB = 300\,\text{m}$ and $AE = 400\,\text{m}$. 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 $BC = x\,\text{m}$.

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