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ADDITIONAL MATHEMATICS

0606/12

Paper 1

October/November 2022

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

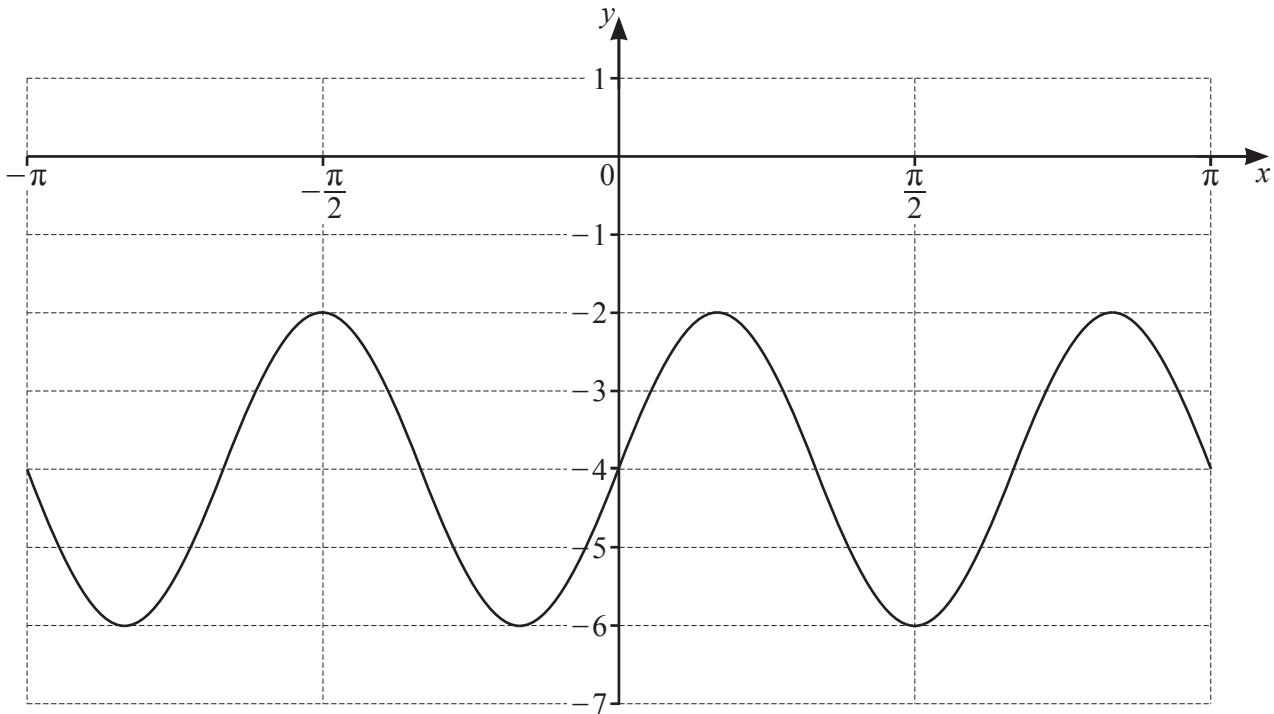
$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

Formulae for ΔABC

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

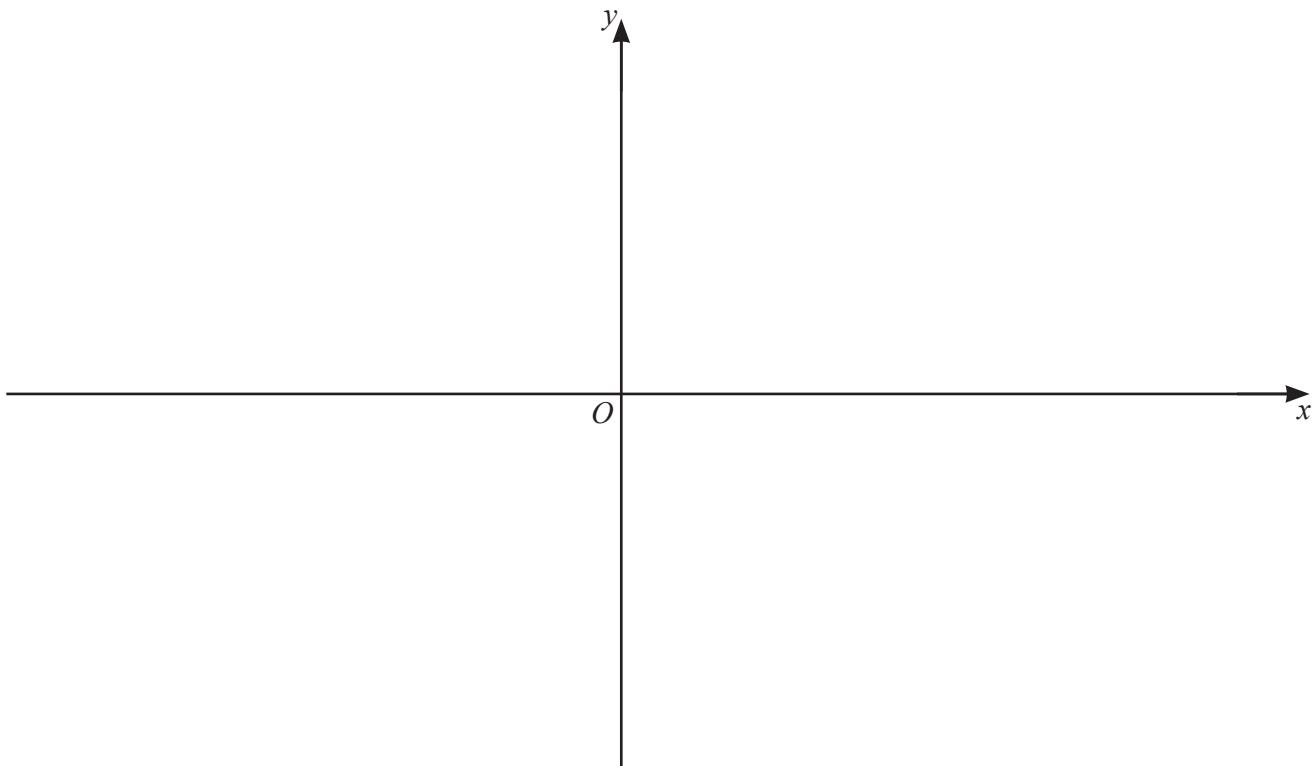
$$a^2 = b^2 + c^2 - 2bc \cos A$$

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



The diagram shows the graph of $y = a \sin bx + c$, where a , b and c are integers. Find the values of a , b and c . [3]

- 2 (a) On the axes, draw the graph of $y = |3x^2 + 13x - 10|$, stating the coordinates of the points where the graph meets the axes. [4]



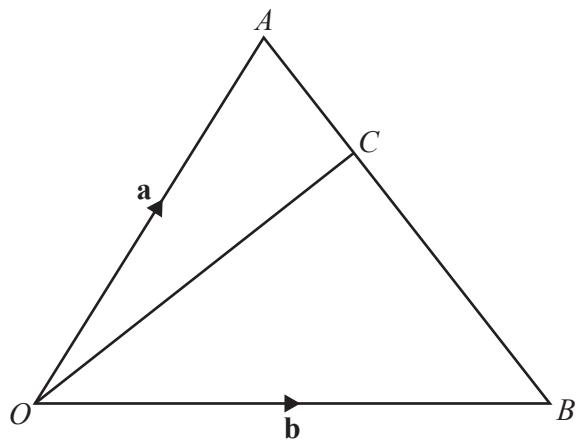
- (b) Find the set of values of the constant k such that the equation $k = |3x^2 + 13x - 10|$ has exactly 2 distinct roots. [4]

3 Write $\frac{\sqrt{(9p^2q)} \times r^{-3}}{(2p)^3 q^{-1} \sqrt[5]{r}}$ in the form $kp^a q^b r^c$, where k, a, b and c are constants. [4]

4 Solve the equation $3 \sin\left(2x + \frac{\pi}{4}\right) = \sqrt{3} \cos\left(2x + \frac{\pi}{4}\right)$, for $0 \leq x \leq \pi$. [5]

- 5 (a) Find the vector with magnitude 200 in the direction of $\begin{pmatrix} 7 \\ -24 \end{pmatrix}$. [2]

(b)

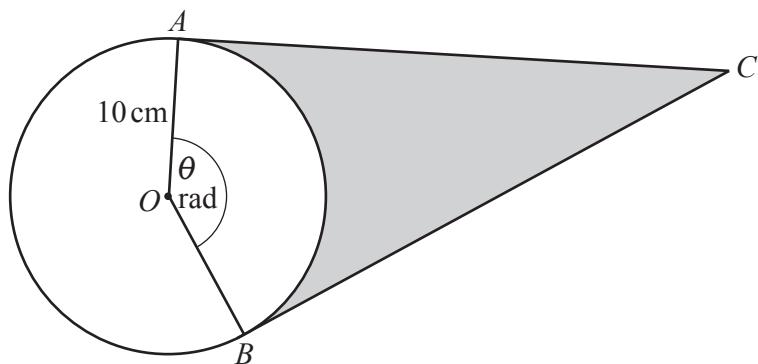


The diagram shows triangle AOB such that $\overrightarrow{OA} = \mathbf{a}$, and $\overrightarrow{OB} = \mathbf{b}$. The point C lies on the line AB such that $AC : AB = 1 : 3$. Find the vector \overrightarrow{OC} in terms of \mathbf{a} and \mathbf{b} , giving your answer in its simplest form.

[3]

(c) Given the vector equation $p\begin{pmatrix} 2 \\ 1 \end{pmatrix} + q\begin{pmatrix} 2 \\ 4 \end{pmatrix} = 5\begin{pmatrix} -p+1 \\ p+q \end{pmatrix}$, find the values of p and q . [3]

- 6 A group of 15 people includes 3 brothers. A team of 6 people is to be chosen from this group. The three brothers must not be separated. Find the number of possible teams that can be chosen. [3]



The diagram shows a circle, centre O , radius 10 cm. The points A and B lie on the circumference of the circle. The tangent at A and the tangent at B meet at the point C . The angle AOB is θ radians. The length of the minor arc AB is 28 cm.

- (a) Find the value of θ . [1]

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

(c) Find the area of the shaded region.

[3]

8 A function $f(x)$ is such that $f(x) = \ln(2x+3) + \ln 4$, for $x > a$, where a is a constant.

(a) Write down the least possible value of a .

[1]

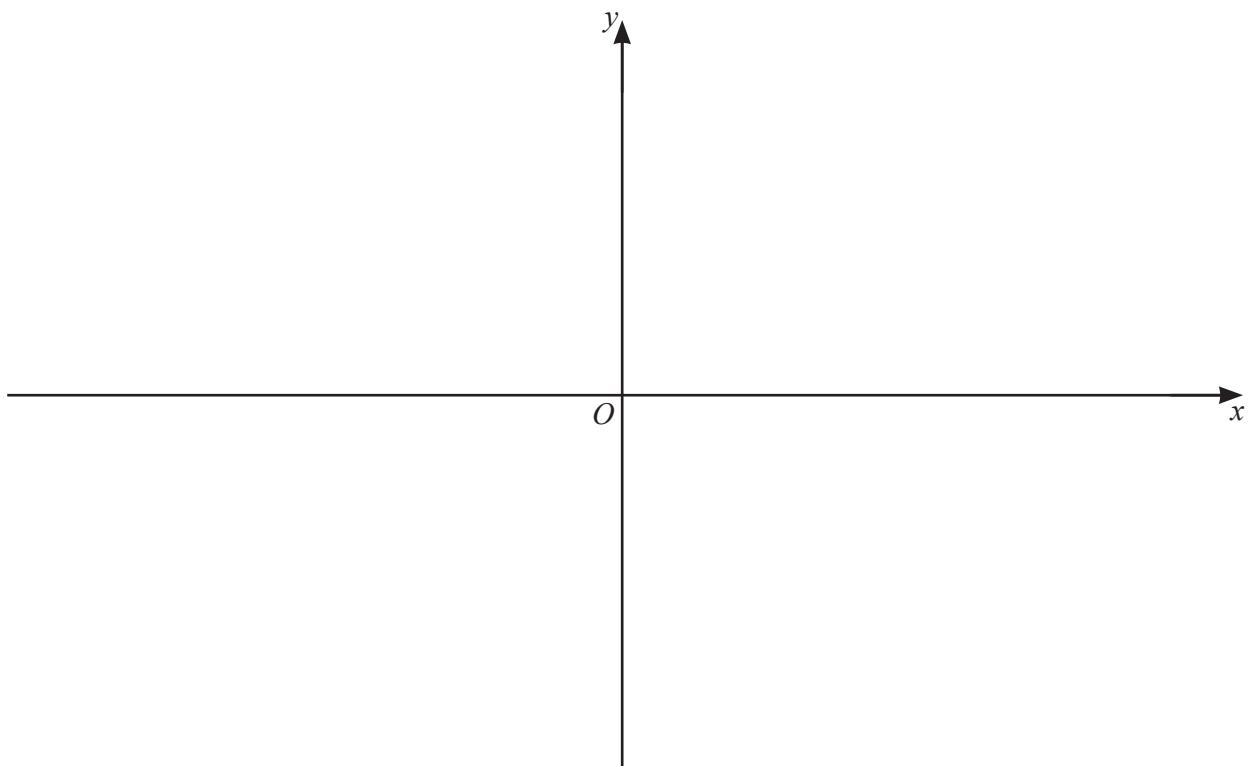
(b) Using your value of a , write down the range of f .

[1]

(c) Using your value of a , find $f^{-1}(x)$, stating its range.

[4]

- (d) On the axes below, sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$, stating the exact intercepts of each graph with the coordinate axes. Label each of your graphs. [4]



9 (a) Show that $\frac{1}{2x+1} - \frac{1}{(2x+1)^2} + \frac{4}{4x-1} = \frac{24x^2 + 14x + 4}{(2x+1)^2(4x-1)}$. [2]

(b) Hence find $\int_{\frac{1}{2}}^1 \frac{24x^2 + 14x + 4}{(2x+1)^2(4x-1)} dx$, giving your answer in the form $\frac{1}{2} \ln p + q$, where p and q are rational numbers. [7]

- 10 The first three terms of an arithmetic progression are $\lg x$, $\lg x^5$, $\lg x^9$, where $x > 0$.
- (a) Show that the sum to n terms of this arithmetic progression can be written as $n(pn - 1)\lg x$, where p is an integer. [4]
- (b) Hence find the value of n for which the sum to n terms is equal to $4950\lg x$. [2]
- (c) Given that this sum to n terms is also equal to -14850 , find the exact value of x . [2]

- 11 A particle P moves in a straight line such that, t seconds after passing through a fixed point O , its displacement, s metres, is given by $s = \frac{(2t+1)^{\frac{3}{2}}}{t+1} - 1$.

(a) Show that the velocity of P at time t can be written in the form $\frac{(2t+1)^{\frac{1}{2}}}{(t+1)^2}(a+bt)$, where a and b are integers to be found. [5]

(b) Show that P is never at instantaneous rest after passing through O . [1]

- 12 The first three terms, in descending powers of x , of the expansion of $\left(ax + \frac{2}{5}\right)^5 \left(1 - \frac{b}{x}\right)^2$, can be written as $32x^5 - 160x^4 + cx^3$, where a , b and c are constants. Find the exact values of a , b and c . [9]

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