Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6714100329

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/61**

Paper 6 (Extended) **May/June 2015**

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, glue or correction fluid.
You may use an HB pencil for any diagrams or graphs.
DO **NOT** WRITE IN ANY BARCODES.

Answer both parts **A** and **B**.
You must show all the 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 **12** printed pages.

CAMBRIDGE International Examinations

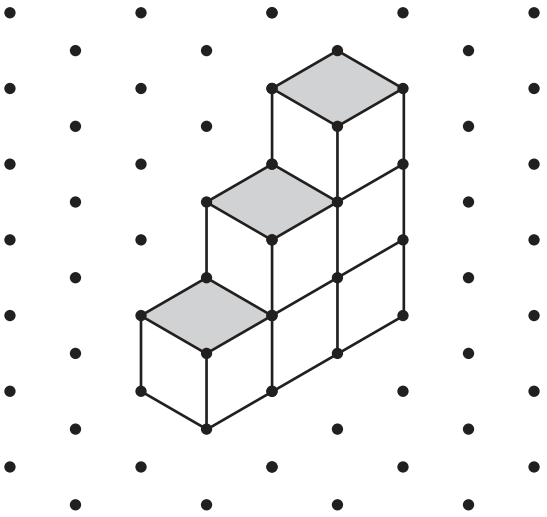
Answer **both** parts **A** and **B**.

A INVESTIGATION STAIRCASES (20 marks)

You are advised to spend no more than 45 minutes on this part.

This investigation looks at the number of cubes that make different types of staircase.

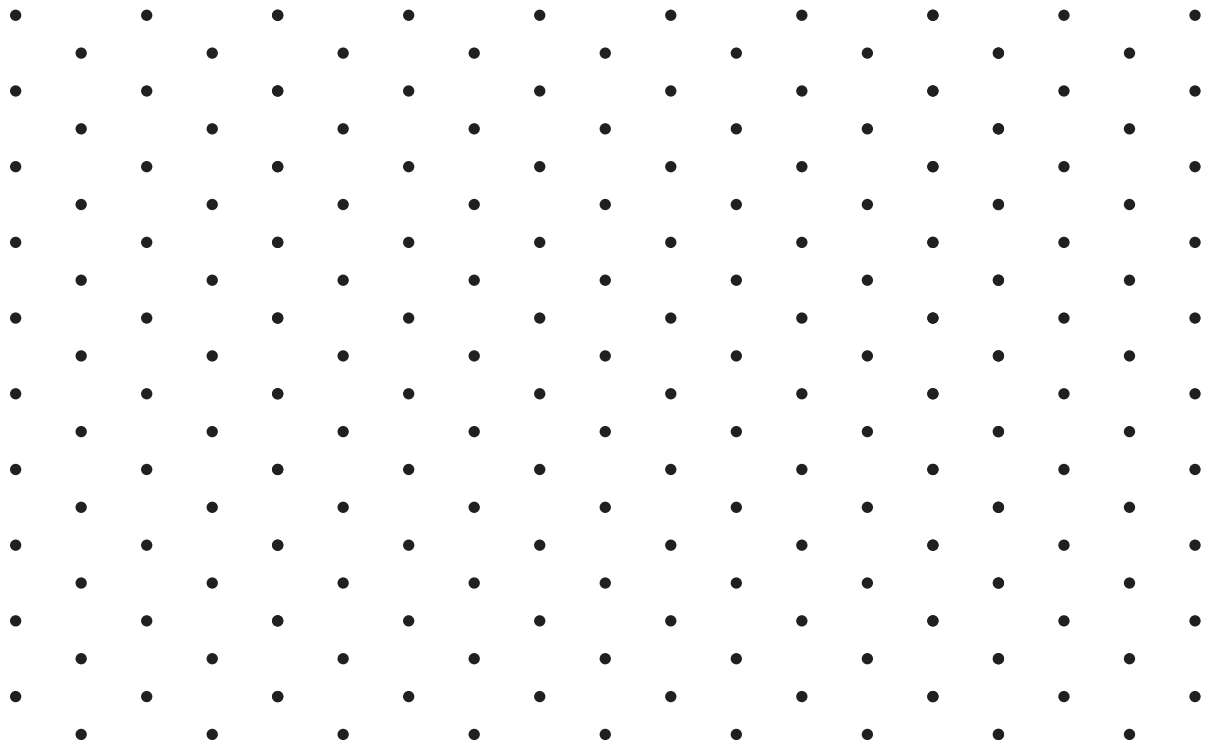
1 This is an *UP staircase* of height 3 made using 6 cubes.
It is a 3-step *UP staircase* because it has a height of 3 cubes.



(a) Write down the number of cubes that make an *UP staircase* of height 2.

.....

(b) On the grid below draw an *UP staircase* of height 4.



(c) Complete the table for the number of cubes that make these *UP staircases.*

Height	1	2	3	4	5	6
Number of cubes	1		6			

(d) Find an expression, in terms of n, for the number of cubes that make an *UP staircase* of height n.

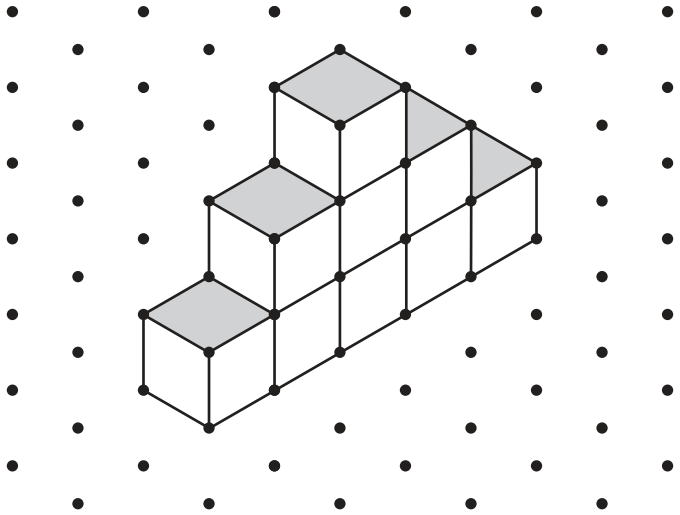
.....

(e) Find how many cubes make an *UP staircase* of height 10.

.....

[Turn over

2 This is an *UP AND DOWN staircase* of height 3 made using 9 cubes.
It is a 3-step *UP AND DOWN staircase* because it has a height of 3 cubes.



(a) Find how many cubes make an *UP AND DOWN staircase* of height 4.

.....

(b) Complete the table for the number of cubes that make these *UP AND DOWN staircases*.

Height	1	2	3	4	5	6
Number of cubes	1		9			

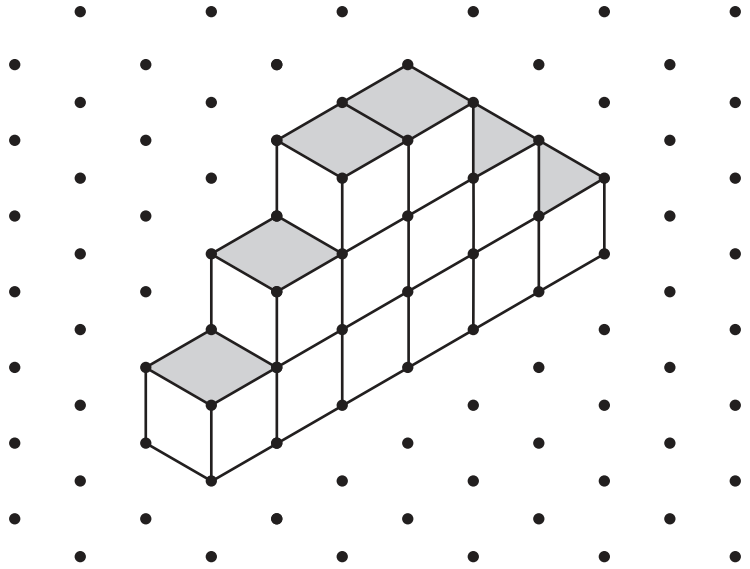
(c) Find an expression, in terms of n, for the number of cubes that make an *UP AND DOWN staircase* of height n.

.....

(d) Find how many cubes make an *UP AND DOWN staircase* of height 10.

.....

3 This is a *DOUBLE staircase* of height 3 made using 12 cubes.
It is a 3-step *DOUBLE staircase* because it has a height of 3 cubes.



(a) Complete the table for the number of cubes that make these *DOUBLE staircases*.

Height	1	2	3	4	5	6
Number of cubes	2		12			

(b) Find an expression, in terms of n, for the number of cubes that make a *DOUBLE staircase* of height n.

.....

(c) Find how many cubes make a *DOUBLE staircase* of height 10.

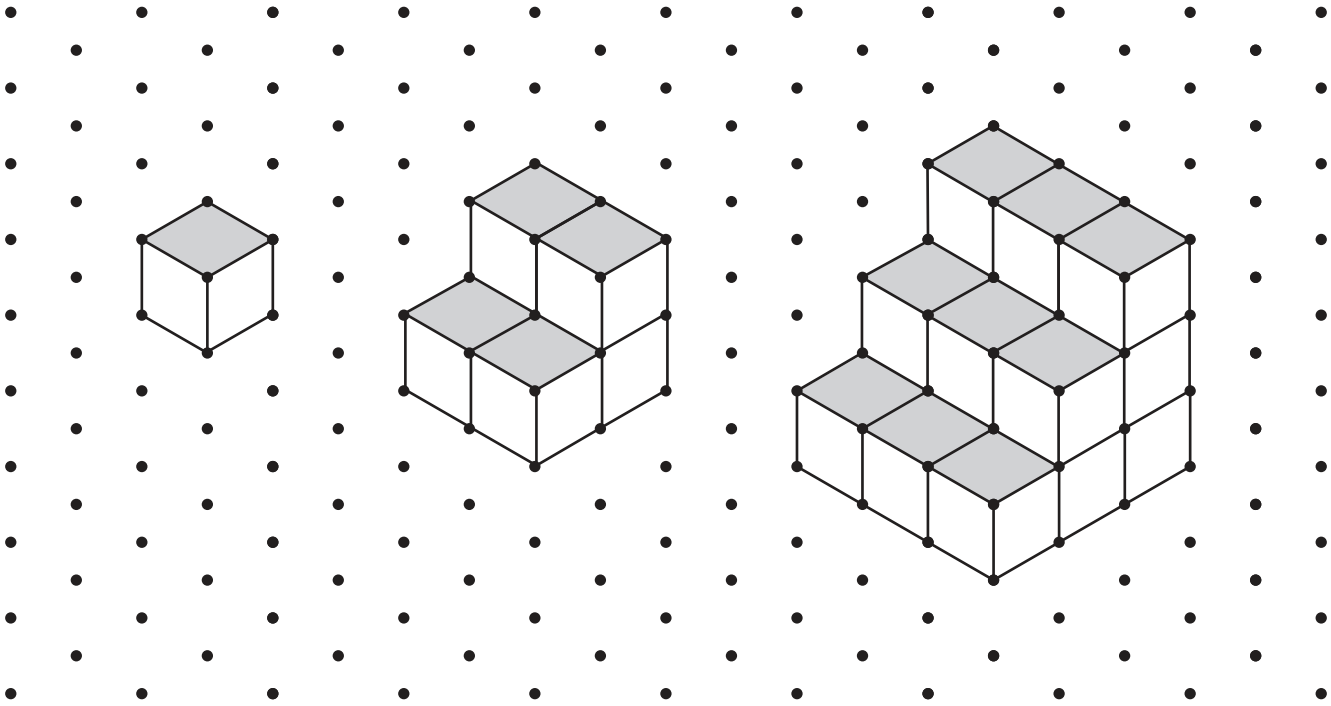
.....

(d) Find the height of a *DOUBLE staircase* made from 240 cubes.

.....

[Turn over

4 This is a sequence of *MULTIPLE staircases* of heights 1, 2 and 3.
These are *MULTIPLE staircases* because, for each staircase, the width, the height and the depth are the same.



(a) Complete the table for the number of cubes that make these *MULTIPLE staircases*.

Height	1	2	3	4	5	6
Number of cubes	1	6	18			

(b) Find an expression, in terms of n, for the number of cubes that make a *MULTIPLE staircase* of height n.

.....

5 There are 1800 cubes available.
Use your expressions in **questions 1(d)**, **3(b)** and **4(b)** to complete the table.

Type of staircase	Maximum height using 1800 cubes	Number of cubes left over
UP		
UP AND DOWN	42	36
DOUBLE		
MULTIPLE		

B MODELLING BOAT TRIPS (20 marks)

You are advised to spend no more than 45 minutes on this part.

A boat travels up and down a river.

The time taken for a journey depends on the speed of the boat and the speed of the water current.

1 In this model the water is still and so the speed of the water current is zero km / h.
The speed of the boat in still water is 15 km / h.

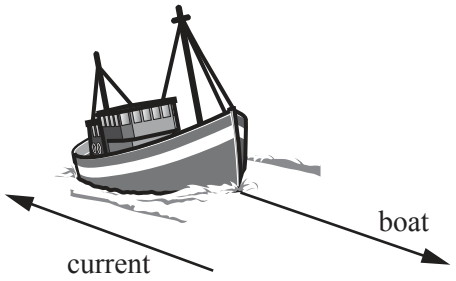
(a) Find how many minutes it will take for the boat to travel 10 km.

..... min

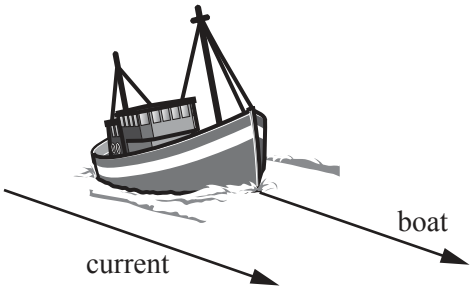
(b) The boat travels for 24 minutes.
Find the distance that it travels.

..... km

When a boat travels **against** the current it goes in exactly the **opposite** direction to the current.



When a boat travels **with** the current it goes in exactly the **same** direction as the current.



2 In this model the water is not still.
The speed of the water current is 2 km / h.
The speed of the boat in still water is 15 km / h.

(a) Show that it will now take the boat approximately 46 minutes to travel 10 km **against** the current.

(b) The boat travels for 20 minutes **against** the current.
Find the distance it travels.

..... km

(c) How far will the boat travel in 46 minutes **with** the current?

..... km

3 The boat travels 20 km up the river before returning to where it started.
The speed of the water current is 2 km / h.
The speed of the boat in still water is v km / h.

(a) (i) Find a model for the **total** travelling time, T hours, for this whole journey.

$T =$ .....

(ii) Show that your model simplifies to $T = \dfrac{40v}{v^2 - 4}$.

(iii) Sketch the graph of $T = \dfrac{40v}{v^2 - 4}$ for $0 \leqslant v \leqslant 20$.

(iv) The model is only appropriate for $v > k$.
Find the value of k and give a practical reason why k must have this value.

$k =$ ..... because .....

.....

(b) When the speed of the boat in still water is 18 km / h, find the time taken for the whole journey.

..... hours

(c) The return journey takes the boat 3 hours.
Find the speed of the boat in still water.

..... km / h

4 The boat travels 20 km up the river before returning to where it started.
The speed of the boat in still water is v km / h.
A whole journey takes the boat 3 hours.

(a) (i) Adjust the model in **question 3(a)(ii)** for a water current of 3 km / h.

$T =$ .....

(ii) Find the speed of the boat in still water.

..... km / h

(b) The speed of the boat in still water is now 15 km / h.
Adjust the model in **question 3(a)(ii)** and find the speed of the water current.

..... km / h

Question 5 is printed on the next page.

5 **(a)** There is a change in the boat's journey.
Explain how the journey has changed when the model in **question 3(a)(ii)** becomes

$$T = \frac{80v}{v^2 - 4} \ .$$

.....

.....

(b) Describe fully the **single** transformation that maps the graph of $T = \frac{40v}{v^2 - 4}$ onto the graph of $T = \frac{80v}{v^2 - 4}$.

.....

.....