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ADDITIONAL MATHEMATICS**0606/13**

Paper 1 Non-calculator

May/June 2025**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.
- Calculators must **not** be used in this paper.
- You must show all necessary working clearly.

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.



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 .

$$A = \pi r l$$

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 $\triangle ABC$

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

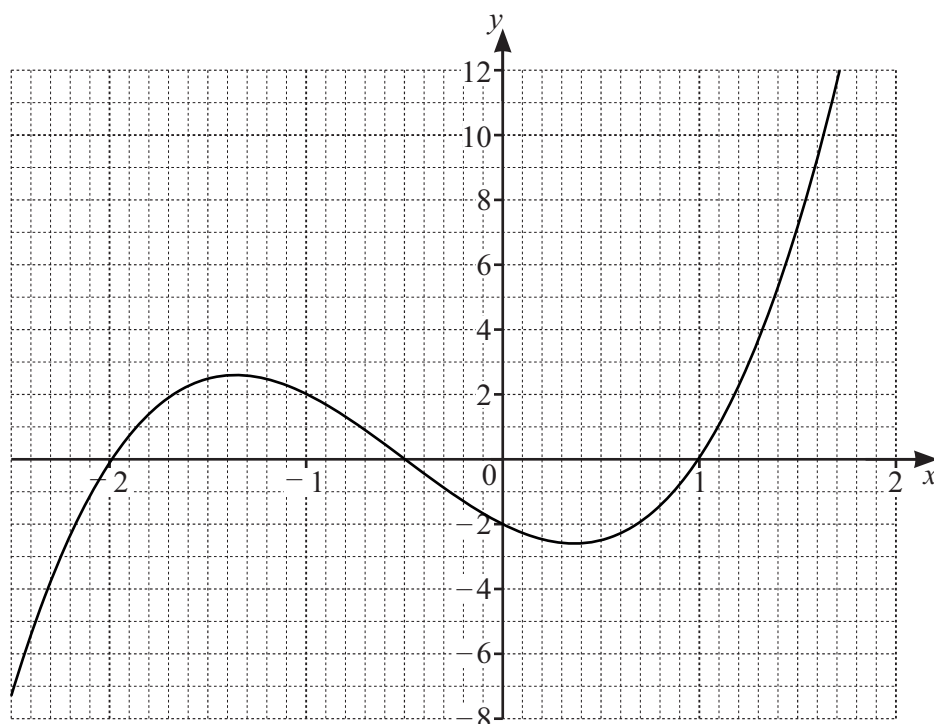
$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} ab \sin C$$



Calculators must **not** be used in this paper.

1 (a)



The diagram shows the graph of $y = (2x + a)(x + b)(x + c)$ where a , b and c are integers.

Find values for a , b and c .

[2]

(b) Use the graph to find the values of x for which $y \geq 2$.

[3]





- 2 Find the values of k for which the equation $x^2 + 4kx + k + 3 = 0$ has two equal roots.

[4]

- 3 The polynomial p is such that $p(x) = x^3 + Ax + 30$, where A is a constant. When $p(x)$ is divided by $x + 2$ the remainder is 84.

Write $p(x)$ as a product of linear factors.

[5]





4 Solve the equation $\frac{2}{\log_x 10} - \lg(x+4) = \lg 2$ for $x > 0$.

[5]



**5 Solutions by accurate drawing will not be accepted.**

A circle, C , has equation $(x-5)^2 + (y-12)^2 = 100$.

- (a) Find the equation of the tangent to C at the point $(11, 4)$.
Give your answer in the form $ax + by = c$, where a , b and c are integers.

[4]

- (b) Show that C and the circle with equation $x^2 + y^2 = 4$ do not intersect.

[2]





- 6 Find the x -coordinates of the points of intersection of the following curves.

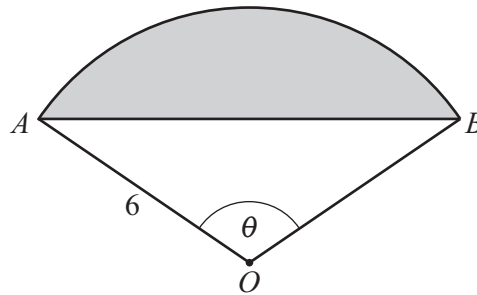
$$y = 4 \ln x \quad \text{and} \quad y = 5 - \frac{3}{\ln(x^2)}$$

Give your answers in exact form.

[5]



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



The diagram shows a sector of a circle with centre O and radius 6.

(a) It is given that the area of triangle AOB is 9 cm^2 .

Find the value of $\sin \theta$.

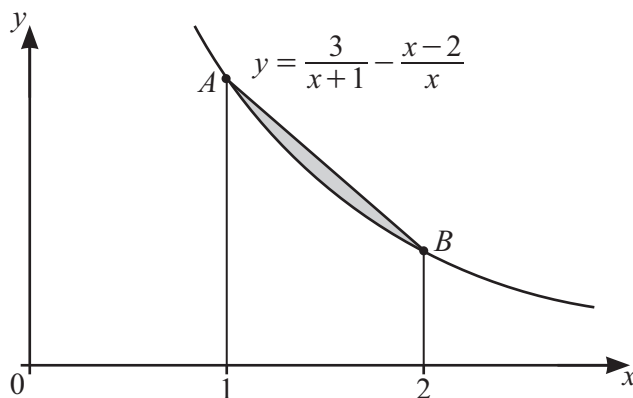
[2]

(b) It is also given that the exact area of the shaded segment is $(15\pi - 9)\text{ cm}^2$.

Find the exact length of the arc AB .

[4]





The diagram shows part of the curve $y = \frac{3}{x+1} - \frac{x-2}{x}$.

The points A and B lie on the curve such that the x -coordinate of A is 1 and the x -coordinate of B is 2.

(a) Find the y -coordinates of A and B . [1]

(b) Show that the area of the shaded region enclosed by the line AB and the curve is $\frac{a}{4} - \ln \frac{b}{2}$, where a and b are integers to be found. [7]



9 The function f is defined by $f(x) = -2x^2 + 9x - 10$ for $0 \leq x \leq 3$.

(a) (i) Write $f(x)$ in the form $a + b(x + c)^2$ where a , b and c are constants.

[3]

(ii) Hence determine whether or not f^{-1} exists.

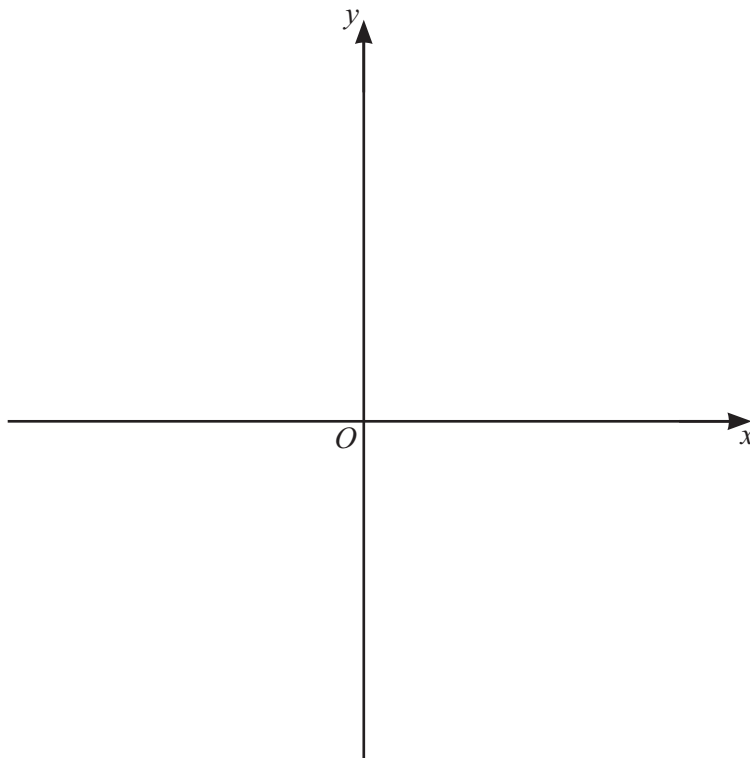
[2]





(b) The function g is defined by $g(x) = 3 \ln(5 - 2x)$ for $0 \leq x < 2.5$.

- (i) On the axes, sketch the graph of $y = g(x)$.
State the exact values of the intercepts with the coordinate axes and the equation of any asymptote. [3]



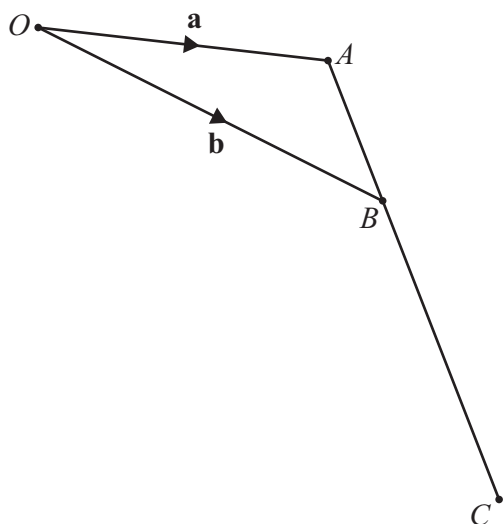
- (ii) Find an expression for $g^{-1}(x)$. [2]

- (iii) Find the domain and range of g^{-1} .
Give each of your answers in exact form. [2]





10



The diagram shows four points, O , A , B and C .

A , B and C lie in a straight line and are such that $\frac{AB}{AC} = \frac{1}{3}$.

$\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

- (a) Find $\overrightarrow{OC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
Simplify your answer.

[3]





- (b) The line OA is extended to the point D such that $OA : AD = 2 : 7$.
 Point E lies on CD such that $\overrightarrow{OE} = \lambda \mathbf{b}$.

Find the value of λ .

[5]





- 11 A particle P moves in a straight line and passes through a fixed point O .
At time t seconds, its displacement from O , s metres, is given by

$$s = t + 6t^2 - t^3 \quad \text{for } 0 \leq t \leq 3$$

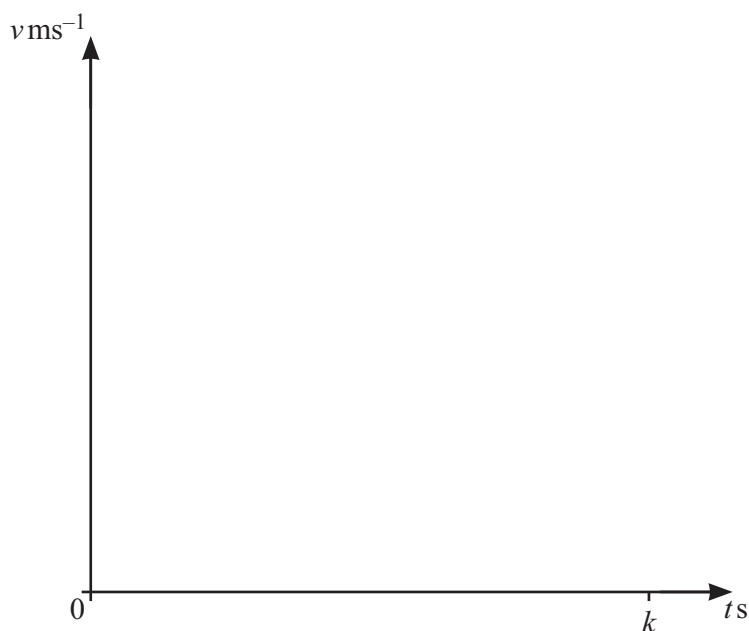
$$s = 12t - \frac{1}{3}t^2 - 3 \quad \text{for } 3 \leq t \leq k \quad \text{where } k \text{ is a constant.}$$

It is given that, for $3 \leq t \leq k$, the velocity of P is positive and its acceleration is negative.

- (a) The maximum velocity of P occurs when $t = 2$.

On the axes below, sketch a velocity–time graph for the first k seconds of the motion of P .

[4]





- (b) The total distance travelled by P for $0 \leq t \leq k$ is 57 metres.

Given that when $t = 3$ the distance and displacement of P from O are equal, find the value of k .
[6]

Question 12 is printed on the next page.





- 12 The normal to the curve $y = \frac{4}{x^2} + ax + 7$ at the point where $x = 2$ has equation $x + 4y = b$.

Find the values of a and b .

[6]

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