Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9164116781

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

This document consists of **16** printed pages.

DC (SC/CB) 165277/2

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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 $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

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 Find the values of x for which $9x^2 + 18x - 1 < x + 1$. [3]

2 Differentiate $\tan 3x \cos \frac{x}{2}$ with respect to x. [4]

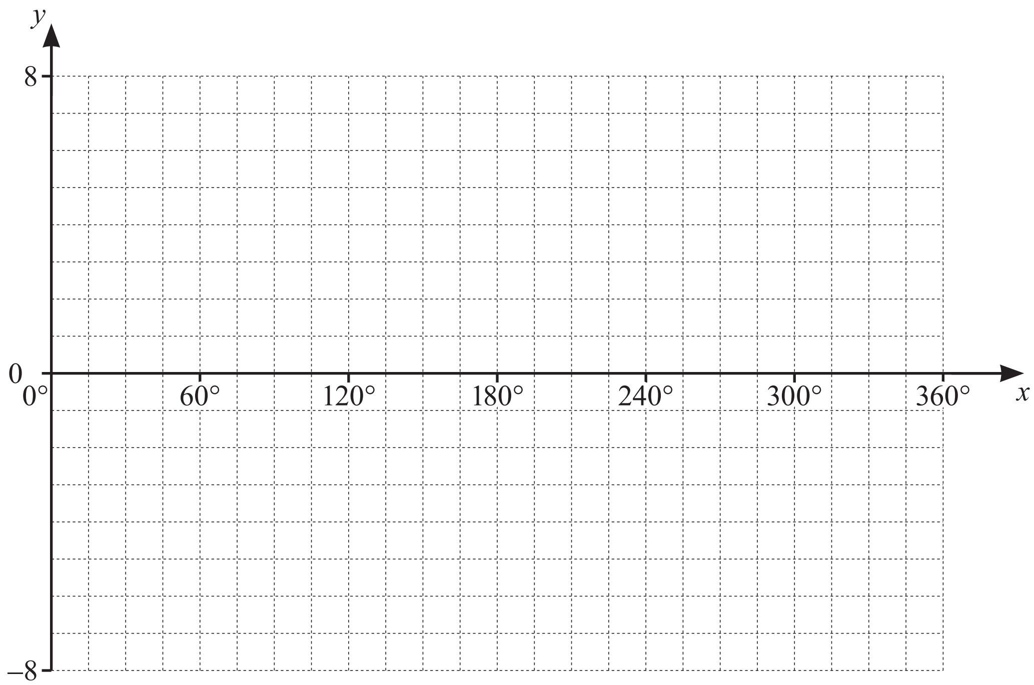
3 The points A, B and C have coordinates (4, 7), (−3, 9) and (6, 4) respectively.

(i) Find the equation of the line, L, that is parallel to the line AB and passes through C. Give your answer in the form $ax + by = c$, where a, b and c are integers. [3]

(ii) The line L meets the x-axis at the point D and the y-axis at the point E. Find the length of DE. [2]

4 The function f is defined, for $0° \leqslant x \leqslant 360°$, by $\mathrm{f}(x) = 4 + 3\sin 2x$.

(i) Sketch the graph of $y = \mathrm{f}(x)$ on the axes below.



[3]

(ii) State the period of f. [1]

(iii) State the amplitude of f. [1]

5 **(a)** Given that $\mathbf{A} = \begin{pmatrix} 2 & 3 \\ 0 & -1 \\ 6 & 4 \end{pmatrix}$ and that $\mathbf{A} + \mathbf{O} = \mathbf{A}$,

(i) state the order of the matrix **A**, [1]

(ii) write down the matrix **O**. [1]

(b) $\mathbf{B} = \begin{pmatrix} 1 & -1 \\ 3 & 2 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 0.4 & 0.2 \\ -0.6 & 0.2 \end{pmatrix}$.

Find the matrix product **BC** and state a relationship between **B** and **C**. [2]

(c) $\mathbf{D} = \begin{pmatrix} a & 4a \\ -1 & 5 \end{pmatrix}$, where a is a positive integer. Find $\mathbf{D}^{-1}$ in terms of a. [2]

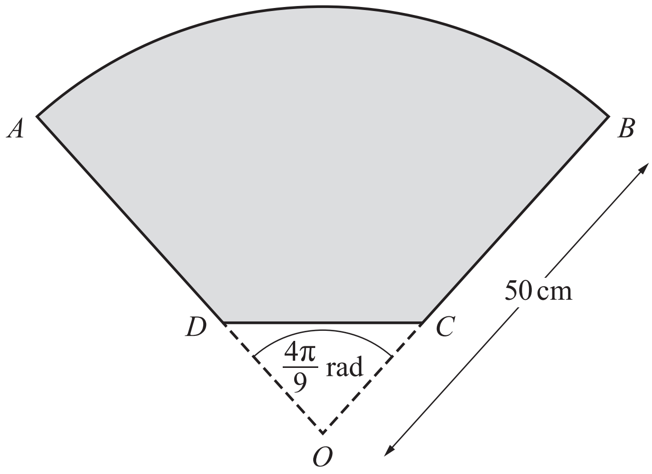
6 A curve has equation $y = (3x-5)^3 - 2x$.

(i) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. [4]

(ii) Find the exact value of the x-coordinate of each of the stationary points of the curve. [2]

(iii) Use the second derivative test to determine the nature of each of the stationary points. [2]

7



The diagram shows a company logo, *ABCD*. The logo is part of a sector, *AOB*, of a circle, centre *O* and radius 50 cm. The points *C* and *D* lie on *OB* and *OA* respectively. The lengths *AD* and *BC* are equal and *AD* : *AO* is 7 : 10. The angle *AOB* is $\frac{4\pi}{9}$ radians.

(i) Find the perimeter of *ABCD*. [5]

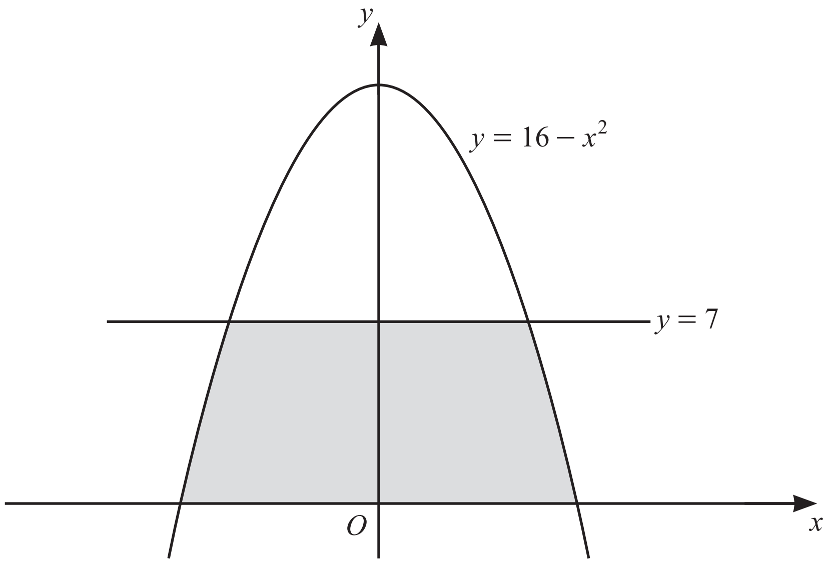
(ii) Find the area of *ABCD*. [3]

8 **(a)** **(i)** Given that $\left(x^2 - \frac{1}{px}\right)^8 = x^{16} - 4x^{13} + qx^{10} + rx^7 + \ldots$, find the value of each of the constants p, q and r. [3]

(ii) Explain why there is no term independent of x in the binomial expansion of $\left(x^2 - \frac{1}{px}\right)^8$. [1]

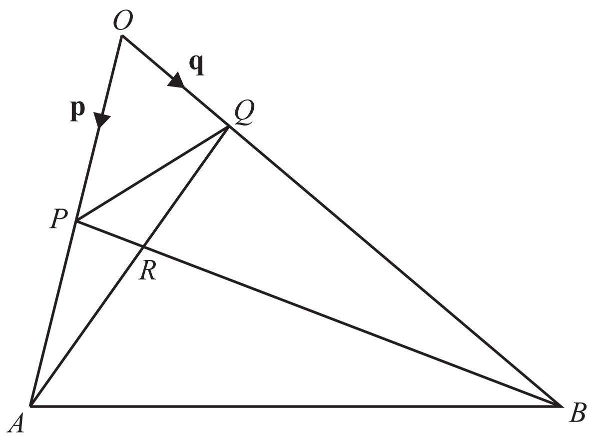
(b) In the binomial expansion of $\left(1 - \frac{\sqrt{x}}{2}\right)^n$, where n is a positive integer, the coefficient of x is 30. Form an equation in n and hence find the value of n. [4]

9



The diagram shows the curve $y = 16 - x^2$ and the straight line $y = 7$. Find the area of the shaded region. You must show all your working. [6]

10



The diagram shows a triangle OAB. The point P is the midpoint of OA and the point Q lies on OB such that $\overrightarrow{OQ} = \frac{1}{4}\overrightarrow{OB}$. The position vectors of P and Q relative to O are $\mathbf{p}$ and $\mathbf{q}$ respectively.

(i) Find, in terms of $\mathbf{p}$ and $\mathbf{q}$, an expression for each of the vectors $\overrightarrow{PQ}$, $\overrightarrow{QA}$ and $\overrightarrow{PB}$. [3]

(ii) Given that $\overrightarrow{PR} = \lambda\overrightarrow{PB}$ and that $\overrightarrow{QR} = \mu\overrightarrow{QA}$, find an expression for $\overrightarrow{PQ}$ in terms of λ, μ, $\mathbf{p}$ and $\mathbf{q}$. [2]

(iii) Using your expressions for $\overrightarrow{PQ}$, find the value of λ and of μ. [4]

11 A particle travelling in a straight line passes through a fixed point O. The displacement, x metres, of the particle, t seconds after it passes through O, is given by $x = 5t + \sin t$.

(i) Show that the particle is never at rest. [2]

(ii) Find the distance travelled by the particle between $t = \frac{\pi}{3}$ and $t = \frac{\pi}{2}$. [2]

(iii) Find the acceleration of the particle when $t = 4$. [2]

(iv) Find the value of t when the velocity of the particle is first at its minimum. [2]

Question 12 is printed on the next page.

12 Do not use a calculator in this question.

The line $y = 4x - 6$ intersects the curve $y = 10x^3 - 19x^2 - x$ at the points A, B, and C. Given that C is the point (2, 2), find the coordinates of the midpoint of AB. [10]