Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

1438509375

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **February/March 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 **14** printed pages and **2** blank pages.

DC (KS/TP) 165271/2

Cambridge Assessment International Education

[Turn over

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 A band can play 25 different pieces of music. From these pieces of music, 8 are to be selected for a concert.

(i) Find the number of different ways this can be done. [1]

The 8 pieces of music are then arranged in order.

(ii) Find the number of different arrangements possible. [1]

The band has 15 members. Three members are chosen at random to be the treasurer, secretary and agent.

(iii) Find the number of ways in which this can be done. [1]

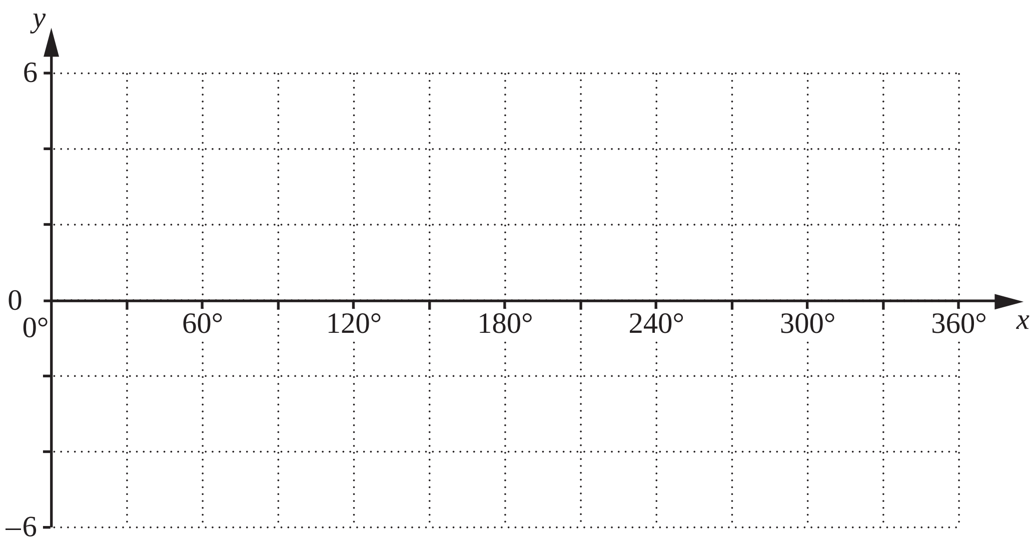
2 Variables x and y are related by the equation $y = \dfrac{\ln x}{e^x}$.

(i) Show that $\dfrac{dy}{dx} = \dfrac{1 - x\ln x}{xe^x}$. [4]

(ii) Hence find the approximate change in y as x increases from 2 to $2 + h$, where h is small. [2]

3 The function f is defined, for $0^\circ \leqslant x \leqslant 360^\circ$, by $f(x) = a + b\sin cx$, where a, b and c are constants with $b > 0$ and $c > 0$. The graph of $y = f(x)$ meets the y-axis at the point $(0, -1)$, has a period of 120° and an amplitude of 5.

(i) Sketch the graph of $y = f(x)$ on the axes below. [3]



(ii) Write down the value of each of the constants a, b and c. [2]

a = ... b = ... c = ...

4 **(a)** Find the values of x for which $(2x+1)^2 \leqslant 3x+4$. [3]

(b) Show that, whatever the value of k, the equation $\frac{x^2}{4}+kx+k^2+1=0$ has no real roots. [3]

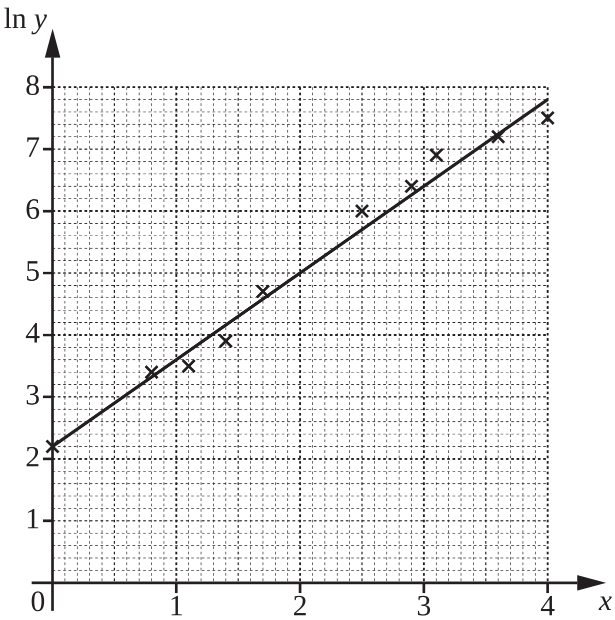
5 **Solutions to this question by accurate drawing will not be accepted.**

The points $A(3, 2)$, $B(7, -4)$, $C(2, -3)$ and $D(k, 3)$ are such that CD is perpendicular to AB. Find the equation of the perpendicular bisector of CD. [6]

6 The relationship between experimental values of two variables, x and y, is given by $y = Ab^x$, where A and b are constants.

(i) Transform the relationship $y = Ab^x$ into straight line form. [2]

The diagram shows $\ln y$ plotted against x for ten different pairs of values of x and y. The line of best fit has been drawn.



(ii) Find the equation of the line of best fit and the value, correct to 1 significant figure, of A and of b. [4]

(iii) Find the value, correct to 1 significant figure, of y when $x = 2.7$. [2]

7 **(i)** Given that $y = x\sqrt{x^2+1}$, show that $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{ax^2+b}{\left(x^2+1\right)^p}$, where a, b and p are positive constants. [4]

(ii) Explain why the graph of $y = x\sqrt{x^2+1}$ has no stationary points. [2]

8 Relative to an origin O, the position vectors of the points A and B are $2\mathbf{i} + 12\mathbf{j}$ and $6\mathbf{i} - 4\mathbf{j}$ respectively.

(i) Write down and simplify an expression for $\overrightarrow{AB}$. [2]

The point C lies on $\overrightarrow{AB}$ such that $AC : CB$ is $1 : 3$.

(ii) Find the unit vector in the direction of $\overrightarrow{OC}$. [4]

The point D lies on $\overrightarrow{OA}$ such that $OD : DA$ is $1 : \lambda$.

(iii) Find an expression for $\overrightarrow{AD}$ in terms of λ, $\mathbf{i}$ and $\mathbf{j}$. [2]

9 **(a)** It is given that $g(x) = 6x^4 + 5$ for all real x.

(i) Explain why g is a function but does not have an inverse. [2]

(ii) Find $g^2(x)$ and state its domain. [2]

It is given that $h(x) = 6x^4 + 5$ for $x \leqslant k$.

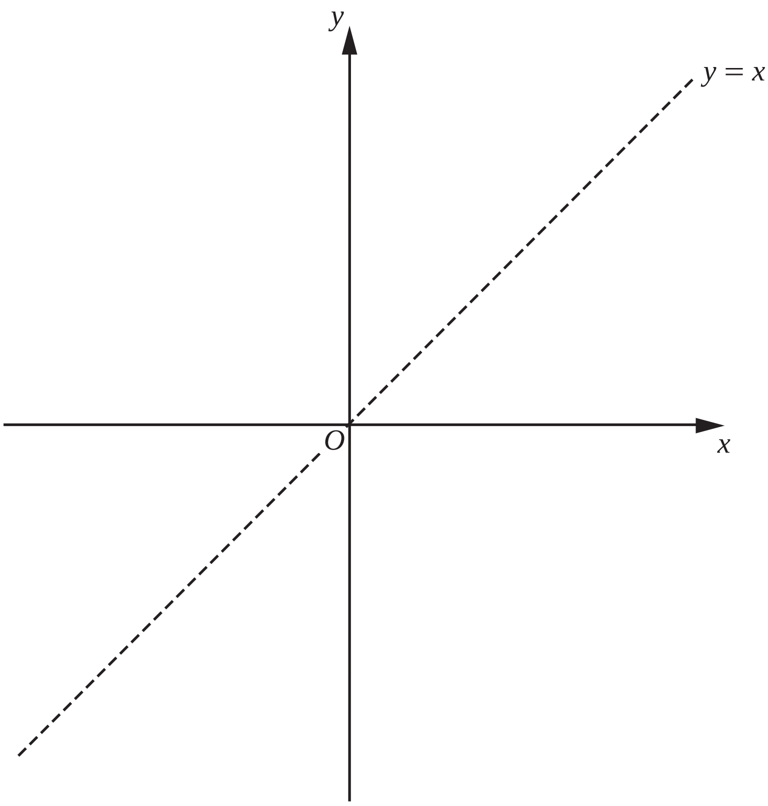
(iii) State the greatest value of k such that h^{-1} exists. [1]

(iv) For this value of k, find $h^{-1}(x)$. [3]

(b) The function p is defined by $\mathrm{p}(x) = 3\mathrm{e}^{x} + 2$ for all real x.

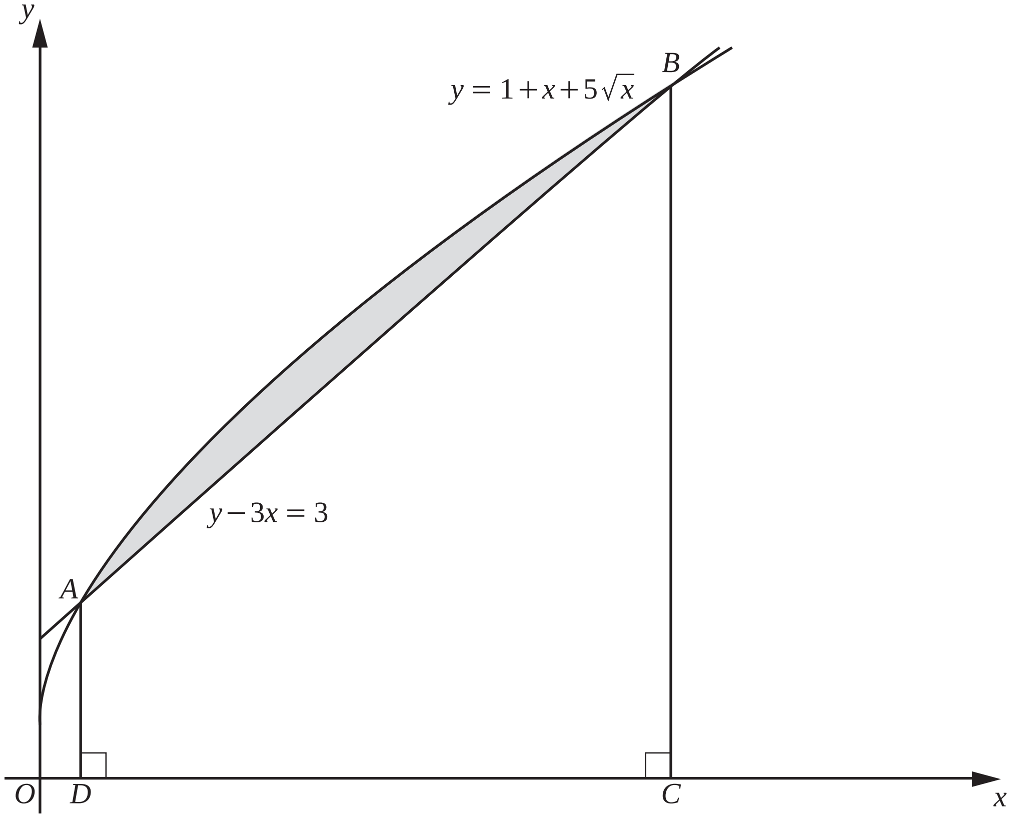
(i) State the range of p. [1]

(ii) On the axes below, sketch and label the graphs of $y = \mathrm{p}(x)$ and $y = \mathrm{p}^{-1}(x)$. State the coordinates of any points of intersection with the coordinate axes. [3]



(iii) Hence explain why the equation $\mathrm{p}(x) = \mathrm{p}^{-1}(x)$ has no solutions. [1]

10



The diagram shows the curve $y = 1 + x + 5\sqrt{x}$ and the straight line $y - 3x = 3$. The curve and line intersect at the points A and B. The lines BC and AD are perpendicular to the x-axis.

(i) Using the substitution $u^2 = x$, or otherwise, find the coordinates of A and of B. You must show all your working. [6]

(ii) Find the area of the shaded region, showing all your working. [6]

11 **(a)** Find $\int \frac{x^2(x^6+1)}{x^6}\,\mathrm{d}x$. [3]

(b) **(i)** Find $\int \cos(4\theta - 5)\,\mathrm{d}\theta$. [2]

(ii) Hence evaluate $\int_{1.25}^{2} \cos(4\theta - 5)\,\mathrm{d}\theta$. [2]

BLANK PAGE

BLANK PAGE