Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6949648158

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/61**

Paper 6 (Extended) **October/November 2018**

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** (questions 1 to 4) and part **B** (questions 5 to 7).
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 **15** printed pages and **1** blank page.

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

A INVESTIGATION (QUESTIONS 1 to 4)

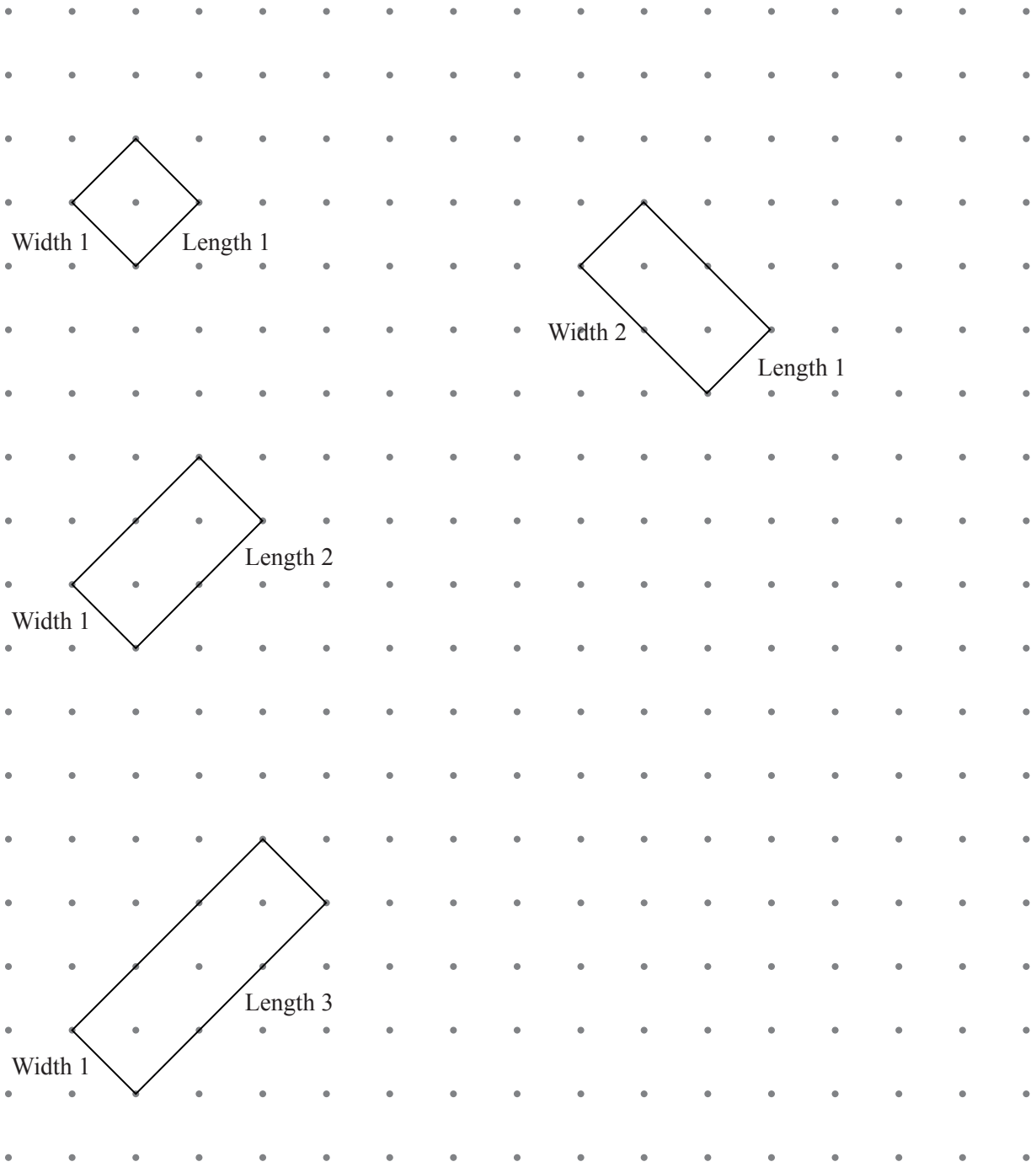
DOTS IN RECTANGLES (20 marks)

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

This investigation looks at the number of dots inside rectangles drawn on square dotty paper.

1 Rectangles are drawn at an angle to the horizontal.
They are called *diagonal* rectangles.

The rectangles below are drawn at an angle of 45° to the horizontal.
Two sides of each rectangle have a gradient of 1.
These are *diagonal* rectangles with gradient 1.



(a) Complete the tables below.

Width (W)	Length (L)	Number of dots inside a *diagonal* rectangle with gradient 1 (d)
1	1	1
1	2	2
1	3	
1	4	
1	5	

Width (W)	Length (L)	Number of dots inside a *diagonal* rectangle with gradient 1 (d)
2	1	2
2	2	
2	3	
2	4	
2	5	

Width (W)	Length (L)	Number of dots inside a *diagonal* rectangle with gradient 1 (d)
3	1	3
3	2	
3	3	
3	4	
3	5	

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(b) Use your results from **part (a)** and any patterns you notice to complete the table.

Width (W)	Number of dots inside a *diagonal* rectangle with gradient 1 (d)
1	
2	$3L - 1$
3	
4	
5	$9L - 4$

(c) A formula, in terms of W and L, for the number of dots, d, inside a *diagonal* rectangle with gradient 1, is

$$d = (aW + b)L - (W + c) .$$

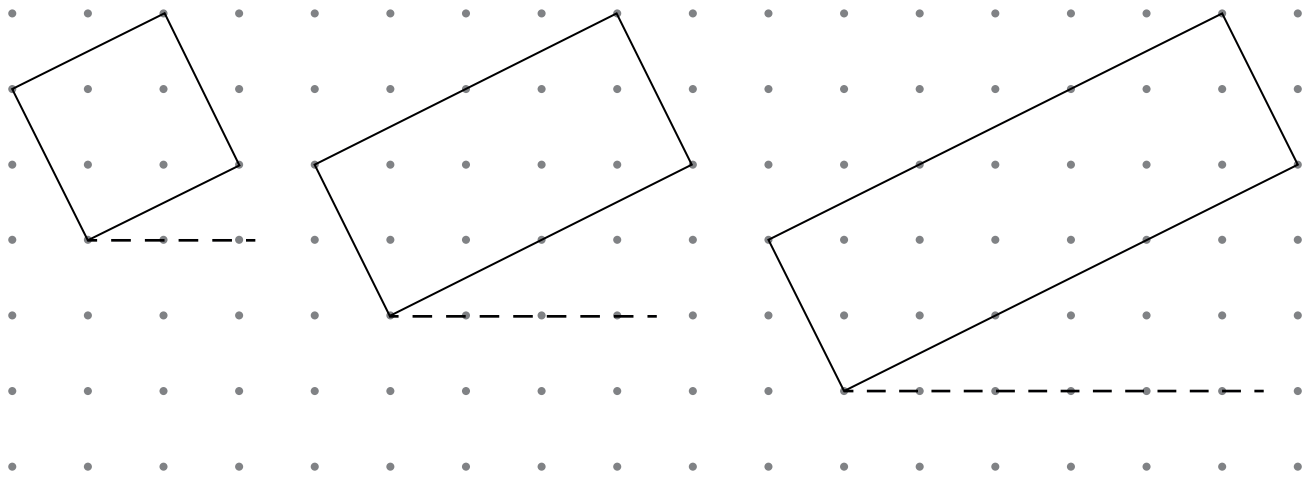
Find the values of a, b and c.

$a =$ .....

$b =$ .....

$c =$ .....

2 The diagram below shows three *diagonal* rectangles, each of width 1 and gradient $\frac{1}{2}$.

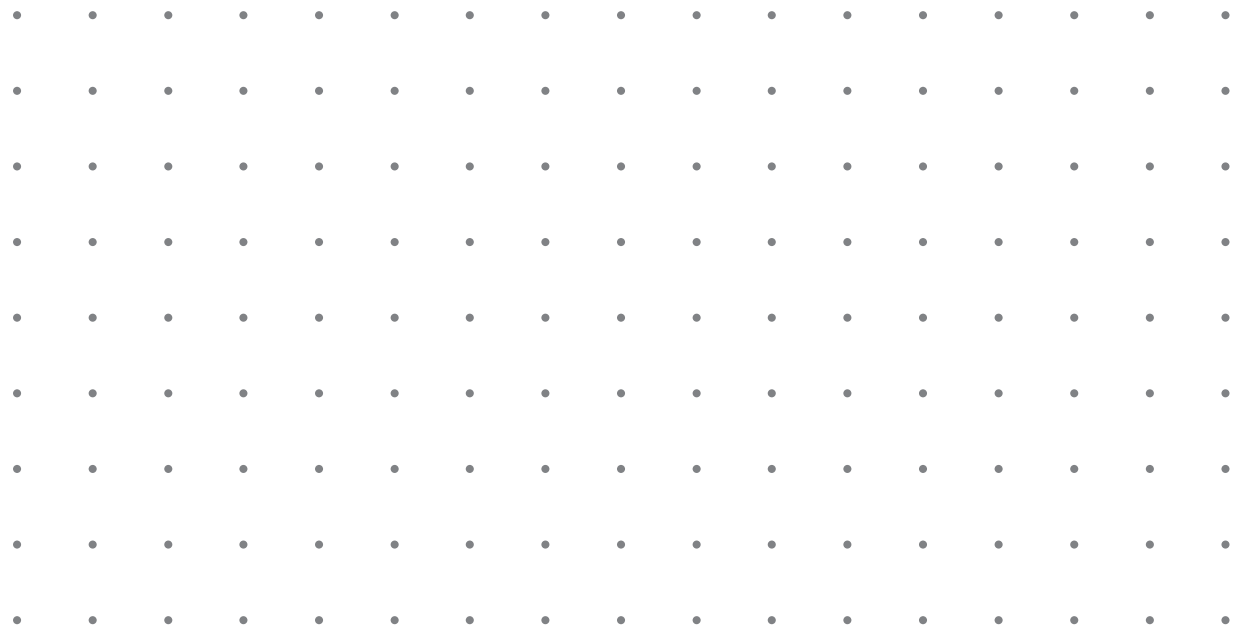


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(a) Complete the tables below.
You may use the square dotty paper to help you.

Width (W)	Length (L)	Number of dots inside a *diagonal* rectangle with gradient $\frac{1}{2}$ (d)
1	1	4
1	2	8
1	3	12
1	4	
1	5	

Width (W)	Length (L)	Number of dots inside a *diagonal* rectangle with gradient $\frac{1}{2}$ (d)
2	1	8
2	2	17
2	3	
2	4	
2	5	



Width (W)	Length (L)	Number of dots inside a *diagonal* rectangle with gradient $\frac{1}{2}$ (d)
3	1	12
3	2	
3	3	40
3	4	
3	5	

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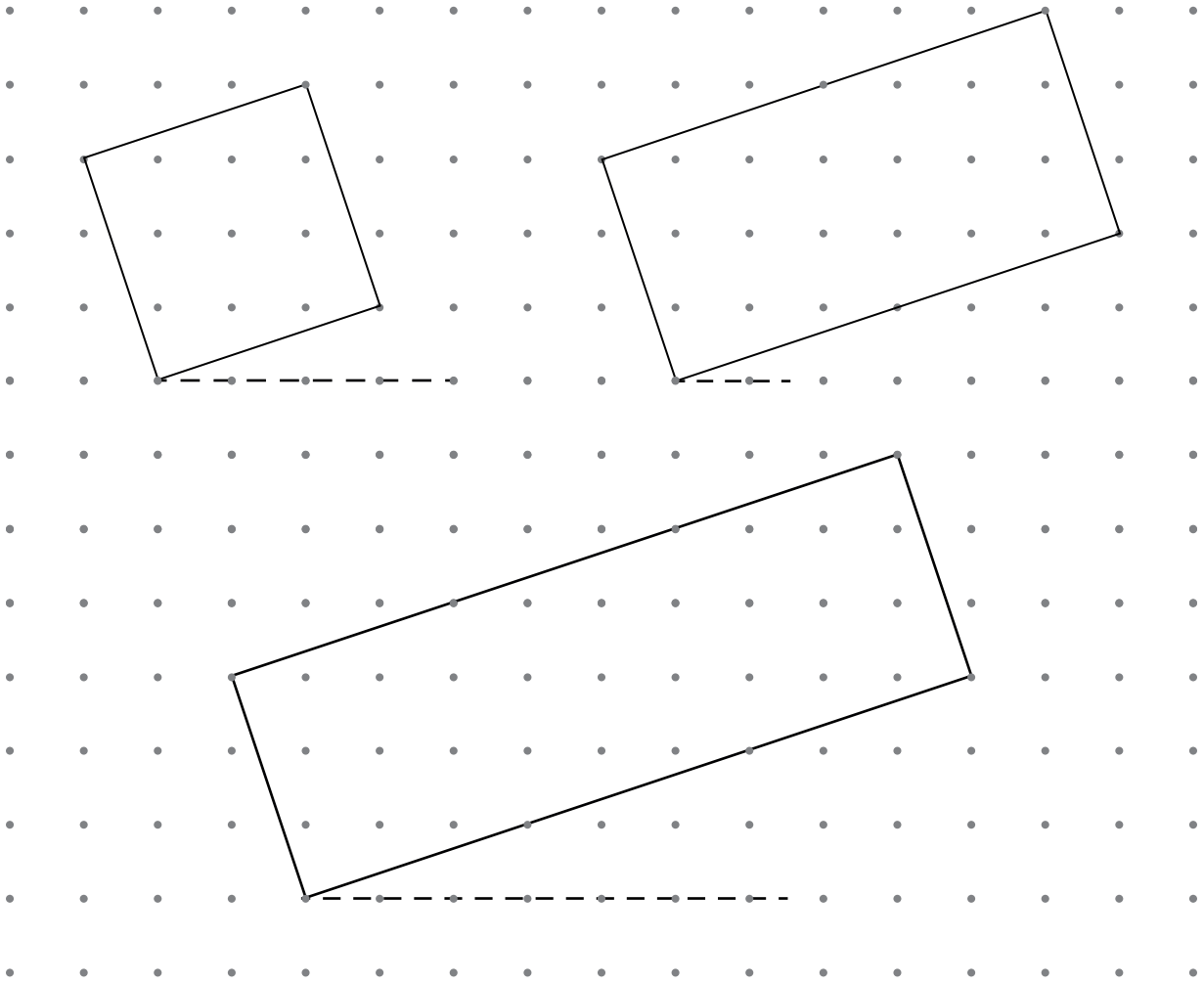
(b) Use your results from **part (a)** and any patterns you notice to complete the table.

Width (W)	Number of dots inside a *diagonal* rectangle with gradient $\frac{1}{2}$ (d)
1	
2	
3	
4	$19L - 3$
5	$24L - 4$

(c) Find a formula, in terms of W and L, for the number of dots, d, inside a *diagonal* rectangle with gradient $\frac{1}{2}$.

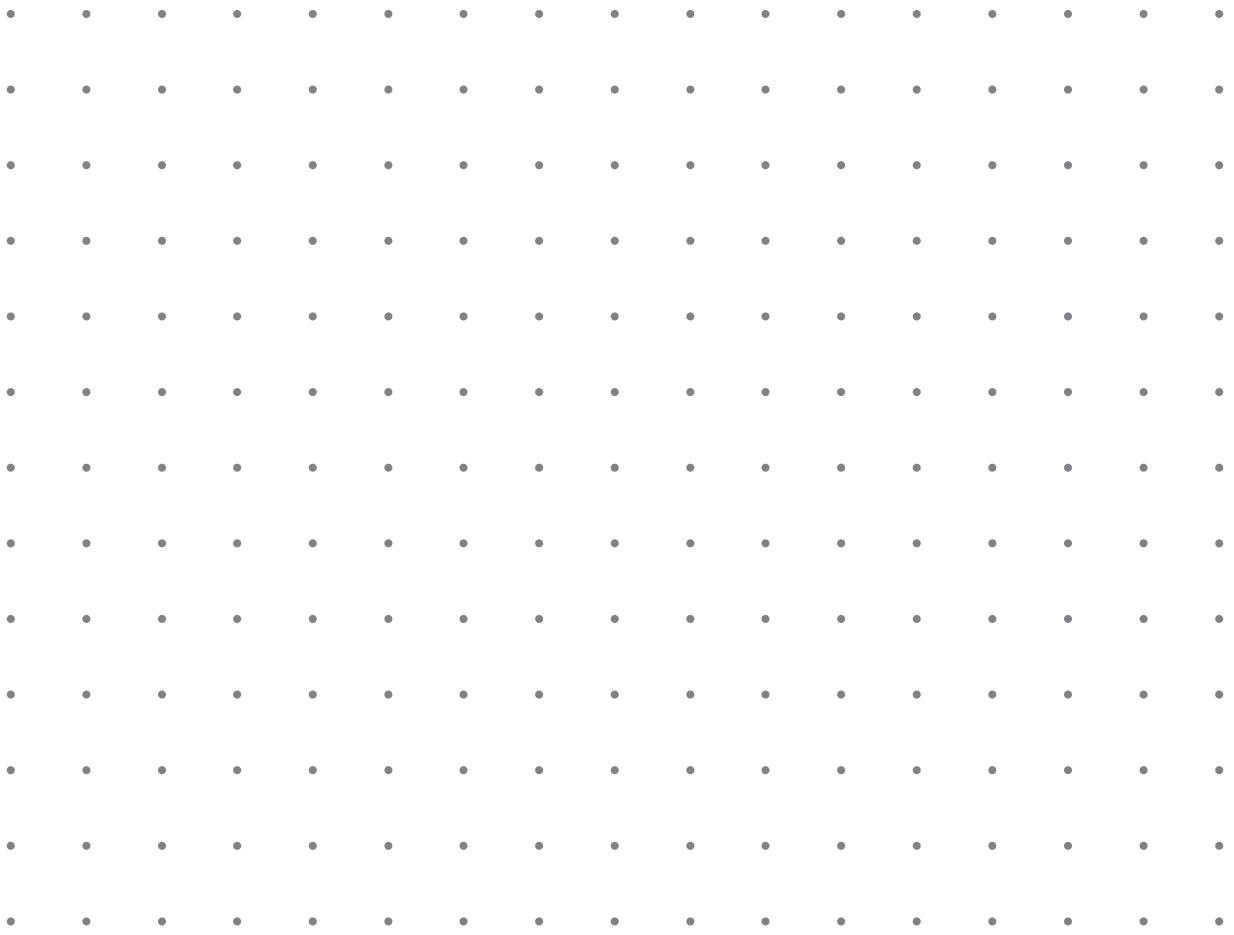
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3 The diagram below shows three *diagonal* rectangles, each of width 1 and gradient $\frac{1}{3}$.



(a) Complete the table.
You may use the square dotty paper below to help you.

Width (W)	Number of dots inside a *diagonal* rectangle with gradient $\frac{1}{3}$ (d)
1	
2	$19L - 1$
3	
4	
5	$49L - 4$



(b) Find a formula, in terms of W and L, for the number of dots, d, inside a *diagonal* rectangle with gradient $\frac{1}{3}$.

.....

4 **(a)** Complete the following table, using your answers to **question 1(c)**, **question 2(c)** and **question 3(b)** and any patterns you notice.

Gradient	Number of dots inside a *diagonal* rectangle (d)
1	
$\frac{1}{2}$	
$\frac{1}{3}$	
$\frac{1}{4}$	$(17W - 1)L - (W - 1)$
$\frac{1}{5}$	

(b) Use your answers to **part (a)** to find a formula, in terms of W, L and n, for the number of dots, d, inside a *diagonal* rectangle with a gradient of $\frac{1}{n}$.

.....

(c) There are 4833 dots inside a 4 by 12 *diagonal* rectangle.

Find the gradient of this rectangle.

.....

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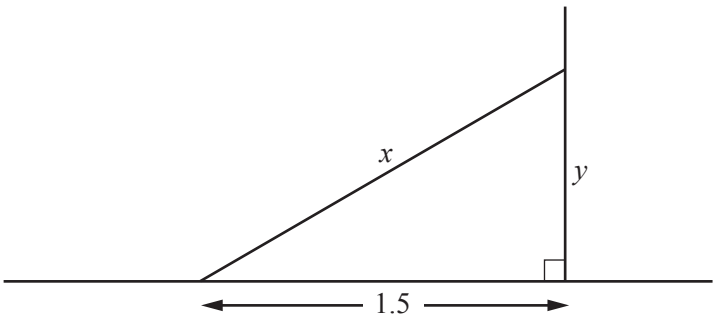
B MODELLING (QUESTIONS 5 to 7)

LADDERS (20 marks)

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

This task looks at the safe positions for placing a ladder against a wall.

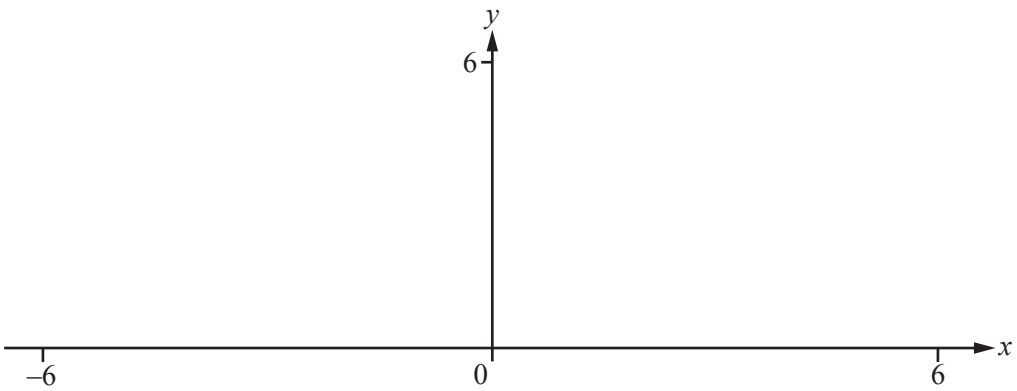
A ladder is x metres long.
It leans against a vertical wall.
The bottom of the ladder is 1.5 m from the base of the wall.
The ladder touches the wall y metres above the ground.



NOT TO SCALE

5 **(a)** Show that $y = \sqrt{x^2 - 2.25}$.

(b) **(i)** Sketch the graph of $y = \sqrt{x^2 - 2.25}$ on the axes below.

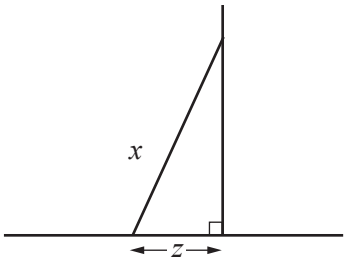


(ii) Only one part of the graph fits this practical situation.
Give a reason why the other part does not.

.....

.....

6 Safety rules for ladders say that the angle between the bottom of the ladder and the ground must be more than 76°.



NOT TO SCALE

(a) To use a ladder safely, show that a model for its position is

$$z < 0.242x.$$

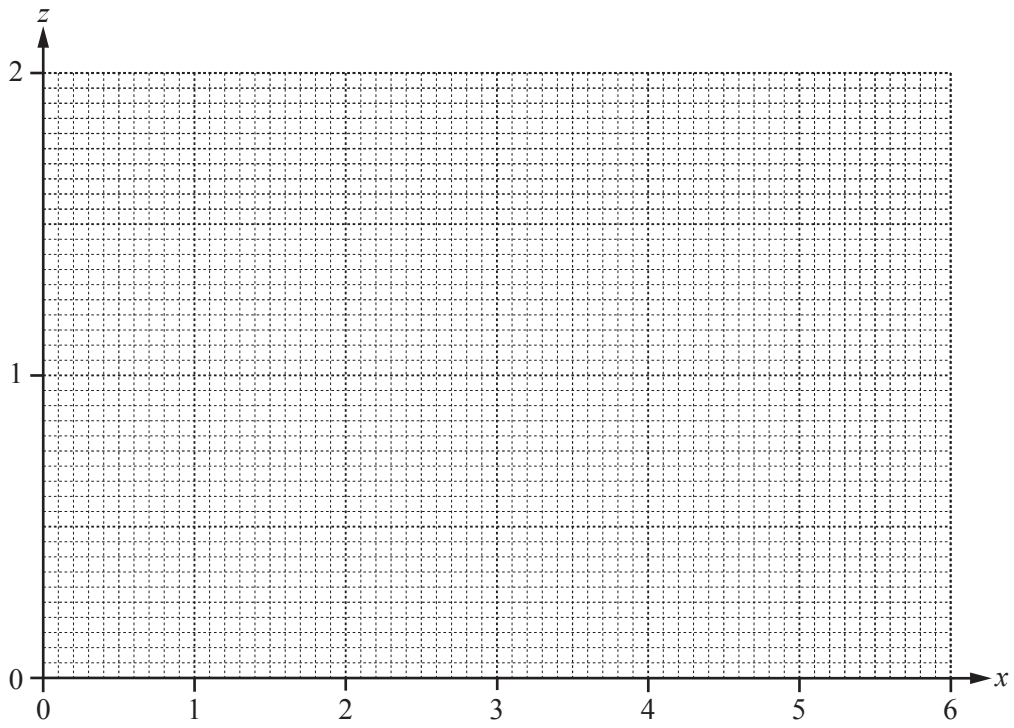
(b) To use a ladder safely the angle between the bottom of the ladder and the ground must be less than 82°.

Find a second inequality connecting z and x.

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(c) On the axes, shade the region defined by the inequalities in **part (a)** and **part (b)**.

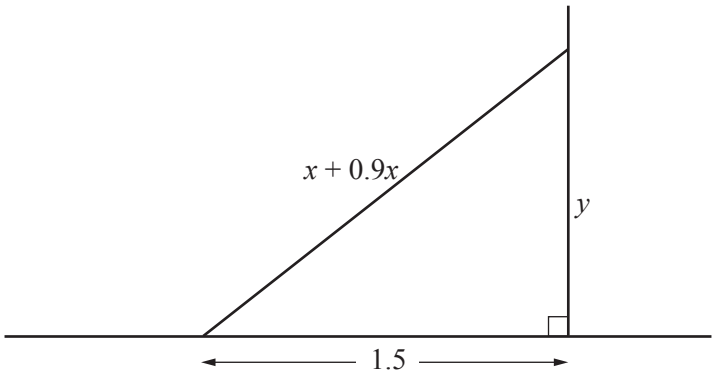


(d) A ladder is 3 m long.
To use this ladder safely, $a < z < b$.

Use your graph in **part (c)** to find the value of a and the value of b.

..... $< z <$ .....

7 Ladders can be extended to increase their original length.
A ladder is extended by 0.9 times its original length.
The bottom of this ladder is 1.5 m from the base of the wall.



(a) Find a formula for y in terms of x.

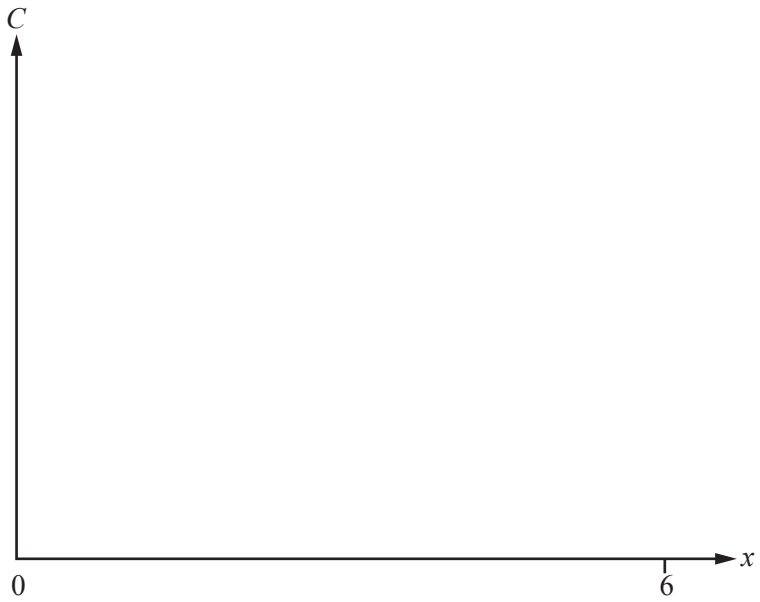
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(b) **(i)** When the ladder is extended it reaches higher up the wall.
This increase in height, y, is C metres.

Using the model in **question 5(a)**, show that a model for C is

$$C = \sqrt{3.61x^2 - 2.25} - \sqrt{x^2 - 2.25}\ .$$

(ii) On the axes below, sketch the graph of C for $0 < x < 6$.



(c) This part is about the smallest increase in height that the ladder reaches up the wall.

(i) Find this smallest increase in height.

.....

(ii) Write down the **original** length of the ladder.

.....

(iii) Show how you can decide whether the **extended** ladder is safe.

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