Cambridge Assessment International Education

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5297052325

CAMBRIDGE INTERNATIONAL MATHEMATICS **0607/52**

Paper 5 Investigation (Core) **February/March 2021**

1 hour 10 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- 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 36.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

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CONSECUTIVE NUMBERS (36 marks)

This task is about what happens when consecutive numbers are changed from positive to negative and added.

Consecutive numbers are sequences of integers which increase by 1 from term to term.

Examples 0, 1, 2, 3, 4 or 5, 6, 7 or 46, 47, 48, 49, 50, 51 or 3, 4, 5, ..., 120.

In this investigation use this **method** throughout.

- Add the positive consecutive numbers.
- Find all the possible additions and totals when you make **one** of the numbers negative.
- Find all the possible additions and totals when you make **two** of the numbers negative.
- Continue in this way until all the numbers are negative.

1 1, 2 is a sequence of two consecutive numbers.

(a) (i) Complete the table using the method with 1 and 2 to find all the possible totals.

	Addition				Total
All positive	1	+	2	=	3
One negative	−1	+	2	=	.....
	1	+	−2	=	.....
All negative	−1	+	−2	=	−3

[1]

(ii) Using the consecutive numbers 1 and 2 the highest total is 3 and the lowest total is −3.

You cannot make all the integers between the highest total and the lowest total using the method.

Write down all the integers between 3 and −3 that **cannot** be made using 1 and 2.
Remember: 0 is an integer.

..... [1]

(b) (i) Complete the table using the method with the consecutive numbers 2 and 3.

	Addition				Total
All positive	2	+	3	=	5
One negative	−2	+	.....	=	1
	2	+	.....	=	.....
All negative	−2	+	−3	=	.....

[2]

(ii) Using the table in **part (i)**, complete these statements.

The highest total is 5 and the lowest total is ..... .

The number of integers between the highest total and the lowest total that **cannot** be made is

..... . [2]

(c) (i) Complete the table using the method with two consecutive numbers.

	Addition				Total
All positive	.....	+	.....	=	15
One negative	.....	+	.....	=	.....
	.....	+	.....	=	.....
All negative	.....	+	.....	=	−15

[2]

(ii) Find the number of integers between 15 and −15 that **cannot** be made using these consecutive numbers.

..... [1]

2 a and $a + 1$ are two consecutive numbers.

(a) Find expressions for the four totals that **can** be made using a and $a + 1$.
Give each expression in its simplest form.

..... , ... , ... , ... [3]

(b) An expression for the number of integers between the highest total and the lowest total that **cannot** be made using a and $a + 1$ is $4a - 1$.

Show that this gives the correct number when $a = 10$.

[4]

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3 **(a)** There are now three consecutive numbers.

(i) Complete the table using the method with the consecutive numbers 3, 4 and 5.

	Addition						Total
All positive	3	+	4	+	5	=	12
One negative	−3	+	4	+	5	=	6
	.....	+	−4	+	.....	=	4
	.....	+	.....	+	.....	=	2
Two negative	−3	+	−4	+	.....	=	−2
	−3	+	.....	+	−5	=	.....
	.....	+	.....	+	.....	=	.....
All negative	−3	+	−4	+	−5	=	−12

[2]

(ii) Find the number of integers that **cannot** be made between 12 and −12.

..... [2]

(b) There are now four consecutive numbers.

Complete the table using the method and the consecutive numbers 3, 4, 5 and 6.

	Addition								Total
All positive	3	+	4	+	5	+	6	=	18
One negative	−3	+	4	+	5	+	6	=	12
	.....	+	−4	+	5	+	6	=	10
	3	+	4	+	−5	+	6	=	8
	.....	+	.....	+	.....	+	.....	=	.....
Two negative	−3	+	−4	+	5	+	6	=	.....
	−3	+	4	+	.....	+	6	=	2
	−3	+	4	+	5	+	−6	=	0
	3	+	−4	+	.....	+	6	=	0
	3	+	−4	+	.....	+	−6	=	.....
	3	+	4	+	−5	+	−6	=	−4
Three negative	−3	+	−4	+	.....	+	.....	=	.....
	−3	+	−4	+	.....	+	.....	=	−8
	−3	+	4	+	−5	+	.....	=	−10
	3	+	.....	+	.....	+	.....	=	−12
All negative	−3	+	−4	+	−5	+	−6	=	−18

[3]

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TURN OVER FOR QUESTION 4

4 **(a)** There are 16 additions in the table on **page 6**.

Complete the table below.
Use **Question 1** and **Question 3** to help you.

Number of consecutive numbers	Number of additions
2	..... = ...
3	..... = 2^3
4	16 = 2^4
5	32 = ...
n	.....

[2]

(b) Complete this table.
Use **Question 2(a)** to help you.

Number of consecutive numbers	Consecutive numbers	Expression for the highest total in terms of a
2	$a, a + 1$	
3		$3a + 3$
4		
5	$a, a + 1, a + 2, a + 3, a + 4$	
n		..... $+ \frac{n(n-1)}{2}$

[5]

(c) Anna uses this method to work out the number of integers that **cannot** be made.

- Use **Question 4(b)** to find the highest total.
- Find the number of integers from the highest total to the lowest total.
- Use **Question 4(a)** to find the number of additions.
- Subtract the number of additions from the number of integers.

Example
There are three consecutive numbers.
The first number is 4.

The highest total is $3a + 3 = 3 \times 4 + 3 = 15$.
The number of integers from 15 to -15 is 31.
The number of additions is 2^3.
The number of integers that **cannot** be made is $31 - 2^3 = 23$.

(i) There are two consecutive numbers.

Use Anna's method to find the number of integers that **cannot** be made when the first number is 9.

..... [3]

(ii) Anna uses her method to find the number of integers that **cannot** be made with the three consecutive numbers 1, 2 and 3.
Her method gives the answer 5.

Explain why her method gives the wrong answer.

..... [3]

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