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CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/62**

Paper 6 Investigation and Modelling (Extended) **May/June 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 9).
- 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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Answer **both** parts **A** and **B**.

A INVESTIGATION (QUESTIONS 1 TO 6)

OPPOSITE CORNERS (30 marks)

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

This investigation is about the difference between the products of the numbers in the opposite corners of a square window on a grid.

To calculate the *opposite difference* for any window:

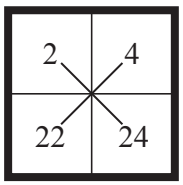
- multiply the numbers in the opposite corners
- subtract the smaller answer from the larger answer.

2	4	6	8	10	12	14	16	18	20
22	24	26	28	30	32	34	36	38	40
42	44	46	48	50	52	54	56	58	60
62	64	66	68	70	72	74	76	78	80
82	84	86	88	90	92	94	96	98	100
102	104	106	108	110	112	114	116	118	120

Consecutive even numbers fill a grid of width 10 as shown.
The grid continues downwards.

A 2 by 2 window moves on the grid.

Example
This is the first window.



$22 \times 4 = 88$

$2 \times 24 = 48$ $\qquad 88 - 48 = 40$

The opposite difference is 40.

1 Use the grid to complete each window and find the opposite difference.

14	
34	36

34 × ..... = ...

14 × 36 = ...

..... − ..... = ...

Opposite difference = ...

66	68
86	

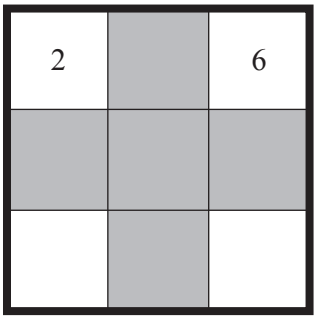
.....

150	152

..... [3]

2 A 3 by 3 window moves on the same grid.

(a) Complete the corner squares in the first window.



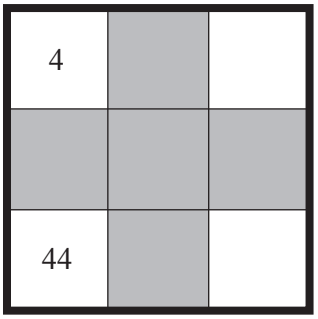
[1]

(b) Complete the opposite difference calculations for this window.

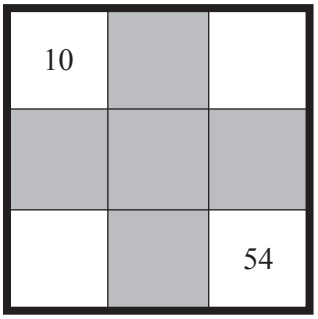
..... × 6 = ...

2 × ..... = ... − ..... = ... [1]

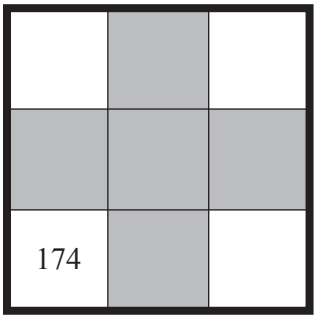
(c) Complete the corner squares for each window and find the opposite difference.



.....



.....



..... [3]

3 **(a)** Copy the opposite differences that you have found and complete the table.

Size of window			Opposite difference
2 by 2	$(2-1)^2$	$= 1$	
3 by 3	$(3-1)^2$	$= 4$	
4 by 4	$(4-1)^2$	$= 9$	
5 by 5			
w by w			40( )

You may use this grid, which continues downwards, to help you.

2	4	6	8	10	12	14	16	18	20
22	24	26	28	30	32	34	36	38	40
42	44	46	48	50	52	54	56	58	60
62	64	66	68	70	72	74	76	78	80
82	84	86	88	90	92	94	96	98	100
102	104	106	108	110	112	114	116	118	120

[4]

(b) Find the greatest possible opposite difference for a window on this grid.

..... [2]

4 Another grid of consecutive even numbers has width 7 units.
The diagram shows the start of the grid.

2	4	6	8	10	12	14
16						

The diagram shows a 2 by 2 window on the grid.
n is the first number in the window.

n	$n + 2$

(a) Complete the window using expressions in terms of n.

[2]

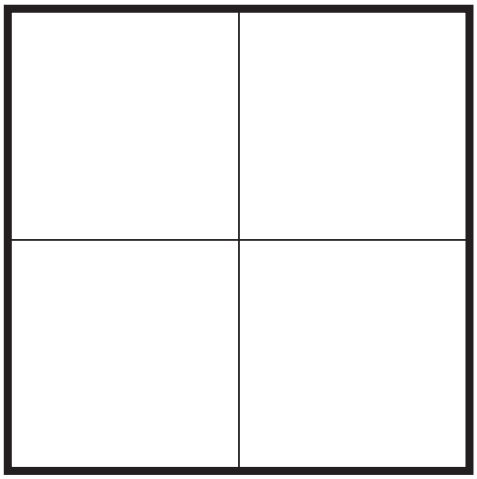
(b) Use **part (a)** to show that the opposite difference for a 2 by 2 window is 28.

[2]

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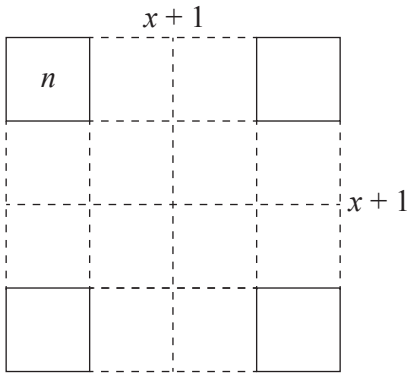
5 A 2 by 2 window moves on a grid of width g, with squares numbered 2, 4, 6, … .

Use algebra to find an expression for the opposite difference on this grid.
Give your answer in its simplest form.
You may use this diagram to help you.



..... [4]

6 **(a)** A square window of side $x + 1$ moves on a grid of width g, with squares numbered 2, 4, 6, … .
n is the first number in the window.



Show that an expression for the opposite difference using this window is $4gx^2$, where x can be any positive integer.

[4]

(b) A square window moves on a grid numbered 2, 4, 6, … .
The opposite difference is 144.

Use your answer to **part (a)** to find all the ways this is possible.

[4]

B MODELLING (QUESTIONS 7 TO 9)

CRICKETS AND TEMPERATURE (30 marks)

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

This task looks at the connection between the temperature and the number of times a cricket, a small insect, makes a chirping sound.

Amos Dolbear (1837 to 1910) was an American scientist who suggested a relationship between the temperature and the number of times a Snowy Tree Cricket makes a chirp.

He measured the air temperature and counted the number of chirps that a cricket makes in a given time.

The table shows his data.

Temperature, T°C	Number of chirps in 60 seconds, N
14	83
16	88
17	102
19	106
21	129
22	138
23	157
25	180
27	208

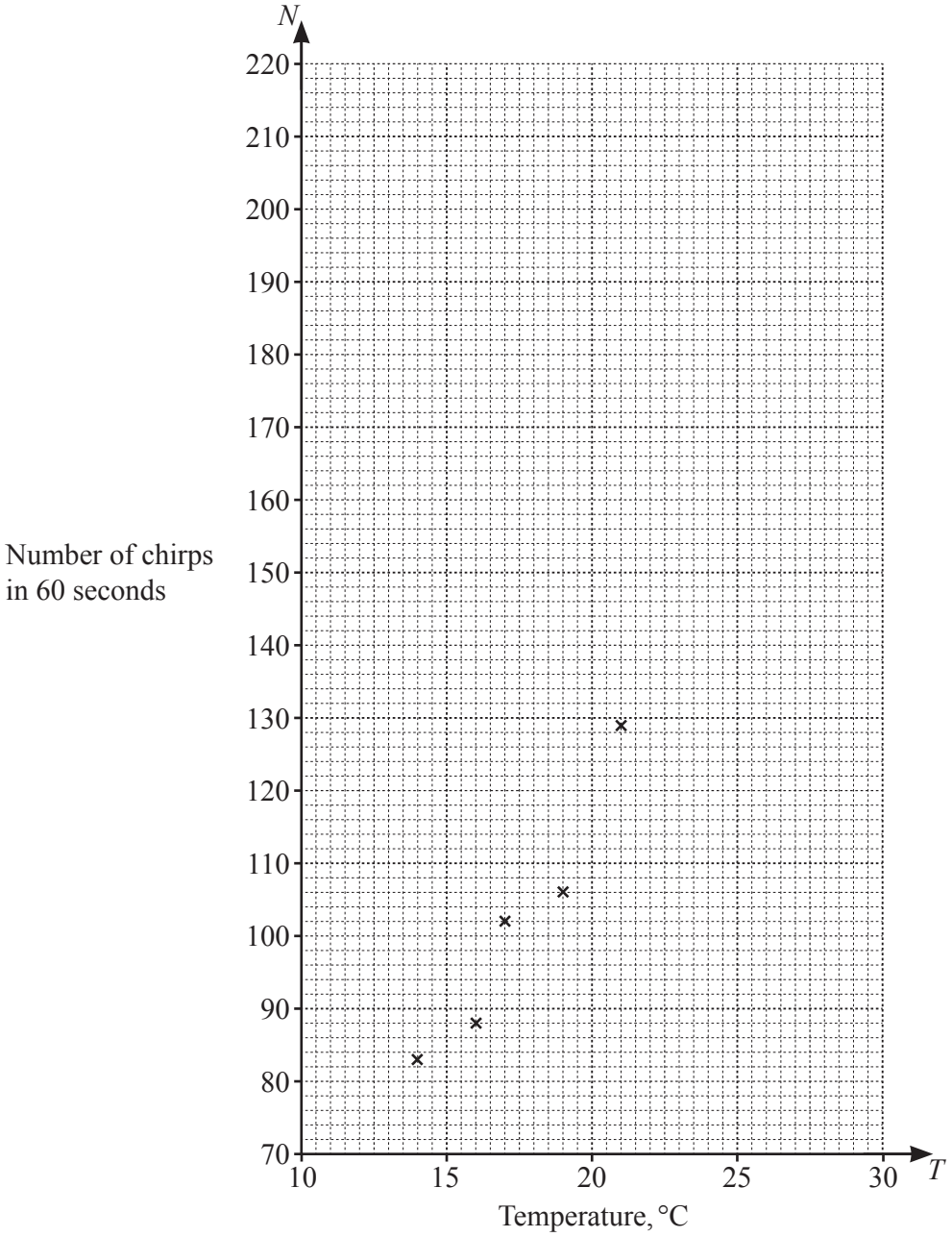
7 **(a)** Calculate the mean temperature and the mean number of chirps.

Temperature .....

Number of chirps ..... [2]

(b) Plot the data on the grid on page 11.
The first five points have been plotted for you.

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[2]

(c) A model for the number of chirps, N, is the regression line for N in terms of T.

Find this model.

..... [2]

(d) Draw the graph of the model on the axes. [2]

(e) A Snowy Tree Cricket chirps 170 times in 60 seconds.

Use your model to find the temperature.

..... [2]

(f) Amos Dolbear originally counted the number of chirps in 13 seconds and measured the temperature in degrees Fahrenheit, F.

To change the temperature from T°C to F, use $F = 1.8T + 32$.

(i) Complete the table to change the data to the form Amos Dolbear used.
All the data in the table is correct to the nearest integer.

Temperature		Number of chirps	
T°C	F	in 60 seconds	in 13 seconds
14	57	83	18
16	61	88	19
17	63	102	22
19		106	
21		129	
22		138	
23	73	157	34
25	77	180	39
27	81	208	45

[4]

(ii) Amos Dolbear suggested a simple model to find the temperature, F, from the number of chirps.

> Add 40 to the number of chirps in 13 seconds to find the temperature, F.

Is this a suitable model for the data?
Give a reason for your answer.

.....

..... [1]

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8 This is another model for the data on page 10.

$$N = 0.5T^2 + aT + b \text{ where } a \text{ and } b \text{ are constants}$$

(a) Use the information in the table on page 10 for temperatures of 16 °C and 27 °C to find the value of a and the value of b, each correct to the nearest integer.
Write down the model.

$a =$ .....

$b =$ .....

$N = 0.5T^2$ ..... [5]

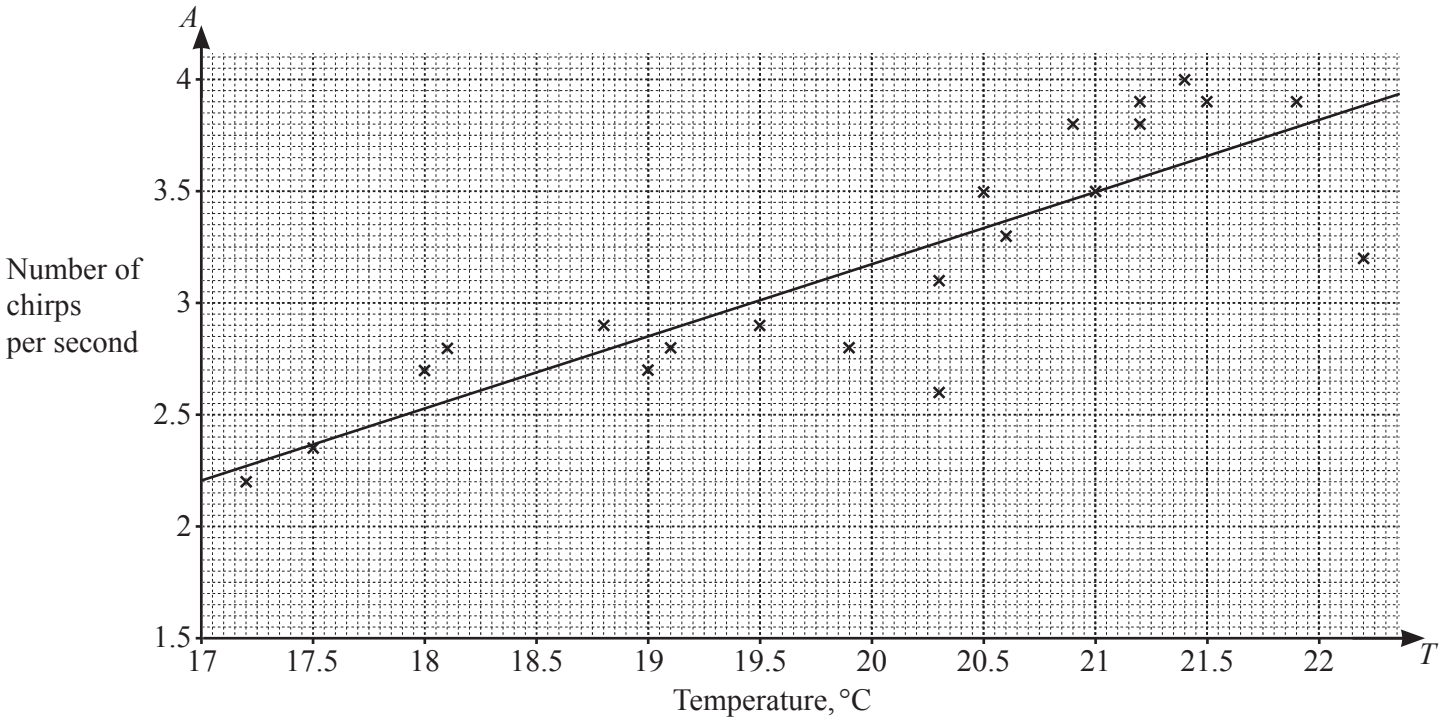
(b) Sketch the graph of the model on the axes on page 11. [2]

(c) Explain how suitable the model is for the data on page 10.

.....

..... [1]

9 The number of chirps per second, A, made by a type of African cricket is counted.
These crickets do not chirp at higher or lower temperatures.
The graph shows the results and a linear model.



(a) (i) Use the points (17.5, 2.35) and (21, 3.5) to find a linear model for A in terms of T.

..... [4]

(ii) A is the number of chirps **per second**.
N is the number of chirps **per minute**.

Use your model for A to write a linear model for N.

..... [1]

(b) Write two statements comparing the chirping of the Snowy Tree Cricket and this African cricket.

Statement 1 .....

.....

.....

Statement 2 .....

.....

..... [2]

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