Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

3463116585

ADDITIONAL MATHEMATICS **4037/22**

Paper 2 **May/June 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.

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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

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

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 $u_n = ar^{n-1}$

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

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

2. TRIGONOMETRY

Identities

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

Formulae for ΔABC

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

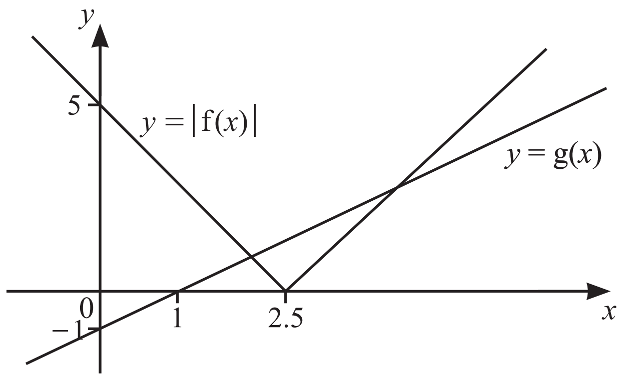
$$a^2 = b^2 + c^2 - 2bc\cos A$$

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

1 **DO NOT USE A CALCULATOR IN THIS QUESTION.**

A curve has equation $y = \dfrac{6+\sqrt{x}}{3+\sqrt{x}}$ where $x \geqslant 0$. Find the exact value of y when $x = 6$. Give your answer in the form $a + b\sqrt{c}$, where a, b and c are integers. [3]

2



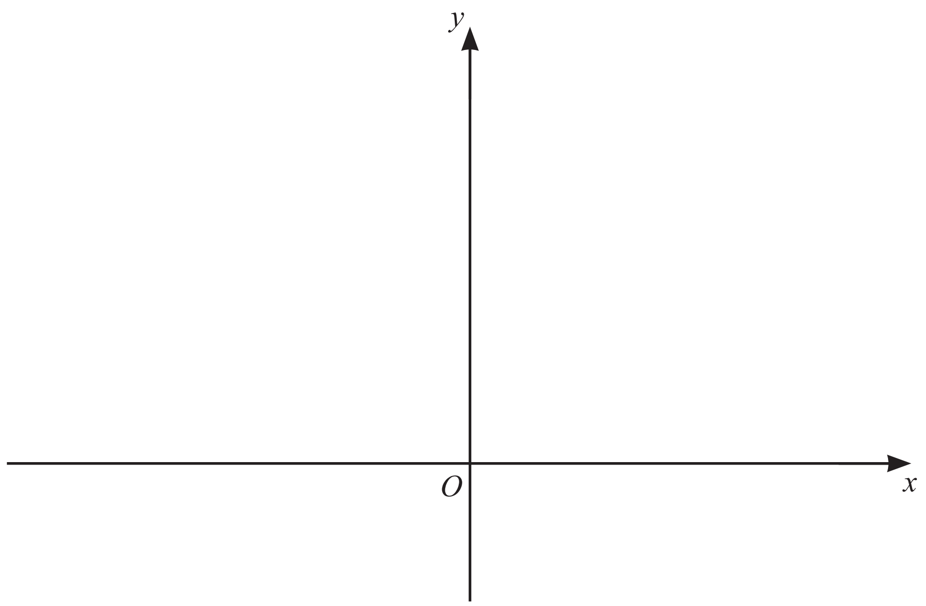
The diagram shows the graphs of $y = |\mathrm{f}(x)|$ and $y = \mathrm{g}(x)$, where $y = \mathrm{f}(x)$ and $y = \mathrm{g}(x)$ are straight lines. Solve the inequality $|\mathrm{f}(x)| \leqslant \mathrm{g}(x)$. [5]

3 Find the possible values of k for which the equation $kx^2 + (k+5)x - 4 = 0$ has real roots. [5]

4 Variables x and y are related by the equation $y = 1 + \frac{2}{x} + \frac{1}{x^2}$ where $x > 0$. Use differentiation to find the approximate change in x when y increases from 4 by the small amount 0.01. [5]

5 **(a)** Solve the equation $\dfrac{625^{\frac{x^3-1}{2}}}{125^{x^3}} = 5.$ [3]

(b) On the axes, sketch the graph of $y = 4e^x + 3$ showing the values of any intercepts with the coordinate axes. [2]



6 **(a)** In this question, **i** is a unit vector due east and **j** is a unit vector due north.

A cyclist rides at a speed of $4\,\text{ms}^{-1}$ on a bearing of 015°. Write the velocity vector of the cyclist in the form $x\mathbf{i} + y\mathbf{j}$, where x and y are constants. [2]

(b) A vector of magnitude 6 on a bearing of 300° is added to a vector of magnitude 2 on a bearing of 230° to give a vector **v**. Find the magnitude and bearing of **v**. [5]

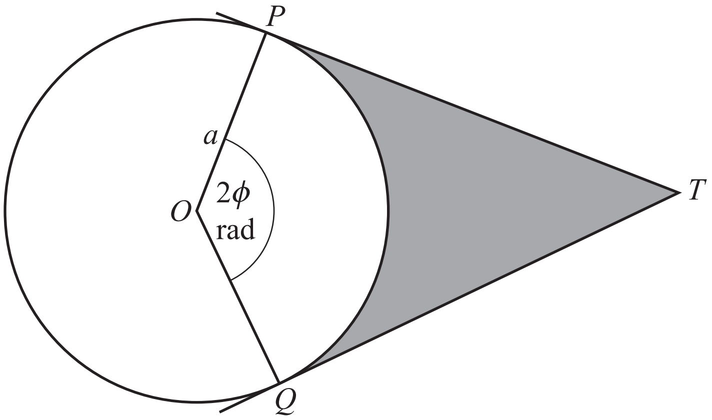
7 Differentiate $y = \dfrac{e^{4x}\tan x}{\ln x}$ with respect to x. [4]

8 The function f is defined by $f(x) = 3\sin^2 x - 2\cos x$ for $2 \leqslant x \leqslant 4$, where x is in radians.

(a) Find the x-coordinate of the stationary point on the curve $y = f(x)$. [5]

(b) Solve the equation $f(x) = 1 - 3\cos x$. [5]

9 In this question all lengths are in centimetres.



The diagram shows a circle, centre O, radius a. The lines PT and QT are tangents to the circle at P and Q respectively. Angle POQ is 2ϕ radians.

(a) In the case when the area of the sector OPQ is equal to the area of the shaded region, show that $\tan\phi = 2\phi$. [4]

(b) In the case when the perimeter of the sector OPQ is equal to half the perimeter of the shaded region, find an expression for $\tan\phi$ in terms of ϕ. [3]

10 **(a)** A geometric progression has first term a and common ratio r, where $r > 0$. The second term of this progression is 8. The sum of the third and fourth terms is 160.

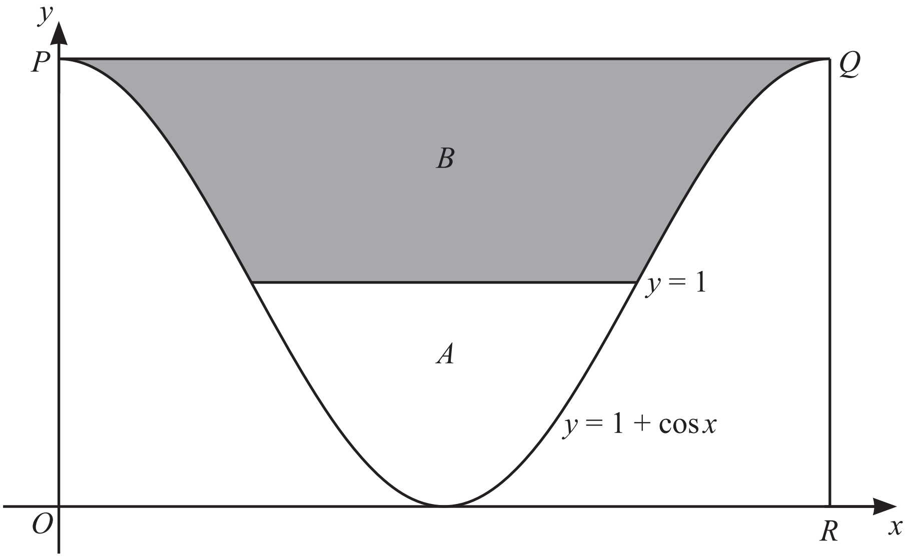
(i) Show that r satisfies the equation $r^2 + r - 20 = 0$. [4]

(ii) Find the value of a. [3]

(b) An arithmetic progression has first term p and common difference 2. The qth term of this progression is 14.
A different arithmetic progression has first term p and common difference 4. The sum of the first q terms of this progression is 168.

Find the values of p and q. [6]

11



The diagram shows part of the line $y = 1$ and one complete period of the curve $y = 1 + \cos x$, where x is in radians. The line PQ is a tangent to the curve at P and at Q. The line QR is parallel to the y-axis. Area A is enclosed by the line $y = 1$ and the curve. Area B is enclosed by the line $y = 1$, the line PQ and the curve.

Given that area A : area B is $1 : k$ find the exact value of k. [9]

Continuation of working space for Question 11.

Question 12 is printed on the next page.

12 A curve is such that $\dfrac{d^2y}{dx^2} = \left(\dfrac{\sqrt{x}+1}{\sqrt[4]{x}}\right)^2$. Given that the gradient of the curve is $\dfrac{4}{3}$ at the point $(1, -1)$, find the equation of the curve. [7]