



## Cambridge O Level

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**ADDITIONAL MATHEMATICS**

**4037/13**

Paper 1

**October/November 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*      $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

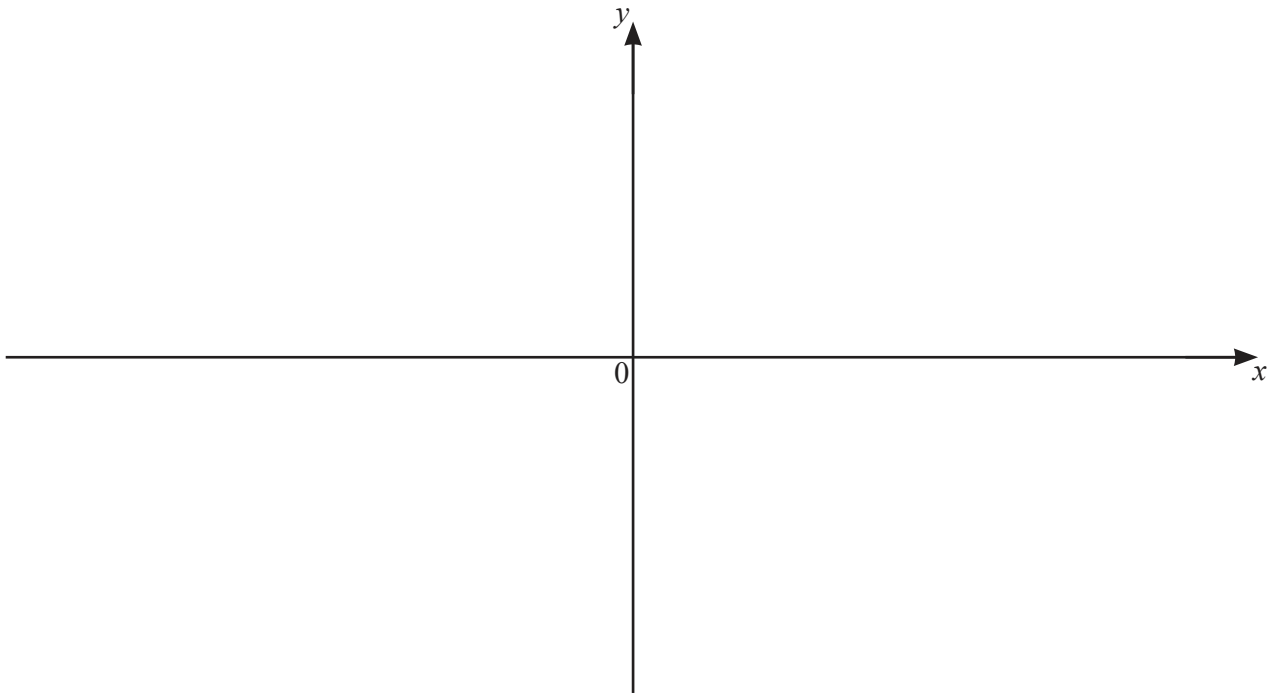
**2. TRIGONOMETRY***Identities*

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

*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 On the axes below, sketch the graph of  $y = -\frac{1}{4}(2x+1)(x-3)(x+4)$  stating the intercepts with the coordinate axes. [3]



- 2 A particle moves in a straight line such that its velocity,  $v \text{ ms}^{-1}$ , at time  $t$  seconds after passing through a fixed point  $O$ , is given by  $v = e^{3t} - 25$ . Find the speed of the particle when  $t = 1$ . [2]

- 3 Solve the equation  $\cot^2\left(2x - \frac{\pi}{3}\right) = \frac{1}{3}$ , where  $x$  is in radians and  $0 \leq x < \pi$ . [5]

- 4 (a) Find the first three terms, in ascending powers of  $x^2$ , in the expansion of  $\left(\frac{1}{2} - \frac{2}{3}x^2\right)^8$ . Write your coefficients as rational numbers. [3]

- (b) Find the coefficient of  $x^2$  in the expansion of  $\left(\frac{1}{2} - \frac{2}{3}x^2\right)^8 \left(2x + \frac{1}{x}\right)^2$ . [3]

5 A geometric progression is such that its sum to 4 terms is 17 times its sum to 2 terms. It is given that the common ratio of this geometric progression is positive and not equal to 1.

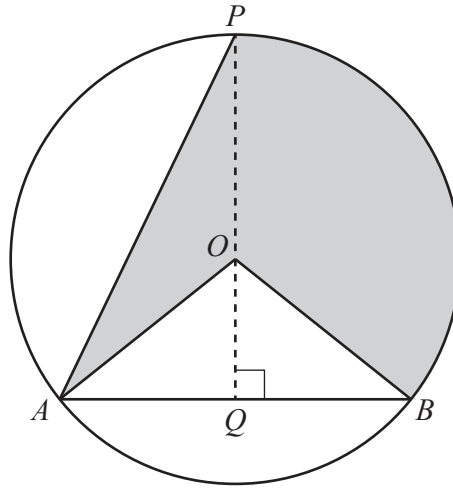
(a) Find the common ratio of this geometric progression. [3]

(b) Given that the 6th term of the geometric progression is 64, find the first term. [2]

(c) Explain why this geometric progression does not have a sum to infinity. [1]

- 6 (a) A 5-digit number is made using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. No digit may be used more than once in any 5-digit number. Find how many such 5-digit numbers are odd and greater than 70 000. [3]

- (b) The number of combinations of  $n$  objects taken 3 at a time is 2 times the number of combinations of  $n$  objects taken 2 at a time. Find the value of  $n$ . [4]



The diagram shows a circle, centre  $O$ , radius 10 cm. The points  $A$ ,  $B$  and  $P$  lie on the circumference of the circle. The chord  $AB$  is of length 14 cm. The point  $Q$  lies on  $AB$  and the line  $PQ$  is perpendicular to  $AB$ .

(a) Show that angle  $POA$  is 2.366 radians, correct to 3 decimal places. [2]

(b) Find the area of the shaded region. [3]



(c) Find the perimeter of the shaded region.

[5]

8 The curves  $y = x^2 + x - 1$  and  $2y = x^2 + 6x - 2$  intersect at the points  $A$  and  $B$ .

(a) Show that the mid-point of the line  $AB$  is  $(2, 9)$ . [5]

The line  $l$  is the perpendicular bisector of  $AB$ .

(b) Show that the point  $C(12, 7)$  lies on the line  $l$ . [3]

- (c) The point  $D$  also lies on  $l$ , such that the distance of  $D$  from  $AB$  is two times the distance of  $C$  from  $AB$ . Find the coordinates of the two possible positions of  $D$ . [4]

9 When  $e^{2y}$  is plotted against  $x^2$ , a straight line graph passing through the points (4, 7.96) and (2, 3.76) is obtained.

(a) Find  $y$  in terms of  $x$ . [5]

(b) Find  $y$  when  $x = 1$ . [2]

(c) Using your equation from **part (a)**, find the positive values of  $x$  for which the straight line exists. [3]

10 A curve with equation  $y = f(x)$  is such that  $\frac{d^2y}{dx^2} = (2x + 3)^{-\frac{1}{2}} + 5$  for  $x > 0$ . The curve has gradient 10 at the point  $\left(3, \frac{19}{2}\right)$ .

(a) Show that, when  $x = 11$ ,  $\frac{dy}{dx} = 52$ . [5]

(b) Find  $f(x)$ . [4]

11 A curve has equation  $y = \frac{(x^2 - 5)^{\frac{1}{3}}}{x + 1}$  for  $x > -1$ .

(a) Show that  $\frac{dy}{dx} = \frac{Ax^2 + Bx + C}{3(x+1)^2(x^2-5)^{\frac{2}{3}}}$  where  $A$ ,  $B$  and  $C$  are integers. [6]

(b) Find the  $x$ -coordinate of the stationary point on the curve. [2]

(c) Explain how you could determine the nature of this stationary point. [2]  
[You are not required to find the nature of this stationary point.]

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