



# Cambridge O Level

CANDIDATE  
NAME

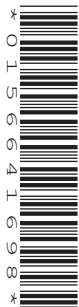
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CENTRE  
NUMBER

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**ADDITIONAL MATHEMATICS**

**4037/11**

Paper 1

**May/June 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*

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

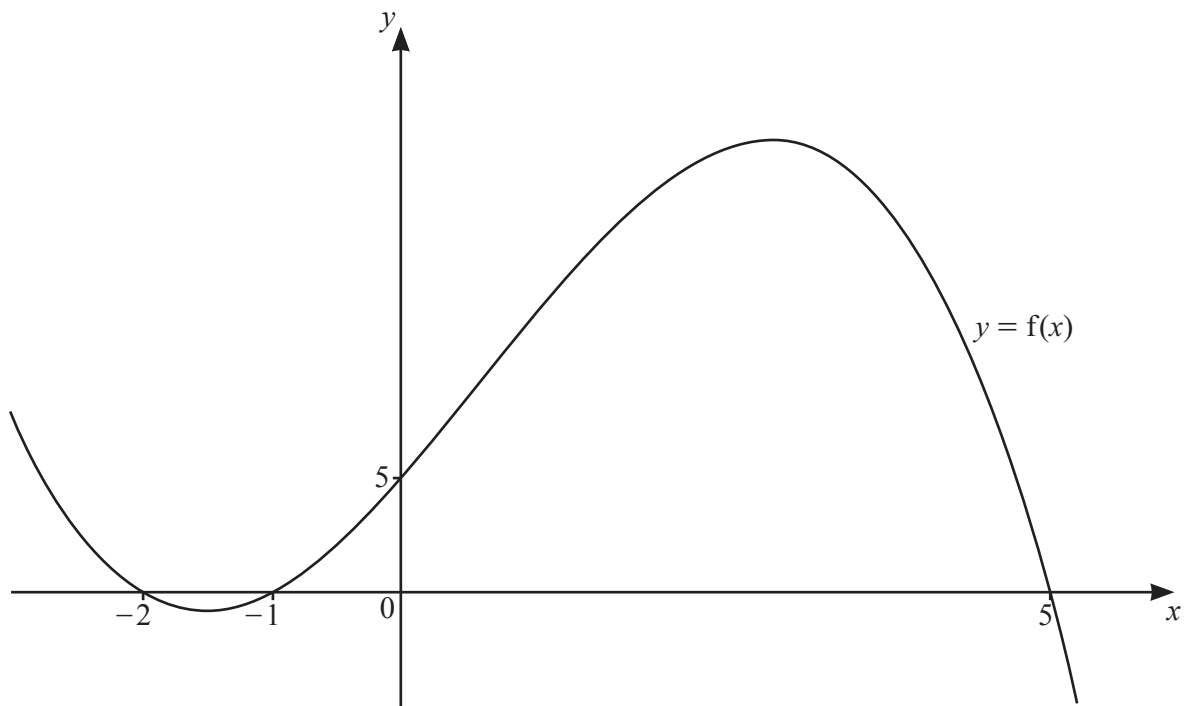
*Formulae for  $\triangle ABC$* 

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

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

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

- 1 The diagram shows the graph of a cubic curve  $y = f(x)$ .



- (a) Find an expression for  $f(x)$ .

[2]

- (b) Solve  $f(x) \leq 0$ .

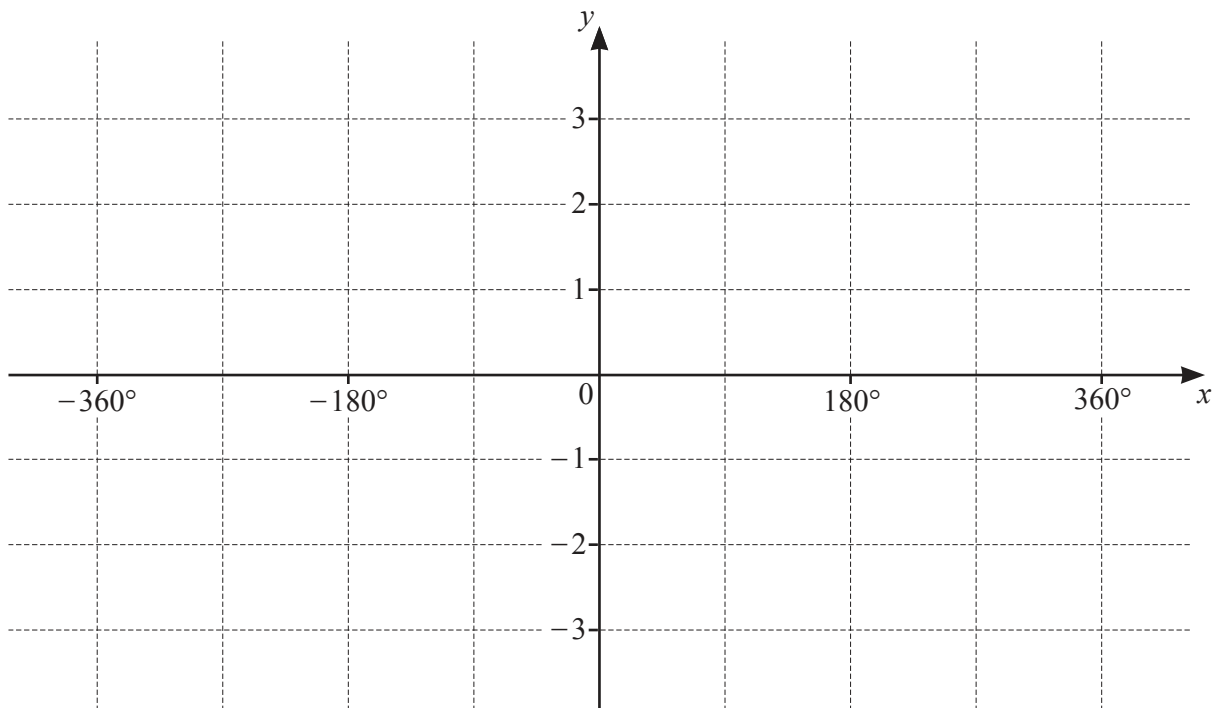
[2]

2 (a) Write down the period of  $2 \cos \frac{x}{3} - 1$ .

[1]

(b) On the axes below, sketch the graph of  $y = 2 \cos \frac{x}{3} - 1$  for  $-360^\circ \leq x \leq 360^\circ$ .

[3]



- 3 The radius,  $r$  cm, of a circle is increasing at the rate of  $5 \text{ cm s}^{-1}$ . Find, in terms of  $\pi$ , the rate at which the area of the circle is increasing when  $r = 3$ . [4]

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

Find the positive solution of the equation  $(5 + 4\sqrt{7})x^2 + (4 - 2\sqrt{7})x - 1 = 0$ , giving your answer in the form  $a + b\sqrt{7}$ , where  $a$  and  $b$  are fractions in their simplest form. [5]

- 5 Find the equation of the tangent to the curve  $y = \frac{\ln(3x^2 - 1)}{x + 2}$  at the point where  $x = 1$ . Give your answer in the form  $y = mx + c$ , where  $m$  and  $c$  are constants correct to 3 decimal places. [6]

6 The line  $y = 5x + 6$  meets the curve  $xy = 8$  at the points  $A$  and  $B$ .

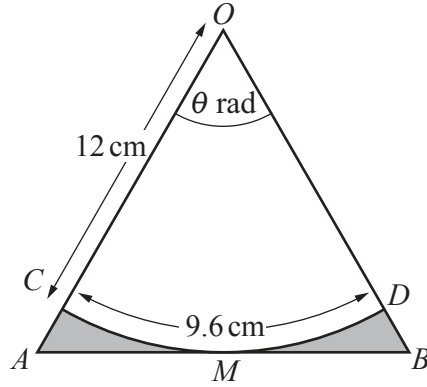
(a) Find the coordinates of  $A$  and of  $B$ .

[3]

(b) Find the coordinates of the point where the perpendicular bisector of the line  $AB$  meets the line  $y = x$ .

[5]





The diagram shows an isosceles triangle  $OAB$  such that  $OA = OB$  and angle  $AOB = \theta$  radians. The points  $C$  and  $D$  lie on  $OA$  and  $OB$  respectively.  $CD$  is an arc of length  $9.6$  cm of the circle, centre  $O$ , radius  $12$  cm. The arc  $CD$  touches the line  $AB$  at the point  $M$ .

(a) Find the value of  $\theta$ . [1]

(b) Find the total area of the shaded regions. [4]

(c) Find the total perimeter of the shaded regions. [3]

8 (a) Show that  $\frac{3}{2x-3} + \frac{3}{2x+3}$  can be written as  $\frac{12x}{4x^2-9}$ . [2]

(b) Hence find  $\int \frac{12x}{4x^2-9} dx$ , giving your answer as a single logarithm and an arbitrary constant. [3]

- (c) Given that  $\int_2^a \frac{12x}{4x^2-9} dx = \ln 5\sqrt{5}$ , where  $a > 2$ , find the exact value of  $a$ . [4]

- 9 (a) An arithmetic progression has a second term of  $-14$  and a sum to 21 terms of 84. Find the first term and the 21st term of this progression. [5]

(b) A geometric progression has a second term of  $27p^2$  and a fifth term of  $p^5$ . The common ratio,  $r$ , is such that  $0 < r < 1$ .

(i) Find  $r$  in terms of  $p$ . [2]

(ii) Hence find, in terms of  $p$ , the sum to infinity of the progression. [3]

(iii) Given that the sum to infinity is 81, find the value of  $p$ . [2]

10 (a) (i) Show that  $\frac{1}{\sec\theta-1} - \frac{1}{\sec\theta+1} = 2\cot^2\theta$ . [3]

(ii) Hence solve  $\frac{1}{\sec 2x-1} - \frac{1}{\sec 2x+1} = 6$  for  $-90^\circ < x < 90^\circ$ . [5]

(b) Solve  $\operatorname{cosec}\left(y + \frac{\pi}{3}\right) = 2$  for  $0 \leq y \leq 2\pi$  radians, giving your answers in terms of  $\pi$ . [4]

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

- 11 A curve is such that  $\frac{d^2y}{dx^2} = 5 \cos 2x$ . This curve has a gradient of  $\frac{3}{4}$  at the point  $\left(-\frac{\pi}{12}, \frac{5\pi}{4}\right)$ . Find the equation of this curve. [8]

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