



# **Cambridge IGCSE™**

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## **ADDITIONAL MATHEMATICS**

**0606/13**

Paper 1

**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.

## **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*

$$\begin{aligned} \sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A \end{aligned}$$

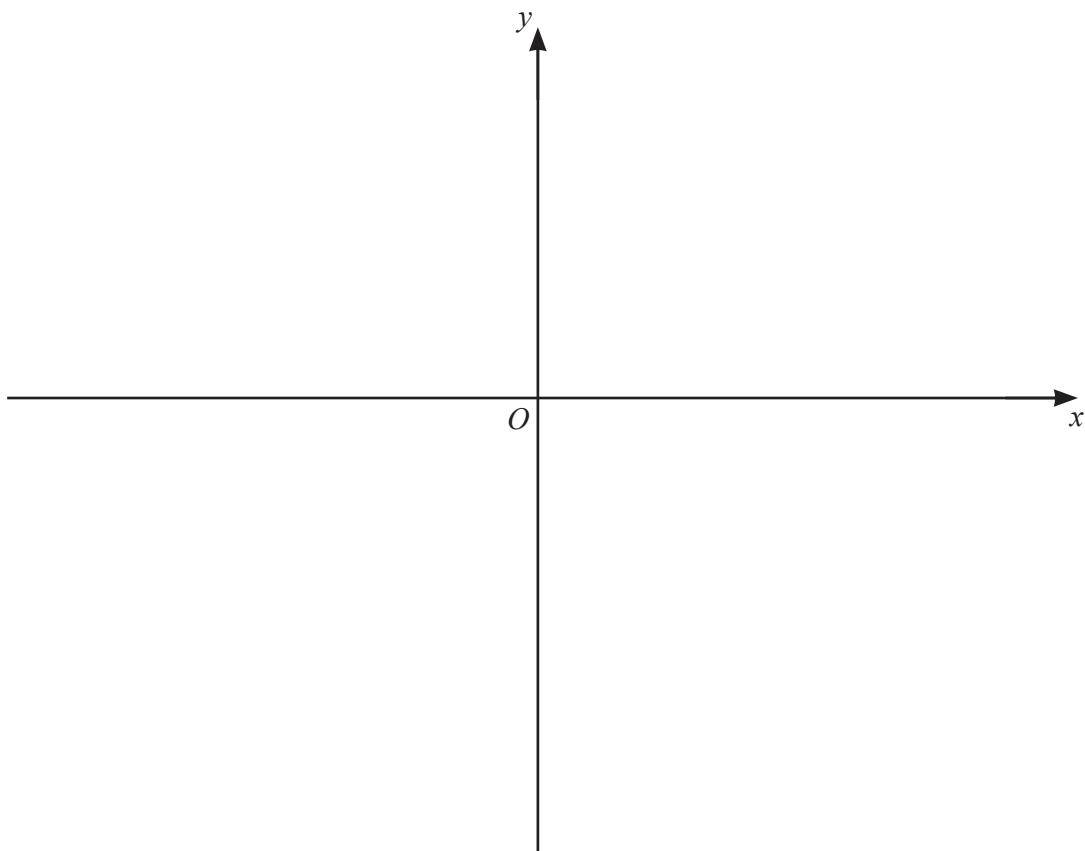
#### *Formulae for $\Delta ABC$*

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

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

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

1 (a) On the axes, sketch the graphs of  $y = 2x + 5$  and  $y = |4x - 3|$ , stating the intercepts with the coordinate axes. [3]

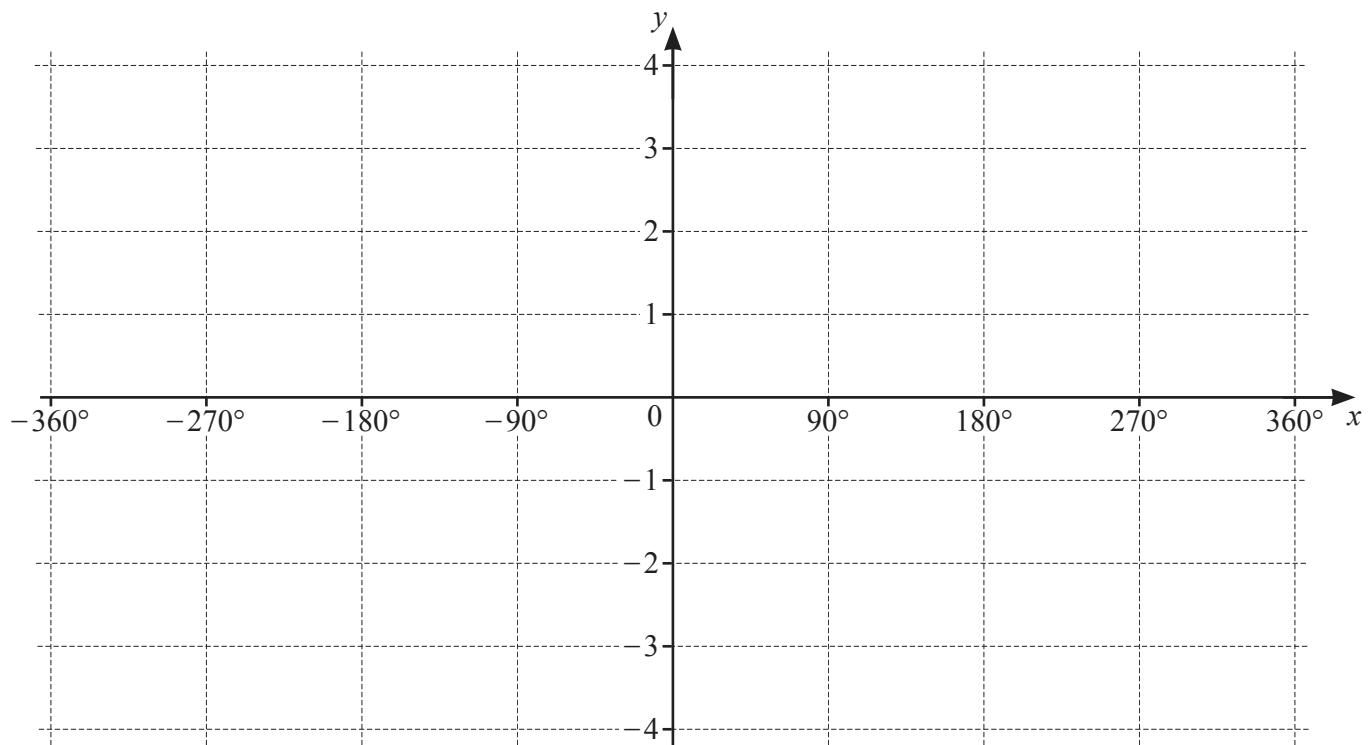


(b) Solve the inequality  $|4x - 3| < 2x + 5$ . [3]

2 The perpendicular bisector of the line joining the points  $\left(-3, \frac{2}{3}\right)$  and  $\left(6, -\frac{7}{3}\right)$  passes through the point  $(2, k)$ . Find the value of  $k$ . [4]

3 On the axes, draw the graph of  $y = 2 \sin \frac{x}{3} - 1$  for  $-360^\circ \leq x \leq 360^\circ$ .

[4]



4 The polynomial  $P$  is given by  $P(x) = ax^3 + bx^2 + 3x + 2$ , where  $a$  and  $b$  are integers.  $P(x)$  has a factor of  $2x + 1$ .  $P(x)$  has a remainder of  $-6$  when divided by  $x + 1$ .

(a) Find the values of  $a$  and  $b$ .

[5]

(b) Show that the equation  $P(x) = 0$  has only one real root.

[3]

5 (a) A 5-character password is to be formed from the following 10 characters.

Letters	A	B	C	X	Y	Z
Symbols	*	\$	#	&		

No character can be used more than once in any 5-character password.

(i) Find the number of passwords that can be formed. [1]

(ii) Find the number of passwords that can be formed if the password has to contain at least one symbol. [2]

(iii) Find the number of passwords that can be formed if the password has to start with two letters and end with two symbols. [2]

(b) A team of 8 people is to be chosen from 5 doctors, 4 teachers and 6 police officers.

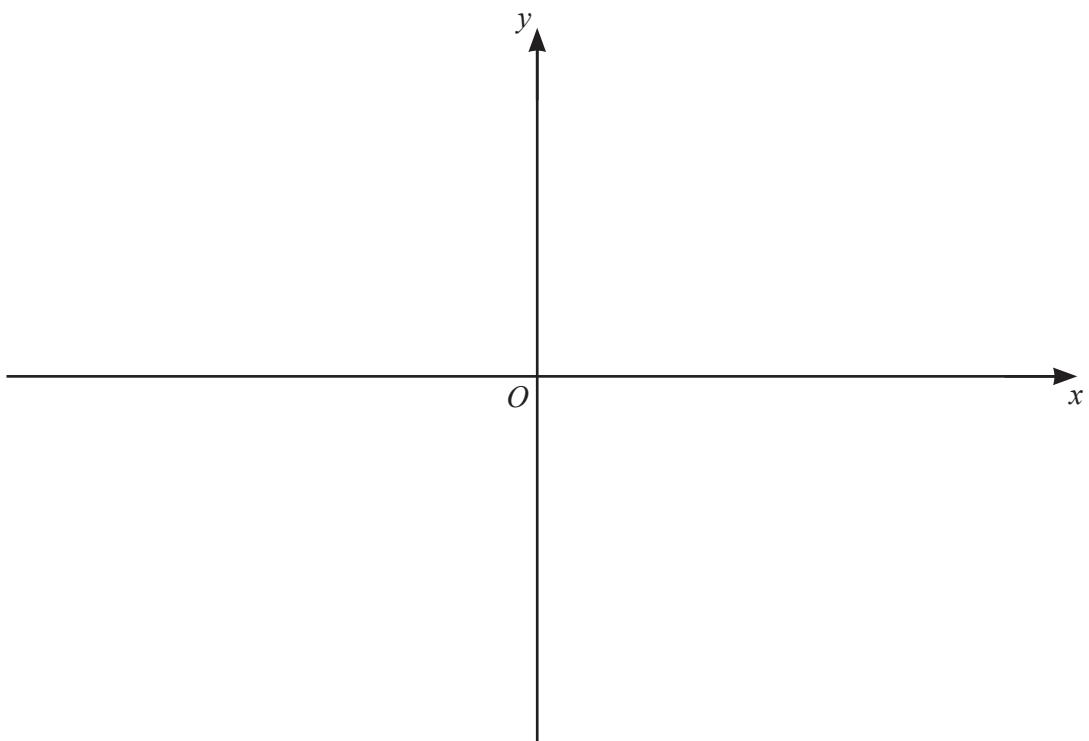
Find how many possible teams have the same number of doctors as teachers. [5]

6 The polynomial  $q(x)$  is given by  $q(x) = -\frac{1}{3}(2x-1)(x+3)^2$ .

(a) Find the  $x$ -coordinates of the stationary points on the curve  $y = q(x)$ .

[4]

(b) On the axes, sketch the graph of  $y = q(x)$  stating the intercepts with the coordinate axes. [3]



(c) Find the values of  $k$  such that  $q(x) = k$  has exactly one solution.

[3]

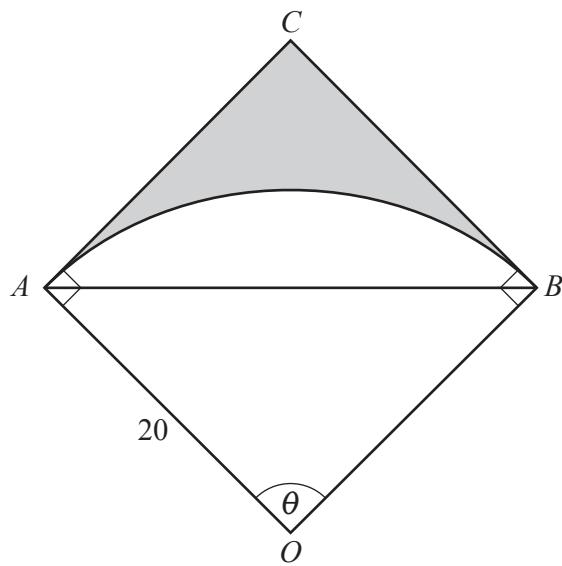
7 Solve the equation  $6x^{\frac{1}{3}} - 2x^{-\frac{1}{3}} - 1 = 0$ . Give your answers in exact form.

[4]

8 The first three terms, in descending powers of  $x$ , in the expansion of  $\left(2x^2 - \frac{1}{4x}\right)^n$  can be written in the form  $256x^{16} + ax^{13} + bx^c$ , where  $n, a, b$  and  $c$  are integers. Find the values of  $n, a, b$  and  $c$ . [6]

9 Given that  $y = \frac{(5x+2)^{\frac{1}{3}}}{(x-1)^2}$ , show that  $\frac{dy}{dx}$  can be written in the form  $\frac{-(Ax+B)}{3(5x+2)^{\frac{2}{3}}(x-1)^3}$ , where  $A$  and  $B$  are integers. [5]

10 In this question, all lengths are in centimetres and all angles are in radians.

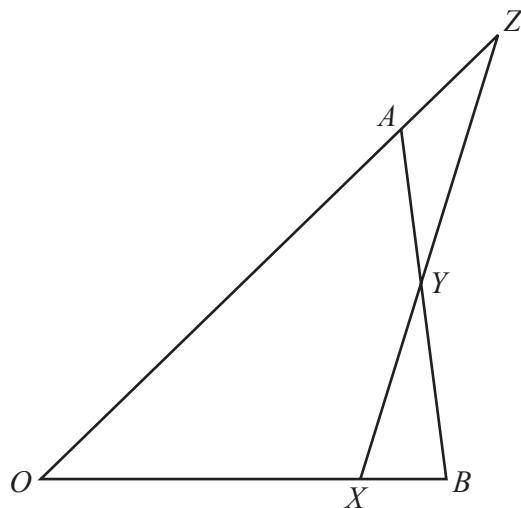


The diagram shows the sector,  $OAB$ , of a circle with centre  $O$  and radius 20. The perimeter of this sector is 65. The lines  $CA$  and  $CB$  are both tangents to the circle at the points  $A$  and  $B$ , so that the triangle  $ABC$  is isosceles, with  $AC = CB$ . The angle  $AOB$  is equal to  $\theta$ .

Find the area of the shaded region.

[9]

**Additional working space for question 10.**



In the triangle  $OAB$ ,  $\overrightarrow{OA} = \mathbf{a}$  and  $\overrightarrow{OB} = \mathbf{b}$ .

The straight line  $XYZ$  is such that:

- $\overrightarrow{OX} = \frac{4}{5}\mathbf{b}$
- $\overrightarrow{AY} = \frac{1}{3}\overrightarrow{AB}$
- $\overrightarrow{AZ} = \mu\mathbf{a}$ , where  $\mu$  is a constant
- $\overrightarrow{YZ} = \lambda\overrightarrow{XY}$ , where  $\lambda$  is a constant.

(a) Show that  $\overrightarrow{XY} = \frac{2}{3}\mathbf{a} - \frac{7}{15}\mathbf{b}$ .

[3]

(b) Find  $\overrightarrow{YZ}$  in terms of  $\lambda$ ,  $\mathbf{a}$  and  $\mathbf{b}$ . [1]

(c) Find  $\overrightarrow{YZ}$  in terms of  $\mu$ ,  $\mathbf{a}$  and  $\mathbf{b}$ . [2]

(d) Hence find the values of  $\lambda$  and  $\mu$ , [3]

**Question 12 is printed on the next page.**

12 Solve the equation  $3 \operatorname{cosec}^2\left(\frac{2x}{3} - \frac{\pi}{3}\right) = 4$ , for  $0 < x \leq 3\pi$ . Give your answers in terms of  $\pi$ . [5]

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