UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

6915781925

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/06**

Paper 6 (Extended) **May/June 2013**

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.

This document consists of **8** printed pages.

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

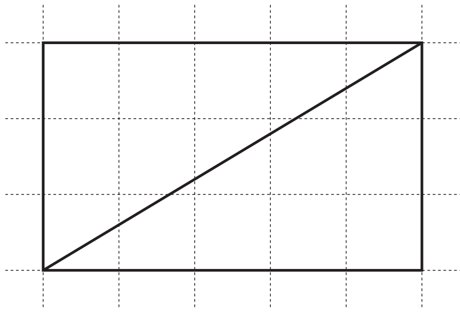
A INVESTIGATION DIAGONALS OF RECTANGLES (20 marks)

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

Rectangles are drawn on a grid.
The sides of each rectangle lie on gridlines and the length is greater than or equal to the width.

This investigation looks for a method for calculating the number of small squares through which a diagonal passes.

1 The diagram shows a rectangle with length 5 and width 3.
The diagonal crosses 4 vertical gridlines **inside** the rectangle.



Write down

(a) the number of horizontal gridlines that the diagonal crosses inside the rectangle,

....

(b) the total number of gridlines that the diagonal crosses inside the rectangle.

....

2 A rectangle has length x and width y.
x and y do not have a common factor.

(a) Write down an expression for

(i) the number of vertical gridlines that a diagonal crosses inside the rectangle, in terms of x,

....

(ii) the number of horizontal gridlines that a diagonal crosses inside the rectangle, in terms of y,

....

(iii) the total number of gridlines, N, which a diagonal crosses inside the rectangle, in terms of x and y. Write your answer in its simplest form.

$N =$ ....

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(b) S is the number of squares through which the diagonal passes.
For example, the diagonal in **question 1** passes through 7 squares.

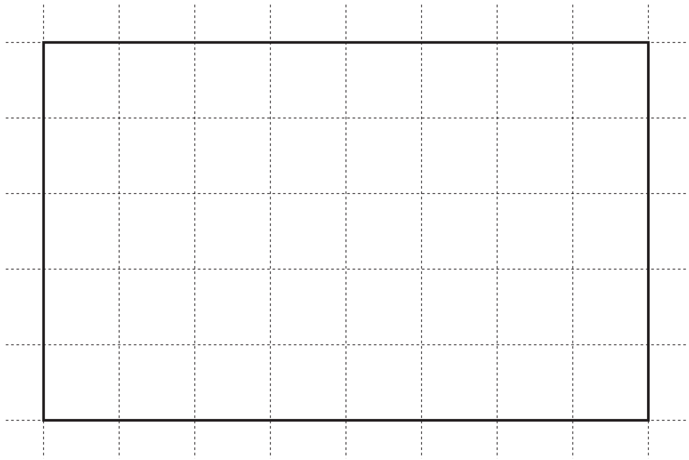
(i) Write S in terms of N.

$S =$ ....

(ii) Write S in terms of x and y.

$S =$ ....

(c) Show that your formula for S in **part (b)(ii)** gives the correct value for an 8 by 5 rectangle.
Use the grid to show clearly how many squares the diagonal passes through.



....

....

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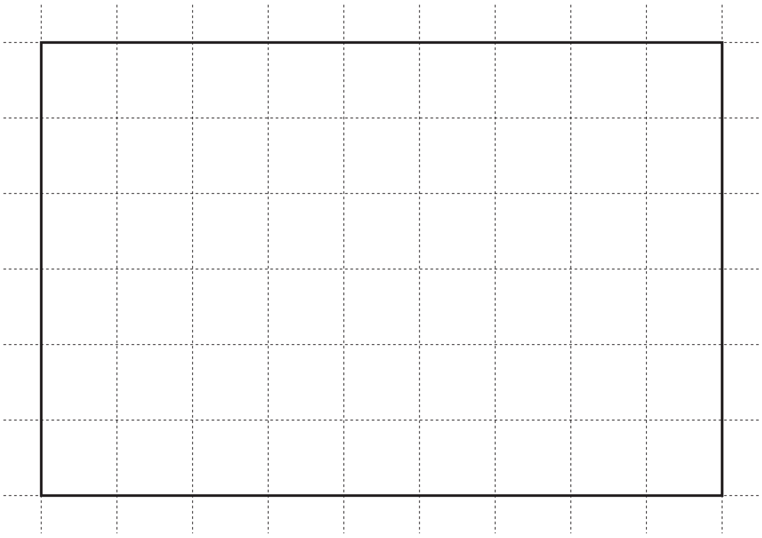
3 In **question 2**, x and y did not have a common factor.
In this question, x and y do have a common factor.

(a) (i) Show clearly that your formula for S does not give the correct value for a 9 by 6 rectangle.



....

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(ii) 9 and 6 have a common factor of 3.
Show how you use the value of S for a 3 by 2 rectangle to calculate S for a 9 by 6 rectangle.

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(b) Use your method in **part (a)(ii)** to find S for each of these rectangles.

(i) 93 by 90

....

(ii) 60 by 35

....

4 The diagonal of a rectangle passes through 6 squares.

Use **question 2** and **question 3** to find the length and the width of each possible rectangle.

B MODELLING DRILLING A TUNNEL (20 marks)

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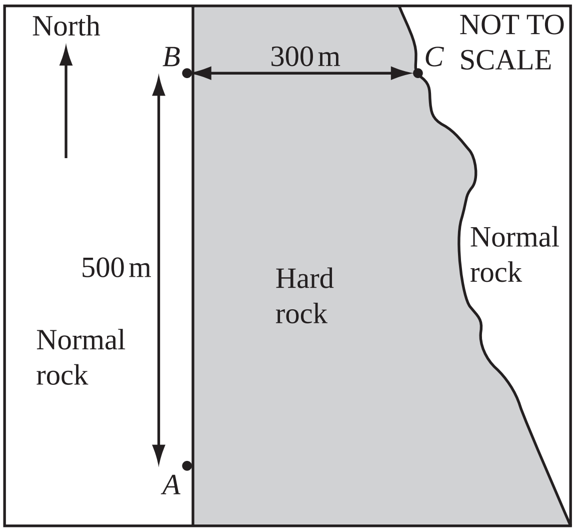
You are advised to spend 45 minutes on part **B**.



On the plan, A is south of B and C is east of B.

$AB = 500$ metres and $BC = 300$ metres.

Engineers want to drill a tunnel from A to C.
The tunnel has one or more straight sections.

1 Calculate the length of the shortest possible tunnel from A to C.
Give your answer correct to the nearest metre.

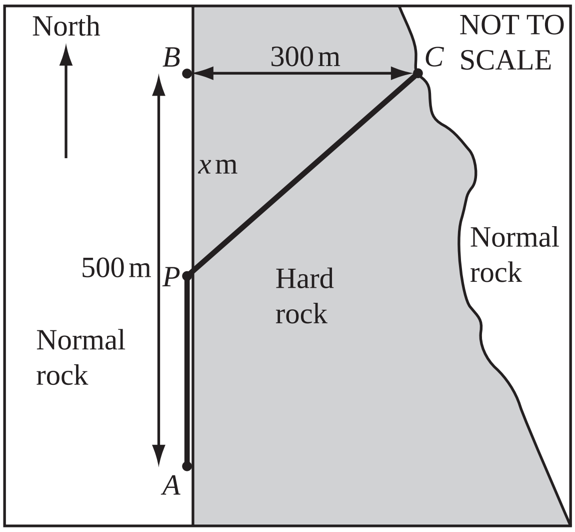
.... m

2 Write down the length of the tunnel if the engineers drill through as little hard rock as possible.

.... m

3 P is a point which is x metres south of B.

The engineers decide to drill from A to P to C.



Through normal rock, from A to P, the drill moves forward at 2 metres per hour.
Through the hard rock, from P to C, the drill moves forward at 1 metre per hour.

(a) Explain why the time in hours, T, that it takes to drill the tunnel, can be modelled by this equation.

$$T = \frac{500 - x}{2} + \sqrt{90000 + x^2}$$

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(b) All the measurements are accurate.
Write down a practical reason why the time given by the model may be different from the actual time.

....

....

(c) On the diagram, sketch the graph of T against x.

(d) **(i)** Find, to the nearest metre, the position of P which gives the minimum time to drill the tunnel.

.... metres from B

(ii) Find this minimum time correct to the nearest 10 hours.

.... hours

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4 To drill through normal rock costs 2 thousand dollars per hour.
To drill through the hard rock costs 3 thousand dollars per hour.

(a) The total cost of drilling the tunnel is n thousand dollars.
Write down a model for n in terms of x.

$n =$ ....

(b) (i) Find, to the nearest metre, the position of P which gives the minimum cost.

.... metres from B

(ii) Write, in full, this minimum cost to the nearest ten thousand dollars.

\$ ....

5 The model for the time taken to drill the tunnel is $T = \dfrac{500 - x}{2} + \sqrt{90000 + x^2}$.

(a) The position of B and C are fixed.
Investigate the position of P which gives the minimum time when A is more than 500 m south of B.

(b) If $AB = d$ metres explain, using **part (a)**, why the minimum time in hours is
$T = \dfrac{d}{2} + k$, where $k = 260$ correct to 3 significant figures.