



# Cambridge IGCSE™

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**ADDITIONAL MATHEMATICS**

**0606/23**

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 DO NOT USE A CALCULATOR IN THIS QUESTION.**

Write  $\frac{4-\sqrt{5}}{7-3\sqrt{5}}$  with a rational denominator, simplifying your answer. [3]

**2** Given that  $y = 2(7^{2x}) - 3(7^{x+1}) + 19$ , find the value of  $x$  when  $y = 30$ . [4]

3 (a) Write  $\frac{x(27xy^3)^{\frac{5}{3}}}{\sqrt[4]{81y^5}}$  in the form  $3^a \times x^b \times y^c$  where  $a$ ,  $b$  and  $c$  are constants. [3]

(b) (i) Find the value of  $a$  such that  $2 \log_a 8 = \frac{3}{2}$ . [2]

(ii) Write  $\log_{(a^2)} 3a$  as a single logarithm to base  $a$ . [2]

- 4 Variables  $x$  and  $y$  are such that  $y = \frac{\sin x}{\cos x}$ . Using differentiation, find the approximate change in  $y$  as  $x$  increases from  $-\frac{\pi}{4}$  to  $h - \frac{\pi}{4}$ , where  $h$  is small. [4]

- 5 (a) Solve the inequality  $2x^2 - 17x + 21 \leq 0$ . [3]

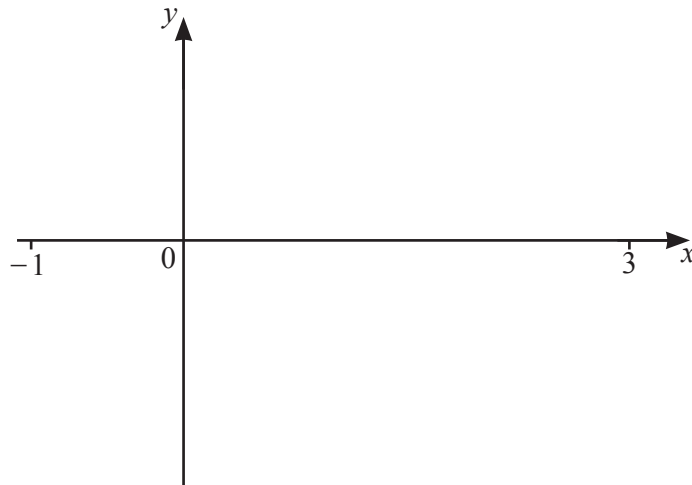
- (b) Hence find the area enclosed between the curve  $y = 2x^2 - 17x + 21$  and the  $x$ -axis. [3]

6 The polynomial  $p$  is given by  $p(x) = 36x^3 - 15x^2 - 2x + 1$ .

(a) Show that  $x = -0.25$  is a root of the equation  $p(x) = 0$ . [1]

(b) Show that the equation  $p(x) = 0$  has a repeated root. [4]

- 7 (a) Sketch the graph of the curve  $y = \ln(4x - 3)$  on the axes, stating the intercept with the  $x$ -axis. [2]



- (b) Find the equation of the tangent to the curve  $y = \ln(4x - 3)$  at the point where  $x = 2$ . [5]

8 (a) (i) Find  $\int \sin\left(\frac{\phi + \pi}{3}\right) d\phi$ . [2]

(ii) Find  $\int (5 \sin^2 \theta + 5 \cos^2 \theta) d\theta$ . [2]

(b) Show that  $\int_1^e \left( \left(1 + \frac{1}{x}\right)^2 - 1 \right) dx = \frac{3e-1}{e}$ . [4]



9 (a) The function  $f$  is defined, for all real  $x$ , by  $f(x) = 13 - 4x - 2x^2$ .

(i) Write  $f(x)$  in the form  $a + b(x + c)^2$ , where  $a$ ,  $b$  and  $c$  are constants. [3]

(ii) Hence write down the range of  $f$ . [1]

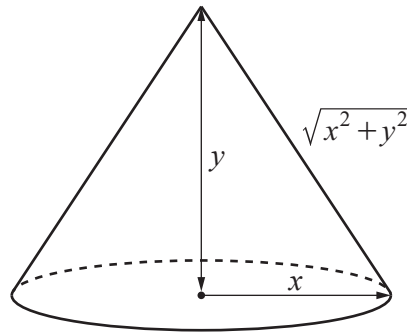
(b) The function  $g$  is defined, for  $x \geq 1$ , by  $g(x) = \sqrt{x^2 + 2x - 1}$ .

(i) Given that  $g^{-1}(x)$  exists, write down the domain and range of  $g^{-1}$ . [2]

(ii) Show that  $g^{-1}(x) = -1 + \sqrt{px^2 + q}$ , where  $p$  and  $q$  are integers. [4]

10 In this question all lengths are in centimetres.

The volume and curved surface area of a cone of base radius  $r$ , height  $h$  and sloping edge  $l$  are  $\frac{1}{3}\pi r^2 h$  and  $\pi r l$  respectively.



The diagram shows a cone of base radius  $x$ , height  $y$  and sloping edge  $\sqrt{x^2 + y^2}$ . The volume of the cone is  $10\pi$ .

(a) Find an expression for  $y$  in terms of  $x$  and show that the curved surface area,  $S$ , of the cone is given

by  $S = \frac{\pi\sqrt{x^6 + 900}}{x}$ . [3]

- (b) Given that  $x$  can vary and that  $S$  has a minimum value, find the exact value of  $x$  for which  $S$  is a minimum. [5]

11 (a) The first three terms of an arithmetic progression are  $\frac{1}{p}$ ,  $\frac{1}{q}$ ,  $-\frac{1}{q}$ .

(i) Show that the common difference can be written as  $-\frac{2}{3p}$ . [3]

(ii) The 10th term of the progression is  $\frac{k}{p}$ , where  $k$  is a constant. Find the value of  $k$ . [2]

- (b) The sum to infinity of a geometric progression is 8. The second term of the progression is  $\frac{3}{2}$ . Find the two possible values of the common ratio. [5]

12 A particle moves in a straight line such that its displacement,  $s$  metres, from a fixed point  $O$  at time  $t$  seconds, is given by  $s = 2 + t - 2 \cos t$ , for  $t \geq 0$ .

(a) Find the displacement of the particle from  $O$  at the time when it first comes to instantaneous rest. [5]

(b) Find the time when the particle next comes to rest. [1]

(c) Find the distance travelled by the particle for  $0 \leq t \leq \frac{3\pi}{2}$ . [2]

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