



# **Cambridge IGCSE™**

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## **ADDITIONAL MATHEMATICS**

**0606/21**

Paper 2

**October/November 2023**

**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 $\Delta ABC$*

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

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

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

1 (a) Write  $19 - 12x - 3x^2$  in the form  $a(x + b)^2 + c$  where  $a$ ,  $b$  and  $c$  are integers. [4]

(b) Hence find the maximum value of  $19 - 12x - 3x^2$  and the value of  $x$  at which this maximum occurs. [2]

(c) Use your answer to part (a) to solve the equation  $19 - 12\sqrt{u} - 3u = 0$ . [3]

2 Solve the following simultaneous equations.

$$\begin{aligned}5x - 3 \ln y &= 2 \\x + \ln y &= 1\end{aligned}$$

[4]

3 (a) Find  $\int \left(4x + 5 - \frac{1}{2x+3}\right) dx$ . [3]

(b) Hence find the exact value of  $\int_1^3 \left(4x + 5 - \frac{1}{2x+3}\right) dx$ , simplifying your answer. [3]

4 In this question  $a$  and  $b$  are integers.

Three terms in the expansion of  $(2+ax)^5(1+bx)$  are  $32 + 112x - 240x^2$ . Find the values of  $a$  and  $b$ . [7]

5 In this question  $p$  and  $q$  are constants.

The normal to the curve  $y = \frac{p}{x^2} + 5x - 2$ , at the point where  $x = 1$ , has equation  $y = -x + q$ .

Find the values of  $p$  and  $q$ .

[6]

6 Find the value of the constant  $a$  for which the line  $y = (2a+1)x - 10$  is a tangent to the curve  $y = ax^2 - 5x + 2$ . [6]

7 A particle moves in a straight line. At time  $t$  seconds after passing through a fixed point  $O$ , its velocity,  $\text{v ms}^{-1}$ , is given by  $v = 10 \sin 2t - 6 \cos 2t$ .

(a) Find an expression for the acceleration of the particle. [2]

(b) Find the acceleration when  $t = \frac{\pi}{4}$ . [1]

(c) Find the first time at which the acceleration is zero. [3]

(d) Find the displacement of the particle between  $t = \frac{\pi}{4}$  and  $t = \frac{\pi}{2}$ . [4]

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

Solve the equation  $(2 - \sqrt{10})x^2 + x + (2 + \sqrt{10}) = 0$ , giving your answers in the form  $a + b\sqrt{10}$ , where  $a$  and  $b$  are rational. [7]

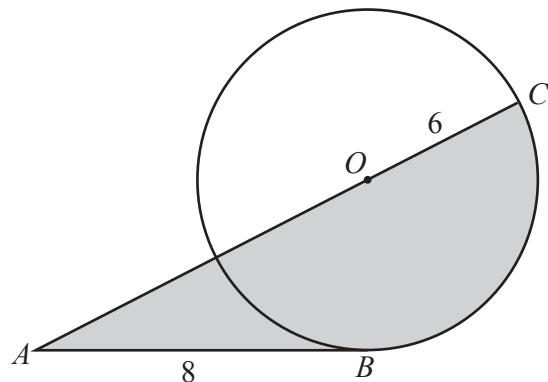
9 The functions  $f$  and  $g$  are defined as follows, for all real values of  $x$ .

$$f(x) = 2x^2 - 1$$
$$g(x) = e^x + 1$$

(a) Solve the equation  $fg(x) = 8$ . [3]

(b) For each of the functions  $f$  and  $g$ , either explain why the inverse function does not exist or find the inverse function, stating its domain. [4]

10 In this question all lengths are in centimetres.



The diagram shows a circle centre  $O$  with radius 6. The line  $AB$  is a tangent to the circle at the point  $B$ . The point  $C$  lies on the circle such that  $AOC$  is a straight line.  $AB = 8$ .

(a) Find the perimeter of the shaded region.

[6]

**(b)** Find the area of the shaded region.

[3]

11 (a) Show that  $\frac{1}{\sec x - \operatorname{cosec} x} + \frac{1}{\sec x + \operatorname{cosec} x} = \frac{2 \cos x}{1 - \cot^2 x}$ . [5]

(b) Solve the equation  $3 \tan^2(y + \frac{\pi}{4}) = 1$  for  $-2\pi < y < 0$ .

[4]

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