



# Cambridge IGCSE™

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**ADDITIONAL MATHEMATICS**

**0606/21**

Paper 2

**May/June 2021**

**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. Any 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 (a) Write the expression  $x^2 - 6x + 1$  in the form  $(x + a)^2 + b$ , where  $a$  and  $b$  are constants. [2]

(b) Hence write down the coordinates of the minimum point on the curve  $y = x^2 - 6x + 1$ . [1]

2 Variables  $x$  and  $y$  are such that, when  $\ln y$  is plotted against  $\ln x$ , a straight line graph passing through the points  $(6, 5)$  and  $(8, 9)$  is obtained. Show that  $y = e^p x^q$  where  $p$  and  $q$  are integers. [4]

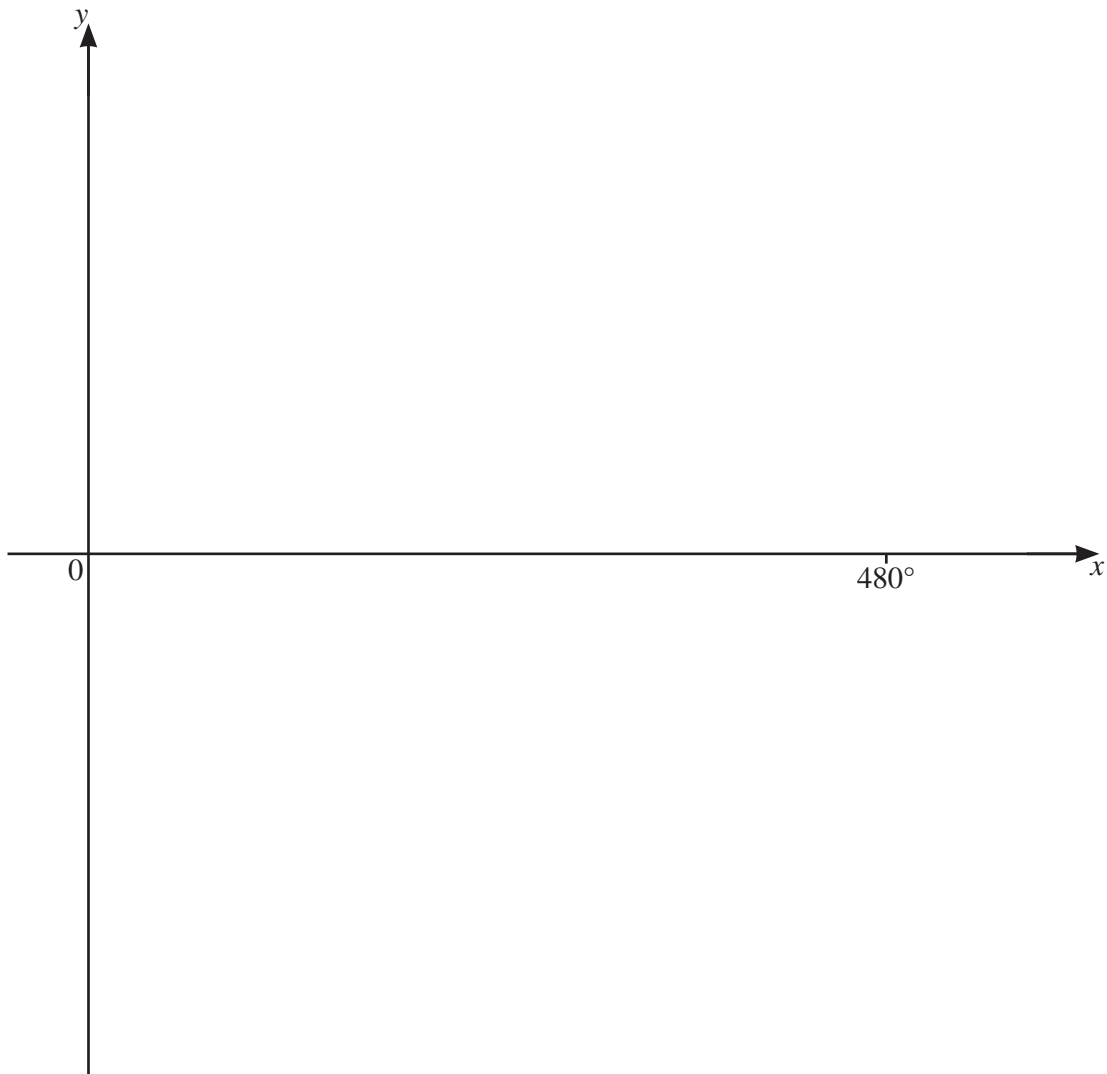
3 (a) Solve the inequality  $|4x - 1| > 9$ . [3]

(b) Solve the equation  $2x - 11\sqrt{x} + 12 = 0$ . [3]

- 4 The graph of  $y = a + 2 \tan bx$ , where  $a$  and  $b$  are constants, passes through the point  $(0, -4)$  and has period  $480^\circ$ .

(a) Find the value of  $a$  and of  $b$ . [3]

(b) On the axes, sketch the graph of  $y$  for values of  $x$  between  $0^\circ$  and  $480^\circ$ . [2]



- 5 The curves  $y = x^2$  and  $y^2 = 27x$  intersect at  $O(0, 0)$  and at the point  $A$ . Find the equation of the perpendicular bisector of the line  $OA$ . [8]

- 6 Variables  $x$  and  $y$  are such that  $y = e^{\frac{x}{2}} + x \cos 2x$ , where  $x$  is in radians. Use differentiation to find the approximate change in  $y$  as  $x$  increases from 1 to  $1 + h$ , where  $h$  is small. [6]

- 7 Find the exact values of the constant  $k$  for which the line  $y = 2x + 1$  is a tangent to the curve  $y = 4x^2 + kx + k - 2$ .

[6]



8 In this question,  $a$ ,  $b$ ,  $c$  and  $d$  are positive constants.

(a) (i) It is given that  $y = \log_a(x+3) + \log_a(2x-1)$ . Explain why  $x$  must be greater than  $\frac{1}{2}$ . [1]

(ii) Find the exact solution of the equation  $\frac{\log_a 6}{\log_a(y+3)} = 2$ . [3]

(b) Write the expression  $\log_a 9 + (\log_a b)(\log_{\sqrt{b}} 9a)$  in the form  $c + d \log_a 9$ , where  $c$  and  $d$  are integers. [4]

- 9 A curve is such that  $\frac{d^2y}{dx^2} = \sin\left(6x - \frac{\pi}{2}\right)$ . Given that  $\frac{dy}{dx} = \frac{1}{2}$  at the point  $\left(\frac{\pi}{4}, \frac{13\pi}{12}\right)$  on the curve, find the equation of the curve. [7]

10 Relative to an origin  $O$ , the position vectors of the points  $A$ ,  $B$ ,  $C$  and  $D$  are

$$\vec{OA} = \begin{pmatrix} 6 \\ -5 \end{pmatrix}, \quad \vec{OB} = \begin{pmatrix} 10 \\ 3 \end{pmatrix}, \quad \vec{OC} = \begin{pmatrix} x \\ y \end{pmatrix} \text{ and } \vec{OD} = \begin{pmatrix} 12 \\ 7 \end{pmatrix}.$$

(a) Find the unit vector in the direction of  $\vec{AB}$ . [3]

(b) The point  $A$  is the mid-point of  $BC$ . Find the value of  $x$  and of  $y$ . [2]

(c) The point  $E$  lies on  $OD$  such that  $OE : OD$  is  $1 : 1 + \lambda$ . Find the value of  $\lambda$  such that  $\vec{BE}$  is parallel to the  $x$ -axis. [3]

**11** The 2nd, 8th and 44th terms of an arithmetic progression form the first three terms of a geometric progression. In the arithmetic progression, the first term is 1 and the common difference is positive.

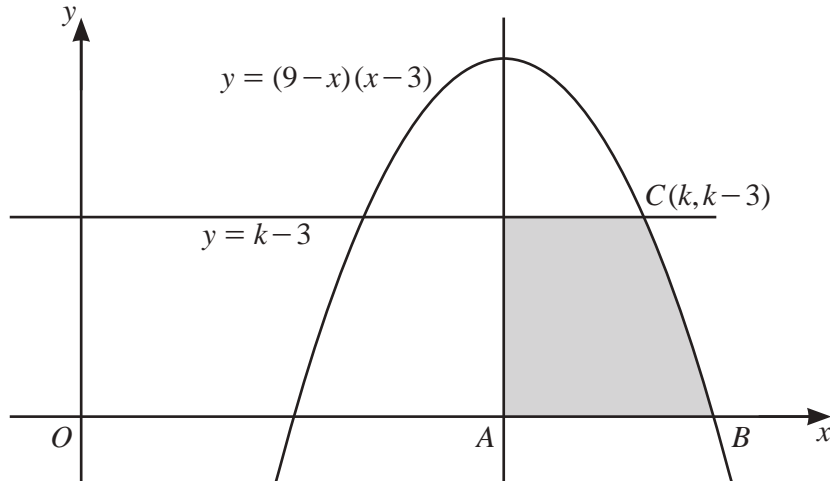
**(a) (i)** Show that the common difference of the arithmetic progression is 5. [5]

**(ii)** Find the sum of the first 20 terms of the arithmetic progression. [2]

(b) (i) Find the 5th term of the geometric progression. [2]

(ii) Explain whether or not the sum to infinity of this geometric progression exists. [1]

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The diagram shows part of the curve  $y = (9-x)(x-3)$  and the line  $y = k-3$ , where  $k > 3$ . The line through the maximum point of the curve, parallel to the  $y$ -axis, meets the  $x$ -axis at  $A$ . The curve meets the  $x$ -axis at  $B$ , and the line  $y = k-3$  meets the curve at the point  $C(k, k-3)$ . Find the area of the shaded region. [9]

Continuation of working space for Question 12.

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