UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

4119238411

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/06**

Paper 6 (Extended) **May/June 2012**

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 **11** printed pages and **1** blank page.

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

A INVESTIGATION ADDITIONAL TRIPLES (20 marks)

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

An addition triple has three **different** numbers.
The numbers (8, 10, 18) form an addition triple because 8 + 10 = 18.
Some other addition triples are (10, 11, 21) and (21, 24, 45).

This investigation explores patterns with addition triples.

1 Nine addition triples can be found from the list of integers 1, 2, 3, 4, 5, 6, 7.
One of these triples is (3, 4, 7).

Write down the other eight addition triples in the spaces provided.
[Note that (3, 4, 7) and (4, 3, 7) are the same addition triple.]

(.......... , ... , ...)

(.......... , ... , ...)

(.......... , ... , ...)

(.......... , ... , ...)

(.......... , ... , ...)

(.......... , ... , ...)

(.......... , ... , ...)

(.......... , ... , ...)

(3 , 4 , 7)

2 Complete the table, showing the addition triples for each list of integers.
In the last column write the total number of triples.

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Number of integers	List of integers	Addition triples	Total number of addition triples
3	1, 2, 3	(1, 2, 3)	1
4	1, 2, 3, 4		2
5	1, 2, 3, 4, 5		
6	1, 2, 3, 4, 5, 6		
7	1, 2, 3, 4, 5, 6, 7	Leave this blank – do not write your answer to question 1 again.	9
8	1, 2, 3, 4, 5, 6, 7, 8		12

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3 Look at the pattern in the last column in the table on page 3.
Use it to complete the following table.

Number of integers	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of addition triples	1	2			9	12	16	20		30			

4 Using **Question 3**, complete the following table when there is an **odd** number of integers in the list.

Number of integers	3	5	7	9	11	13	15
Number of addition triples	1		9	16			

5 For the table in **Question 4**, the same three arithmetic operations **always** take you from the number of integers in the list to the corresponding number of addition triples.

The first operation is **subtract 1**.

Find the other two operations.
Show that these three operations take you
from 7 integers in the list to 9 addition triples,
and from 9 integers in the list to 16 addition triples.

6 Using **Question 5**, find

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(a) the number of addition triples when there are 101 integers in the list,

....

(b) the number of integers in the list when there are 11 449 addition triples,

....

(c) an expression for the number of addition triples when the list has n integers and n is odd.

....

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7 Using patterns in the table in **Question 3**, find

(a) the number of addition triples when there are 100 integers in the list,

....

(b) the number of integers in the list when there are 1332 addition triples,

....

(c) an expression for the number of addition triples when the list has n integers and n is even.

....

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B MODELLING REGIOMONTANUS' STATUE (20 marks)

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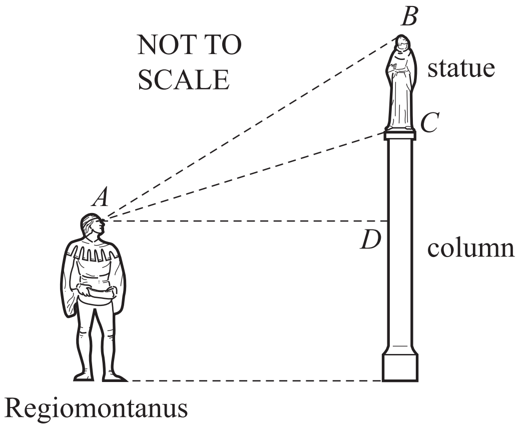
You are advised to spend 45 minutes on part **B**.

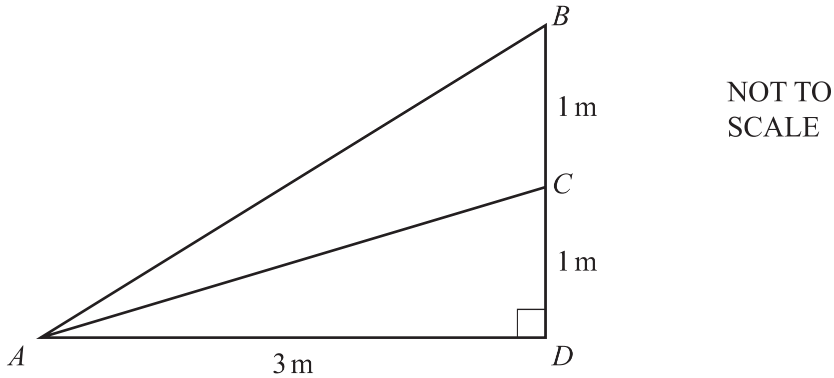
In the 15th century the German mathematician Regiomontanus worked out the best place to stand to view a statue that was on top of a column.

The picture shows a statue of height one metre.
The base C of the statue is one metre above the line of sight AD.
Angle BAC is called the angle of view.

The largest angle of view gives the best view of the statue.



1 The diagram models the picture.



Regiomontanus stands 3 metres from the base of the column so $AD = 3$ m.

(a) (i) Use the **right-angled triangle** ***ADB*** to show that the length $AB = \sqrt{13}$.

(ii) Use this answer to write down sin ABD as a fraction.

....

(b) Show that the length $AC = \sqrt{10}$.

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(c) Regiomontanus wrote that, in triangle *ABC*,

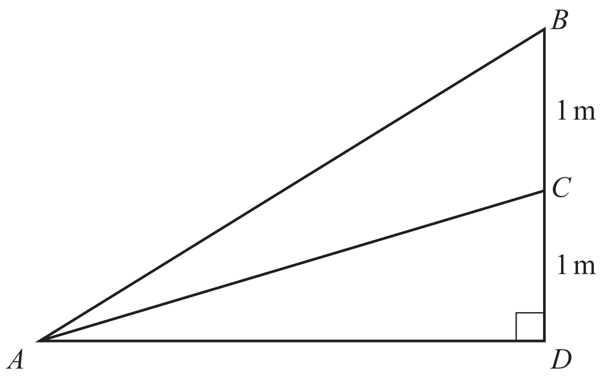
$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

Show that $\sin BAC = \dfrac{3}{\sqrt{130}}$.

2 Using the method in **Question 1**, find $\sin BAC$ when $AD = 1$ m.

3 Model sin BAC by letting AD = x metres.

Show that $\sin BAC = \dfrac{x}{\sqrt{(x^2+1)(x^2+4)}}$.



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4 **(a)** Using the model in **Question 3**, sketch the graph of sin *BAC* against *x*.

(b) Find the value of *x* which makes sin *BAC* a maximum.

....

(c) Find the largest angle of view.

....

Question 5 is printed on the next page.

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5 **(a)** Instead of one metre high, the statue is h metres high.
The base of the statue is still one metre above the line of sight.

Modify the model in **Question 3**.

(b) The one metre high statue is replaced by a statue that is 2 metres high.
Use your model from **part (a)** to find the change (if any) in

(i) the largest angle of view,

....

(ii) the corresponding distance from the column.

....