



# Cambridge IGCSE™

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NAME



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## ADDITIONAL MATHEMATICS

0606/21

Paper 2

October/November 2024

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.



## **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 $\Delta ABC$*

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

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

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





1 Show that  $\tan \theta + \cot \theta$  can be written as  $\sec \theta \cosec \theta$ .

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2 (a) Given that  $y = \tan x - x$ , find  $\frac{dy}{dx}$ . Write your answer in terms of  $\tan x$ .

(b) Hence find  $\int_0^{\frac{\pi}{4}} \tan^2 x dx$ . Give your answer in exact form.





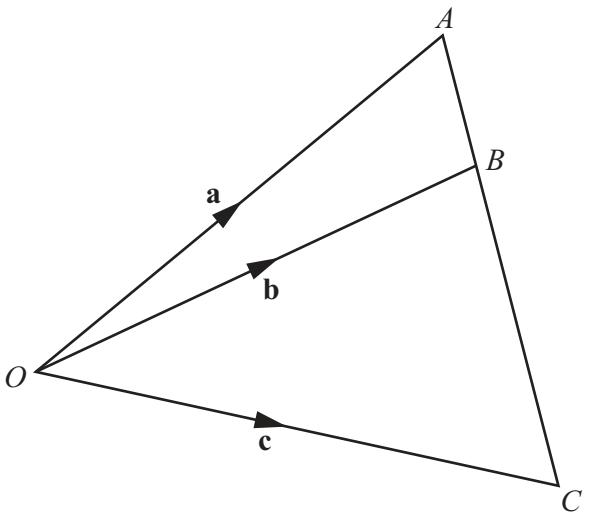
3 (a) Solve the equation  $8^{\frac{1}{x}} - 2 \times 8^{-\frac{1}{x}} = 1$ .

[4]

(b) It is given that  $(a - \sqrt{3})^2 = b + (3 - b)\sqrt{3}$ , where  $a$  and  $b$  are integers. Find the possible values of  $a$  and  $b$ .

[6]





The diagram shows the triangle  $OAC$ . The point  $B$  lies on  $AC$  such that  $AB:BC = p:q$ , where  $p$  and  $q$  are constants ( $p \neq -q$ ).

$$\overrightarrow{OA} = \mathbf{a}, \overrightarrow{OB} = \mathbf{b} \text{ and } \overrightarrow{OC} = \mathbf{c}.$$

Show that  $\mathbf{b} = \frac{q\mathbf{a} + p\mathbf{c}}{q + p}$ .

[5]





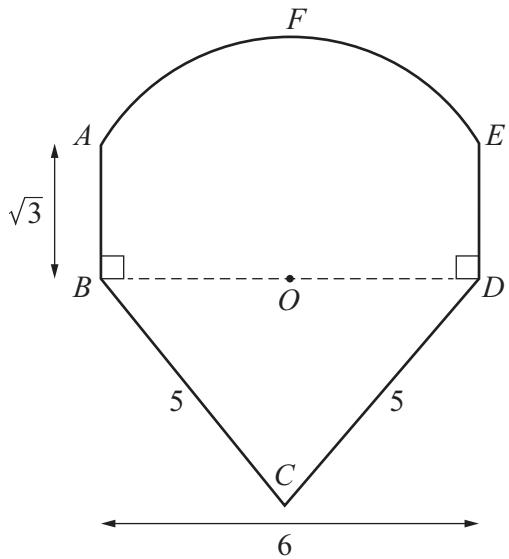
5 Given that  $\log_a(p+1) + \frac{1}{\log_p a} - \log_a(p+2) + \log_a 5 = \log_a 12$ , find the value of  $p$ . [5]

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6 In this question all lengths are in metres.



The diagram shows a shape  $ABCDEF$ .

$AB$ ,  $BD$  and  $DE$  are three sides of a rectangle.

$O$  is the mid-point of  $BD$ .

$AFE$  is an arc of a circle whose centre is  $O$ .

$AB = \sqrt{3}$ ,  $BC = CD = 5$  and  $BD = 6$ .

(a) Find the exact value of the perimeter of the shape, giving your answer in terms of  $\pi$ .

[5]





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**(b)** Find the exact value of the area of the shape, giving your answer in terms of  $\pi$ .

[3]





7 A curve has equation  $y = 2x \cos x$ . The normal to the curve at  $(\pi, -2\pi)$  meets the  $x$ -axis and  $y$ -axis at points  $P$  and  $Q$ . Find the exact area of triangle  $POQ$ . [7]





8 A particle moves in a straight line so that its displacement from a fixed point  $O$  at time  $t$  seconds is  $x$  metres, where  $x = t^3 + t^2 - t + 8$  and  $t \geq 0$ .

(a) Find the time when the particle changes direction.

[3]

(b) Show that the particle is moving towards  $O$  when  $t = 0$ .

[3]

(c) Find the total distance travelled by the particle during the first 2 seconds of its motion.

[4]





9 A curve has equation  $y = x^2 - 8x + c$ , where  $c$  is a constant.

(a) Find the value of  $c$  in each of the following cases.

(i) The curve crosses the  $x$ -axis at  $x = 2$ .

[1]

(ii) The minimum value of  $y$  is 3.

[3]

(b) Find the range of values of  $c$  for which  $y$  is always greater than 0.

[2]





**10 (a)** A class contains 7 girls and 8 boys. A group of 6 is selected from the class. The group must contain at least 3 girls and at least 2 boys. Find the number of different groups that can be selected. [3]

**(b)** A 5-character code is to be formed from the following characters.

Letters      A    B    C    D    E    F

Numbers    1    2    3

No character may be used more than once in any code. The characters may be arranged in any order.

Find the number of different codes that can be formed using 4 letters and 1 number.

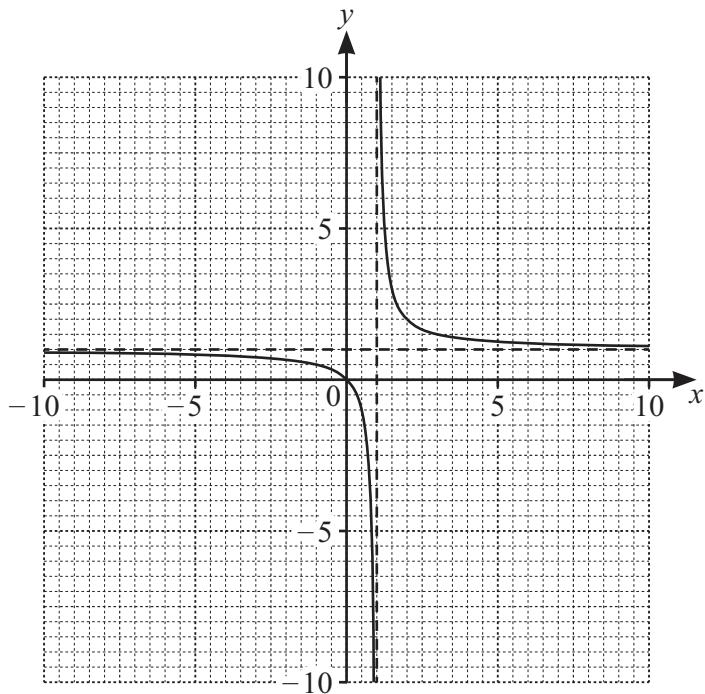
[3]





11 (a)  $f(x) = \frac{x}{x-1}$  for  $-10 \leq x \leq 10, x \neq 1$ .

The diagram shows the graph of  $y = f(x)$ .



(i) Use the diagram to explain why  $f$  is a function.

[1]

(ii) Find  $ff(x)$ , giving your answer in its simplest form.

[2]





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(iii) Using your answer to part (ii) state the relationship between the functions  $f$  and  $f^{-1}$ . [1]

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(iv) Explain how the diagram shows the relationship between  $f$  and  $f^{-1}$ . [1]

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(b) A function  $g$  is defined by  $g(x) = \frac{x}{x-1}$  for  $x \geq 2$ . Find the range of  $g$ . [1]

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(c) A function  $h$  is defined by  $h(x) = \frac{2x}{3x+1}$  for the largest possible domain. State the domain of  $h$ . [1]

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Question 12 is printed on the next page.





12 Two arithmetic progressions,  $A$  and  $B$ , each have 100 terms. Their terms are denoted by  $a_1, a_2, a_3, a_4, \dots, a_{100}$  and  $b_1, b_2, b_3, b_4, \dots, b_{100}$  respectively.

It is given that  $a_1 = b_{100} = 1$  and  $a_{100} = b_1 = 298$ .

(a) Find  $n$  such that  $a_n - b_n = 45$ .

[6]

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(b) Find the smallest  $m$  such that  $a_m > 2b_m$ .

[3]

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