

# **Cambridge O Level**

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
ADDITIONAL	MATHEMATICS	4037/23	
Paper 2		October/November 2022	
		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 
$$u_n = a + (n-1)d$$
$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\left\{2a + (n-1)d\right\}$$

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

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\csc^2 A = 1 + \cot^2 A$$

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 Solve the following inequality.

$$(2x+3)(x-4) > (3x+4)(x-1)$$
[5]

2 The tangent to the curve  $y = ax^2 - 5x + 2$  at the point where x = 2 has equation y = 7x + b. Find the values of the constants *a* and *b*. [5]

3 Solve the equation  $\lg(2x-1) + \lg(x+2) = 2 - \lg 4$ .

[5]

- 4 The line y = kx + 6 intersects the curve  $y = x^3 4x^2 + 3kx + 2$  at the point where x = 2.
  - (a) Find the value of k.

(b) Show that, for this value of k, the line cuts the curve only once.

[4]

[2]

5 (a) Show that 
$$\frac{\cos x}{1-\sin x} + \frac{1-\sin x}{\cos x} = 2 \sec x$$
.

(b) Hence solve the equation 
$$\frac{\cos\frac{\theta}{2}}{1-\sin\frac{\theta}{2}} + \frac{1-\sin\frac{\theta}{2}}{\cos\frac{\theta}{2}} = 8\cos^2\frac{\theta}{2} \text{ for } -360^\circ < \theta < 360^\circ.$$
[4]

[4]

6 The first four terms in ascending powers of x in the expansion  $(3 + ax)^4$  can be written as  $81 + bx + cx^2 + \frac{3}{2}x^3$ . Find the values of the constants a, b and c. [6]

7 Given that  ${}^{n}C_{4} = 13 \times {}^{n}C_{2}$ , find the value of  ${}^{n}C_{8}$ .

[5]

8 (a) Particle A starts from the point with position vector  $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$  and travels with speed 26 ms<sup>-1</sup> in the direction of the vector  $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$ . Find the position vector of A after t seconds. [3]

(b) At the same time, particle *B* starts from the point with position vector  $\begin{pmatrix} 67 \\ -18 \end{pmatrix}$ . It travels with speed  $20 \text{ ms}^{-1}$  at an angle of  $\alpha$  above the positive *x*-axis, where  $\tan \alpha = \frac{3}{4}$ . Find the position vector of *B* after *t* seconds. [4]

(c)	Hence find the time at which A and B meet, and the position where this occurs.	[3]
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(a) Find 
$$\frac{dy}{dx}$$
. [2]

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(b) Find the coordinates of the stationary point on the curve  $y = 10xe^{-2x}$ . [3]

(c) Use your answer to part (a) to find  $\int 4xe^{-2x}dx$ .

(d) Find the exact value of  $\int_0^1 4x e^{-2x} dx$ .

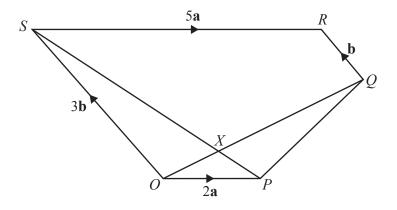
[2]

[3]

10 (a) The third term of an arithmetic progression is 10 and the sum of the first 8 terms is 116. Find the first term and common difference. [5]

(b) Find the sum of nineteen terms of the progression, starting with the twelfth term. [4]

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In the vector diagram,  $\overrightarrow{OP} = 2\mathbf{a}$ ,  $\overrightarrow{SR} = 5\mathbf{a}$ ,  $\overrightarrow{OS} = 3\mathbf{b}$  and  $\overrightarrow{QR} = \mathbf{b}$ . (a) Given that  $\overrightarrow{PX} = \lambda \overrightarrow{PS}$ , write  $\overrightarrow{OX}$  in terms of  $\mathbf{a}$ ,  $\mathbf{b}$  and  $\lambda$ .

[3]

**(b)** Given that  $\overrightarrow{OX} = \mu \overrightarrow{OQ}$ , write  $\overrightarrow{OX}$  in terms of **a**, **b** and  $\mu$ .

[2]

(c) Find the values of  $\lambda$  and  $\mu$ .

[1]

[4]

(e) Find the value of  $\frac{PX}{XS}$ .

(d) Write down the value of  $\frac{OX}{OQ}$ .

[1]

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