Number Patterns: Linear Sequences (Grade 10)

MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
31	50 minutes	3

Name: _____ Class: _____

Date: _____

MARK ____ / 31

INSTRUCTIONS AND INFORMATION

1. Answer **ALL** the questions in this question paper.
2. Answer QUESTION 1 by **circling** the letter (A–D) in the answer grid at the end of that section.
3. Show **ALL** calculations clearly.
4. Show all units where applicable.
5. Number the answers correctly according to the numbering system used in this question paper.
6. A non-programmable calculator may be used, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1 [10 MARKS]

Four options are given as possible answers to the following questions. Choose the correct answer and circle the letter (A–D) in the grid at the end of this section. If you want to change your choice, put a cross through the wrong letter and circle your new choice.

1.1 The next term of $5\ ;\ 9\ ;\ 13\ ;\ 17\ ;\ \ldots$ is ... (1)

A) 34 **B)** **21 ✓**

C) 22 **D)** 20

Answer: B — The constant difference is 4, so the next term is $17 + 4 = 21$.

- **A** — doubled 17
- **C** — added 5, the FIRST term, instead of the difference
- **D** — added 3 instead of the constant difference of 4

1.2 The general term of $5\ ;\ 9\ ;\ 13\ ;\ 17\ ;\ \ldots$ is ... (1)

A) $T_n = 5n - 1$ **B)** $T_n = 4n$

C) $T_n = n + 4$ **D)** **$T_n = 4n + 1$ ✓**

Answer: D — $T_n = dn + c$ with $d = 4$, and $c = 5 - 4 = 1$.

- **A** — used the FIRST TERM as the coefficient of n instead of the difference
- **B** — left out the constant c — this gives 4, not 5, as the first term
- **C** — swapped the difference and the constant

1.3 The 20th term of $5\ ;\ 9\ ;\ 13\ ;\ \ldots$ is ... (1)

A) 100 **B)** **81 ✓**

C) 85 **D)** 80

Answer: B — $T_{20} = 4(20) + 1 = 81$.

- **A** — used 5×20 instead of $4n + 1$
- **C** — added 5 instead of 1
- **D** — used $4n$ and left out the $+ 1$

1.4 Which term of 5 ; 9 ; 13 ; ... is equal to 101? (1)

A) the 26th
B) the 20th
C) the 101st
D) the 25th ✓

> **Answer: D** — $4n + 1 = 101$ gives $4n = 100$, so $n = 25$.
> - **A** — divided 101 by 4 and rounded up, without subtracting the 1 first
> - **B** — divided 101 by 5 instead of using the general term
> - **C** — read the VALUE of the term as its position

1.5 The constant difference of 20 ; 17 ; 14 ; 11 ; ... is ... (1)

A) -20
B) -3 ✓
C) 17
D) 3

> **Answer: B** — Each term is 3 LESS than the one before, so $d = -3$.
> - **A** — that is the first term with a minus put on it
> - **C** — that is the second term, not the difference
> - **D** — the sequence decreases, so the difference must be negative

1.6 If $T_n = 3n - 7$, then the FIRST term is ... (1)

A) 7
B) 3
C) -4 ✓
D) -7

> **Answer: C** — $T_1 = 3(1) - 7 = -4$.
> - **A** — dropped the minus sign on the 7
> - **B** — that is the constant difference, not the first term
> - **D** — that is c, which is T_0, not T_1

1.7 A pattern of figures uses 4, 7, 10 and 13 matchsticks. Its general term is ... (1)

A) $T_n = 3n + 1$ ✓
B) $T_n = n + 3$
C) $T_n = 4n$
D) $T_n = 3n$

> **Answer: A** — The difference is 3, and $4 - 3 = 1$, so $T_n = 3n + 1$.
> - **B** — swapped the difference and the constant
> - **C** — used the FIRST value as the coefficient of n instead of the difference
> - **D** — left out the $+ 1$ — this gives 3 for the first figure, not 4

1.8 How many matchsticks does the 50th figure of that pattern need? (1)

A) 200
B) 150
C) 151 ✓
D) 154

> **Answer: C** — $T_{50} = 3(50) + 1 = 151$.
> - **A** — used 4×50
> - **B** — left out the $+ 1$
> - **D** — added 4 instead of 1

1.9 A sequence is LINEAR when ... (1)

A) all its terms are positive

B) its second difference is constant

C) each term is double the one before

D) its first difference is constant ✓

> **Answer: D** — A constant first difference is exactly what makes the general term $dn + c$.
>
> - **A** — the signs of the terms do not decide the type of sequence
> - **B** — a constant SECOND difference gives a QUADRATIC sequence
> - **C** — that is a GEOMETRIC sequence

1.10 For the sequence $2\ ;\ 5\ ;\ 8\ ;\ \ldots$, the value of $T_1 + T_{10}$ is ... (1)

A) 31 ✓

B) 29

C) 30

D) 32

> **Answer: A** — $T_n = 3n - 1$, so $T_{10} = 29$ and $2 + 29 = 31$.
>
> - **B** — gave T_{10} on its own, without adding T_1
> - **C** — used 3×10 for T_{10} and left out T_1
> - **D** — used $T_{10} = 30$, forgetting the -1

ANSWER GRID — MARKING GUIDELINE

1.1	A	**(B)**	C	D
1.2	A	B	C	**(D)**
1.3	A	**(B)**	C	D
1.4	A	B	C	**(D)**
1.5	A	**(B)**	C	D
1.6	A	B	**(C)**	D
1.7	**(A)**	B	C	D
1.8	A	B	**(C)**	D
1.9	A	B	C	**(D)**
1.10	**(A)**	B	C	D

QUESTION 2 [12 MARKS]

$3x + 1\ ;\ 2x\ ;\ 3x - 7$ are the first three terms of a LINEAR pattern.

2.1 Calculate the value of x. (3)

> In a linear pattern the first differences are equal *(1)*
> $2x - (3x + 1) = (3x - 7) - 2x$ *(1)*
> $-x - 1 = x - 7$, so $\boldsymbol{x = 3}$ *(1)*

2.2 Determine the numerical value of the first three terms. (2)

> $3(3) + 1 = 10;\ 2(3) = 6;\ 3(3) - 7 = 2$ *(1)*
> **10 ; 6 ; 2** *(1)*

2.3 Determine T_n, the general term of the pattern. (3)

> $d = -4$ *(1)*
> $-4(1) + c = 10$, so $c = 14$ *(1)*
> $\boldsymbol{T_n = -4n + 14}$ *(1)*

2.4 Determine which term will be the FIRST to be less than -31. **(4)**

> $-4n + 14 < -31$ *(1)*
> $-4n < -45$ *(1)*
> $n > 11{,}25$ — note the sign REVERSES when dividing by -4 *(1)*
> n must be a whole number, so it is the **12th term** ($T_{12} = -34$) *(1)*

QUESTION 3 [9 MARKS]

Consider the linear pattern 5 ; 8 ; 11 ; 14 ; ...

3.1 Determine the general term T_n. **(3)**

> $d = 3$ and $T_1 = 5$, so $c = 2$ *(2)*
> **$T_n = 3n + 2$** *(1)*

3.2 Calculate T_{50}. **(2)**

> $3(50) + 2$ *(1)* $=$ **152** *(1)*

3.3 Determine whether 100 is a term of this pattern. Justify your answer. **(4)**

> $3n + 2 = 100$ *(1)*
> $3n = 98$ *(1)*
> $n = 32{,}67...$ *(1)*
> n is not a whole number, so **100 is NOT a term** *(1)*

TOTAL: 31 marks

This question paper consists of 3 questions.

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