UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **May/June 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.
Do not use staples, paper clips, highlighters, 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.

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International Examinations

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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

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

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

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

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1 **(i)** Given that $y = \sin 3x$, find $\frac{dy}{dx}$. [1]

(ii) Hence find the approximate increase in y as x increases from $\frac{\pi}{9}$ to $\frac{\pi}{9} + p$, where p is small. [2]

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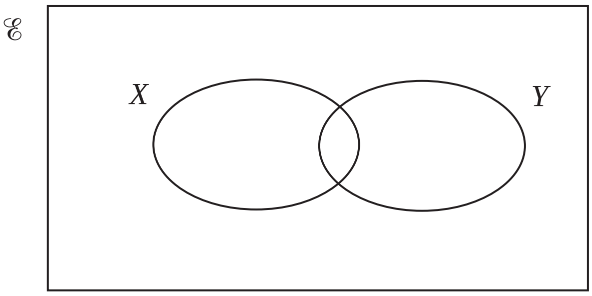
2 **(a)** An outdoor club has three sections, walking, biking and rock-climbing. Using $\mathscr{E}$ to denote the set of all members of the club and W, B and R to denote the members of the walking, biking and rock-climbing sections respectively, write each of the following statements using set notation.

(i) There are 72 members in the club. [1]

(ii) Every member of the rock-climbing section is also a member of the walking section. [1]

(b) **(i)**



On the diagram shade the region which represents the set $X \cup Y'$. [1]

(ii) Using set notation express the set $X \cup Y'$ in an alternative way. [1]

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3 **(i)** Given that $\mathbf{A} = \begin{pmatrix} 2 & 1 \\ -2 & 5 \end{pmatrix}$, find the inverse of the matrix $\mathbf{A} + \mathbf{I}$, where $\mathbf{I}$ is the identity matrix. [3]

(ii) Hence, or otherwise, find the matrix $\mathbf{X}$ such that $\mathbf{AX} + \mathbf{X} = \mathbf{B}$, where $\mathbf{B} = \begin{pmatrix} 14 \\ 4 \end{pmatrix}$. [2]

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4 **(a)** Prove that $\dfrac{1}{1 - \sin x} - \dfrac{1}{1 + \sin x} = 2\tan x \sec x$. [3]

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(b) An acute angle x is such that $\sin x = p$. Given that $\sin 2x = 2\sin x \cos x$, find an expression, in terms of p, for cosec $2x$. [3]

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5 **(i)** Given that $y = x\sqrt{2x + 15}$, show that $\frac{dy}{dx} = \frac{k(x + 5)}{\sqrt{2x + 15}}$, where k is a constant to be found. [3]

(ii) Hence find $\int \frac{x + 5}{\sqrt{2x + 15}}\,dx$ and evaluate $\int_{-3}^{5} \frac{x + 5}{\sqrt{2x + 15}}\,dx$. [3]

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6 The line $y = 3x - 9$ intersects the curve $49x^2 - y^2 + 42x + 8y = 247$ at the points A and B. Find the length of the line AB. [7]

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7 A particle moves in a straight line so that, t s after passing through a fixed point O, its velocity, v ms^{-1}, is given by $v = \dfrac{60}{(3t+4)^2}$.

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(i) Find the velocity of the particle as it passes through O. [1]

(ii) Find the acceleration of the particle when $t = 2$. [3]

(iii) Find an expression for the displacement of the particle from O, t s after it has passed through O. [4]

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8 **(a)** **(i)** Solve $3^x = 200$, giving your answer to 2 decimal places. [2]

(ii) Solve $\log_5 (5y + 40) - \log_5 (y + 2) = 2$. [4]

(b) Given that $\dfrac{(24z^3)^2}{27 \times 12z} = 2^a 3^b z^c$, evaluate a, b and c. [3]

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

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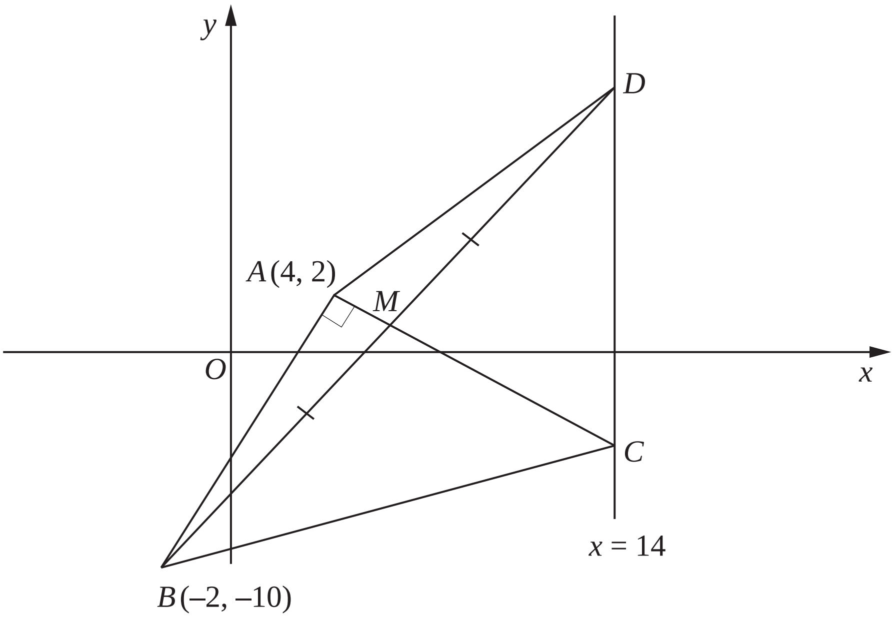

The diagram shows the quadrilateral *ABCD* in which *A* is the point (4, 2) and *B* is the point (–2, –10). The points *C* and *D* lie on the line $x = 14$. The diagonal *AC* is perpendicular to *AB* and passes through the mid-point, *M*, of the diagonal *BD*. Find the area of the quadrilateral *ABCD*. [9]

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Continue your answer here if necessary.

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10 (a) (i) Express $18 + 16x - 2x^2$ in the form $a + b(x + c)^2$, where a, b and c are integers. [3]

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A function f is defined by $\mathrm{f} : x \to 18 + 16x - 2x^2$ for $x \in \mathbb{R}$.

(ii) Write down the coordinates of the stationary point on the graph of $y = \mathrm{f}(x)$. [1]

(iii) Sketch the graph of $y = \mathrm{f}(x)$. [2]

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(b) A function g is defined by $g : x \to (x + 3)^2 - 7$ for $x > -3$.

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(i) Find an expression for $g^{-1}(x)$. [2]

(ii) Solve the equation $g^{-1}(x) = g(0)$. [3]

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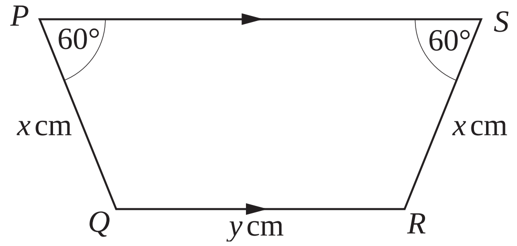
11 Answer only **one** of the following two alternatives.

EITHER

(a) Using an equilateral triangle of side 2 units, find the exact value of sin 60° and of cos 60°. [3]

(b)



PQRS is a trapezium in which $PQ = RS = x$ cm and $QR = y$ cm.
Angle *QPS* = angle *RSP* = 60° and *QR* is parallel to *PS*.

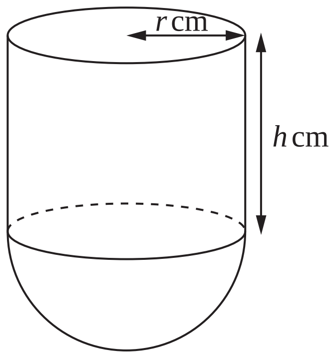
(i) Given that the perimeter of the trapezium is 60 cm, express y in terms of x. [2]

(ii) Given that the area of the trapezium is A cm^2, show that

$$A = \frac{\sqrt{3}(30x - x^2)}{2}.$$ [3]

(iii) Given that x can vary, find the value of x for which A has a stationary value and determine the nature of this stationary value. [4]

OR



For a sphere of radius r:

Volume = $\frac{4}{3}\pi r^3$

Surface area = $4\pi r^2$

The diagram shows a solid object in the form of a cylinder of height h cm and radius r cm on top of a hemisphere of radius r cm. Given that the volume of the object is 2880π cm^3,

(i) express h in terms of r, [2]

(ii) show that the external surface area, A cm^2, of the object is given by

$$A = \frac{5}{3}\pi r^2 + \frac{5760\pi}{r}.$$ [3]

Given that r can vary,

(iii) find the value of r for which A has a stationary value, [4]

(iv) find this stationary value of A, leaving your answer in terms of π, [2]

(v) determine the nature of this stationary value. [1]

Start your answer to Question 11 here.

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Indicate which question you are answering.

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Continue your answer here if necessary.

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