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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4623317708

ADDITIONAL MATHEMATICS **4037/22**

Paper 2 **October/November 2011**

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 a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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.

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This document consists of **16** printed pages.

DC (LEO/CGW) 35878/3

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

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

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

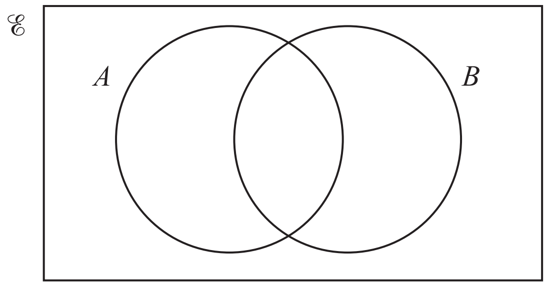
$$a^2 = b^2 + c^2 - 2bc\cos A$$

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

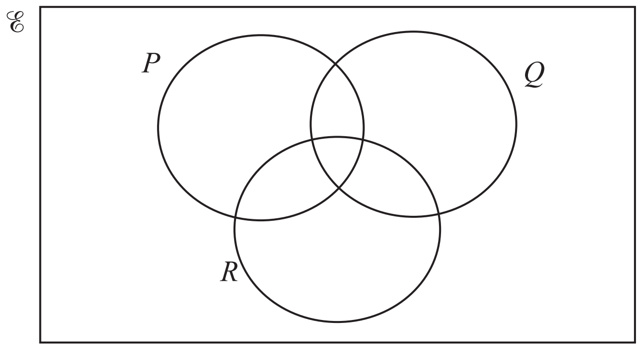
1 **(a)** The universal set $\mathscr{E}$ and the sets A and B shown in the Venn diagram below are such that

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

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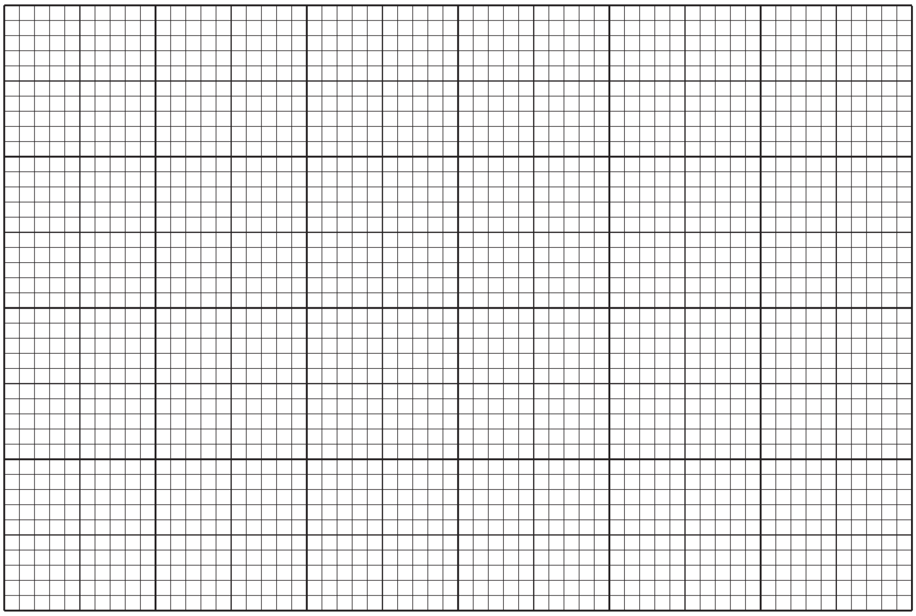
2 **(i)** On the grid below, draw on the same axes, for $0° \leqslant x \leqslant 180°$, the graphs of $y = \sin x$ and $y = 1 + \cos 2x$. [3]



(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]

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]

5 Four boys and three girls are to be seated in a row. Calculate the number of different ways that this can be done if

(i) the boys and girls sit alternately, [2]

(ii) the boys sit together and the girls sit together, [2]

(iii) a boy sits at each end of the row. [2]

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

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(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]

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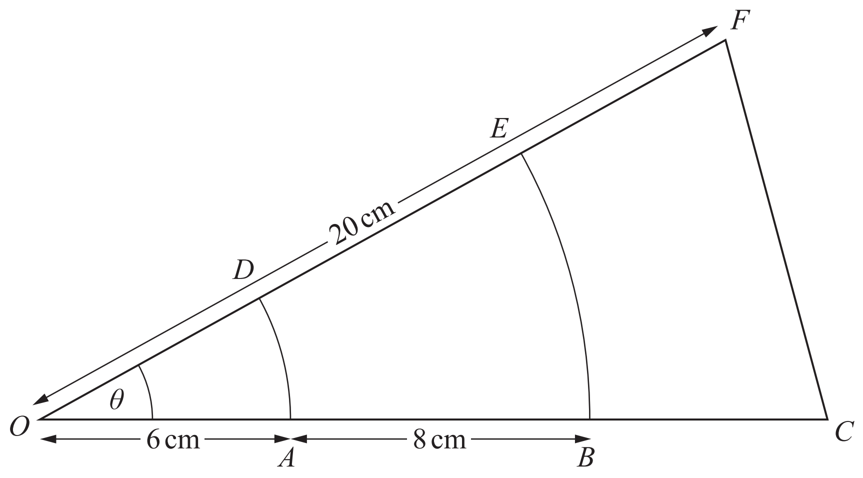

In the diagram AD and BE are arcs of concentric circles centre O, where $OA = 6$ cm and $AB = 8$ cm. The area of the region $ABED$ is 32 cm^2. The triangle OCF is isosceles with $OC = OF = 20$ cm.

(i) Find the angle θ in radians. [3]

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

[Turn over

8 A particle travels in a straight line so that, t s after passing through a fixed point O, its velocity, $v\,\text{ms}^{-1}$, is given by $v = 12\cos\left(\frac{t}{3}\right)$.

(i) Find the value of t when the velocity of the particle first equals $2\,\text{ms}^{-1}$. [2]

(ii) Find the acceleration of the particle when $t = 3$. [3]

(iii) Find the distance of the particle from O when it first comes to instantaneous rest. [4]

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

(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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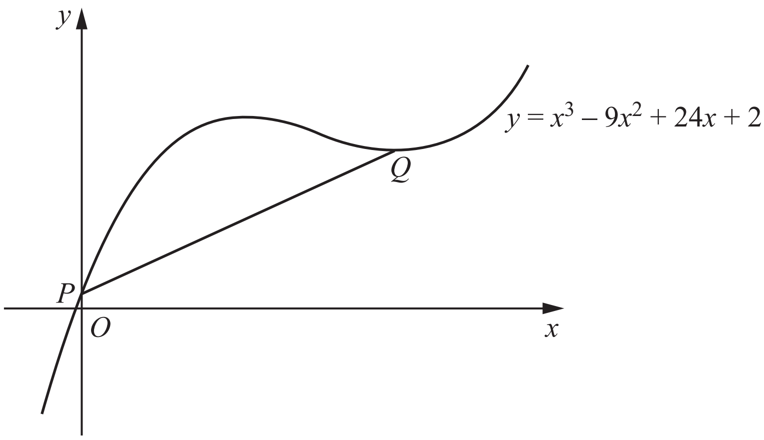


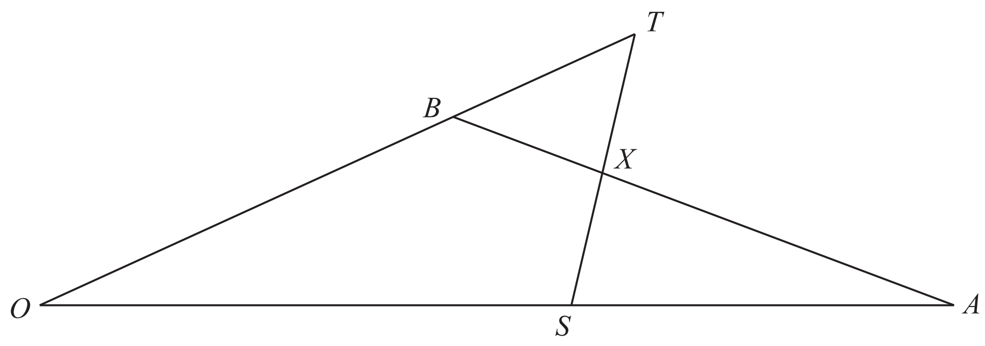
The diagram shows part of the curve $y = x^3 - 9x^2 + 24x + 2$ cutting the y-axis at the point P. The curve has a minimum point at Q.

(i) Find the coordinates of the point Q. [4]

(ii) Find the area of the region enclosed by the curve and the line *PQ*. [6]

11 Answer only **one** of the following two alternatives.

EITHER



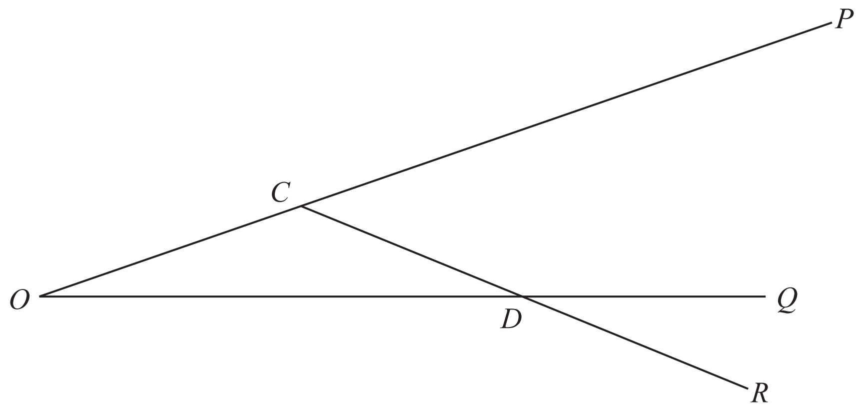
In the diagram above $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$, $\overrightarrow{OS} = \frac{3}{5}\overrightarrow{OA}$ and $\overrightarrow{OT} = \frac{7}{5}\overrightarrow{OB}$.

(i) Given that $\overrightarrow{AX} = \mu\overrightarrow{AB}$, where μ is a constant, express $\overrightarrow{OX}$ in terms of μ, **a** and **b**. [2]

(ii) Given that $\overrightarrow{SX} = \lambda\overrightarrow{ST}$, where λ is a constant, express $\overrightarrow{OX}$ in terms of λ, **a** and **b**. [4]

(iii) Hence evaluate μ and λ. [4]

OR



In the diagram above $\overrightarrow{OC} = \mathbf{c}$ and $\overrightarrow{OD} = \mathbf{d}$. The points P and Q lie on OC and OD produced respectively, so that $OC : CP = 1 : 2$ and $OD : DQ = 2 : 1$. The line CD is extended to R so that $CD = DR$.

(i) Find, in terms of **c** and/or **d**, the vectors $\overrightarrow{OP}$, $\overrightarrow{OQ}$ and $\overrightarrow{OR}$. [5]

(ii) Show that the points P, Q and R are collinear and find the ratio $PQ : QR$. [5]

Start your answer to Question 11 here.

Indicate which question you are answering.

EITHER	
OR	

Continue your answer here if necessary.