Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME											
CENTRE NUMBER							CANDIDATE NUMBER				

0123456789

ADDITIONAL MATHEMATICS **4037/02**

Paper 2 **For examination from 2020**

SPECIMEN PAPER **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. 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

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

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

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

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

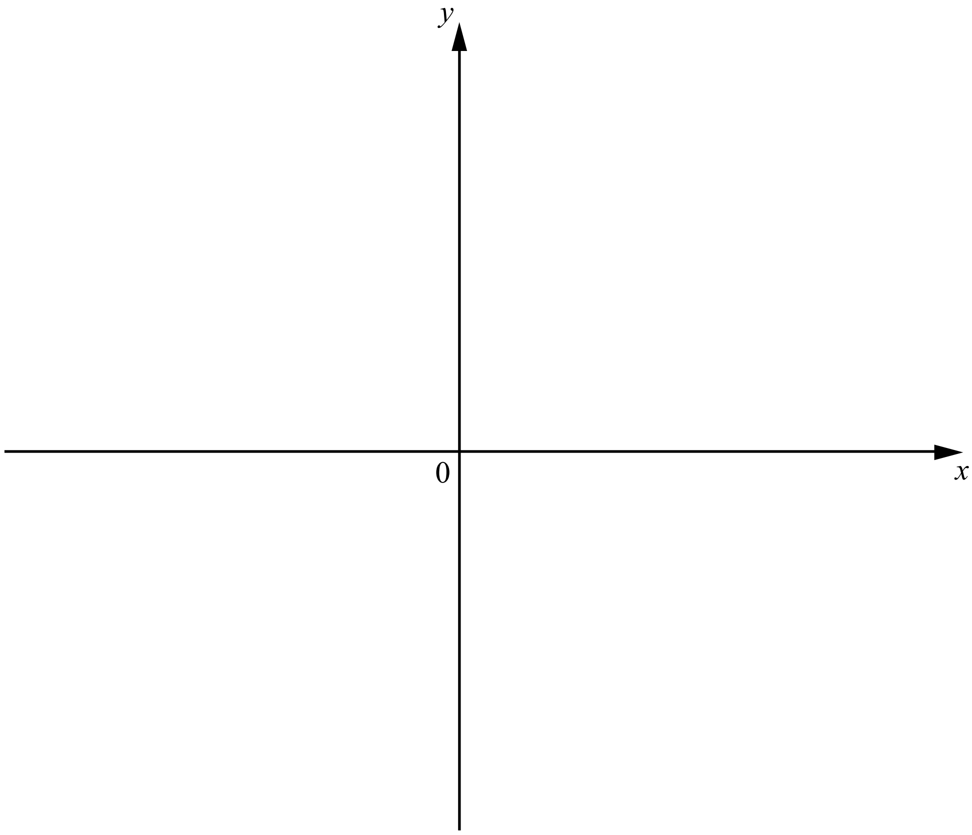
$$\Delta = \frac{1}{2} bc \sin A$$

1 Solve

$$xy = 3,$$

$$x^4y^5 = 486.$$

2 **(a)** On the axes below, sketch the graph of $y = \frac{1}{5}(x-2)(x-4)(x+5)$, showing the coordinates of the points where the graph meets the coordinate axes.



[2]

(b) Explain why your sketch in part **(a)** can be used to solve $(x-2)(x-4)(x+5) \leqslant 0$. [1]

(c) Hence solve $(x-2)(x-4)(x+5) \leqslant 0$. [1]

3 Functions g and h are such that

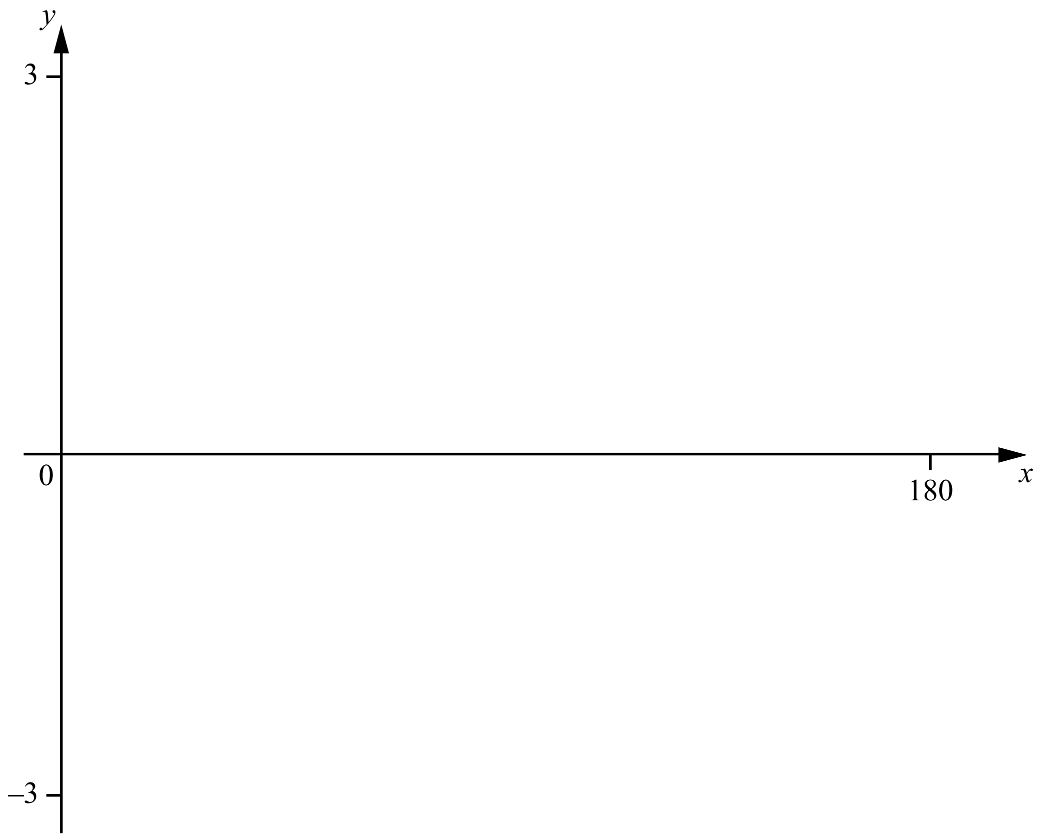
$$g(x) = 2 + 4\ln x \quad \text{for } x > 0,$$
$$h(x) = x^2 + 4 \quad \text{for } x > 0.$$

(a) Find g^{-1}, stating its domain and its range. [4]

(b) Solve $gh(x) = 10$. [3]

(c) Solve $g'(x) = h'(x)$.

4 On the axes below, sketch the graph of $y = 2\sin\frac{3}{2}x - 1$ for $0° \leqslant x \leqslant 180°$, showing the coordinates of the points where the graph meets the coordinate axes. [4]



5 **(a)** A 6-character password is to be chosen from the following 9 characters.

letters	A	B	E	F
numbers	5	8	9	
symbols	*	$		

Each character may be used only once in any password.

Find the number of different 6-character passwords that may be chosen if

(i) there are no restrictions, [1]

(ii) the password consists of 2 letters, 2 numbers and 2 symbols in that order, [2]

(iii) the password must start and finish with a symbol. [2]

(b) An examination consists of a section A, containing 10 short questions, and a section B
5 long questions. Candidates are required to answer 6 questions from section A and 3 q
from section B.

Find the number of different selections of questions that can be made if

(i) there are no further restrictions, [2]

(ii) candidates must answer the first 2 questions in section A and the first question in section B. [2]

6 A particle P travels in a straight line such that, t s after passing through a fixed point O, its vel… is given by $v = \left(e^{\frac{t^2}{8}} - 4\right)^3$.

(a) Find the speed of P at O. [1]

(b) Find the value of t for which P is instantaneously at rest. [2]

(c) Find the acceleration of P when $t = 1$. [4]

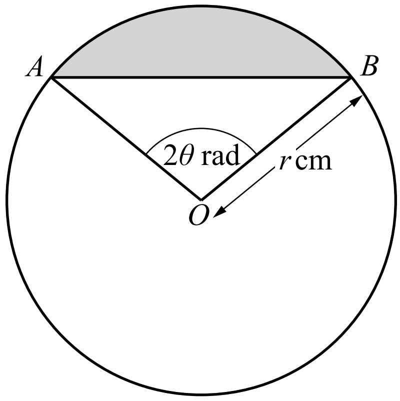
7 Variables x and y are such that when $\lg y$ is plotted against x^2, a straight line graph pass… the points (1, 0.73) and (4, 0.10) is obtained.

(a) Given that $y = Ab^{x^2}$, find the value of each of the constants A and b.

(b) Find the value of y when $x = 1.5$. [2]

(c) Find the positive value of x when $y = 2$. [2]

8

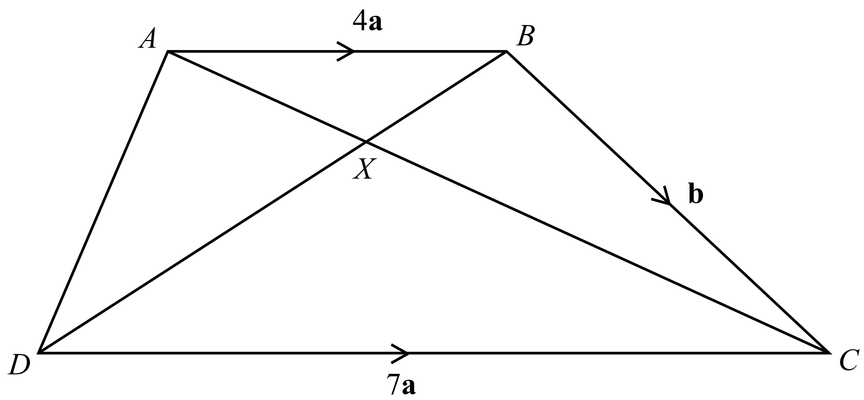


The diagram shows a circle, centre O, radius r cm. The points A and B lie on the circle such that angle $AOB = 2\theta$ radians.

(a) Given that the perimeter of the shaded region is 20 cm, show that $r = \dfrac{10}{\theta + \sin\theta}$. [3]

(b) Given that r and θ can vary, find the value of $\dfrac{dr}{d\theta}$ when $\theta = \dfrac{\pi}{6}$.

9



In the diagram $\overrightarrow{AB} = 4\mathbf{a}$, $\overrightarrow{BC} = \mathbf{b}$ and $\overrightarrow{DC} = 7\mathbf{a}$. The lines AC and DB intersect at the point X.

Find, in terms of **a** and **b**,

(a) $\overrightarrow{DB}$, [1]

(b) $\overrightarrow{DA}$. [1]

Given that $\overrightarrow{AX} = \lambda\overrightarrow{AC}$ find, in terms of **a**, **b** and λ,

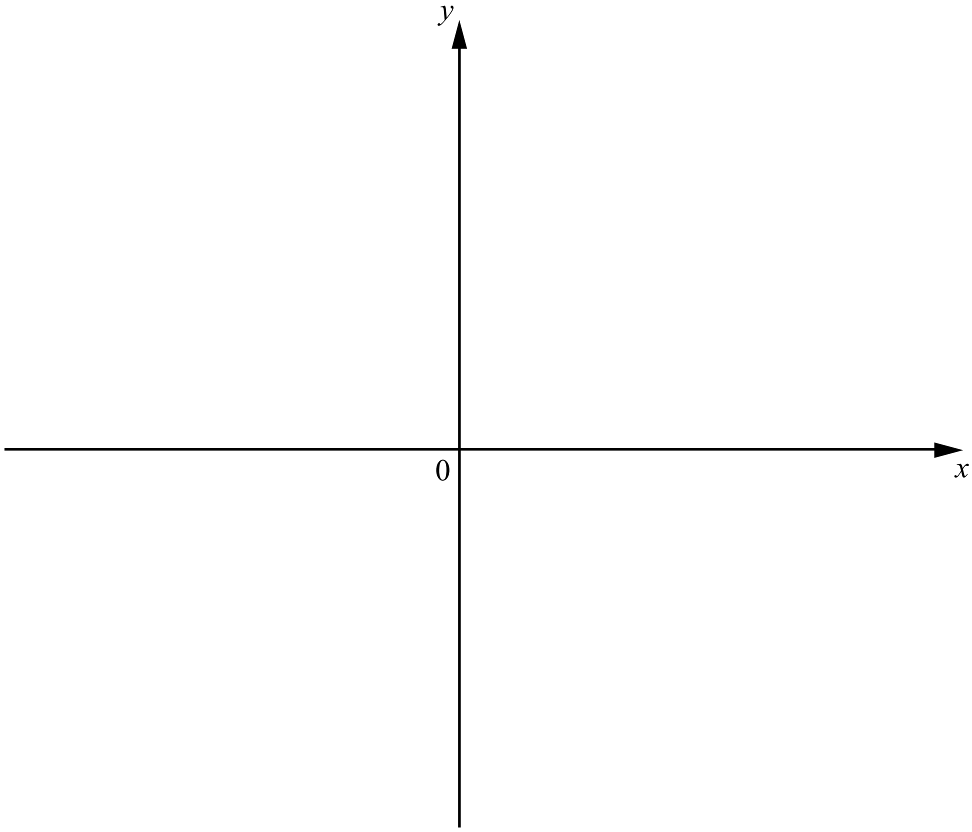
(c) $\overrightarrow{AX}$, [1]

(d) $\overrightarrow{DX}$. [2]

Given that $\overrightarrow{DX} = \mu\overrightarrow{DB}$,

(e) find the value of λ and of μ.

10 (a) (i) Sketch the graph of $y = e^x - 5$ on the axes below, showing the exact coo[rdinates of] any points where the graph cuts the coordinate axes.



[3]

(ii) Find the range of values of k for which the equation $e^x - 5 = k$ has no solutions. [1]

(b) Simplify $\log_a \sqrt{2} + \log_a 8 + \log_a\left(\frac{1}{2}\right)$, giving your answer in the form $p\log_a 2$, whe
constant.

(c) Solve the equation $\log_3 x - \log_9 4x = 1$. [4]

Question 11 is printed on the next page.

11 **(a)** **(i)** Show that $\dfrac{\operatorname{cosec}\theta}{\operatorname{cosec}\theta - \sin\theta} = \sec^2\theta$.

(ii) Hence solve $\dfrac{2\operatorname{cosec}\phi}{\operatorname{cosec}\phi - \sin\phi} = 8$ for $0° < \phi < 360°$. [3]

(b) Solve $\sqrt{3}\tan\left(x + \dfrac{\pi}{4}\right) = 1$ for $0 < x < 2\pi$, giving your answers in terms of π. [3]