# Worksheet 01 - Patterns, Sequences and General Terms

Recognising rules, finite and infinite sequences, and expressing general terms

Corrected notation: formulas use proper superscripts and subscripts, and sigma notation uses vertically stacked upper and lower limits.

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|---|---|
| **Time** | 45 minutes |
| **Total marks** | 35 |
| **Calculator** | Allowed unless stated |
| **Level** | IB SL/HL mixed |

Instructions: Show sufficient working for non-multiple-choice questions. Where appropriate, define variables, state restrictions and interpret results in context.

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## Section A - Multiple choice (5 marks)

1. The sequence 4, 7, 10, 13, ... has general term:

A. $u_r = r + 3$

B. $u_r = 3r + 1$

C. $u_r = 4r - 1$

D. $u_r = 7r - 3$

Answer: ______

2. Which statement best describes a finite sequence?

A. It must contain only positive terms.

B. It has a fixed number of terms.

C. It must be arithmetic.

D. It cannot be written using a general term.

Answer: ______

3. The next three terms of 6, 16, 26, 36, 46, ... are:

A. 52, 58, 64

B. 56, 66, 76

C. 60, 74, 90

D. 66, 86, 106

Answer: ______

4. For $u_r = (-1)^r r$, the first three terms are:

A. 1, -2, 3

B. -1, 2, -3

C. -1, -2, -3

D. 1, 2, 3

Answer: ______

5. The value of $\sum_{r=1}^{4} (2r + 1)$ is:

A. 16

B. 20

C. 24

D. 28

Answer: ______

## Section B - Short answer (12 marks)

1. Find the next three terms and a possible general term for 5, 9, 13, 17, ... (3 marks)

2. For $u_r = r^2 - 1$, r in positive integers, write the first five terms. (2 marks)

3. Write the finite series 11 + 14 + 17 + 20 + 23 in sigma notation. (3 marks)

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4. A student claims that 1, 4, 9, 16, ... is arithmetic because the terms increase. Explain why this is incorrect, and give the correct general term. (4 marks)

## Section C - Data response / case study (10 marks)

## Case study: Diagonal floor tiles

A square floor with an odd number of tiles along each side has both diagonals shaded. The diagonals share one central tile. Let n be the number of tiles on one side and D be the number of distinct shaded diagonal tiles.

n

3

5

7

9

D

5

9

13

17

Total floor tiles

9

25

49

81

1. Find a formula for D in terms of n. (2 marks)

2. Use your formula to find D when n = 21. (2 marks)

3. If D = 135, find n and the total number of floor tiles. (3 marks)

4. Explain why an algebraic formula is more efficient than generating a long table. (3 marks)

## Section D - Extended response (8 marks)

Discuss how visual or numerical patterns can lead to a conjecture. Use the arithmetic sequence a, a + d, a + 2d, ... to prove that $u_r = a + (r - 1)d$. Your response should include a clear definition of the variables and a short explanation of why the formula works for every positive integer r.

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## Answer Key and Marking Guidance

Award marks for valid mathematical reasoning, clear notation and correctly interpreted results. Equivalent methods should receive full credit unless the question specifies a method.

## Section A

1: B

2: B

3: B

4: B

5: C

## Section B

1: 21, 25, 29; $u_r = 4r + 1$. Award 1 for terms, 1 for common difference, 1 for formula.

2: 0, 3, 8, 15, 24. Award 2 for all correct; 1 for at least three correct.

3: For example, $\sum_{r=1}^{5} (3r + 8)$. Equivalent forms such as $\text{sum}_{r=0}$^{4}(11 + 3r) are valid.

4: The first differences are 3, 5, 7, so they are not constant; the sequence is quadratic with $u_r = r^2$.

## Section C

1: D = 2n - 1.

2: D = 2(21) - 1 = 41.

3: 135 = 2n - 1, so n = 68. Total tiles = $68^2$ = 4624. Accept discussion that a true shared central tile requires odd n; this is a model extension.

4: A formula gives direct calculation for any valid input and supports proof/generalization rather than repeated arithmetic.

## Section D

8 marks: 2 for explaining observation to conjecture; 2 for defining a, d, r; 2 for deriving a + (r - 1)d from repeated addition; 1 for checking early terms; 1 for clear conclusion that the formula applies to all positive integer positions.