



# Cambridge O Level

CANDIDATE  
NAME

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CENTRE  
NUMBER

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**ADDITIONAL MATHEMATICS**

**4037/02**

Paper 2

**For examination from 2025**

SPECIMEN PAPER

**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 scientific calculator where appropriate.
- You must show all necessary working clearly.
- 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.
- For  $\pi$ , use either your calculator value or 3.142.

## 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.

## List of formulas

Equation of a circle with centre  $(a, b)$  and radius  $r$ .  $(x - a)^2 + (y - b)^2 = r^2$

Curved surface area,  $A$ , of cone of radius  $r$ , sloping edge  $l$ .  $A = \pi rl$

Surface area,  $A$ , of sphere of radius  $r$ .  $A = 4\pi r^2$

Volume,  $V$ , of pyramid or cone, base area  $A$ , height  $h$ .  $V = \frac{1}{3}Ah$

Volume,  $V$ , of sphere of radius  $r$ .  $V = \frac{4}{3}\pi r^3$

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  $u_n = ar^{n-1}$   
 $S_n = \frac{a(1 - r^n)}{1 - r} \quad (r \neq 1)$   
 $S_\infty = \frac{a}{1 - r} \quad (|r| < 1)$

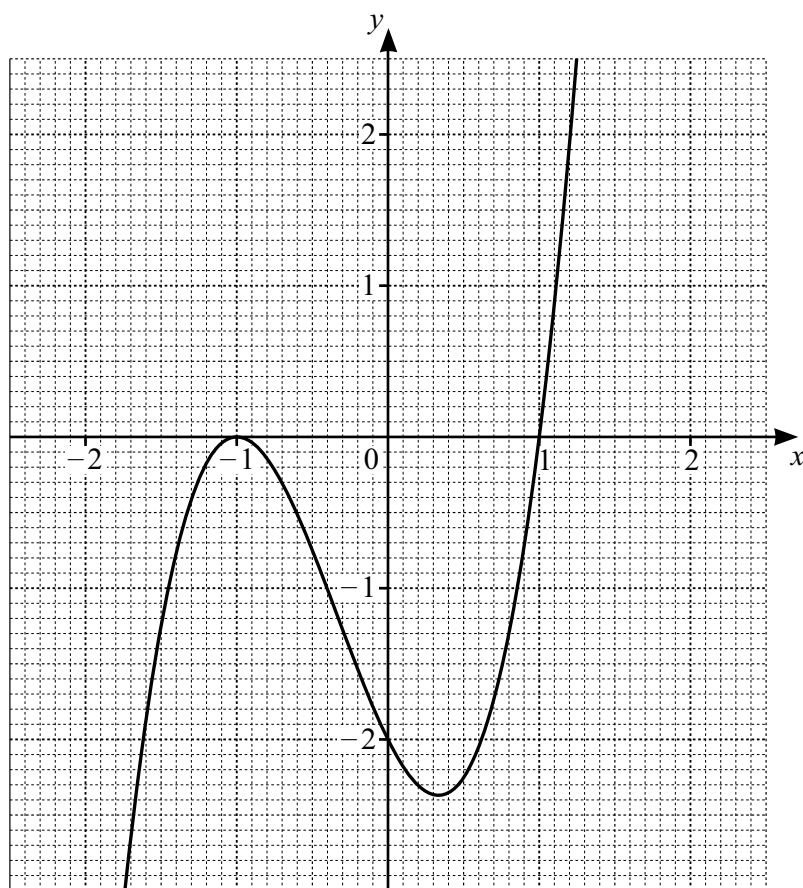
Identities  $\sin^2 A + \cos^2 A = 1$   
 $\sec^2 A = 1 + \tan^2 A$   
 $\operatorname{cosec}^2 A = 1 + \cot^2 A$

Formulas for  $\triangle ABC$   $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$   
 $a^2 = b^2 + c^2 - 2bc \cos A$   
 $\Delta = \frac{1}{2} ab \sin C$

1 (a) Solve the equation  $5|5x - 7| - 1 = 14$ .

[3]

(b)



The diagram shows the graph of  $y = f(x)$ , where  $f(x) = 2(x + 1)^2(x - 1)$ .

Use the graph to solve the inequality  $f(x) \leq -1$ .

[3]

- 2 For variables  $x$  and  $y$ , plotting  $\ln y$  against  $\ln x$  gives a straight-line graph passing through the points  $(6, 5)$  and  $(8, 9)$ .

Show that  $y = e^p x^q$  where  $p$  and  $q$  are integers to be found. [4]

- 3 Find the values of the constant  $k$  for which the equation  $(2k - 1)x^2 + 6x + k + 1 = 0$  has real roots. [5]

4 A photographer takes 12 different photographs. There are 3 photographs of sunsets, 4 of oceans and 5 of mountains.

(a) The photographs are arranged in a line on a wall.

(i) Find the number of possible arrangements if the first photograph is of a sunset and the last photograph is of an ocean. [2]

(ii) Find the number of possible arrangements if all the photographs of mountains are next to each other. [2]

(b) Three of the photographs are selected for a competition.

(i) Find the number of different possible selections if no photograph of a sunset is chosen. [2]

(ii) Find the number of different possible selections if one photograph of each type (sunset, ocean, mountain) is chosen. [2]

- 5 Given that  $y = \tan x$ , use calculus to find the approximate change in  $y$  as  $x$  increases from  $-\frac{\pi}{4}$  to  $h - \frac{\pi}{4}$ , where  $h$  is small. [3]

- 6 A curve has equation  $y = \ln(5 - 3x)$  where  $x < \frac{5}{3}$ . The normal to the curve at the point where  $x = -5$ , cuts the  $x$ -axis, at the point  $P$ .

Find the equation of the normal and the  $x$ -coordinate of  $P$ . [7]

**7 Solutions to this question by accurate drawing will not be accepted.**

A circle has equation  $x^2 + y^2 - 16x - 10y + 73 = 0$ .

**(a) (i)** Find the coordinates of the centre of the circle and the length of the radius. [3]

**(ii)** Hence show that the point  $(10, 6.5)$  lies inside the circle. [2]

**(b)** A different circle has equation  $(x - 10)^2 + (y - 6.5)^2 = 2.25$ .

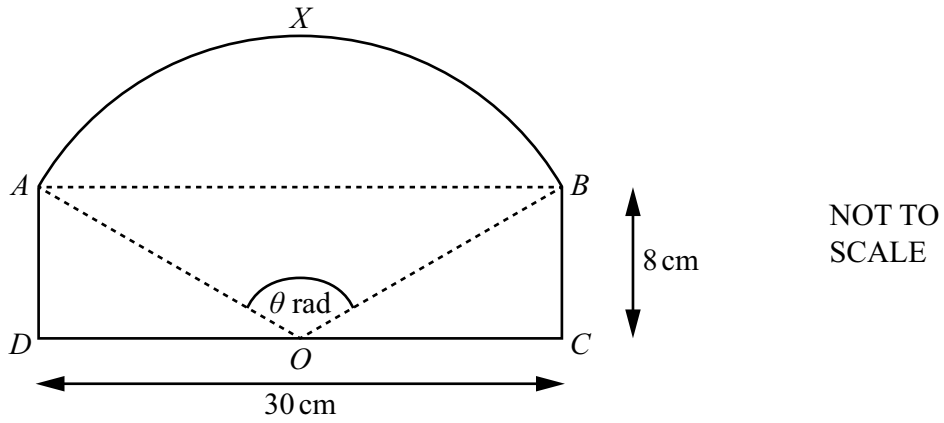
Show that the two circles touch. You are not required to find the coordinates of the common point. [1]

8 (a) (i) Show that  $\frac{\cos^2 2x}{1 + \sin 2x} = 1 - \sin 2x$ . [2]

(ii) Hence solve the equation for  $\frac{3 \cos^2 2x}{1 + \sin 2x} = 1$  for  $0^\circ \leq x \leq 90^\circ$ . [4]

(b) Solve the equation  $\cot\left(y - \frac{\pi}{2}\right) = \sqrt{3}$ , where  $y$  is in radians and  $0 \leq y \leq \pi$ . [3]





The diagram shows a rectangle  $ABCD$  and an arc  $AXB$  of a circle with centre at  $O$ , the midpoint of  $DC$ . The length of  $BC$  is 8 cm and the length of  $DC$  is 30 cm. Angle  $AOB$  is  $\theta$  radians.

(a) Find the perimeter of the shape  $ADOCBX$ . [5]

(b) Find the area of the shape  $ADOCBX$ . [2]

- 10 (a) In the expansion of  $\left(2k - \frac{x}{k}\right)^5$ , where  $k$  is a constant, the coefficient of  $x^2$  is 160.

Find the value of  $k$ .

[3]

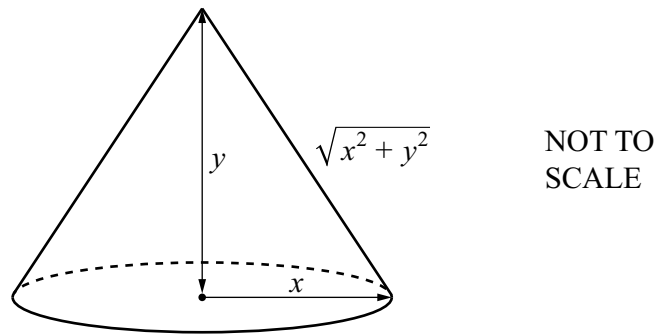
- (b) (i) Find the first 3 terms in the expansion of  $(1 + 3x)^6$ , in ascending powers of  $x$ . Simplify the coefficient of each term.

[2]

- (ii) When the expansion of  $(1 + 3x)^6(a + x)^2$  is written in ascending powers of  $x$ , the first three terms are  $4 + 68x + bx^2$ , where  $a$  and  $b$  are constants.

Find the value of  $a$  and the value of  $b$ . [3]

11 In this question, all lengths are in centimetres.

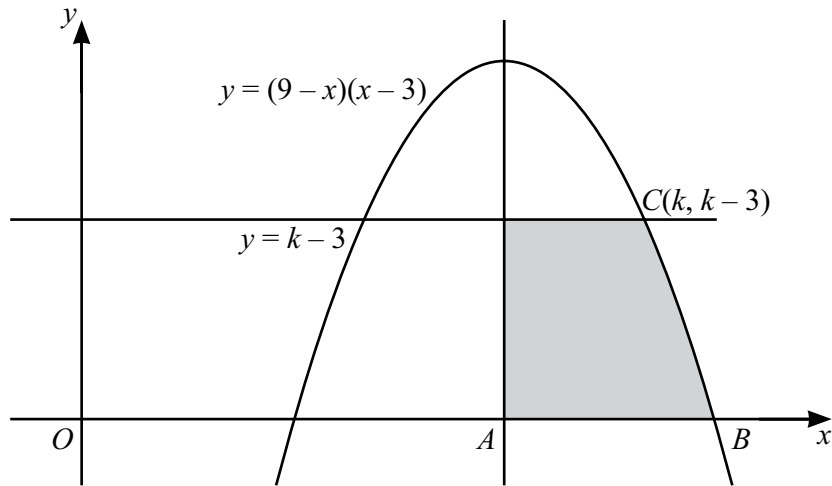


The diagram shows a cone of base radius  $x$ , height  $y$  and sloping edge  $\sqrt{x^2 + y^2}$ . The volume of the cone is  $10\pi \text{ cm}^3$ .

(a) Show that the curved surface area,  $S$ , of the cone is given by  $S = \frac{\pi\sqrt{x^6 + 900}}{x}$ . [3]

- (b) Given that  $x$  can vary and that  $S$  has a minimum value, find the value of  $x$  for which  $S$  is a minimum. [5]

12



The diagram shows part of the curve  $y = (9-x)(x-3)$  and the line  $y = k-3$ , where  $k > 3$ . The line through the maximum point of the curve, parallel to the  $y$ -axis, meets the  $x$ -axis at  $A$ . The curve meets the  $x$ -axis at  $B$ , and the line  $y = k-3$  meets the curve at the point  $C(k, k-3)$ .

Find the area of the shaded region.

[9]

Continuation of working space for Question 12.

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