Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3872696403

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/63**

Paper 6 Investigation and Modelling (Extended) **May/June 2021**

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 **12** pages.

DC (LK/CB) 207549/3

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

A INVESTIGATION (QUESTIONS 1 TO 3)

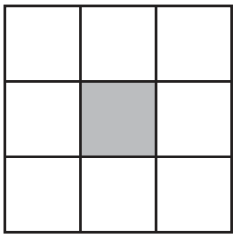
PATHS AROUND SHAPES (30 marks)

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

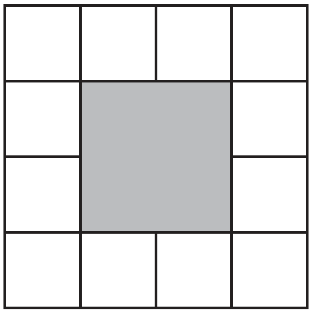
This investigation looks at paths around different shapes.

In this investigation
- all lengths are in metres
- all tiles are squares of side 1 metre.

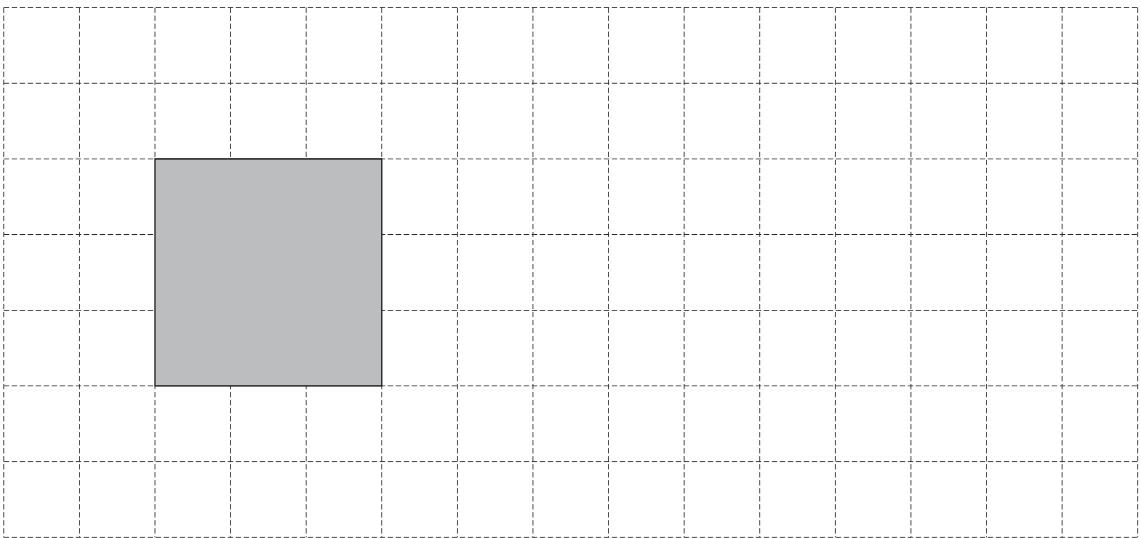
The path around a square of side 1 needs 8 square tiles.



This is the path around a square of side 2.



1 **(a)** On the grid, draw the path around the square of side 3.



[1]

(b) This table shows the number of tiles in the paths around squares of different sizes.

Complete the table.

Side of square	Number of tiles in path
1	8
2	
3	
4	

[2]

(c) Explain why the path around a square cannot have exactly 50 tiles.

.... [1]

(d) Find an expression, in terms of n, for the number of tiles in the path around a square of side n.

.... [2]

(e) Work out the number of tiles in the path around a square of side 88.

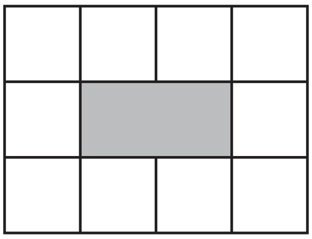
.... [2]

(f) The path around a square has 400 tiles.

Work out the area of the square.

.... [3]

2 This is the path around a rectangle of width 1 and length 2.



(a) **(i)** Complete the table to show the number of tiles in the paths around rectangles of width 1 with different lengths.

Length of rectangle (L)	Number of tiles in path
2	10
3	
4	
5	

[1]

(ii) Complete the expression for the number of tiles in the path around a rectangle of width 1 and length L.

$2L$ + ... [1]

(b) Write your expression from **Question 2(a)(ii)** in the table.

Complete the table to show expressions for the number of tiles in the paths around rectangles of different widths and lengths.

Width of rectangle (W)	Number of tiles in path around a rectangle of length L
1	
2	
3	
4	

[3]

(c) Find an expression, in terms of L and W, for the number of tiles in the path around a rectangle of length L and width W.

.... [2]

(d) The path around a rectangle has 20 tiles.

Find all the possible dimensions of the rectangle.

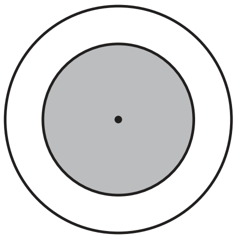
.... [3]

3

Area, A, of circle, radius r.	$A = \pi r^2$

This question looks at the area of a path around a circle.

(a) The shaded circle has radius 2.
There is a path of width 1 around the shaded circle.



Show that the area of the path is 5π.

[2]

(b) Show that the area of a path of width 1 around a circle of radius 3 is 7π.

[2]

(c) Complete the table to show the areas of paths of width 1 around circles of different sizes.

Radius of shaded circle	Area of path
1	
2	5π
3	7π
4	

[2]

(d) Find an expression for the area of a path of width W around a circle of radius R.
Give your answer in its simplest form in terms of π, R and W.

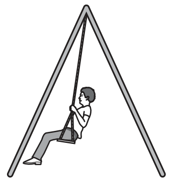
.... [3]

B MODELLING (QUESTIONS 4 TO 7)

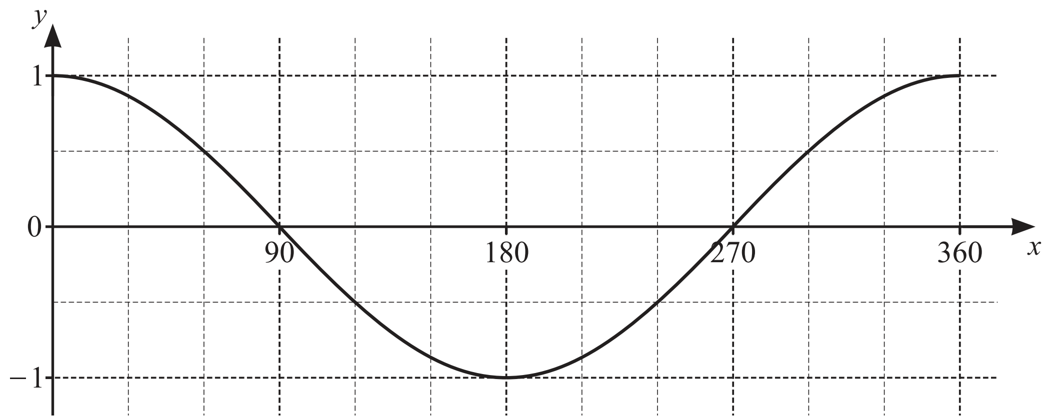
PLAYGROUND SWING (30 marks)

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

This task looks at the height of the seat of a playground swing as it moves.



4 (a) This is the graph of $y = \cos x°$ for $0 \leqslant x \leqslant 360$.
Its period is 360.



(i) On the same grid, sketch the graph of $y = \cos(2x)°$ for $0 \leqslant x \leqslant 360$. [2]

(ii) Write down the period of the graph of $y = \cos(2x)°$.

.... [1]

(b) Show that the period of the graph of $y = \cos(15x)°$ is 24.

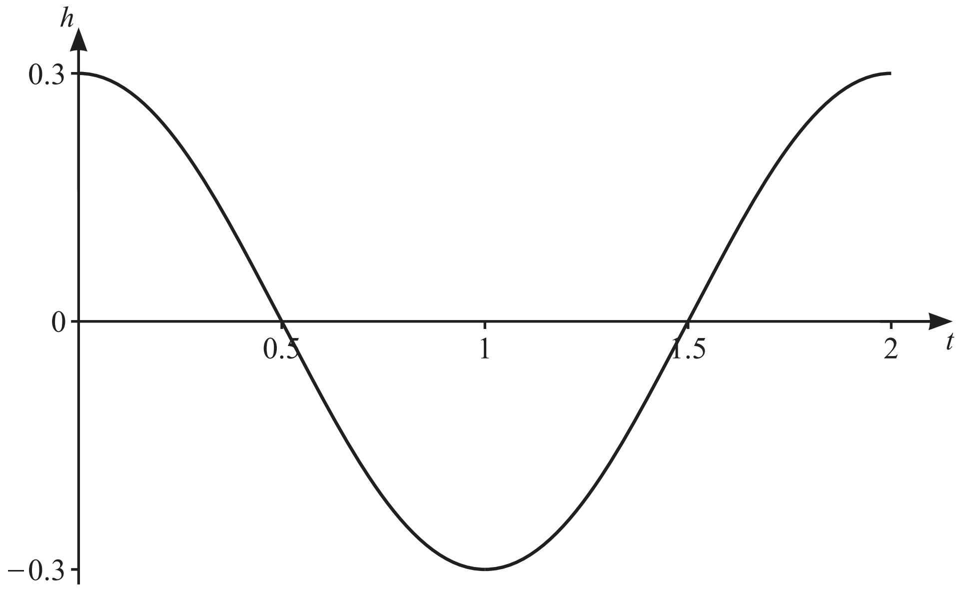
[1]

(c) Write down an expression, in terms of k, for the period of the graph of $y = \cos(kx)°$.

.... [1]

5 The graph models the height of the seat of a swing from its highest point, down to its lowest point, and back to its highest point again.

t is the time in seconds.
h is the height in metres from a fixed point.



The equation of the model is $h = a\cos(bt)°$.

(a) Write down the period of the graph and find the value of b.

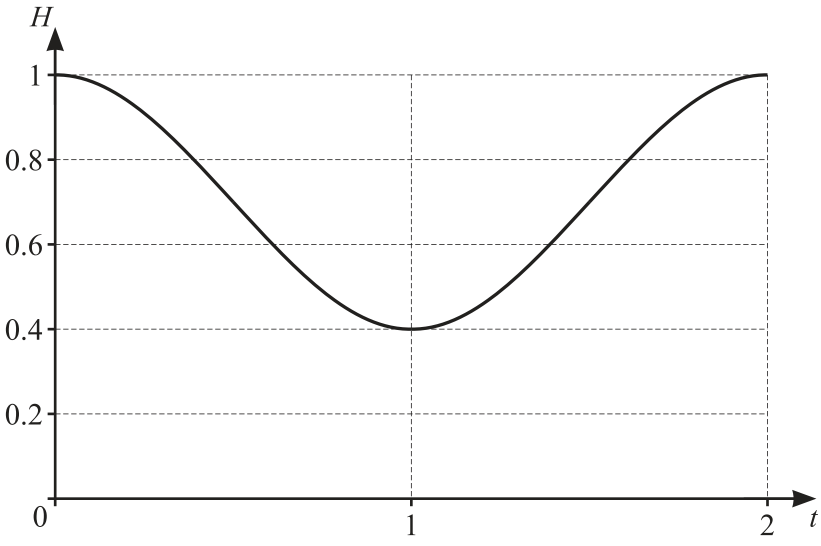
Period = ...

b = ... [2]

(b) Find the value of a and use this to write down the equation of the model.

.... [1]

(c) H is the height in metres of the seat above the ground.
This graph models H.



Use your answer to **part (b)** to write down the model for H.

.... [2]

(d) Find the two times when the swing is 0.8 m above the ground for $0 \leqslant t \leqslant 2$.

.... and .... [3]

6 Another model for the height of the seat above the ground is

$$d = 0.4(0.7)^t \cos(200t)° + 0.6$$

where d is the height in metres and t is the time in seconds.

(a) Find the height of the seat above the ground when $t = 0$.

.... [1]

(b) Sketch the graph of this model for $0 \leqslant t \leqslant 5$.

[3]

(c) Find the total time that the seat is at least 75 cm above the ground.

.... [3]

(d) What does the model suggest about the height of the seat as t gets larger?

....

.... [2]

Question 7 is printed on the next page.

7 A different model for the height of the seat above the ground is

$$D = 1 + at^2(t-1) + bt^4$$

where D is the height in metres and t is the time in seconds.

(a) Given that $D = 0.4$ when $t = 1$, find the value of b.

.... [2]

(b) Given that $D = 1$ when $t = 2$, find the value of a.

.... [2]

(c) Write down the model for D and use it to find the height of the seat when $t = 0.5$.

.... [2]

(d) Is this a reasonable model?
Show how you decide.

....

.... [2]