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ADDITIONAL MATHEMATICS

0606/11

Paper 1

October/November 2021

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.

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 $u_n = ar^{n-1}$

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

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

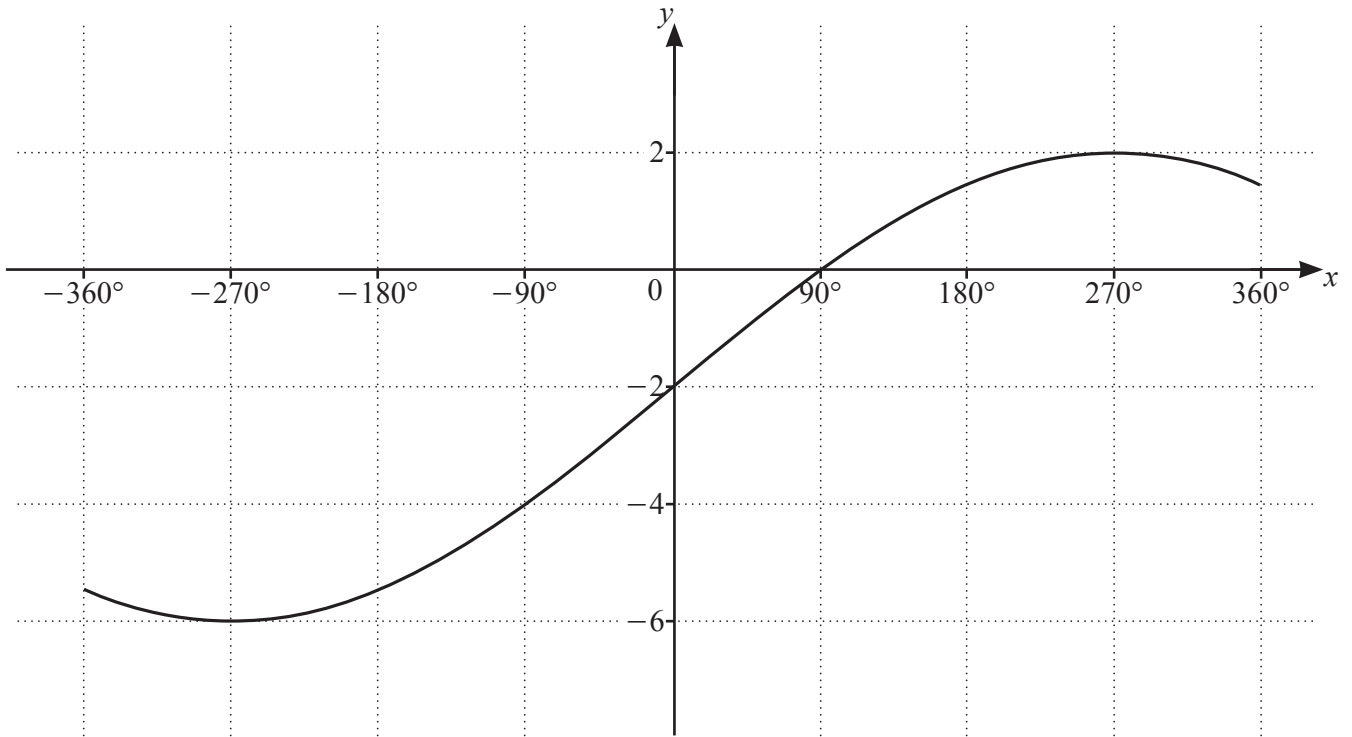
2. TRIGONOMETRY*Identities*

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

Formulae for $\triangle ABC$

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

1



The diagram shows the graph of $y = a \sin \frac{x}{b} + c$ for $-360^\circ \leq x \leq 360^\circ$, where a , b and c are integers.

(a) Write down the period of $a \sin \frac{x}{b} + c$. [1]

(b) Find the value of a , of b and of c . [3]

- 2 Points A and C have coordinates $(-4, 6)$ and $(2, 18)$ respectively. The point B lies on the line AC such that $\overrightarrow{AB} = \frac{2}{3} \overrightarrow{AC}$.

(a) Find the coordinates of B . [2]

(b) Find the equation of the line l , which is perpendicular to AC and passes through B . [2]

(c) Find the area enclosed by the line l and the coordinate axes. [2]

- 3 (a) Find the vector which has magnitude 39 and is in the same direction as $\begin{pmatrix} 12 \\ -5 \end{pmatrix}$. [2]

- (b) Given that $\mathbf{a} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$, find the constants λ and μ such that $5\mathbf{a} + \lambda\begin{pmatrix} 4 \\ 6 \end{pmatrix} = \mu\mathbf{b}$. [4]

4 (a) Given that $\frac{q^{-2}\sqrt{pr}}{\sqrt[3]{r}(pq)^{-3}} = p^a q^b r^c$, find the value of each of the constants a , b and c . [3]

(b) Solve the equation $3x^{\frac{4}{5}} - 8x^{\frac{2}{5}} + 5 = 0$. [4]

- 5 The polynomial $p(x) = ax^3 + bx^2 + 6x + 4$, where a and b are integers, is divisible by $x - 2$. When $p'(x)$ is divided by $x + 1$ the remainder is -7 .

(a) Find the value of a and of b .

[5]

(b) Using your answers to **part (a)**, find the remainder when $p''(x)$ is divided by x .

[2]

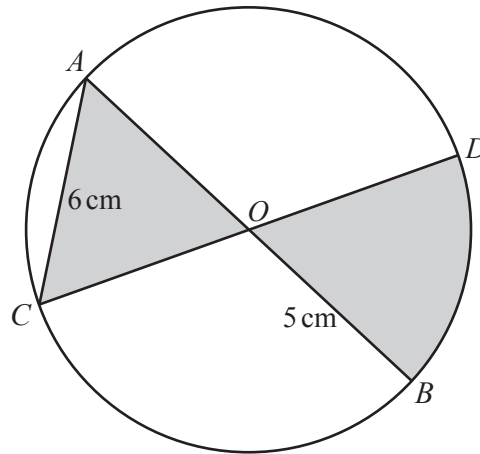
- 6 A curve with equation $y = f(x)$ is such that $\frac{d^2y}{dx^2} = 6e^{3x} + 4x$. The curve has a gradient of 5 at the point $\left(0, \frac{5}{3}\right)$. Find $f(x)$. [7]

- 7 The first three terms, in ascending powers of x , in the expansion of $(2+ax)^n$ can be written as $64+bx+cx^2$, where n , a , b and c are constants.

(a) Find the value of n . [1]

(b) Show that $5b^2 = 768c$. [4]

(c) Given that $b = 12$, find the exact value of a and of c . [2]



The diagram shows a circle, centre O , radius 5 cm. The lines AOB and COD are diameters of this circle. The line AC has length 6 cm.

(a) Show that angle $AOC = 1.287$ radians, correct to 3 decimal places. [2]

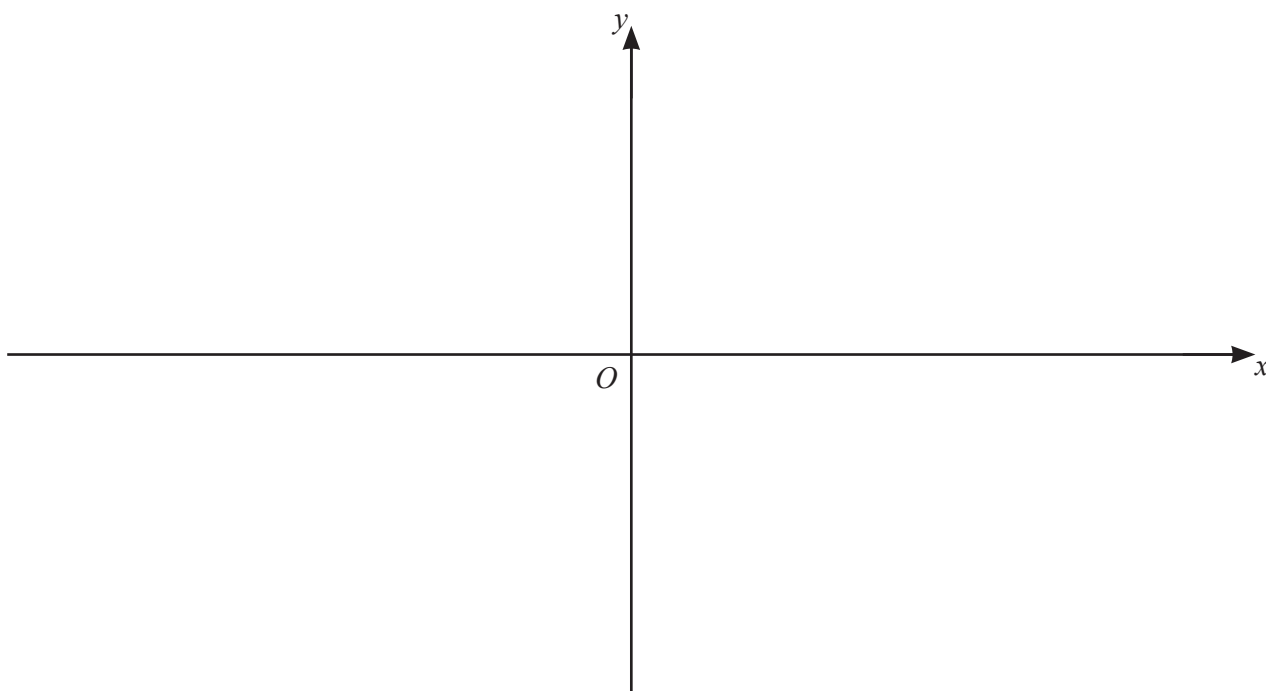
(b) Find the perimeter of the shaded region. [2]

(c) Find the area of the shaded region.

[3]

- 9 (a) Find the coordinates of the stationary points on the curve $y = (2x + 1)(x - 3)^2$. Give your answers in exact form. [4]

- (b) On the axes below, sketch the graph of $y = |(2x+1)(x-3)^2|$, stating the coordinates of the points where the curve meets the axes. [4]



- (c) Hence write down the value of the constant k such that $|(2x+1)(x-3)^2| = k$ has exactly 3 distinct solutions. [1]

- 10 (a)** Jess runs on 5 days each week to prepare for a race.

In week 1, every run is 2 km.

In week 2, every run is 2.5 km.

In week 3, every run is 3 km.

Jess increases the distance of the run by 0.5 km every week.

- (i)** Find the week in which Jess runs 16 km on each of the 5 days.

[2]

- (ii)** Find the total distance Jess will have run by the end of week 8.

[3]

- (b) Kyle also runs on 5 days each week to prepare for a race.
In week 1, every run is 2 km.
In week 2, every run is 2.5 km.
In week 3, every run is 3.125 km.
The distances he runs each week form a geometric progression.

(i) Find the common ratio of the geometric progression. [1]

(ii) Find the first week in which Kyle will run more than 16 km on each of the 5 days. [3]

(iii) Find the total distance Kyle will have run by the end of week 8. [3]

- 11 (a) Solve the equation $3 \operatorname{cosec}^2 \theta - 5 = 5 \cot \theta$ for $0^\circ \leq \theta \leq 180^\circ$. [4]

- (b) Solve the equation $\sin\left(\phi + \frac{\pi}{3}\right) = -\frac{1}{2}$, where ϕ is in radians and $-\pi \leq \phi \leq \pi$. Give your answers in terms of π . [4]

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