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CAMBRIDGE INTERNATIONAL MATHEMATICS**0607/52**

Paper 5 Investigation (Core)

May/June 2025**1 hour 15 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 40.
- The number of marks for each question or part question is shown in brackets [].

This document has **8** pages. Any blank pages are indicated.



INVESTIGATION

THE CORE AND SHELL OF SEQUENCES

In this investigation you will look at the values of the shell and the core in sequences of positive integers. Each sequence has an odd number of terms.

The *core integer* is the integer in the middle of the sequence.

The *shell integers* are the integer at the beginning and the integer at the end of the sequence.

Example

For the sequence 6 9 12 15 18 21 24 the core integer is 15 and the shell integers are 6 and 24.

core integer
 ↓
 6 9 12 15 18 21 24
 ↖ ↗
 shell integers

- 1 (a) Write down the core integer and the shell integers for the sequence

5 6 7 8 9 10 11 12 13.

Core integer

Shell integers and [1]

- (b) You calculate the *value of the core*, C , by multiplying the core integer by itself.
In the example $C = 15 \times 15 = 225$.

Calculate C for the sequence in **part (a)**.

..... [1]

- (c) You calculate the *value of the shell*, S , by multiplying the two shell integers together.
In the example $S = 6 \times 24 = 144$.

Calculate S for the sequence in **part (a)**.

..... [1]

2 Exponential sequences

In an *exponential sequence* the term-to-term rule is multiply by the same number.

Examples

Sequence: 1 2 4 8 16 Term-to-term rule: $\times 2$

Sequence: 1 5 25 125 625 Term-to-term rule: $\times 5$





- (a) Calculate C and S for the exponential sequence 2 6 18 54 162.

$$C = \dots\dots\dots$$

$$S = \dots\dots\dots [2]$$

- (b) (i) Complete the 4th and 5th terms in this exponential sequence.

$$3 \quad 6 \quad 12 \quad \dots\dots\dots [1]$$

- (ii) Calculate C and S .

$$C = \dots\dots\dots$$

$$S = \dots\dots\dots [2]$$

- (c) Write down what you notice about C and S for the sequences in **part (a)** and **part (b)**.

$$\dots\dots\dots [1]$$

- (d) (i) The 1st term of an exponential sequence is a .
To get the next term you multiply by m .

Write expressions for the 3rd and 5th terms of this sequence.

$$a \quad am \quad \dots\dots\dots am^3 \quad \dots\dots\dots [1]$$

- (ii) Use algebra to show that your answer in **part (c)** is always true.

$$\dots\dots\dots [2]$$

- (e) An exponential sequence has 5 terms.
The 1st term is 2 and the middle term is 722.

Use **part (c)** to find the 5th term.

$$\dots\dots\dots [3]$$





3 **Fibonacci sequence** 1 1 2 3 5 8 13 ...

In the Fibonacci sequence you find the next term by adding the previous two terms.
For example 5th term + 6th term = 7th term so $5 + 8 = 13$.

(a) Calculate C and S for these sequences of 3 consecutive terms in the Fibonacci sequence.

(i) The 2nd, 3rd and 4th terms. 1 2 3

$C =$

$S =$ [1]

(ii) The 4th, 5th and 6th terms. 3 5 8

$C =$

$S =$ [1]

(iii) The 6th, 7th and 8th terms.

$C =$

$S =$ [2]

(b) In the Fibonacci sequence there are 3 consecutive terms where the value of their shell is $S = 17\,480\,760$.

Use what you notice in your answers to **part (a)** to calculate the middle term.

..... [2]





4 Linear sequences with three terms

In a linear sequence the term-to-term rule is add the same number.
This number is the *common difference*, d .

- (a) F is the difference between the value of the core and the value of the shell.
So $F = C - S$.

Complete the table.

Linear sequence	Common difference d	F
17 18 19	1	1
24 27 30		
14 20 		36
20 40		

[5]

- (b) Use **part (a)** to find a formula for F in terms of d .

..... [2]

- (c) A linear sequence of 3 terms has $F = 49$.
The 1st term is 11.

Complete the sequence.

11, , [2]





5 Sequences of consecutive integers

(a) Complete the table.

Consecutive integers	Number of integers <i>n</i>	<i>F</i>
17 18 19	3	1
20 21 22 23 24	5	
13 14 15 16 17 18 19		9
1 2 3 4 5 6 7 8 9		

[3]

(b) A formula for *F* is $F = k(n - 1)^2$ where *k* is a fraction.

Find the value of *k*.

..... [2]





(c) Find the value of F for a sequence of 99 consecutive integers.

..... [2]

(d) In a sequence of consecutive integers, the difference in the value of the core and the value of the shell is 529.

Find the number of integers in the sequence.

..... [3]





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