



# Cambridge IGCSE™

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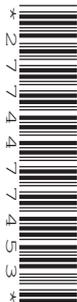
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**CAMBRIDGE INTERNATIONAL MATHEMATICS**

**0607/62**

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 6) and part **B** (Questions 7 to 10).
- 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. Any blank pages are indicated.

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

**A INVESTIGATION (QUESTIONS 1 to 6)**

**TWO-STEP SEQUENCES (30 marks)**

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

This investigation looks at *two-step sequences*.

These are sequences which use two steps to get from one term to the next.

The first term in every sequence is 1.

The two steps are:

- multiply by a given number
- then add a given number.

**1** In this question the two steps are:

- multiply by 2
- then add 1.

$$\text{1st term} = 1$$

$$\text{2nd term} = \text{1st term} \times 2 + 1 = 1 \times 2 + 1 = 3$$

$$\text{3rd term} = \text{2nd term} \times 2 + 1 = 3 \times 2 + 1 = 7$$

$$\text{4th term} = \text{3rd term} \times 2 + 1 = 7 \times 2 + 1 = 15$$

**(a)** Work out the 5th term of this sequence.

1, 3, 7, 15, ..... [2]

**(b)** The  $n$ th term of another sequence is  $2^n$ .

Calculate the 2nd, 3rd and 4th terms of this sequence.

2, ....., ....., ....., 32 [1]

**(c)** Look at your answers to **part (a)** and **part (b)**.

Write down an expression, in terms of  $n$ , for the  $n$ th term of the sequence in **part (a)**.

..... [1]

- 2 In this question the two steps are:
- multiply by 2
  - then add 3.

The first term is 1.

- (a) Work out the 2nd, 3rd and 4th terms of this sequence.

1, ....., ....., ....., 61 [2]

- (b) The  $n$ th term of this sequence is  $a \times 2^n + b$ .

- (i) Substituting  $n = 1$ , to get the first term of the sequence, gives the equation  $2a + b = 1$ .

Substitute another value for  $n$  to make another equation in terms of  $a$  and  $b$ .

..... [1]

- (ii) Solve the simultaneous equations in **part (i)** to show that the  $n$ th term of the sequence is

$$2 \times 2^n - 3.$$

[2]

- 3 In this question the two steps are:
- multiply by 2
  - then add 5.

The first term is 1.

The expression for the  $n$ th term is  $3 \times 2^n - 5$ .

Show that this expression gives the correct value for the 4th term of this sequence.

[3]

4 In this question the two steps are always:

- multiply by 2
- then add  $k$ .

The first term is 1.

(a) Complete the table.

Use your answer to **Question 1(c)** and any patterns you notice.

Steps to get the next term	Expression for the $n$ th term
Multiply by 2, then add 1	.....
Multiply by 2, then add 3	$2 \times 2^n - 3$
Multiply by 2, then add 5	$3 \times 2^n - 5$
Multiply by 2, then add 7	.....
Multiply by 2, then add .....	..... - 9

[2]

(b) An expression for the  $n$ th term of this sequence is  $a \times 2^n + b$ .

Find expressions for  $a$  and  $b$  in terms of  $k$ .

Write down the expression for the  $n$ th term of the sequence.

$$a = \dots\dots\dots$$

$$b = \dots\dots\dots$$

$$n\text{th term} = \dots\dots\dots [3]$$

(c) The 5th term of a sequence using the  $n$ th term in **part (b)** is 286.

Complete the two steps.

- multiply by 2
- then add ..... [3]

5 In this question the two steps are:

- multiply by 3
- then add 2.

The expression for the  $n$ th term is  $a \times 3^{(n-1)} + b$ .

(a) The first term is 1.

(i) Find the value of the second term of the sequence.

..... [1]

(ii) Use the first two terms to write two equations in terms of  $a$  and  $b$ .

.....  
 ..... [2]

(b) Find the value of  $a$  and the value of  $b$ .

$a =$  .....

$b =$  ..... [3]

- 6 (a) Complete the table.  
Use your answer to **Question 5(b)** and any patterns you notice.

Steps to get the next term	Expression for the $n$ th term
Multiply by 2, then add 1	$2 \times 2^{(n-1)} - 1$
Multiply by 3, then add 2	
Multiply by 4, then add 3	
Multiply by 5, then add 4	
Multiply by 6, then add 5	$2 \times 6^{(n-1)} - 1$

[1]

- (b) For the sequence in the last row of the table,  
the first term has the value 1 and the second term has the value 11.

Find which term has its value closest to 20 000 000.

..... [3]

**B MODELLING (QUESTIONS 7 to 10)****DRIVING TO MY PLACE OF WORK (30 marks)**

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

This task looks at a model for the time that I take to drive from my home to my place of work.

I live 20 km from my place of work.

When I leave my home at 7.00 am, I drive at an average speed of 50 km/h.

- 7 (a) Calculate the time, in minutes, to drive to work when I leave home at 7.00 am.

..... [3]

- (b) The time that it takes me to drive to work is  $m$  minutes.

Find, in its simplest form, a model for  $m$  when my average speed is  $v$  km/h.

..... [1]

- 8 When I leave home after 7.00 am, there is more traffic, and my average speed is less than 50 km/h.

My average speed decreases steadily by 1 km/h for every 2 minutes after 7.00 am that I leave home. For example, when I leave at 6 minutes after 7.00 am, my average speed is 3 km/h less, which is 47 km/h.

- (a) I leave home at 7.40 am.

- (i) Find my average speed.

..... [2]

- (ii) Show that the time to drive to work is 40 minutes.

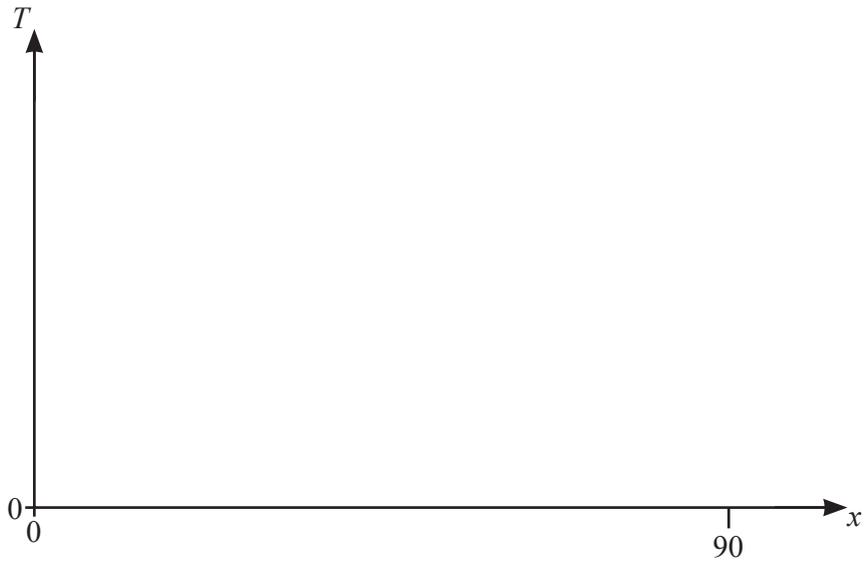
[1]

- (b) I leave home  $x$  minutes after 7.00 am.

Show that a model for the time,  $T$  minutes, to drive to work is  $T = \frac{2400}{100-x}$ .

[2]

- (c) Sketch the graph of the model  $T = \frac{2400}{100-x}$  for  $0 \leq x \leq 90$ .



[2]

- (d) I do not want to drive for more than 30 minutes.

Find the latest time that I should leave home.

..... [2]

- (e) I must be at work by 9.00 am.  
One day I oversleep and leave home at 8.35 am.

- (i) Use the model to find how late I will be for work.  
Give your answer in hours and minutes.

..... [3]

- (ii) Make a statement about the suitability of the model.

..... [1]

9 I leave home  $x$  minutes after 7.00 am.

(a) Explain why a model for  $A$ , the number of minutes after 7.00 am when I arrive at work, is

$$A = x + \frac{2400}{100 - x}.$$

..... [1]

(b) I must be at work by 9.00 am, which is two hours after 7.00 am.  
So my maximum value of  $A$  is 120.

(i) Show that, for this maximum value of  $A$ ,  $x$  is a solution to the equation

$$x^2 - 220x + 9600 = 0 .$$

[3]

(ii) Find this value of  $x$ .

..... [3]

(iii) Find the latest time that I can leave home to arrive at work on time.

..... [1]

10 I move to a new home and now live  $d$  km from my work.

When I leave my new home at 7.00 am, my average speed is  $v$  km/h.

As before, my average speed decreases steadily by 1 km/h for every 2 minutes after 7.00 am that I leave home.

(a) I leave my new home  $x$  minutes after 7.00 am.

Show that a model for the time,  $T$  minutes, to drive to work is  $T = \frac{120d}{2v-x}$ .

[2]

(b) I want to leave my new home at 7.30 am and arrive at work at 9.00 am.

Find a model for  $v$  in terms of  $d$ .

..... [3]

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