



# CHAPTER 19

*Numeric Patterns*

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# 1 INVESTIGATING AND EXTENDING NUMERIC PATTERNS

## DEFINITION: CONSTANT DIFFERENCE

A constant-difference sequence is formed by adding the constant difference each time to form the next term.

### 1.1 Exercise 1: Patterns in two directions

1. The numbers below form sequence  $A$ , but not all of the numbers are given.

A						4	6	8	10					
---	--	--	--	--	--	---	---	---	----	--	--	--	--	--

1.1 Fill in the missing numbers

1.2 What is the constant difference in sequence  $A$ ?

2. The numbers below form sequence  $B$ , but not all of the numbers are given.

B						10	8	6	4					
---	--	--	--	--	--	----	---	---	---	--	--	--	--	--

2.1 Fill in the missing numbers

2.2 What is the constant difference in sequence  $B$ ?

3. The numbers below form sequence  $C$ , but not all the numbers are given.

C						5	8	11	14					
---	--	--	--	--	--	---	---	----	----	--	--	--	--	--

3.1 Fill in the missing numbers.

3.2 What is the constant difference in sequence  $C$ ?

4. The numbers below form sequence  $D$ , but not all the numbers are given

D						20	17	13	8					
---	--	--	--	--	--	----	----	----	---	--	--	--	--	--

4.1 Fill in the missing numbers.

4.2 What is the constant difference in sequence  $D$ ?

5. The first term of a certain sequence is 100 and the constant difference is 20.

5.1 What is the second term, the third term and the fourth term?

5.2 What is the tenth term in this sequence?

6. The first term of a sequence is 100 and the constant difference is  $-20$ .

6. 1 What is the second term, the third term and the fourth term?

6. 2 What is the tenth term in this sequence ?

7. The sequence  $E$  is given in the table below,

Term number	1	2	3	4	5	6	7	8	9
E with constant difference 10						30			

Copy the table and fill in the other terms

8. The sixth term of sequence  $F$  is given in the table below.

Term number	1	2	3	4	5	6	7	8	9
F with constant difference						30			

Copy the table and fill in the other terms.

9. The sixth term of sequence  $G$  is given in the table below.

Term number	1	2	3	4	5	6	7	8	9
G with constant difference						30			

Copy the table and fill in the other terms

10. Investigate each of the patterns below. Find the pattern and write the next four terms in the sequence.

10. 1 1 4 9 16 25

10. 2 3 6 11 18 27

10. 3 20 19 17 14 10

10. 4 20 25 29 32 34

11. Make some numeric patterns of your own.

## 2 MAKING PATTERNS FROM RULES

### 2.1 Exercise 2

1. Continue until you have a number sequence with ten terms:

1. 1 Start at 30. Add  $-5$  and write the answer. Add  $-5$  again and write the answer.

1. 2 Start at  $-30$ . Add  $5$  and write the answer. Add  $5$  again and write the answer.

1. 3 Start at  $-30$ . Add  $-5$  and write the answer. Add  $-5$  again and write the answer.

2. Write down the first ten terms of the following sequences:
  2. 1 The first term of a sequence is  $-10$  and there is a constant difference of  $5$  between the terms. Write down the first ten terms of the sequence.
  2. 2 The first term of a sequence is  $-10$  and there is a constant difference of  $-5$  between the terms.
3. Choose a number to be your first term and another number to be a constant difference. Write the first ten terms of your sequence.
4. Choose a number smaller than  $-10$  to be your first term and another number to be a constant difference. Write the first ten terms of your sequence.
5. Choose a number to be your first term and a negative number to be a constant difference. Write the first ten terms of your sequence.
6. Choose a negative number to be your first term and another negative number to be a constant difference. Write the first ten terms of your sequence.
7. Choose a number to be your tenth term and another number to be a constant difference. Write the first ten terms of your sequence.
8. Choose a negative number to be your tenth term and another negative number to be a constant difference. Write the first ten terms of your sequence.

## 3 MAKING PATTERNS FROM EXPRESSIONS

### DEFINITION: CONSECUTIVE TERMS

When one number follows another in a sequence they are called **consecutive terms**.

### DEFINITION: INCREASING AND DECREASING SEQUENCES

**Decreasing sequence:** The numbers become smaller as the sequence progresses.

**Increasing sequence:** Each term is bigger than the last.

### 3.1 Exercise 3

1. Answer the following questions using the table:

$x$	0	1	2	3	4	5	6	7	8
$2 \times x - 10$									

1. 1 Copy and complete the table.

1. 2 Do the outputs of  $2 \times x - 10$  form a pattern with a constant difference? If they do, what is the constant difference?

2. Answer the questions using the table:

$x$	0	1	2	3	4	5	6	7	8
$3 \times x - 20$									

2. 1 Copy and complete the table

2. 2 What is the constant difference ?

3. Answer the questions using the table:

$x$	0	1	2	3	4	5	6	7	8
$2 - 3 \times x$	2	-1	-4	-7	-10	-13	-16	-19	-22

3. 1 Copy and complete the table

3. 2 What is the constant difference ?

4. Answer the questions using the table:

$x$	0	1	2	3	4	5	6	7	8
$1 - 2 \times x$	1	-1	-3	-5	-7	-9	-11	-13	-15

4. 1 Copy and complete the table

4. 2 What is the constant difference ?

5. Look at the pattern

$$-15; -19; -23; -27; -31; \dots$$

In this pattern  $-19$  is followed by  $-23$  and  $-23$  is followed by  $-27$

5. 1 What number in the pattern is followed by 19?

5. 2 What number in the pattern is followed by  $-31$ ?

5. 3 In the pattern,  $-19$  follows on  $-15$  and  $-23$  follows on  $-19$ . What number follows on  $-31$ ?

6. A certain pattern is formed by a common difference of 6.

6. 1 What number follows 23 on in this pattern?

6. 2 What number is followed by 23 in this pattern?

6. 3 What number follows 47 in this pattern?

6. 4 What number is followed by 47 in this pattern?

7. Write down any two consecutive terms in the pattern formed by  $2 \times x + 3$ , when the inputs are consecutive whole numbers.

8. Each of the patterns below were formed by an expression. Establish which pattern belongs to each expression.

Pattern A:	6	11	16	21	26
Pattern B:	13	17	21	25	29
Pattern C:	20	23	26	29	32
Pattern D:	1	-3	-7	-11	-15
Pattern E:	31	33	35	37	39
Pattern F:	-20	-25	-30	-35	-40
Pattern G:	25	31	37	43	49
Pattern H:	26	33	40	47	54
Pattern I:	-11	-17	-23	-29	-35

- 8.1  $2 \times x + 5$
- 8.2  $3 \times x + 2$
- 8.3  $4 \times x + 1$
- 8.4  $5 \times x + 6$
- 8.5  $6 \times x - 5$
- 8.6  $7 \times x - 2$
- 8.7  $1 - 4 \times x$
- 8.8  $5 - 5 \times x$
- 8.9  $-5 - 6 \times x$

9. Answer the following questions using the sequences below.

A :	6	11	16	21	26
B :	13	17	21	25	29
C :	20	23	26	29	32
D :	1	-3	-7	-11	-15
E :	31	33	35	37	39
F :	-20	-25	-30	-35	-40
G :	25	31	37	43	49
H :	26	33	40	47	54
I :	-11	-17	-23	-29	-35

- 9.1 Which sequences are increasing sequences ?
- 9.2 Which sequences are decreasing sequences?
- 9.3 By how much does sequence *A* increase from one term to the next?
- 9.4 By how much does sequence *B* increase from one term to the next?

9. 5 Which of the sequences increases by the fastest rate? and by how much does it increase?
9. 6 Which sequence decreases the fastest?
9. 7 Which sequence decreases the slowest?
9. 8 Write five consecutive terms of a sequence which decreases faster than sequence  $D$ .
9. 9 Write five consecutive terms of a sequence which increases slower than sequence  $B$
10. Each of the expressions below can be used to produce a sequence. Which of the expressions will produce the sequence that increases fastest?

$$3 \times x + 5$$

$$2 \times x + 10$$

$$6 \times x - 1$$

$$20 + 3 \times x$$

$$4 \times x - 9$$

10. 1 Which of the expressions will produce the sequence that increases fastest?
10. 2 Think of a way in which you can test your answer and do it.
11. In each case, state whether the sequence will be increasing or decreasing.
11. 1  $10 + 3 \times x$
11. 2  $10 - 3 \times x$
11. 3  $10 \times x + 3$
11. 4  $3 \times x - 10$

## 4 ANSWERS FOR EXERCISES

### 4.1 Exercise 1

1. 1

A	-6	-4	-2	0	2	4	6	8	10	12	14	16	18	20
---	----	----	----	---	---	---	---	---	----	----	----	----	----	----

1. 2 +2

2. 1

B	20	18	16	14	12	10	8	6	4	2	0	-2	-4	-6
---	----	----	----	----	----	----	---	---	---	---	---	----	----	----

2. 2 -2



3. 1

C	-10	-7	-4	-1	2	5	8	11	14	17	20	23	26	29
---	-----	----	----	----	---	---	---	----	----	----	----	----	----	----

3. 2 +3

4. 1

D	20	22	23	23	22	20	17	13	8	2	-5	-13	-22	-32
---	----	----	----	----	----	----	----	----	---	---	----	-----	-----	-----

4. 2 The difference is not constant

5. 1 120; 140; 160

5. 2 280

6. 1 80; 60; 40

6. 2 -80

7.

Term number	1	2	3	4	5	6	7	8	9
E with constant difference 10	-20	-10	0	10	20	30	40	50	60

8.

Term number	1	2	3	4	5	6	7	8	9
F with constant difference -5	55	50	45	40	35	30	25	20	15

9.

Term number	1	2	3	4	5	6	7	8	9
G with constant difference -10	80	70	60	50	40	30	20	10	0

10. 1 36 49 64 81

10. 2 38 51 66 83

10. 3 5 -1 -8 -16

10. 4 35 35 34 32

## 4.2 Exercise 2

1. 1 30 25 20 15 10 5 0 -5 -10 -15

1. 2 -30 -25 -20 -15 -10 -5 0 5 10 15

1. 3 -30 -35 -40 -45 -50 -55 -60 -65 -70 -75

2. 1 -10 -5 0 5 10 15 20 25 30 35

2. 2 -10 -15 -20 -25 -30 -35 -40 -45 -50 -55

3. to 8. Learner's own answer

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### 4.3 Exercise 3

1. 1

$x$	0	1	2	3	4	5	6	7	8
$2 \times x - 10$	-10	-8	-6	-4	-2	0	2	4	6

1. 2 Yes, The constant difference is +2

2. 1

$x$	0	1	2	3	4	5	6	7	8
$3 \times x - 20$	-20	-17	-14	-11	-8	-5	-2	1	4

2. 2 +3

3. 1

$x$	0	1	2	3	4	5	6	7	8
$2 - 3 \times x$	2	-1	-4	-7	-10	-13	-16	-19	-22

3. 2 -3

4. 1

$x$	0	1	2	3	4	5	6	7	8
$1 - 2 \times x$	1	-1	-3	-5	-7	-9	-11	-13	-15

4. 2 -2

5. 1 -15

5. 2 -27

5. 3 -35

6. 1 29

6. 2 17

6. 3 53

6. 4 41

7. 1 Any two consecutive odd numbers bigger than 5. Example: 5 and 7 or 9 and 11

8. 1 Pattern  $E$

8. 2 Pattern  $C$

8. 3 Pattern  $B$

8. 4 Pattern  $A$

---

8. 5 Pattern  $G$

8. 6 Pattern  $H$

8. 7 Pattern  $D$

8. 8 Pattern  $F$

8. 9 Pattern  $I$

9. 1  $A, B, C, E, G$  and  $H$

9. 2  $D, F$  and  $I$

9. 3 5

9. 4 4

9. 5  $H$

9. 6  $I$

9. 7  $D$

9. 8 Learner's own answer

Example : 50, 42, 34, 26, 18

9. 9 Learner's own answer

Example: 50, 52, 54, 56, 58

10. 1  $6 \times x - 1$

10. 2 Learners own answer. One way is to write some terms of the sequence for each of the expressions.

11. 1 Increasing

11. 2 Decreasing

11. 3 Increasing

11. 4 Increasing