Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

5605923000

ADDITIONAL MATHEMATICS **4037/13**

Paper 1 **October/November 2019**

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 **15** printed pages and **1** blank page.

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Cambridge Assessment International Education

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 In a group of 145 students, the numbers studying mathematics, physics and chemistry are given below. All students study at least one of the three subjects.

x students study all 3 subjects

24 students study both mathematics and chemistry

23 students study both physics and chemistry

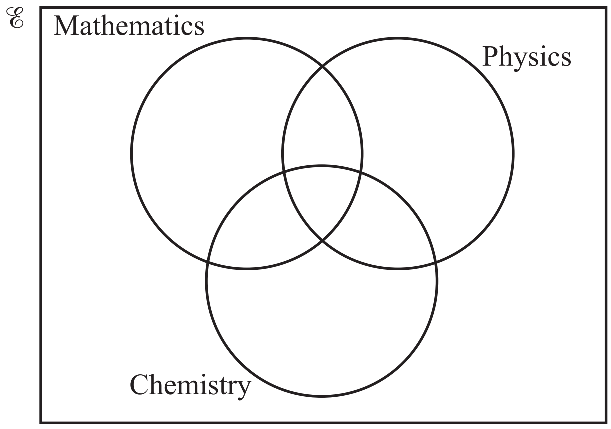
28 students study both mathematics and physics

50 students study chemistry

75 students study physics

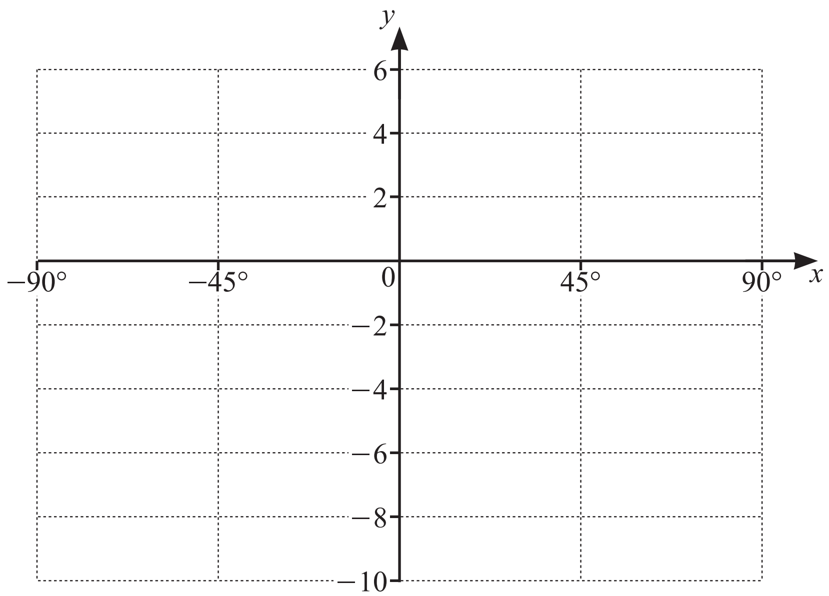
80 students study mathematics

(i) Using the Venn diagram, find the value of x. [4]



(ii) Find the number of students who study mathematics only. [1]

2 **(i)** On the axes below, sketch the graph of $y = 5\cos 4x - 3$ for $-90° \leqslant x \leqslant 90°$.



[4]

(ii) Write down the amplitude of y. [1]

(iii) Write down the period of y. [1]

3 **(i)** Differentiate $y = \left(3x^2 - 1\right)^{-\frac{1}{3}}$ with respect to x. [2]

(ii) Find the approximate change in y as x increases from $\sqrt{3}$ to $\sqrt{3} + p$, where p is small. [1]

(iii) Find the equation of the normal to the curve $y = \left(3x^2 - 1\right)^{-\frac{1}{3}}$ at the point where $x = \sqrt{3}$. [3]

4 It is given that $\mathbf{A} = \begin{pmatrix} 5 & 2 \\ 4 & -1 \end{pmatrix}$.

(i) Find $\mathbf{A}^{-1}$. [2]

(ii) Hence find, in radians, the acute angles x and y such that

$$5\tan x + 2\tan y = 12,$$
$$4\tan x - \tan y = 7.$$

[5]

5 **(i)** Differentiate $(x^2+3)\ln(x^2+3)$ with respect to x. [3]

(ii) Hence find $\int x\ln(x^2+3)\,dx$. [2]

6

x	1	1.5	2	2.5	3
y	6	14.3	48	228	1536

The table shows values of the variables x and y such that $y = Ab^{x^2}$, where A and b are constants.

(i) Draw a straight line graph to show that $y = Ab^{x^2}$. [4]

(ii) Use your graph to find the value of A and of b. [4]

(iii) Estimate the value of x when $y = 100$. [2]

  [Turn over

7 **(a)** A 5-digit code is to be chosen from the digits 1, 2, 3, 4, 5, 6, 7, 8 and 9. Each digit may be used once only in any 5-digit code. Find the number of different 5-digit codes that may be chosen if

(i) there are no restrictions, [1]

(ii) the code is divisible by 5, [1]

(iii) the code is even and greater than 70 000. [3]

(b) A team of 6 people is to be chosen from 8 men and 6 women. Find the number of different teams that may be chosen if

(i) there are no restrictions, [1]

(ii) there are no women in the team, [1]

(iii) there are a husband and wife who must not be separated. [3]

8 **(a)** Given that $\log_a x = p$ and $\log_a y = q$, find, in terms of p and q,

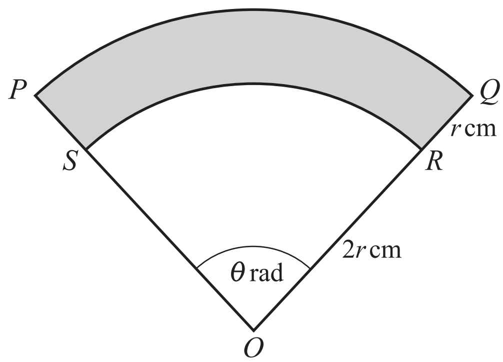
(i) $\log_a axy^2$, [2]

(ii) $\log_a \left(\dfrac{x^3}{ay}\right)$, [2]

(iii) $\log_x a + \log_y a$. [1]

(b) Using the substitution $m = 3^x$, or otherwise, solve $3^x - 3^{1+2x} + 4 = 0$. [3]

9



The diagram shows a sector OPQ of the circle centre O, radius $3r$ cm. The points S and R lie on OP and OQ respectively such that ORS is a sector of the circle centre O, radius $2r$ cm. The angle $POQ = \theta$ radians. The perimeter of the shaded region $PQRS$ is 100 cm.

(i) Find θ in terms of r. [2]

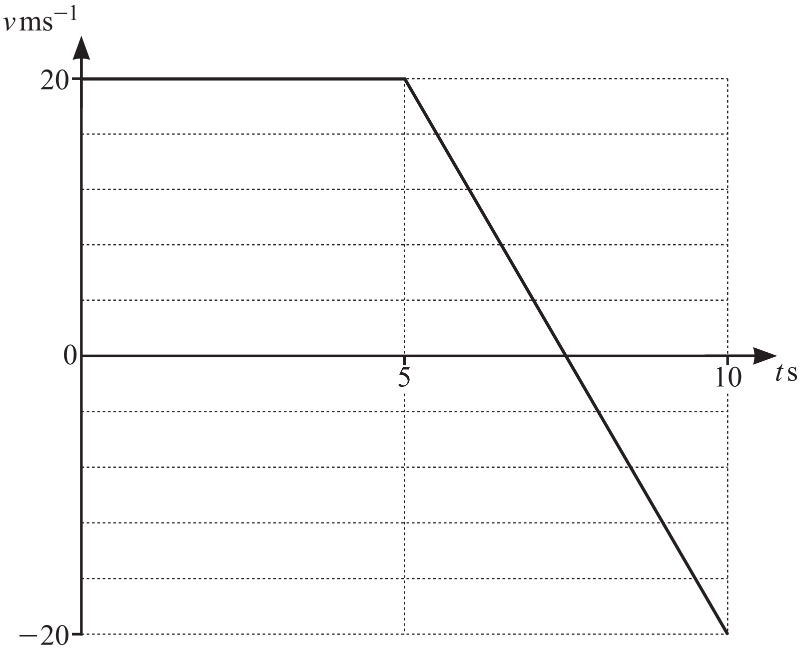
(ii) Hence show that the area, A cm^2, of the shaded region $PQRS$ is given by $A = 50r - r^2$. [2]

(iii) Given that r can vary and that A has a maximum value, find this value of A. [2]

(iv) Given that A is increasing at the rate of $3\,\text{cm}^2\,\text{s}^{-1}$ when $r = 10$, find the corresponding rate of change of r. [3]

(v) Find the corresponding rate of change of θ when $r = 10$. [3]

10 **(a)**



The velocity-time graph for a particle P is shown by the two straight lines in the diagram.

(i) Find the deceleration of P for $5 \leqslant t \leqslant 10$. [2]

(ii) Write down the value of t when the speed of P is zero. [1]

(iii) Find the distance P has travelled for $0 \leqslant t \leqslant 10$. [2]

(b) A particle Q has a displacement of x m from a fixed point O, t s after leaving O. The velocity, $v\,\text{ms}^{-1}$, of Q at time t s is given by $v = 6e^{2t} + 1$.

(i) Find an expression for x in terms of t. [3]

(ii) Find the value of t when the acceleration of Q is $24\,\text{ms}^{-2}$. [3]

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