Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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7657714890

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/63**

Paper 6 Investigation and Modelling (Extended) **October/November 2022**

1 hour 40 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer both part **A** (Questions 1 to 4) and part **B** (Questions 5 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 [ ].

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

A INVESTIGATION (QUESTIONS 1 TO 4)

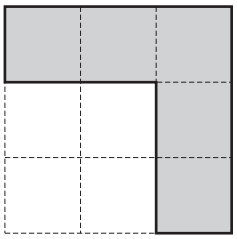
REMAINING SHAPES (30 marks)

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

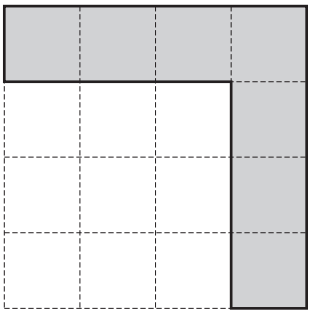
This investigation looks at the area of the remaining shape when part of a larger shape is removed.
The *side difference* is the difference between the lengths of the sides of the two shapes.
In this investigation all lengths are in centimetres.

1 A square is removed from a larger square.
The side difference is 1.

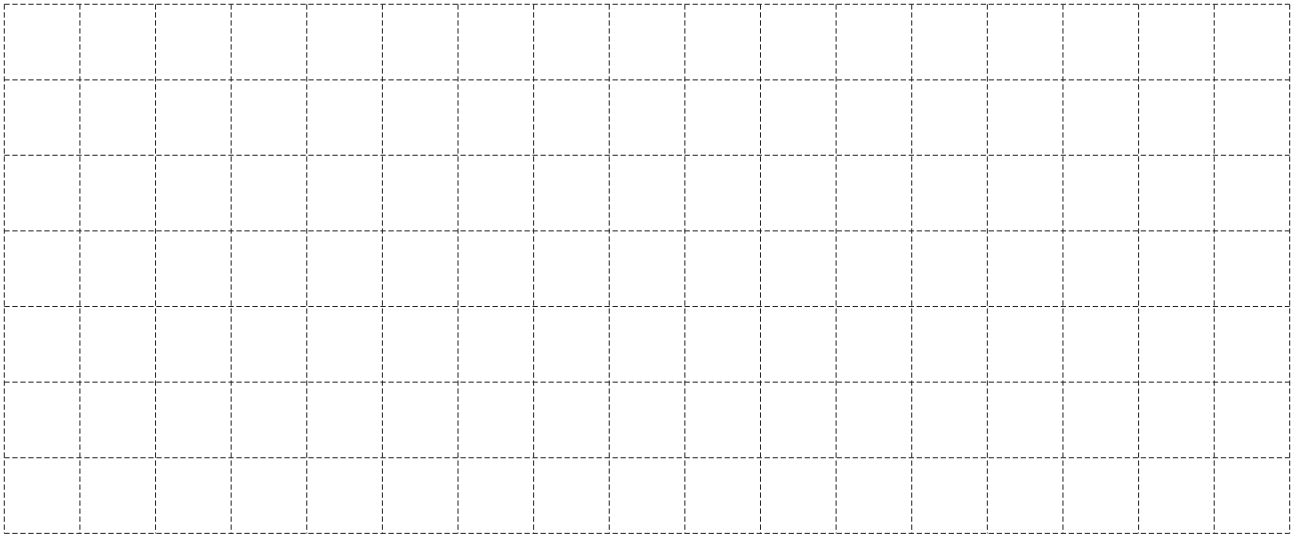
A square of side 2 is removed from a larger square of side 3.
The area of the remaining shape is 5.



A square of side 3 is removed from a larger square of side 4.
This is the remaining shape.



(a) On this grid, draw the remaining shape for a larger square of side 5.



[1]

(b) Complete the table.

Side of larger square	Area of remaining shape
2	
3	5
4	
5	
6	

[3]

(c) Find an expression, in terms of n, for the area of the remaining shape when the larger square has side n.

..... [2]

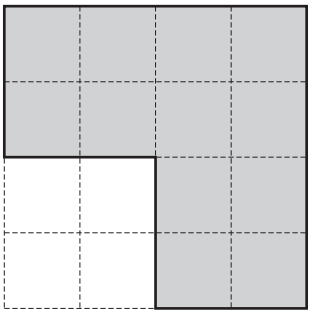
(d) The area of a remaining shape is 381.

Work out the length of the side of the larger square.

..... [2]

2 The side length of the square removed is now 2 less than the side length of the larger square.
The side difference is 2.

A square of side 2 is removed from a larger square of side 4.
The area of the remaining shape is 12.



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

Side of larger square	Area of remaining shape
3	
4	12
5	
6	

[3]

(b) Complete the expression for the area of the remaining shape when the larger square has side n and the side difference is 2.

$4n$ ..... [1]

3 **(a)** Complete the table using expressions in the form $an + b$, where a and b are integers.

Use your expressions from **Question 1(c)** and **Question 2(b)**.
You may use the grid below to help you.

Side difference (d)	Area of remaining shape for larger square of side n
1	
2	
3	
4	

[4]

(b) Find an expression, in terms of n and d, for the area of the remaining shape when the side difference is d.

..... [2]

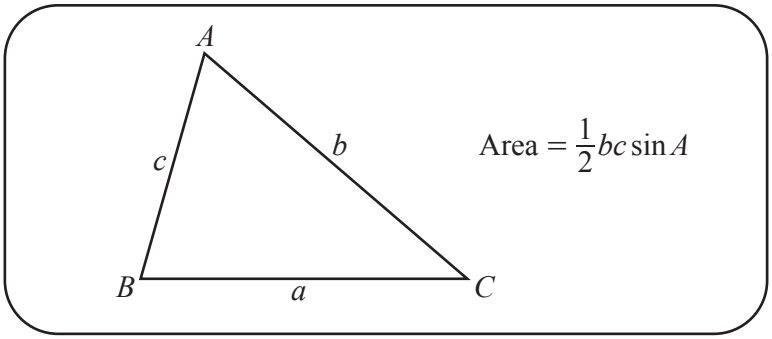
(c) The area of a remaining shape is 343.
The side difference is 7.

Find the length of the side of the larger square.

..... [2]

[Turn over

4



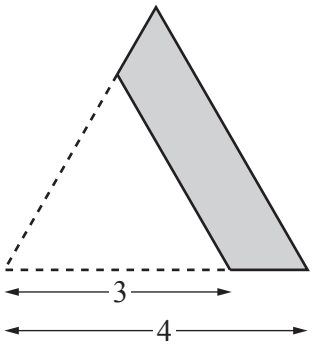
This question looks at the area of a remaining shape for an equilateral triangle.

(a) Show that the area of an equilateral triangle with side of length n is $\frac{n^2\sqrt{3}}{4}$.

[1]

(b) An equilateral triangle is removed from a larger equilateral triangle.
The side difference is 1.

An equilateral triangle with a side of length 3 is removed from a larger equilateral triangle with a side of length 4.



Show that the area of the remaining shape is $\frac{7\sqrt{3}}{4}$.

[1]

(c) Find the area of the remaining shape for a larger equilateral triangle with a side of length 5 and a side difference of 1.

Give your answer in the form $\frac{k\sqrt{3}}{4}$.

..... [2]

(d) Complete the table.

Side of larger triangle	Area of remaining shape
2	
3	
4	$\frac{7\sqrt{3}}{4}$
5	

[3]

(e) Find an expression, in terms of n and d, for the area of the remaining shape for a larger equilateral triangle with side of length n when the side difference is d.

Give an exact answer in its simplest form.

..... [3]

B MODELLING (QUESTIONS 5 TO 7)

ESCALATORS (30 marks)

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

This task looks at going up and down on escalators.

5 **(a)** Every step of an escalator travels at a speed of 1.8 km/h.

Show that the distance a step moves in 1 second is 0.5 m.

[2]

(b) The length of the escalator is 40 m.

Find the time, in seconds, for a step to travel the length of the escalator.

..... [2]

6 Matt travels up a different escalator.
The length of this escalator is 24 metres.

(a) (i) The escalator is not moving.
It takes Matt 50 seconds to walk up the length of the escalator.

Find his speed.

..... [2]

(ii) The escalator is now moving.
When Matt stands on the escalator it takes him 30 seconds to move up the length of the escalator.

Matt now walks up the **moving** escalator at the same speed as in **part (a)(i)**.

Show that his speed walking up the moving escalator is 1.28 m/s.

[2]

(iii) Find how long it will take him to walk up the length of the moving escalator.

..... [2]

(b) (i) Matt walks down the escalator when it is not moving.
It takes him 24 seconds to walk down the length of the escalator.

The escalator starts moving **upwards** at the same speed as in **part (a)**.
Matt now walks down the **moving** escalator.

Show that his speed walking down the moving escalator is 0.2 m/s.

[2]

(ii) Find how long it will take Matt to walk down the length of the escalator when it is moving **upwards** at the same speed as before.

..... [2]

7 Another escalator has a length of 6.2 m.
The escalator travels upwards at a speed of v metres per second.

(a) With the escalator travelling upwards, Matt walks **up** the escalator and then immediately turns around and walks **down** the escalator.

His walking speed is 0.8 m/s.
The total time for Matt to walk up and down the moving escalator is T seconds.

(i) Give reasons why the model for T is $T = \frac{6.2}{0.8+v} + \frac{6.2}{0.8-v}$.

.....

.....

..... [3]

(ii) Show that the model simplifies to $T = \frac{9.92}{0.64-v^2}$.

[3]

(iii) When the speed of the escalator is 0.4 m/s, find how long it takes Matt to walk up and down the escalator.

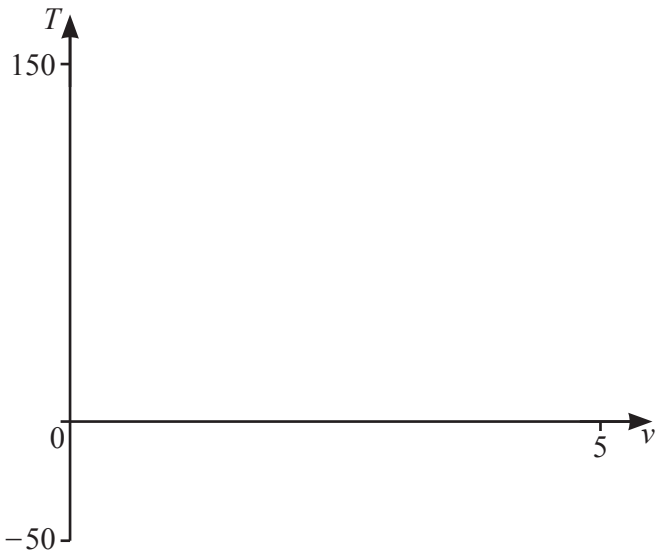
..... [1]

(b) Matt continues to walk at 0.8 m/s.
He walks up the moving escalator, waits for 10 seconds, then walks down the escalator.

(i) Change the model in **part (a)(ii)** to find a new model for T.
You do not need to simplify your model.

..... [1]

(ii) Sketch the graph of T for $0 \leqslant v \leqslant 5$.



[4]

(iii) The total time for Matt to walk up, wait, and walk down the moving escalator is 138 seconds.

Find the speed of the escalator.

..... [2]

(iv) Give a reason why the model is not valid when $v = 5$.

..... [1]

(v) For what range of values of v is the model valid?

..... [1]

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