Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

4364429874

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/62**

Paper 6 (Extended) **October/November 2017**

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 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 to 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 **14** printed pages and **2** blank pages.

DC (NF/FC) 134786/2

[Turn over

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

A INVESTIGATION NUMBER WALLS (20 marks)

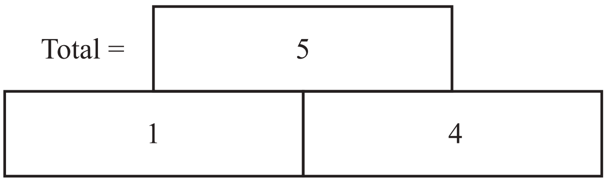
You are advised to spend no more than 45 minutes on this part.

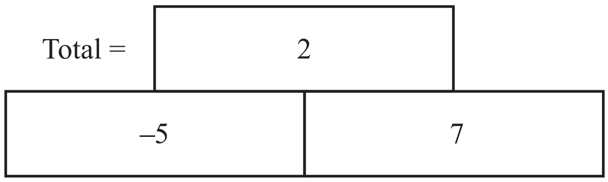
This investigation looks at what happens when you place numbers on a *Number Wall*.

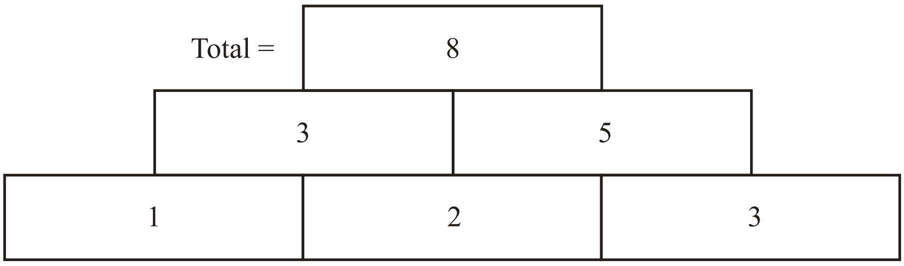
You make a *Number Wall* like this.

- Integers are put on the bottom row of bricks.
- The number on a brick is the sum of the numbers on the two bricks below.

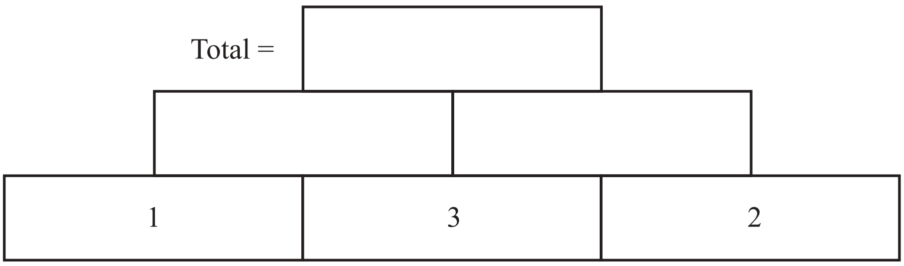
<u>Examples</u>







1 **(a)** Complete this *Number Wall*.



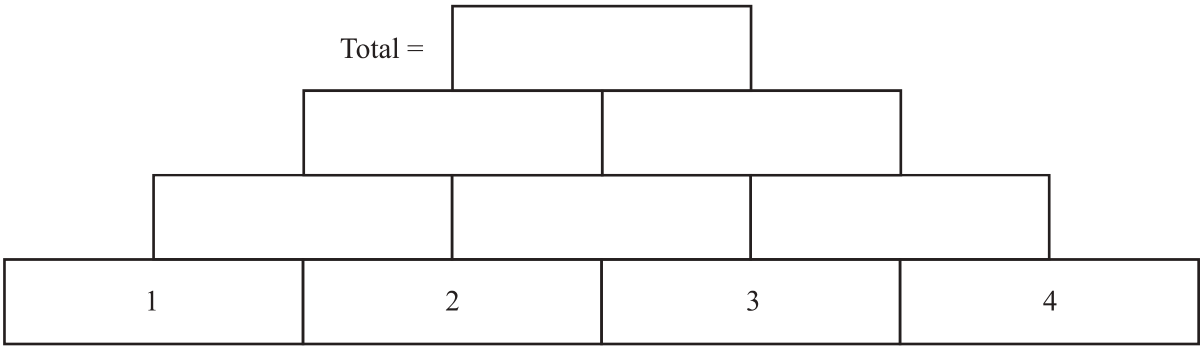
(b) In **part (a)**, the number 3 is on the middle brick of the bottom row.
In the example, the number 3 is on the end brick of the bottom row.

Explain why putting the number 3 on the middle brick of the bottom row increases the total.

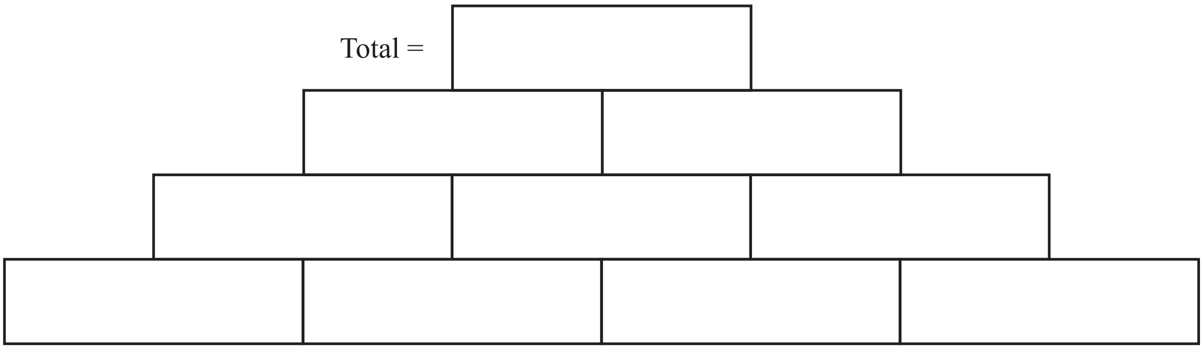
....

....

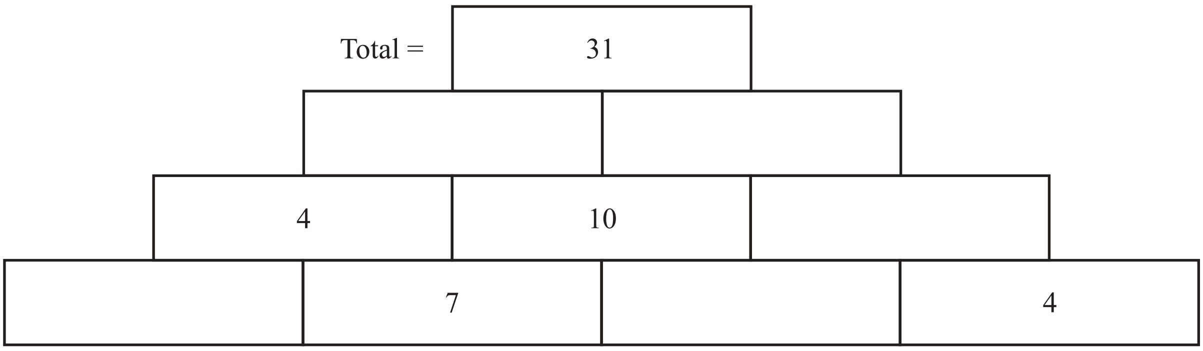
2 **(a)** Complete this *Number Wall*.



(b) Put the numbers 1, 2, 3 and 4 on the bottom row and complete this *Number Wall* so that the total is bigger than the total in **part (a)**.

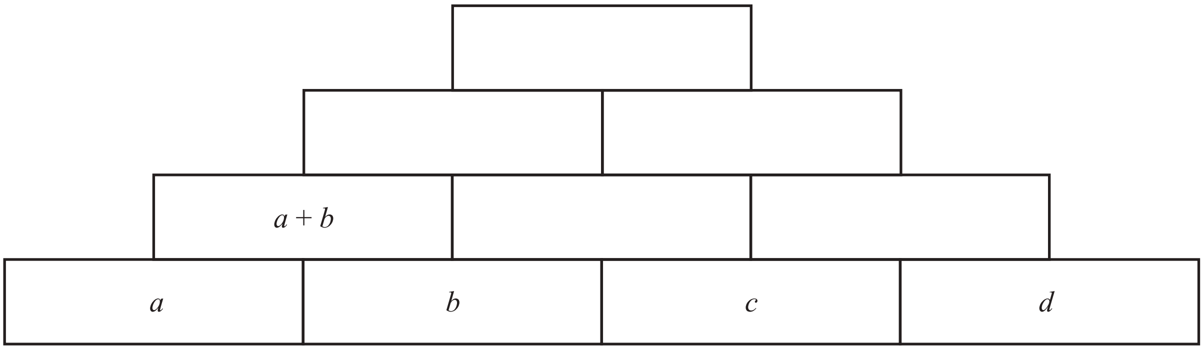


(c) Complete this *Number Wall*.
You may use negative numbers.



3 **(a)** This *Number Wall* is 4 bricks high.

Complete each brick using expressions in terms of a, b, c and d.
Write each expression in its simplest form.

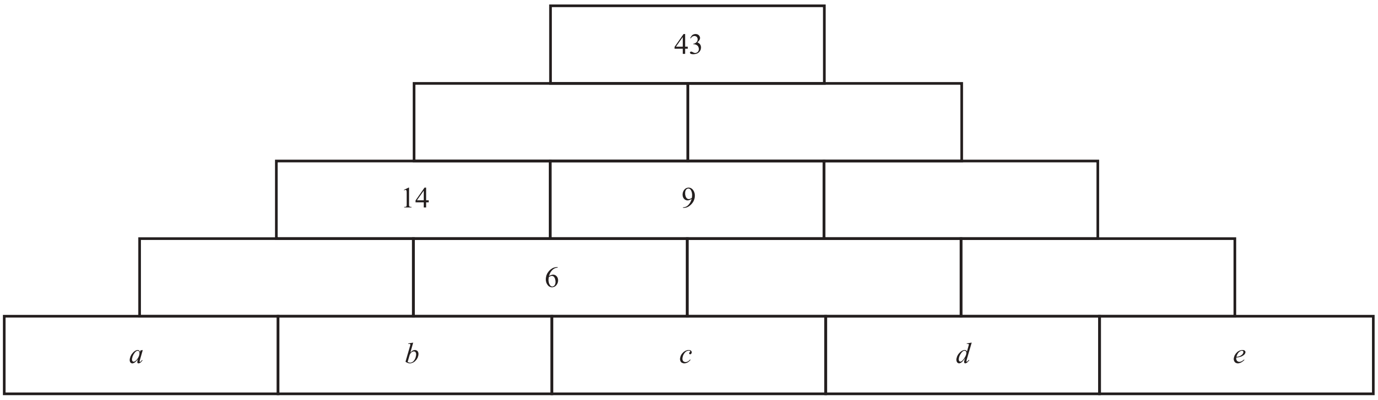


(b) In another wall that is 4 bricks high, the total is 34 and the values of a, b, c and d are all the same.

Use the expression for the total you found in **part (a)** to show that the value of a cannot be an integer.

(c) In this *Number Wall* that is 5 bricks high, only integers greater than 0 are used.

Find both sets of possible values for a, b, c, d and e.



Set 1 a = ... b = ... c = ... d = ... e = ...

Set 2 a = ... b = ... c = ... d = ... e = ...

4 In 1653 a French mathematician, Blaise Pascal, wrote about a triangle of numbers similar to the one shown below.
It is made in the same way as *Number Walls* but

- the number on a brick is the sum of the numbers on the two bricks **above**

and

- the number on the first and last brick in each row is always 1.

Row 1	1	1					
Row 2	1	2	1				
Row 3	1	3	3	1			
Row 4	1	4	6	4	1		
Row 5	1	5	10	10	5	1	
Row 6	1	6	15	20	15	6	1

(a) The wall in **question 3(a)** is 4 bricks high.

Show clearly how your expression for the total in **question 3(a)** connects to the numbers in one row of this triangle.
Write down which row this is.

Row ....

(b) A wall that is 5 bricks high has *a*, *b*, *c*, *d* and *e*, in that order, along the bottom row.

Write down an expression in terms of *a*, *b*, *c*, *d* and *e* for the total.

....

(c) Use your expression from **part (b)** to check that one of the sets of values you found for *a*, *b*, *c*, *d* and *e* in **question 3(c)** gives a total of 43.

5 **(a)** Each brick in the bottom row of a *Number Wall* has the letter a written on it.

Complete this table.

Height of wall (h bricks high)	Total
1	a
2	$2a$
3	
4	
h	

(b) A wall that is 6 bricks high has the same integer written on each brick on the bottom row.
The total is 96.

Find the integer that has been used.

....

(c) A wall has the number 5 written on each brick on the bottom row.
The total is 20 971 520.

Find the height of the wall.

....

6 The bricks on the bottom row of a wall are numbered consecutively using positive integers.
For example, 7, 8, 9, …
The total for the wall is 80.

Find all the possible heights of the wall.

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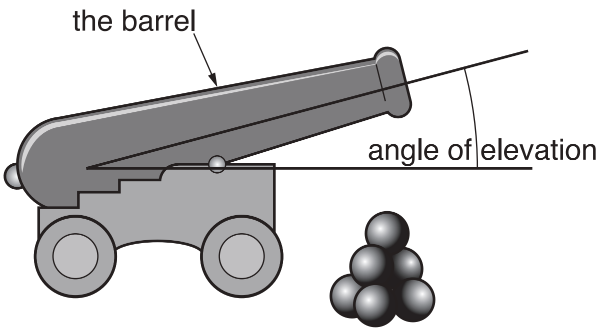
B MODELLING RANGES (20 marks)

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

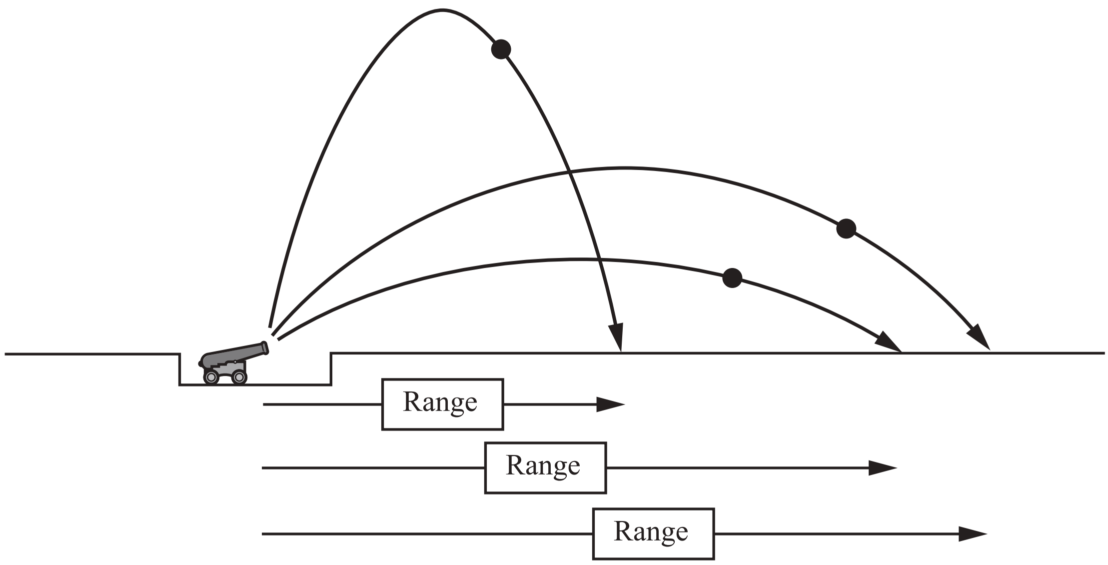
This task looks at the horizontal distance a ball, fired from a toy cannon on horizontal ground, travels before it hits the ground.

The horizontal distance that the ball travels is called the range.
The angle the barrel of the toy cannon makes with horizontal ground is called the angle of elevation.



The range depends on the angle of elevation.

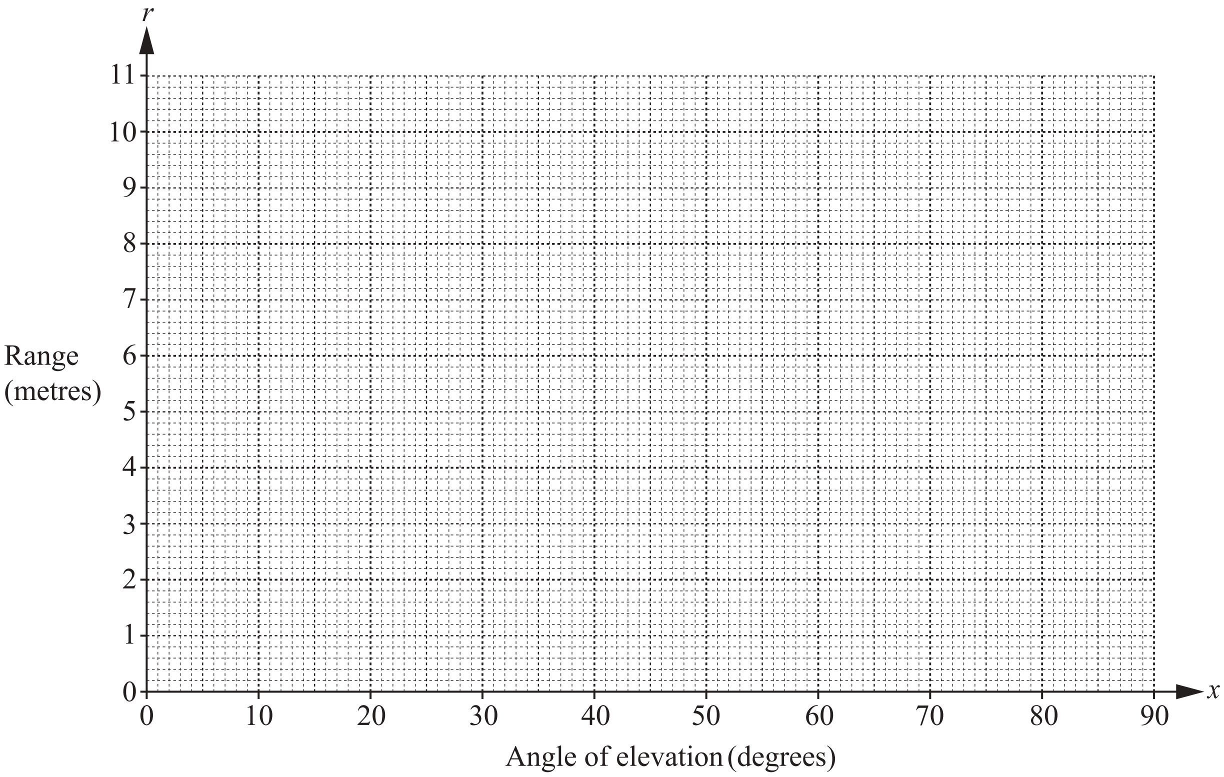
This diagram shows the path of a ball and its range for three different angles of elevation.



1 Paul has a toy cannon which fires a ball at a speed of v m/s.
He uses a model to calculate the range for the same speed but for different angles of elevation.

Angle of elevation (x degrees)	0	10	20	30	40	50	60	70	80	90
Range (r metres)	0	3.5	6.6	8.8	10.0	10.0	8.8	6.6	3.5	0

(a) On the grid, plot these points and draw a graph to show this information.



(b) Paul wants the range to be 8 m.

Use the graph to find the angles of elevation he could use.

....

(c) Paul wants the range to be the maximum.

Use the graph to find the angle of elevation he should use.

....

(d) A model for the range is $r = a\sin(2x)°$.

Find the value of a and write down the model.

....

(e) Use your model to find r when $x = 100$.
Explain your result.

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2 Paul now fires 8 balls from his cannon.
Each ball has the same mass and is fired at the same speed of v m/s.

He records the angle of elevation and range for each ball.

Angle of elevation (x degrees)	10	20	30	40	50	60	70	80
Range (r metres)	3.4	5.9	8.3	9.1	9.1	8.0	5.8	3.2

(a) Paul did not use an angle of elevation of 90°.

Give a reason why.

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(b) Use the information in the table to draw a graph using the axes on the previous page.

(c) How can you tell that the model in **question 1** is a good model for these results?

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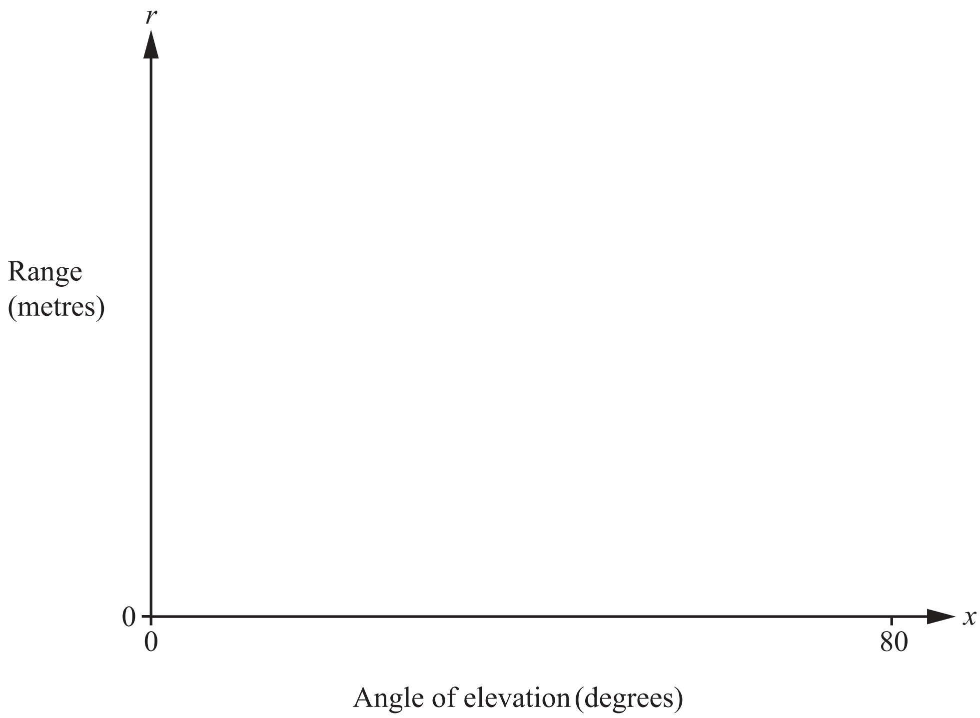
3 Paul now fires balls from his cannon, each with a speed of 20 m/s.

(a) Another model for the range is $r = \frac{v^2}{9.81}\sin(2x)°$.

On the axes below, sketch a graph of the expected ranges using this model.



(b) Paul records the actual range when he fires the balls.

Angle of elevation (*x* degrees).	10	20	30	40	50	60	70	80
Range (*r* metres).	12.0	21.8	29.2	30.7	30.2	26.3	19.5	10.6

On the same axes, sketch the graph for these ranges.
Comment on the suitability of using the model to predict the range.

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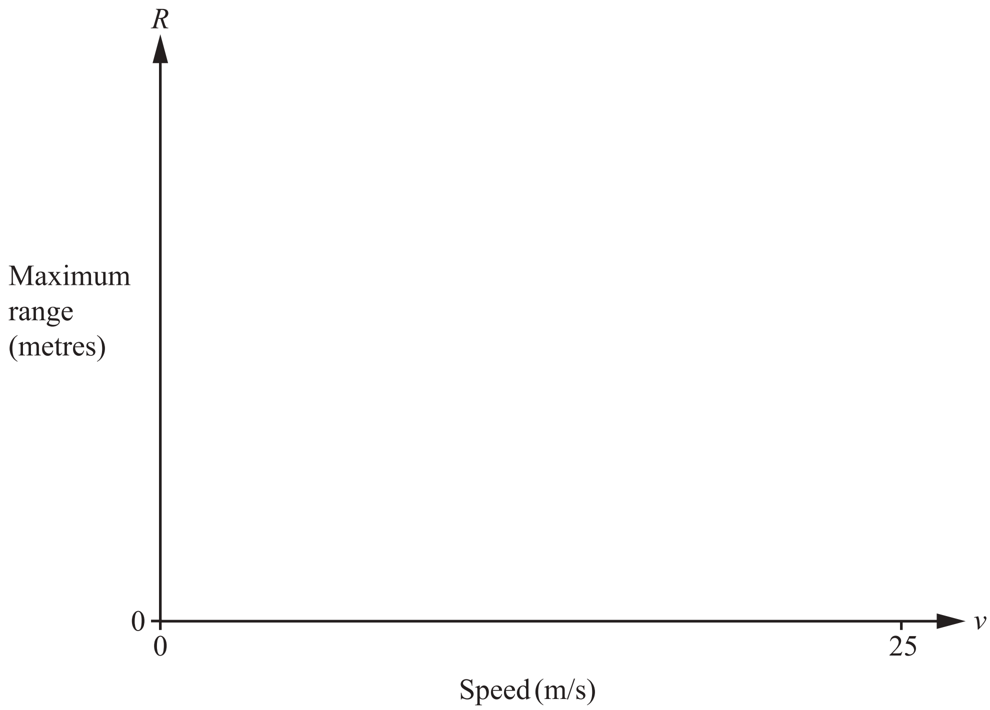
4 Paul changes the speed with which each ball is fired.
He records each speed and the maximum range, R metres.

Speed (v m/s)	1	5	10	15	20	25
Maximum range (R metres)	0.10	2.49	9.62	19.85	31.03	43.26

(a) On the axes below, sketch the graph of R against v.



(b) Paul improves his model in **question 3(a)** to estimate the maximum range, and to take account of air resistance.
The new model is

$$R = \frac{v^2}{9.81} - \frac{v^2 \times 2^{kv}}{981} \qquad \text{where } k \text{ is a constant.}$$

When $v = 15$ m/s, find the value of k, correct to 2 decimal places.

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(c) Comment on the suitability of the model as speed increases.

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