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Cambridge Assessment International Education

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 5 3 1 6 3 2 5 7 9 2 *

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **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.
- 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 π, 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.

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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

$$(a+b)^n=a^n+\binom{n}{1}a^{n-1}b+\binom{n}{2}a^{n-2}b^2+\ldots+\binom{n}{r}a^{n-r}b^r+\ldots+b^n,$$

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 ΔABC

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

1 Solve the inequality $(x+2)(4x-5) \leqslant 0$. [2]

2 Given that $y = \dfrac{4x^3-5}{x^2}$, show that $\dfrac{dy}{dx}$ can be written as $\dfrac{2(2x^3+5)}{x^3}$. [3]

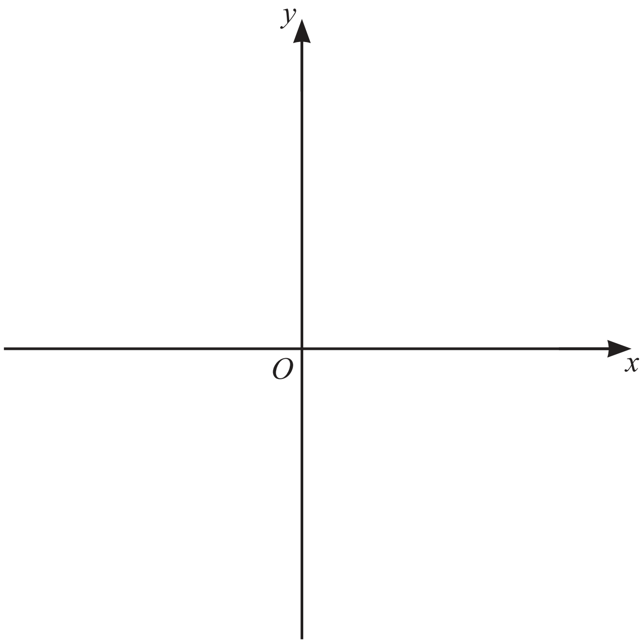
3 Variables x and y are such that when $\sqrt{y}$ is plotted against x^3 a straight line graph passing through the points (2, 5) and (10, 21) is obtained.

Find y in terms of x. [4]

4 The function f is defined by $f(x) = 2x - 1$ for $x \in \mathbb{R}$.

(a) Explain why the function f^2 can be formed. [1]

(b) On the axes, sketch the graph of $y = |f^2(x)|$.
State any intercepts with the coordinate axes. [4]



(c) It is given that $|f^2(x)| \leqslant ax + b$ for $-1 \leqslant x \leqslant 3$ and for **no other** values of x.

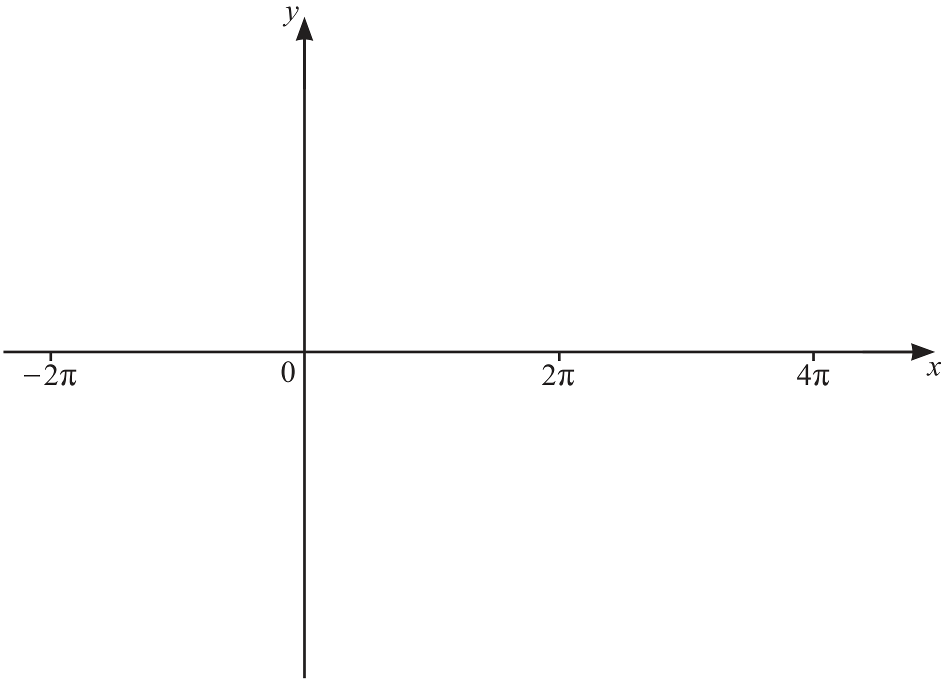
Find the values of a and b. [3]

5 In this question, all angles are in radians.

(a) Write down the period of $5\tan\left(\frac{x}{4}\right)+1$. [1]

(b) On the axes, sketch the graph of $y = 5\tan\left(\frac{x}{4}\right)+1$ for $-2\pi \leqslant x \leqslant 4\pi$.

State the intercept with the y-axis.
Show clearly the positions of any asymptotes. [3]



6 **(a)** Five of the digits 1 2 3 4 5 6 7 8 9 are used to make a 5-digit number.

Find how many ways this can be done when the 5-digit number is greater than 50 000. [2]

(b) In a group of 13 people, 7 have red hair and 6 have brown hair.

(i) The 13 people stand in line for a photograph.
No person with red hair is standing next to another person with red hair.

Find the number of different ways this can be done. [2]

(ii) Chris chooses 5 people from this group.

Find the number of ways Chris can do this if at least 1 person chosen has brown hair. [2]

7 **(a)** Find the term independent of x in the expansion of $\left(x^2 - \frac{3}{x^4}\right)^{15}$. [2]

(b) In the expansion of $(1+ax)^9$ the coefficient of x^3 is 7 times the coefficient of x^2.

Given that a is a positive constant, find the value of a. [3]

8 **(a)** It is given that $y = e^{3x+2}\tan x$.

Use calculus to find the approximate change in y as x increases from 0.1 to $0.1 + h$, where h is small. [5]

(b) A curve is such that $\frac{dy}{dx} = \sin(3x + \pi)$.

The curve passes through the point $\left(\frac{\pi}{9}, \frac{4}{3}\right)$.

Find the exact y-coordinate of the point on the curve where $x = \frac{5\pi}{12}$. [4]

9 **(a)** The 1st term of an arithmetic progression is 9.
The last term of this progression is 159.
The sum of all the terms is 2604.

The 12th term of this arithmetic progression is the 1st term of a geometric progression.
The 8th term of this arithmetic progression is the 2nd term of the geometric progression.

Find the sum of the first 6 terms of the geometric progression. [7]

(b) A different geometric progression has 1st term $\sin\theta$.
The common ratio of this progression is $\cos\theta$ where $45° \leqslant \theta \leqslant 135°$.

(i) Show that this progression has a sum to infinity. [1]

(ii) Show that this sum to infinity can be written as $\operatorname{cosec}\theta + \cot\theta$. [4]

10 In this question, time is in seconds.

(a) At time $t = 0$, particle P starts from the point with position vector $-30\mathbf{j}$.
P travels with speed $58\,\text{ms}^{-1}$ in the direction $20\mathbf{i}+21\mathbf{j}$.

Find the position vector of P at time t. [3]

(b) Also at time $t = 0$, particle Q starts from the point with position vector $-10\mathbf{i}+18\mathbf{j}$.

Q travels with speed $75\,\text{ms}^{-1}$ at an angle α above the positive x-axis, where $\tan\alpha = \frac{7}{24}$.

Find the position vector of Q at time t. [4]

(c) Determine whether P and Q collide. [2]

11 Given that $\frac{^{n+1}\mathrm{P}_5}{437} = {}^{n}\mathrm{P}_3$, use an algebraic method to find the value of n. [4]

12 The function f is defined by $f(x) = 15\cos^2(3x + 1.5) + 7\sin(3x + 1.5) - 13$ for $-0.3 \leqslant x \leqslant 0.5$, where x is in radians.

(a) Solve the equation $f(x) = 0$. [5]

(b) Find the x-coordinates of the two stationary points on the curve $y = \text{f}(x)$. [5]

Question 13 is printed on the next page.

13 Solve the equation $64^{x+\frac{1}{3}}+2^{3x}-3=0$. [4]