Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/61**

Paper 6 Investigation and Modelling (Extended) **October/November 2024**

1 hour 40 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer both part **A** (Questions 1 to 3) and part **B** (Questions 4 to 7).
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a graphic display calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly, including sketches, to gain full marks for correct methods.
- In this paper you will be awarded marks for providing full reasons, examples and steps in your working to communicate your mathematics clearly and precisely.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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[Turn over

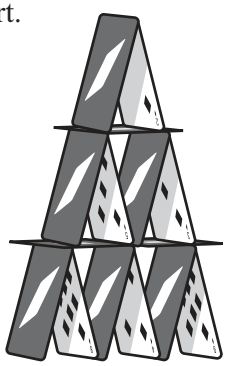
The investigation starts on the next page.

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

A INVESTIGATION (QUESTIONS 1 TO 3)

HOUSE OF CARDS (30 marks)

You are advised to spend no more than 50 minutes on this part.



This investigation looks at the number of cards in a house of cards.
The diagram shows a house of cards with three rows.

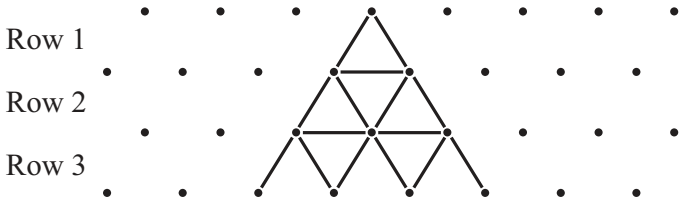
Rows are counted down from the top of the house.

In this investigation

—— is a horizontal card and / \ are diagonal cards.

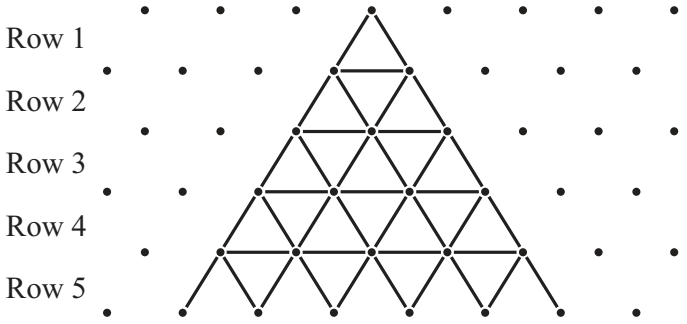
Example 1

This house of cards has 3 rows of cards.



Example 2

This house of cards has 5 rows of cards.



1 This is Row 1 in a house of cards.

There are 0 horizontal cards.

There are 2 diagonal cards.

There are 2 cards in total.

This is Row 2 in a house of cards.

There is 1 horizontal card.

There are 4 diagonal cards.

There are 5 cards in total.

This is Row 3 in a house of cards.

(a) Complete the table.

Row (n)	Number of horizontal cards	Number of diagonal cards	Total number of cards
1	0	2	2
2	1	4	5
3			
4			
5			

[3]

(b) Find an expression, in terms of n, for the total number of cards in Row n.

..... [3]

(c) The total number of cards in Row p is 368.

Work out how many **diagonal** cards are in Row p.

..... [3]

2 The house number is the number of rows in the house.

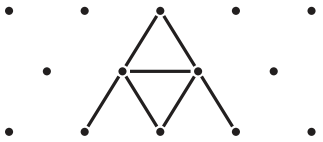
This is House 1.

There are 0 horizontal cards.

There are 2 diagonal cards.

There are 2 cards in total.

This is House 2.

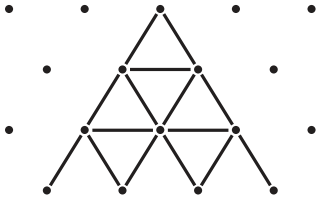


There is 1 horizontal card.

There are 6 diagonal cards.

There are 7 cards in total.

This is House 3.



(a) Complete the table.
You may use the grid to help you.

House (h)	Number of horizontal cards	Number of diagonal cards	Total number of cards
1	0	2	2
2	1	6	7
3			
4			
5			

[4]

(b) Find an expression, in terms of h, for the number of diagonal cards in House h.

..... [2]

(c) This is an expression for the number of horizontal cards in House h.

$$0.5h(h-1)$$

Use this expression and your answer from **part (b)** to find an expression for the total number of cards in House h.
Give your answer in its simplest form.

..... [2]

(d) The total number of cards in House k is 737.

Find the number of rows in House k.

..... [3]

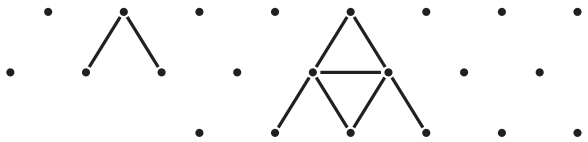
3 The investigation now looks at the total number of cards in a sequence of houses of cards.

This is the first diagram in the sequence of houses.
There is 1 house.

There are 0 horizontal cards.
There are 2 diagonal cards.
There are 2 cards in total.

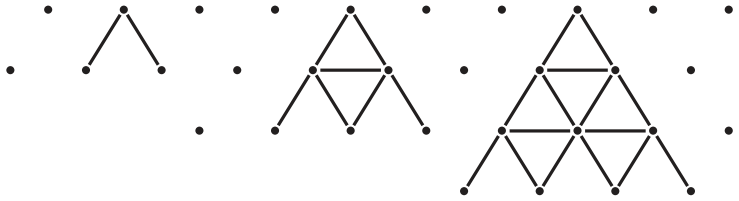
This is the second diagram in the sequence of houses.
There are 2 houses.

There is 1 horizontal card.
There are 8 diagonal cards.
There are 9 cards in total.



This is the third diagram in the sequence of houses.
There are 3 houses.

There are 4 horizontal cards.
There are 20 diagonal cards.
There are 24 cards in total.



(a) Complete the table.
You may use the table in **Question 2(a)** to help you.

Total number of houses (t)	Number of horizontal cards (H)	Number of diagonal cards	Total number of cards
1	0	2	2
2	1	8	9
3	4	20	24
4			
5			

[2]

(b) This is a formula for the number of horizontal cards, H, in a sequence of t houses of cards.

$$H = \frac{1}{6}t(t+a)(t-a),$$

where a is a positive constant.

Find the value of a and write down the formula.

$a =$ .....

$H =$ ..... [3]

(c) The nth diagram, with n houses, in the sequence of houses has 2925 horizontal cards.

Use **part (b)** and **Question 2(c)** to find the total number of cards in the last house in the diagram.

..... [5]

B MODELLING (QUESTIONS 4 TO 7)

AGE AND FASTEST TIMES (30 marks)

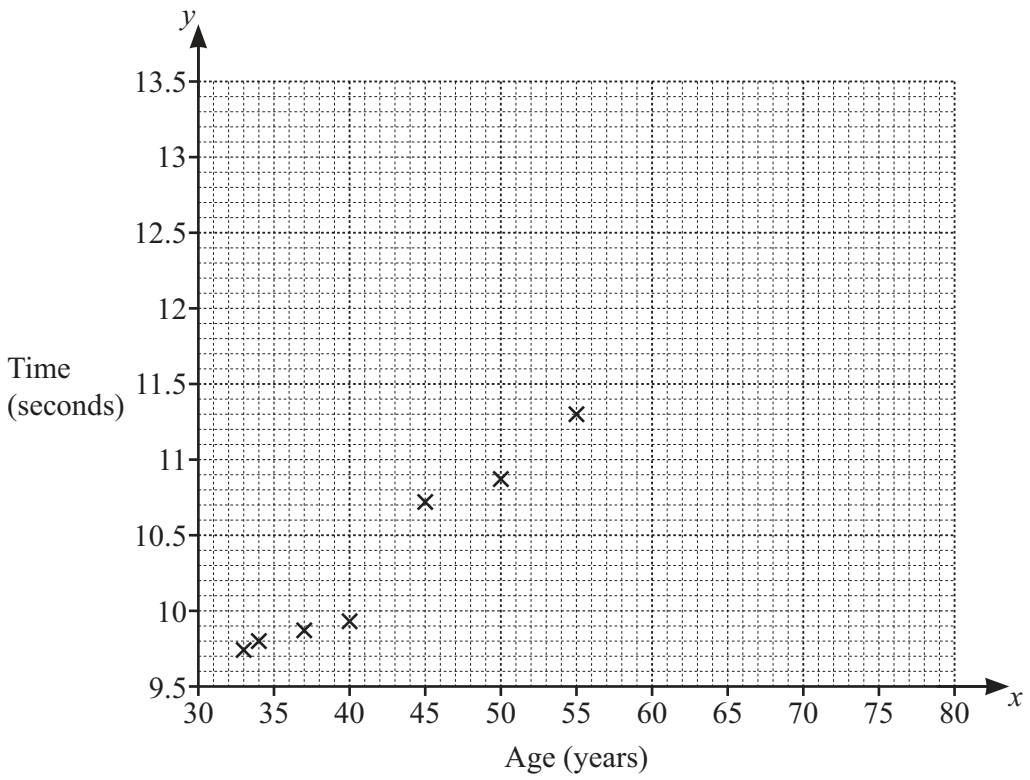
You are advised to spend no more than 50 minutes on this part.

This task looks at how age affects the fastest recorded times for athletes to run 100 metres.

4 The table shows the age of athletes running 100 m and their fastest times.

Age (x years)	33	34	37	40	45	50	55	60	65	70	76
Time (y seconds)	9.74	9.80	9.87	9.93	10.72	10.88	11.30	11.70	12.31	12.77	13.25

(a) Complete the scatter diagram to show the results.
The first seven points have been plotted for you.



[2]

(b) A straight line through the points (38, 10) and (74, 13) models the data.

(i) On the grid, draw the model. [1]

(ii) Find the equation of the model.

..... [3]

(iii) The fastest time for a certain age is 12 seconds.

Use the model to find this age.

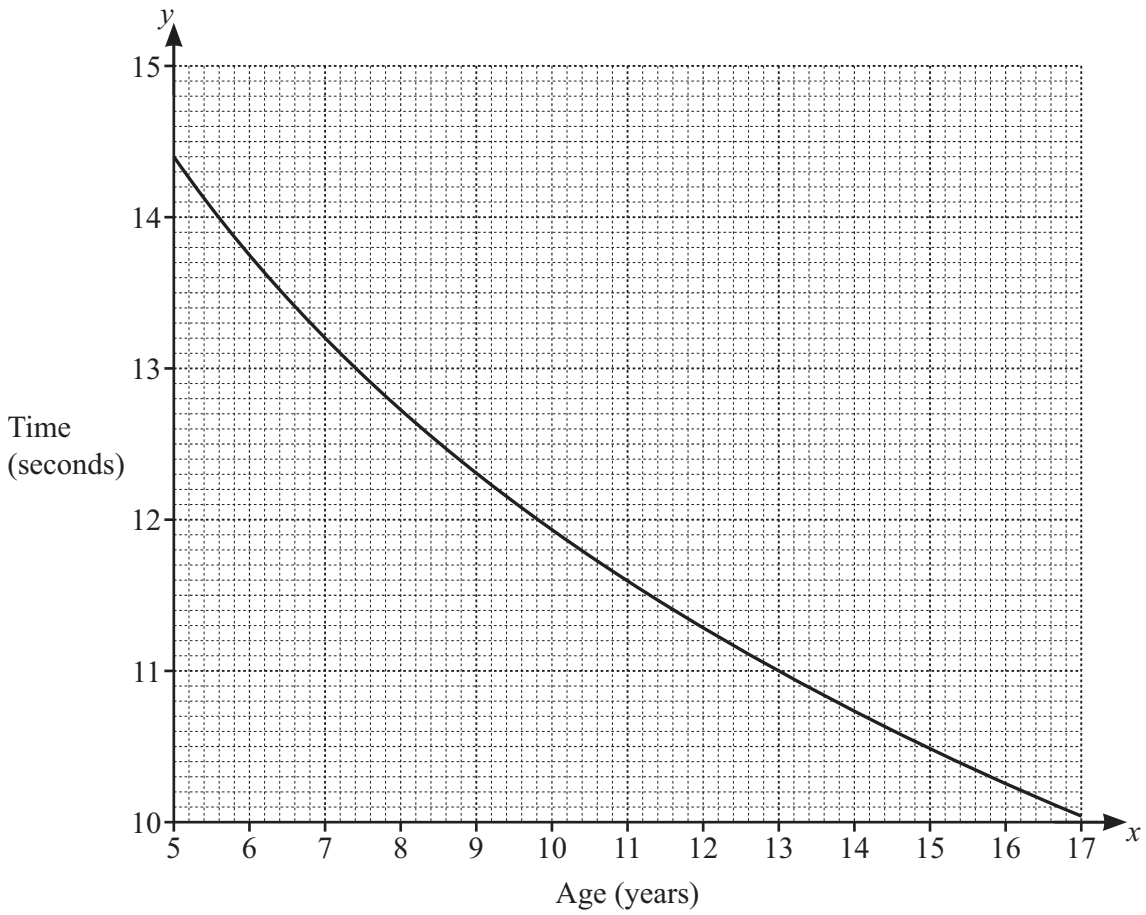
..... [2]

(iv) The fastest recorded time to run 100 m is 9.58 seconds.

Comment on the validity of the model for an athlete aged 20 years.

..... [2]

5 For athletes younger than 20 years there is a different model for the fastest time to run 100 m. This is a graph of the model.



(a) An athlete aged 13 years runs 100 m.

Use the graph to write down the fastest time for this age.

..... [2]

(b) The model for the fastest times for athletes younger than 20 years is

$$y = 268 + c \times x^{0.0139}$$

where c is a constant.

Use your answer to **part (a)** to find the value of c correct to the nearest integer.
Write down the model.

$c =$ .....

$y =$ ..... [3]

(c) 10.0 seconds is the fastest time for a certain age that is below 20 years.

Using your model in **part (b)**, solve an equation to show that this age is 17 years.

[4]

6 For athletes aged from 82 years to 105 years there is a different model for the fastest time to run 100 m. This model is

$$y = 0.0381x^2 - 6.23x + 269.$$

(a) On the axes, sketch the graph of the model for $82 \leqslant x \leqslant 105$.

[3]

(b) The fastest time for an athlete aged 100 years to run 100 m is 26.99 seconds.

Find the difference between this time and the time that the model predicts.

..... [2]

(c) 18.32 seconds is the fastest time for a certain age between 82 years and 105 years.

Use the model to find this age.

..... [1]

7 For any age, the fastest recorded time to run 100 m is 9.58 seconds.

Use each model to find the possible ages of the athlete who ran this fastest time.

[5]

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