UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

5529328366

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/06**

Paper 6 (Extended) **May/June 2011**

1 hour 30 minutes

Candidates answer on the Question Paper

Additional Materials: Graphics 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.
Do not use staples, paper clips, highlighters, glue or correction fluid.
You may use a pencil for any diagrams or graphs.
DO **NOT** WRITE IN ANY BARCODES.

Answer both parts **A** and **B**.

You must show all relevant working to gain full marks for correct methods, including sketches.

In this paper you will also be assessed on your ability to provide full reasons and communicate your mathematics clearly and precisely.

At the end of the examination, fasten all your work securely together.
The total number of marks for this paper is 40.

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Answer **both** parts **A** and **B**.

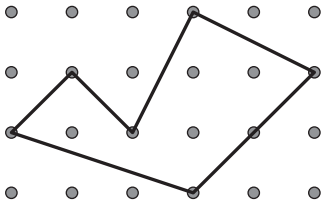
A INVESTIGATION PICK'S EQUATION (20 marks)

You are advised to spend 45 minutes on part **A**.

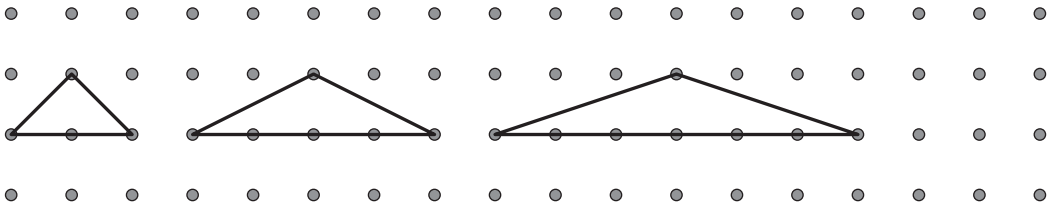
In 1899 the Austrian mathematician Georg Pick found a method to work out the area of any polygon that has its vertices on a square grid.

His method used the number of dots (p) on the perimeter of the polygon and the number of dots (i) inside the polygon.

In the polygon shown, $p = 7$ and $i = 4$.



1 **(a)** The diagram below shows the first three triangles of a sequence with $i = 0$.



For the first triangle in the sequence $p = 4$.
Its area is $A = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 2 \times 1 = 1$ square.

Complete the table for the first 6 triangles in this sequence.

Area (A)	1					
Number of dots on the perimeter (p)	4	6				

(b) Find a formula for p in terms of A.

$p =$ .....

(c) Make A the subject of the formula.

$A =$ .....

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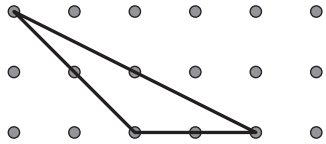
(d) Show that your formula for A gives the correct value of the area for this triangle.



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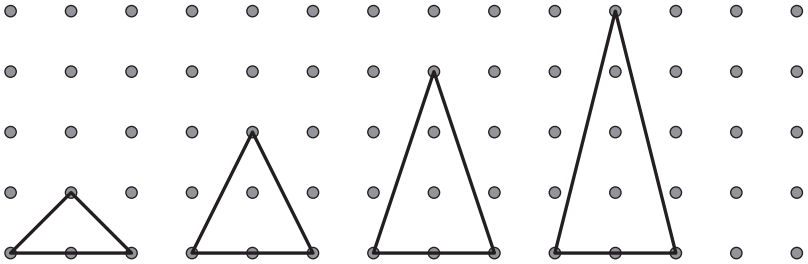
2 The diagram below shows a sequence of triangles, each with $p = 4$.
The number of dots (i) inside the polygon increases by one each time.



(a) The area of the first triangle is 1.

Find the area, A, of each of the other three triangles.

..... , ... , ...

(b) Explain how the connection between the increase in i and the increase in A changes your answer in **question 1(c)** to give $A = \frac{1}{2}p + i - 1$.

.....

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This is **Pick's Equation** which works for all polygons.

(c) Write down the range of possible values for p.

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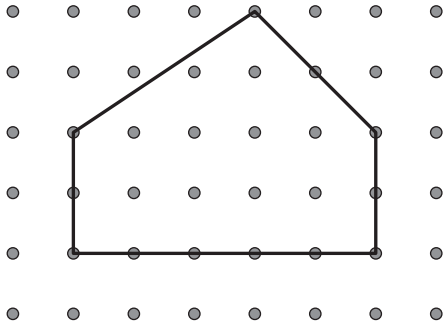
3 Show that Pick's Equation gives the correct value for the area of this polygon.



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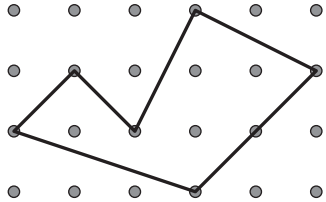
4 Use Pick's Equation to find the area of this polygon.



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Area = ... squares

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5 A polygon has an area, A, of 4 squares.

(a) Using Pick's Equation, a possible pair of values for p and i is $p = 6$ and $i = 2$.
Use Pick's Equation to find **all** the other possible pairs of values.

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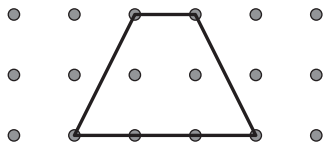
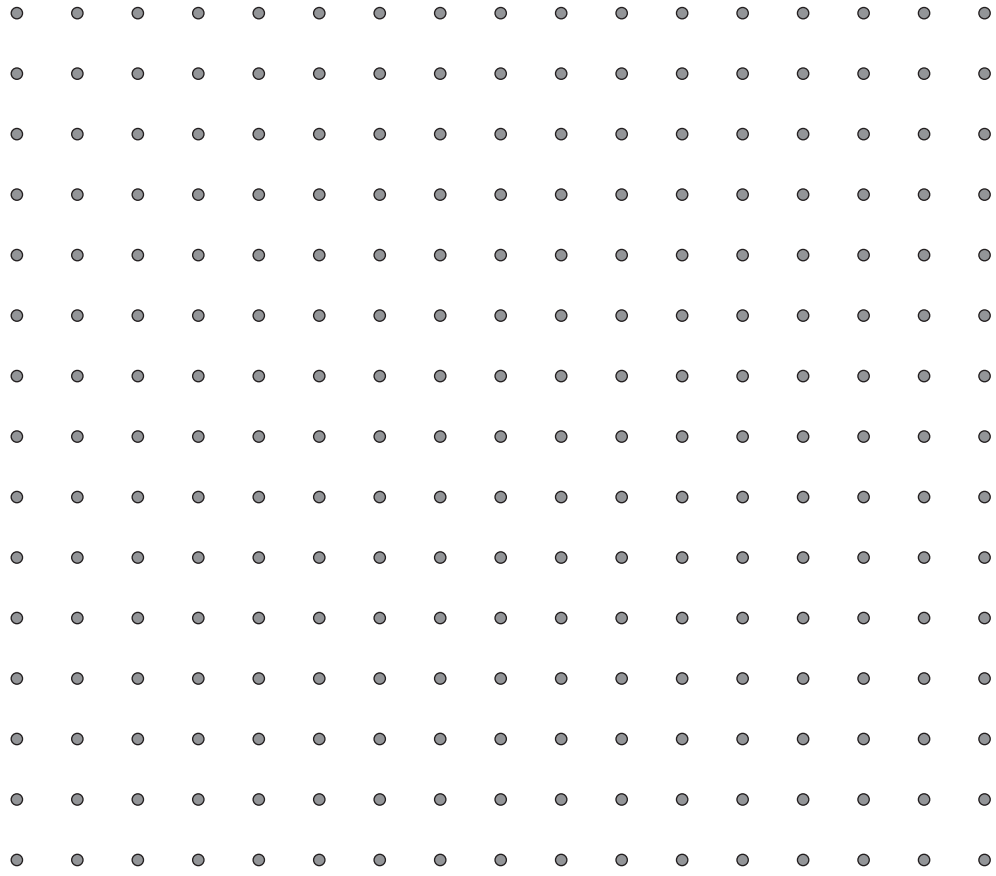
(b) The diagram below shows a quadrilateral with $A = 4$, $p = 6$ and $i = 2$.



Draw, on the square grid below, a quadrilateral with $A = 4$ for each of the pairs of values of p and i that you found in **part (a)**.



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B MODELLING THE DOUBLING TIME (20 marks)

You are advised to spend 45 minutes on part **B**.

1 \$1000 is invested at a rate of 5% compound interest per year.

(a) (i) Explain why, after 10 years, the total amount of money is $\$1000 \times 1.05^{10}$.

.....

.....

(ii) Calculate this total amount.

\$ .....

(b) Write down the total amount of money after y years.

\$ .....

(c) (i) When y is the number of years it takes for the investment of \$1000 to double, show that $1.05^y = 2$.

.....

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(ii) Show how you can use logarithms to solve the equation $1.05^y = 2$ to give $y = 14.2$, correct to 3 significant figures.

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.....

(d) (i) When the rate is x% (instead of 5%) show, by referring to **question 1(c)**, that the time to double is given by the following model.

$$y = \frac{\log 2}{\log\left(1 + \frac{x}{100}\right)}$$

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(ii) Using the axes given, sketch the graph of y against x for $0 < x \leqslant 100$.

2 **(a)** There is a different model for y, the time for the investment to double.
Which of the following approximates the model in **question 1**?

A $y = kx$ **B** $y = \frac{k}{x}$ **C** $y = kx^2$

D $y = k\cos x$ **E** $y = k - x$

.....

(b) In **question 1**, $x = 5$ and $y = 14.2$.
Use this information in your model to find k, correct to the nearest 10.
Write down your model.

$y =$ .....

3 Use your model to **write down** the doubling time for a rate of 2%.

..... years

4 **(a)** Find the doubling time for a rate of 7% using

(i) the model in **question 1**,

..... years

(ii) your model.

..... years

(b) Write down the difference between the times given by these two models.

..... years

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5 The difference between the times given by the models is

$$d = \frac{\log 2}{\log\left(1+\frac{x}{100}\right)} - \left(\text{your model}\right)$$

(a) On the axes, sketch the graph of d against x for $2 \leqslant x \leqslant 100$.

(b) Find the maximum value of d for $2 \leqslant x \leqslant 100$.

.....

6 The model in **question 1** is accurate for $0 < x \leqslant 100$.
Comment on the accuracy of your model for $0 < x \leqslant 100$.

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