UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

ADDITIONAL MATHEMATICS **0606/21**

Paper 2 **October/November 2011**

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 a pencil for any diagrams or graphs.
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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.
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You are reminded of the need for clear presentation in your answers.

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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.

For Examiner's Use	
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UNIVERSITY of CAMBRIDGE International Examinations

Mathematical Formulae

For Examiner's Use

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

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

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

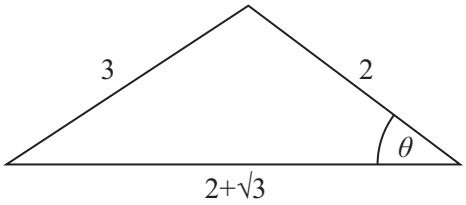
$$\Delta = \frac{1}{2}bc \sin A$$

1 Solve the equation $|4x - 5| = 21$. [3]

For Examiner's Use

2 Given that the straight line $y = 3x + c$ is a tangent to the curve $y = x^2 + 9x + k$, express k in terms of c. [4]

3



Without using a calculator, find the value of $\cos\theta$, giving your answer in the form $\frac{a + b\sqrt{3}}{c}$, where a, b and c are integers. [5]

For Examiner's Use

For Examiner's Use

5 **(a)** The functions f and g are defined, for $x \in \mathbb{R}$, by

$$\mathrm{f} : x \mapsto 2x + 3,$$
$$\mathrm{g} : x \mapsto x^2 - 1.$$

Find fg(4). [2]

(b) The functions h and k are defined, for $x > 0$, by

$$\mathrm{h} : x \mapsto x + 4,$$
$$\mathrm{k} : x \mapsto \sqrt{x}\ .$$

Express each of the following in terms of h and k.

(i) $x \mapsto \sqrt{x + 4}$ [1]

(ii) $x \mapsto x + 8$ [1]

(iii) $x \mapsto x^2 - 4$ [2]

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

The points $A(1, 4)$, $B(3, 8)$, $C(13, 13)$ and D are the vertices of a trapezium in which AB is parallel to DC and angle BAD is 90°. Find the coordinates of D. [6]

For Examiner's Use

7 **(a)** Given that $\tan x = p$, find an expression, in terms of p, for $\operatorname{cosec}^2 x$. [3]

For Examiner's Use

(b) Prove that $(1 + \sec\theta)(1 - \cos\theta) = \sin\theta \tan\theta$. [4]

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9 The table shows experimental values of two variables x and y.

x	1	2	3	4	5
y	3.40	2.92	2.93	3.10	3.34

It is known that x and y are related by the equation $y = \frac{a}{\sqrt{x}} + bx$, where a and b are constants.

(i) Complete the following table.

$x\sqrt{x}$					
$y\sqrt{x}$					

[1]

(ii) On the grid on page 11 plot $y\sqrt{x}$ against $x\sqrt{x}$ and draw a straight line graph. [2]

(iii) Use your graph to estimate the value of a and of b. [3]

(iv) Estimate the value of y when x is 1.5. [1]

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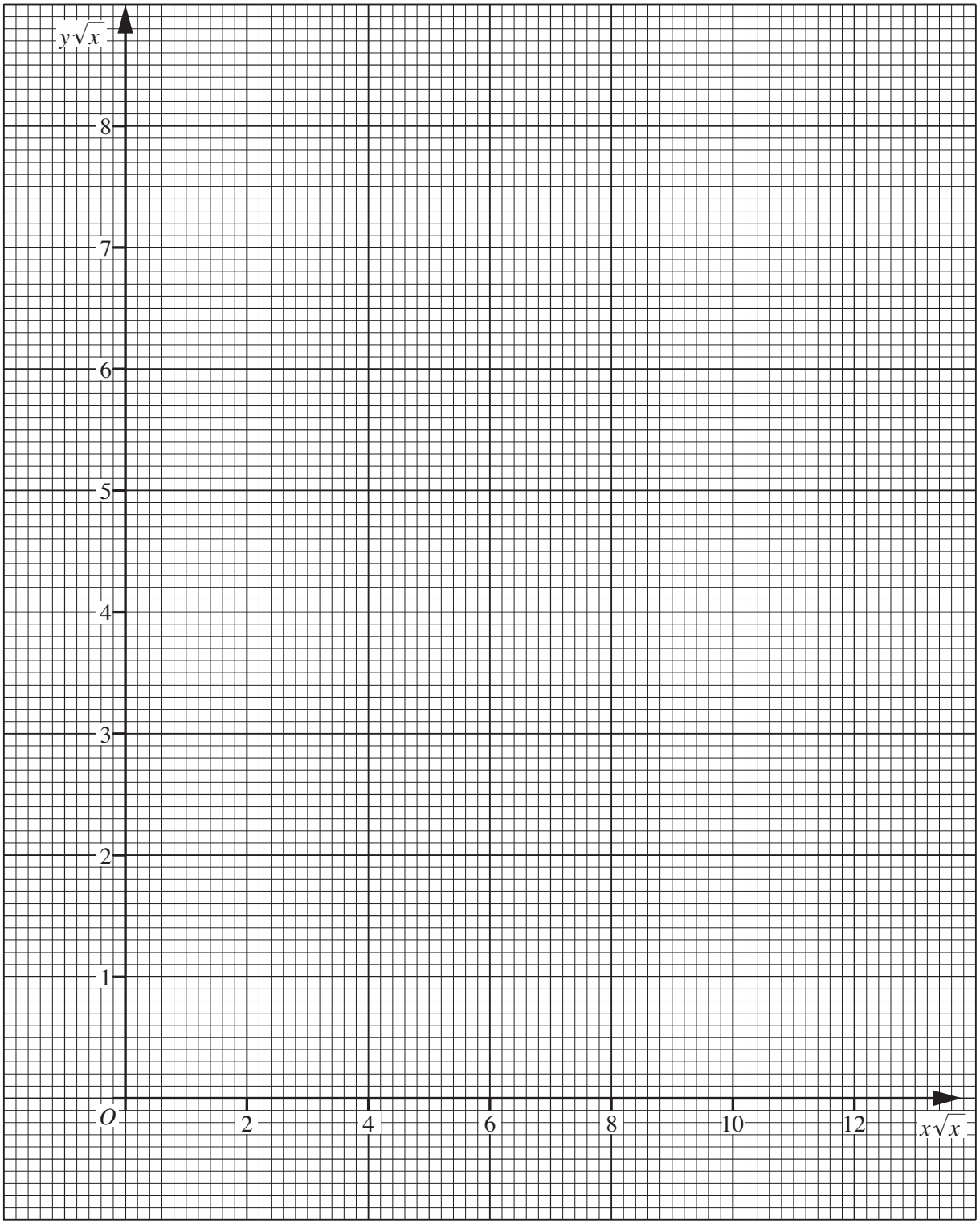

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10 It is given that $\mathbf{A} = \begin{pmatrix} 3 & 2 \\ 1 & -5 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 1 & 4 \\ -2 & 3 \end{pmatrix}$.

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

(ii) Find $\mathbf{BA}$. [2]

(iii) Find the inverse matrix, $\mathbf{A}^{-1}$. [2]

For Examiner's Use

(iv) Use your answer to part **(iii)** to solve the simultaneous equations

$$3x + 2y = 23,$$
$$x - 5y = 19.$$

[2]

11 **(a)** **(i)** Solve $\frac{5^{2x+3}}{25^{2x}} = \frac{25^{2-x}}{125^{x}}$. [3]

For Examiner's Use

(ii) Solve $\lg y + \lg(y - 15) = 2$. [4]

(b) Without using a calculator, and showing each stage of your working, find the value of

$2 \log_{12} 4 - \frac{1}{2} \log_{12} 81 + 4 \log_{12} 3.$ [3]

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ADDITIONAL MATHEMATICS **0606/22**

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2 hours

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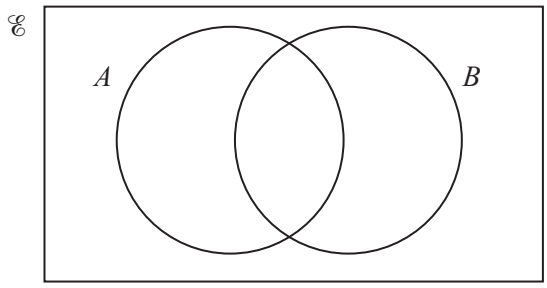
For Examiner's Use

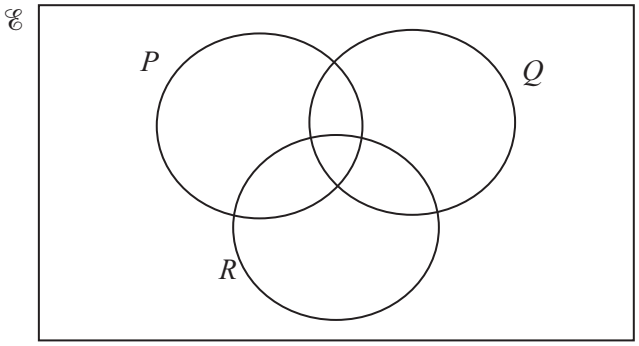
1 **(a)** The universal set $\mathscr{E}$ and the sets A and B shown in the Venn diagram below are such that

$$n(A) = 15, \quad n(B) = 20, \quad n(A' \cap B) = 6 \text{ and } \quad n(\mathscr{E}) = 30.$$

In the Venn diagram below insert the number of elements in the set represented by each of the four regions. [4]



(b) In the Venn diagram below shade the region that represents $(P \cup Q) \cap R'$. [1]



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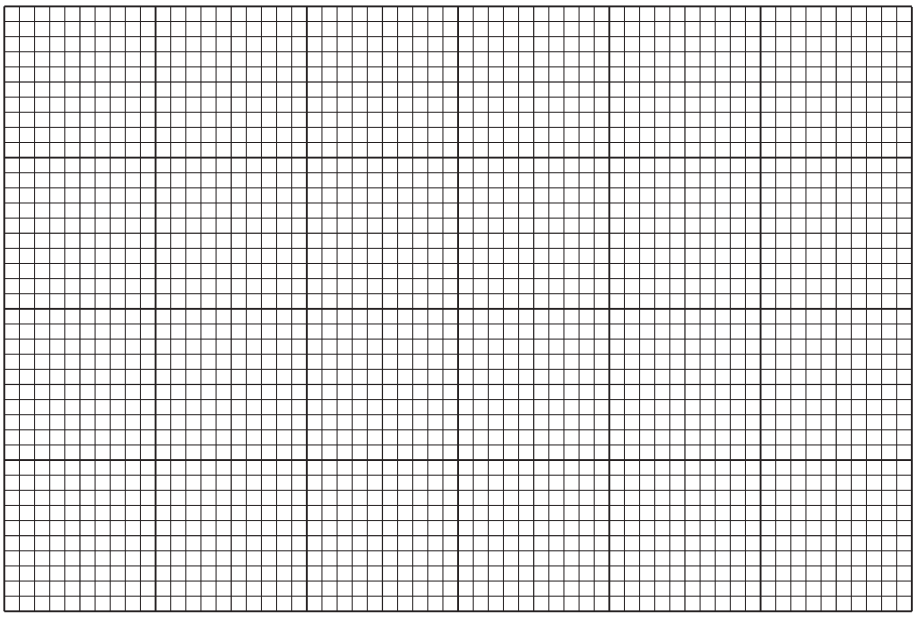
2 **(i)** On the grid below, draw on the same axes, for $0° \leqslant x \leqslant 180°$, the graphs of $y = \sin x$ and $y = 1 + \cos 2x$. [3]



(ii) State the number of roots of the equation $\sin x = 1 + \cos 2x$ for $0° \leqslant x \leqslant 180°$. [1]

(iii) Without extending your graphs state the number of roots of the equation $\sin x = 1 + \cos 2x$ for $0° \leqslant x \leqslant 360°$. [1]

3 It is given that $2x - 1$ is a factor of the expression $4x^3 + ax^2 - 11x + b$ and that the remainder when the expression is divided by $x + 2$ is 25. Find the remainder when the expression is divided by $x + 1$. [6]

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4 It is given that $\mathbf{A} = \begin{pmatrix} 3 & -2 \\ 1 & -5 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 1 & -4 & 2 \\ -3 & 5 & 0 \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 4 \\ 2 \\ -7 \end{pmatrix}$.

(i) Calculate **AB**. [2]

(ii) Calculate **BC**. [2]

(iii) Find the inverse matrix, $\mathbf{A}^{-1}$. [2]

For Examiner's Use

6 The length of a rectangular garden is x m and the width of the garden is 10 m less than the length.

(i) Given that the perimeter of the garden is greater than 140 m, write down a linear inequality in x. [1]

(ii) Given that the area of the garden is less than 3000 m^2, write down a quadratic inequality in x. [1]

(iii) By solving these two inequalities, find the set of possible values of x. [4]

7

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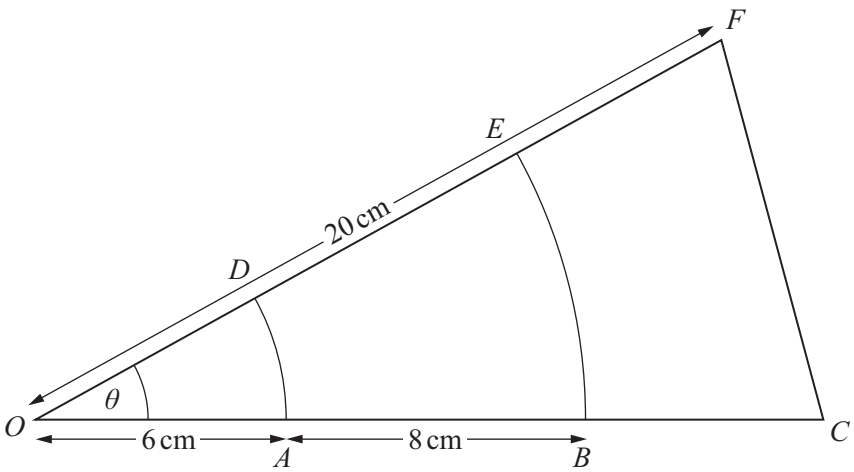

In the diagram AD and BE are arcs of concentric circles centre O, where $OA = 6$ cm and $AB = 8$ cm. The area of the region $ABED$ is $32\,\text{cm}^2$. The triangle OCF is isosceles with $OC = OF = 20$ cm.

(i) Find the angle θ in radians. [3]

(ii) Find the perimeter of the region $BCFE$. [5]

9 It is given that $f(x) = 2x^2 - 12x + 10$.

For Examiner's Use

(i) Find the value of a, of b and of c for which $f(x) = a(x + b)^2 + c$. [3]

(ii) Sketch the graph of $y = |f(x)|$ for $-1 \leqslant x \leqslant 7$. [4]

(iii) Find the set of values of k for which the equation $|f(x)| = k$ has 4 distinct roots. [2]

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1 Solve the inequality $x(2x - 1) > 15$. [3]

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2 **(i)** Given that $y = (12 - 4x)^5$, find $\frac{dy}{dx}$. [2]

(ii) Hence find the approximate change in y as x increases from 0.5 to $0.5 + p$, where p is small. [2]

---

3 **(i)** Find the coefficient of x^3 in the expansion of $(1 - 2x)^7$. [2]

For Examiner's Use

(ii) Find the coefficient of x^3 in the expansion of $(1 + 3x^2)(1 - 2x)^7$. [3]

4 Without using a calculator, find the positive root of the equation

$$(5 - 2\sqrt{2})x^2 - (4 + 2\sqrt{2})x - 2 = 0,$$

giving your answer in the form $a + b\sqrt{2}$, where a and b are integers. [6]

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6 **(i)** In the space below sketch the graph of $y = |(2x + 3)(2x - 7)|$. [4]

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(ii) How many values of x satisfy the equation $|(2x + 3)(2x - 7)| = 2x$? [2]

7

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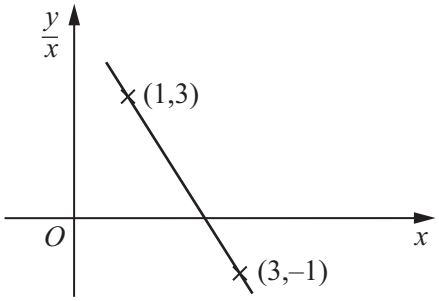

The variables x and y are related in such a way that when $\frac{y}{x}$ is plotted against x a straight line is obtained, as shown in the graph. The line passes through the points (1, 3) and (3, –1).

(i) Express y in terms of x. [4]

(ii) Find the value of x and of y such that $\frac{y}{x} = -9$. [2]

8 A sector of a circle, of radius r cm, has a perimeter of 200 cm.

For Examiner's Use

(i) Express the area, A cm^2, of the sector in terms of r. [3]

~~**(ii)** Given that r can vary, find the stationary value of A.~~ ~~[3]~~

10 The line $y = 2x + 10$ intersects the curve $2x^2 + 3xy - 5y + y^2 = 218$ at the points A and B. Find the equation of the perpendicular bisector of AB. [9]

For Examiner's Use

11 **(i)** Solve $4\cot\frac{1}{2}x = 1$, for $0° < x < 360°$. [3]

For Examiner's Use

(ii) Solve $3(1 - \tan y \cos y) = 5\cos^2 y - 2$, for $0° < y < 360°$. [5]

(iii) Solve $3\sec^2 z = 4$, for $0 < z < 2\pi$ radians. [3]

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