Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

ADDITIONAL MATHEMATICS **0606/12**

Paper 1 **February/March 2017**

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 (LK/SG) 129474/2

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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 **(a)** It is given that $\mathscr{E} = \{x : 0 < x < 35, x \in \mathbb{R}\}$ and sets A and B are such that

$$A = \{\text{multiples of } 5\} \text{ and } B = \{\text{multiples of } 7\}.$$

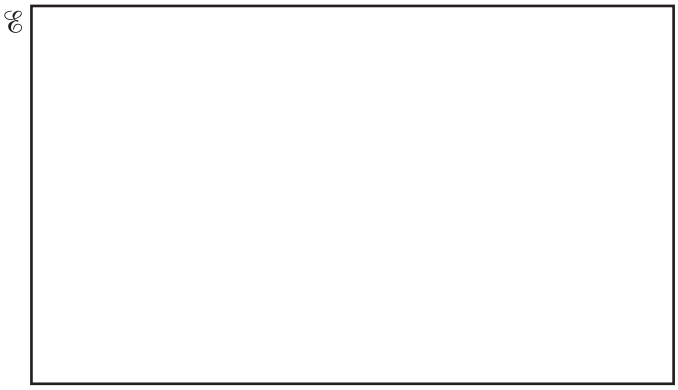
(i) Find $\mathrm{n}(A \cap B)$. [1]

(ii) Find $\mathrm{n}(A \cup B)$. [1]

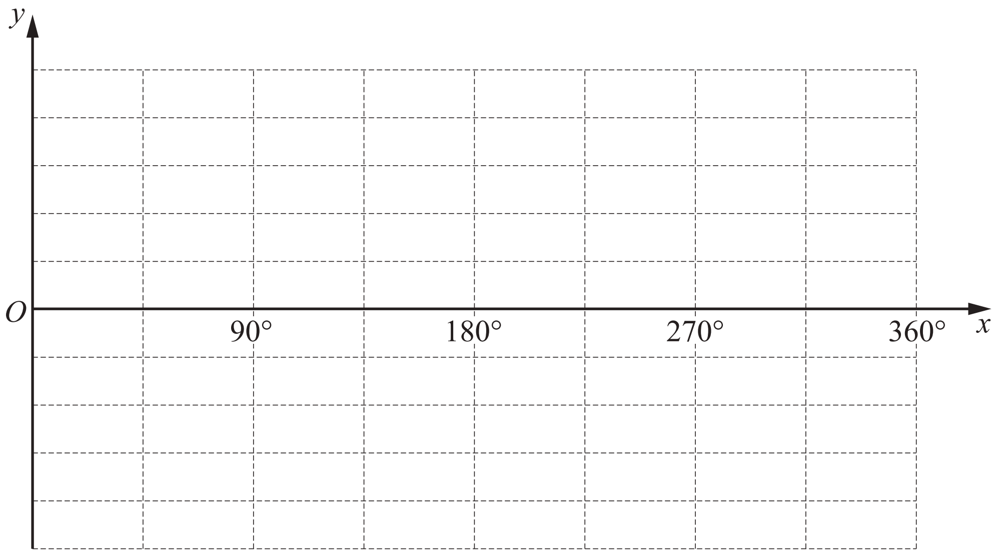
(b) It is given that sets X, Y and Z are such that

$$X \cap Y = Y, \quad X \cap Z = Z \quad \text{and } Y \cap Z = \varnothing.$$

On the Venn diagram below, illustrate sets X, Y and Z. [3]



2 **(i)** On the axes below sketch, for $0° \leqslant x \leqslant 360°$, the graph of $y = 1 + 3\cos 2x$. [3]



(ii) Write down the coordinates of the point where this graph first has a minimum value. [1]

3 The first three terms in the expansion of $\left(a + \frac{x}{4}\right)^5$ are $32 + bx + cx^2$. Find the value of each of the constants a, b and c. [5]

4 **(a)** It is given that $\mathbf{A} = \begin{pmatrix} 1 & -3 \\ 2 & 4 \end{pmatrix}$.

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

(ii) Using your answer to part **(i)**, find the matrix **M** such that $\mathbf{AM} = \begin{pmatrix} -1 & -5 \\ 4 & 2 \end{pmatrix}$. [3]

(b) **X** is $\begin{pmatrix} a & -1 \\ 2 & -3 \end{pmatrix}$ and **Y** is $\begin{pmatrix} 2 & 1 \\ 4 & 3a \end{pmatrix}$, where a is a constant.

Given that $\det \mathbf{X} = 4 \det \mathbf{Y}$, find the value of a. [2]

5 **(i)** Show that $\operatorname{cosec}\theta - \sin\theta = \cot\theta\cos\theta$. [3]

(ii) Hence solve the equation $\operatorname{cosec}\theta - \sin\theta = \frac{1}{3}\cos\theta$, for $0 \leqslant \theta \leqslant 2\pi$ radians. [4]

6 **(a)** The letters of the word THURSDAY are arranged in a straight line. Find the number of different arrangements of these letters if

(i) there are no restrictions, [1]

(ii) the arrangement must start with the letter T and end with the letter Y, [1]

(iii) the second letter in the arrangement must be Y. [1]

(b) 7 children have to be divided into two groups, one of 4 children and the other of 3 children. Given that there are 3 girls and 4 boys, find the number of different ways this can be done if

(i) there are no restrictions, [1]

(ii) all the boys are in one group, [1]

(iii) one boy and one girl are twins and must be in the same group. [3]

7 **(a)** A vector **v** has a magnitude of 102 units and has the same direction as $\begin{pmatrix} 8 \\ -15 \end{pmatrix}$. Find **v** in the form $\begin{pmatrix} a \\ b \end{pmatrix}$, where a and b are integers. [2]

(b) Vectors $\mathbf{c} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $\mathbf{d} = \begin{pmatrix} p - q \\ 5p + q \end{pmatrix}$ are such that $\mathbf{c} + 2\,\mathbf{d} = \begin{pmatrix} p^2 \\ 27 \end{pmatrix}$. Find the possible values of the constants p and q. [6]

8 A curve is such that $\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 4\sin 2x$. The curve has a gradient of 5 at the point where $x = \frac{\pi}{2}$.

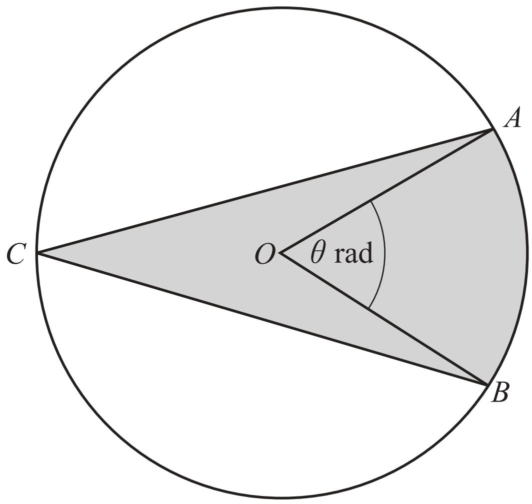
(i) Find an expression for the gradient of the curve at the point (x, y). [4]

The curve passes through the point $P\left(\frac{\pi}{12}, -\frac{1}{2}\right)$.

(ii) Find the equation of the curve. [4]

(iii) Find the equation of the normal to the curve at the point P, giving your answer in the form $y = mx + c$, where m and c are constants correct to 3 decimal places. [3]

9



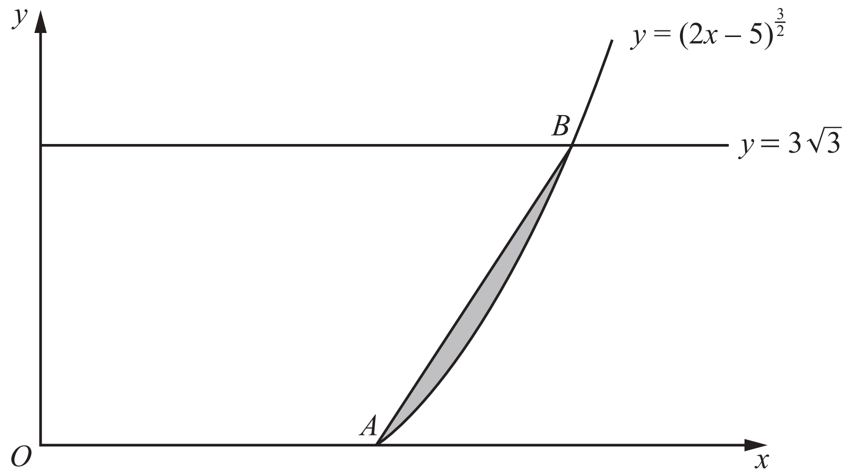
The diagram shows a circle, centre O, radius 10 cm. Points A, B and C lie on the circumference of the circle such that $AC = BC$. The area of the minor sector AOB is $20\pi\,\text{cm}^2$ and angle AOB is θ radians.

(i) Find the value of θ in terms of π. [2]

(ii) Find the perimeter of the shaded region. [4]

(iii) Find the area of the shaded region. [3]

10



The diagram shows part of the curve $y = (2x-5)^{\frac{3}{2}}$ and the line $y = 3\sqrt{3}$. The curve meets the x-axis at the point A and the line $y = 3\sqrt{3}$ at the point B. Find the area of the shaded region enclosed by the line AB and the curve, giving your answer in the form $\frac{p\sqrt{3}}{20}$, where p is an integer. You must show all your working. [8]

11 It is given that $y = Ae^{bx}$, where A and b are constants. When $\ln y$ is plotted against x a straight line graph is obtained which passes through the points (1.0, 0.7) and (2.5, 3.7).

(i) Find the value of A and of b. [6]

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