Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6189625671

ADDITIONAL MATHEMATICS **4037/21**

Paper 2 **May/June 2017**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

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 **12** printed pages.

DC (ST/FC) 143155

CAMBRIDGE International Examinations

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 equation of the curve which passes through the point (2, 17) and for which $\frac{dy}{dx} = 4x^3 + 1$. [4]

2 **Do not use a calculator in this question.**

(a) Show that $\sqrt{24} \times \sqrt{27} + \frac{9\sqrt{30}}{\sqrt{15}}$ can be written in the form $a\sqrt{2}$, where a is an integer. [3]

(b) Solve the equation $\sqrt{3}(1 + x) = 2(x - 3)$, giving your answer in the form $b + c\sqrt{3}$, where b and c are integers. [3]

3 The variables x and y are such that $y = \ln(x^2 + 1)$.

(i) Find an expression for $\frac{dy}{dx}$. [2]

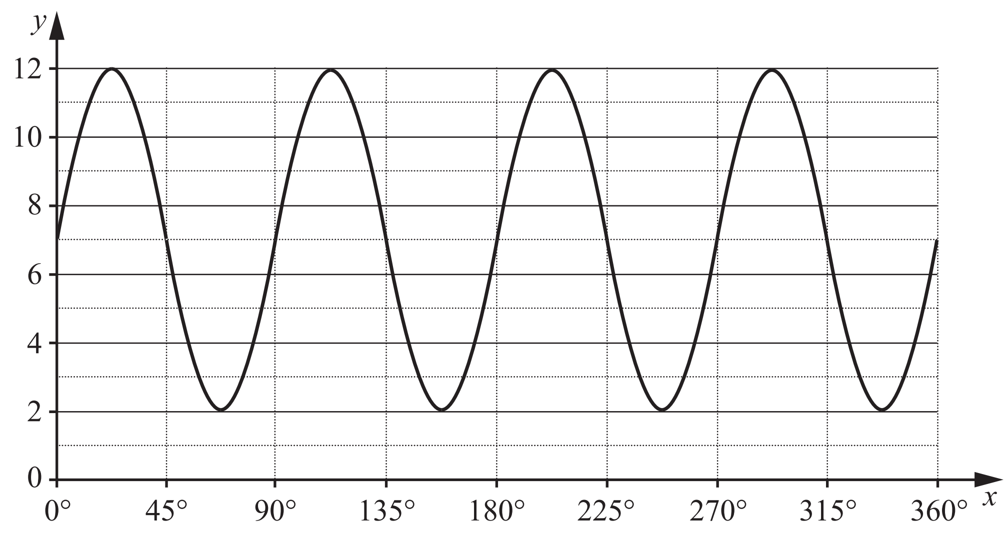
(ii) Hence, find the approximate change in y when x increases from 3 to $3 + h$, where h is small. [2]

4 **(a)** Given that $y = 7\cos 10x - 3$, where the angle x is measured in degrees, state

(i) the period of y, [1]

(ii) the amplitude of y. [1]

(b)



Find the equation of the curve shown, in the form $y = a\mathrm{g}(bx) + c$, where $\mathrm{g}(x)$ is a trigonometric function and a, b and c are integers to be found. [4]

5 **(i)** Given that a is a constant, expand $(2+ax)^4$, in ascending powers of x, simplifying each term of your expansion. [2]

Given also that the coefficient of x^2 is equal to the coefficient of x^3,

(ii) show that $a = 3$, [1]

(iii) use your expansion to show that the value of 1.97^4 is 15.1 to 1 decimal place. [2]

6 Four cinemas, P, Q, R and S each sell adult, student and child tickets. The number of tickets sold by each cinema on one weekday were

P: 90 adult, 10 student, 30 child
Q: 45 student
R: 25 adult, 15 child
S: 10 adult, 100 child.

(i) Given that $\mathbf{L} = \begin{pmatrix} 1 & 1 & 1 & 1 \end{pmatrix}$, construct a matrix, **M**, of the number of tickets sold, such that the matrix product **LM** can be found. [1]

(ii) Find the matrix product **LM**. [1]

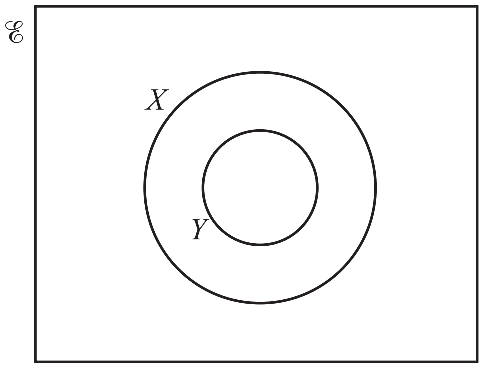
(iii) State what information is represented by the matrix product **LM**. [1]

An adult ticket costs \$5, a student ticket costs \$4 and a child ticket costs \$3.

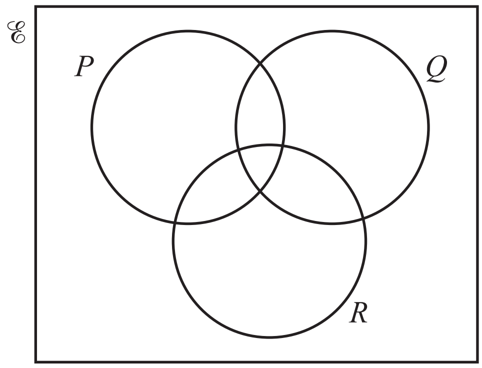
(iv) Construct a matrix, **N**, of the ticket costs, such that the matrix product **LMN** can be found and state what information is represented by the matrix product **LMN**. [2]

7 **(a)** On each of the Venn diagrams below shade the region which represents the given set.

$X \cap Y'$



$P' \cap Q \cap R$



[2]

(b) In a group of students, each student studies at most two of art, music and design. No student studies both music and design.

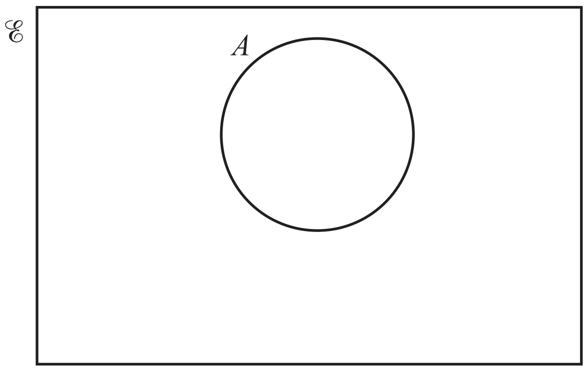
A denotes the set of students who study art,
M denotes the set of students who study music,
D denotes the set of students who study design.

(i) Write the following using set notation.

No student studies both music and design. [1]

There are 100 students in the group. 39 students study art, 45 study music and 36 study design. 12 students study both art and music. 25 students study both art and design.

(ii) Complete the Venn diagram below to represent this information and hence find the number of students in the group who do not study any of these subjects.



[3]

8 **(a)** A football club has 30 players. In how many different ways can a captain and a vice-captain be selected at random from these players? [1]

(b) A team of 11 teachers is to be chosen from 2 mathematics teachers, 5 computing teachers and 9 science teachers. Find the number of different teams that can be chosen if

(i) the team must have exactly 1 mathematics teacher, [2]

(ii) the team must have exactly 1 mathematics teacher and at least 4 computing teachers. [4]

9 The curve $3x^2 + xy - y^2 + 4y - 3 = 0$ and the line $y = 2(1 - x)$ intersect at the points A and B.

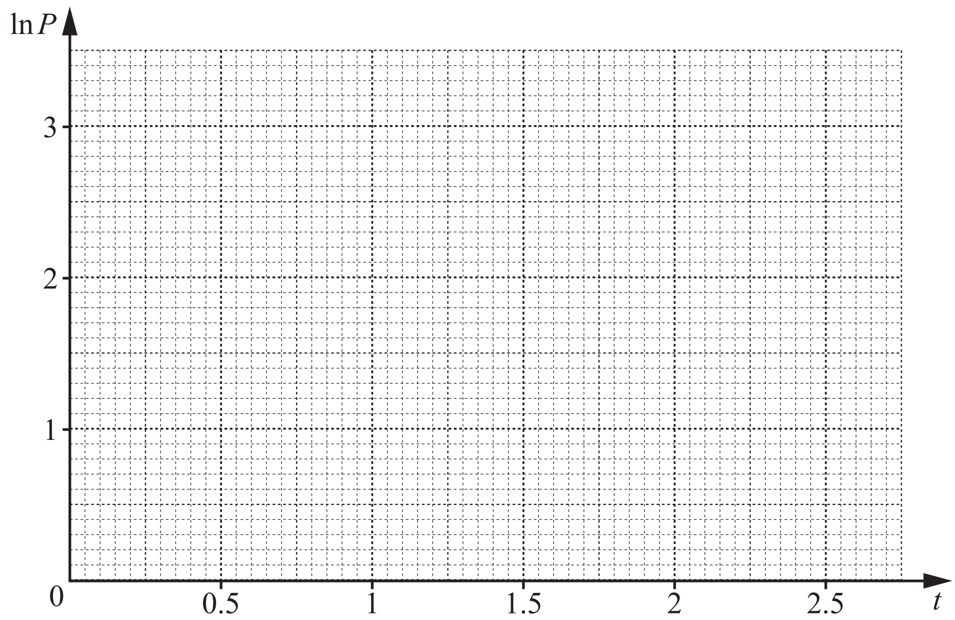
(i) Find the coordinates of A and of B. [5]

(ii) Find the equation of the perpendicular bisector of the line AB, giving your answer in the form $ax + by = c$, where a, b and c are integers. [4]

10 The table shows values of the variables t and P.

t	1	1.5	2	2.5
P	4.39	8.33	15.8	30.0

(i) Draw the graph of $\ln P$ against t on the grid below. [2]



(ii) Use the graph to estimate the value of P when $t = 2.2$. [2]

(iii) Find the gradient of the graph and state the coordinates of the point where the graph meets the vertical axis. [2]

(iv) Using your answers to part **(iii)**, show that $P = ab^t$, where a and b are constants to be found. [3]

(v) Given that your equation in part **(iv)** is valid for values of t up to 10, find the smallest value of t, correct to 1 decimal place, for which P is at least 1000. [2]

11 **(i)** Prove that $\sin x(\cot x + \tan x) = \sec x$. [4]

(ii) Hence solve the equation $|\sin x(\cot x + \tan x)| = 2$ for $0° \leqslant x \leqslant 360°$. [4]

Question 12 is printed on the next page.

12 A particle moves in a straight line so that, t seconds after passing a fixed point O, its displacement, s m, from O is given by

$$s = 1 + 3t - \cos 5t.$$

(i) Find the distance between the particle's first two positions of instantaneous rest. [7]

(ii) Find the acceleration when $t = \pi$. [2]