

15. [Number Patterns]

Skill 15.1 Completing number patterns in table format by adding, subtracting or multiplying by the same number.

MM5.2 1 2 2 3 3 4 4
MM10 1 1 2 2 3 3 4 4

- Look at consecutive terms in the second row of the table.
- Find the number and operation used to get from one term to the next.
- Define the rule (operation) of the pattern.
- Apply this rule to the last given term and find the next term of the pattern.

Q. What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	-1	3	-27	81	-243	?

A. $-1, 3, -27, 81, -243, ?$
 $\times (-3)$

Rule: Multiply each term by -3 .

$$-1 \times (-3) = 3$$

$$3 \times (-3) = -27$$

$$-27 \times (-3) = 81$$

$$81 \times (-3) = -243$$

$$-243 \times (-3) = 729$$

$$-1, 3, -27, 81, -243, 729$$

Note that the value of each term in the pattern is a multiple of 3 in increasing order. The signs are changing.

a) What is the value of the missing term in the pattern?

position	1	2	3	4	5	
term	3	7	11	15	?	<input type="text"/>

$$3 + 4 = 7, 7 + 4 = 11, 11 + 4 = 15, 15 + 4 = 19$$

b) What is the value of the missing term in the pattern?

position	1	2	3	4	5	
term	1	6	11	16	?	<input type="text"/>

c) What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	17	12	7	2	-3	?

d) What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	21	15	9	3	-3	?

e) What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	1	-5	25	-125	625	?

f) What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	2	-4	8	-16	32	?

g) What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	-10	20	-40	80	-160	?

h) What is the value of the missing term in the pattern?

position	1	2	3	4	5	6
term	2	-10	50	-250	1250	?

Skill 15.2 Completing number patterns by using changing values in the rule.

MM5.2 1 2 2 3 3 4 4
MM10 1 1 2 2 3 3 4 4

- Look at consecutive terms of the pattern.
- Find the operation used to get from one term to the next.
- Define the rule (operation) of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Hints: Every number pattern is created by a rule involving numbers and operations.

Counting numbers, even numbers and odd numbers have patterns themselves that can become part of the rule (see below).

Q. Complete the pattern:

3, 5, 9, 15, 23, ,

A. 3, 5, 9, 15, 23, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +2 & +4 & +6 & +8 \end{array}$

Rule: Add 2, then 4, then 6, then 8, etc.
The pattern is formed by adding consecutive even numbers.

$$23 + 10 = 33$$

$$33 + 12 = 45$$

3, 5, 9, 15, 23, 33, 45

a) Complete the pattern:

11, 13, 16, 20, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +2 & +3 & +4 & +5 & +6 \end{array}$

$$20 + 5 = 25$$

$$25 + 6 = 31$$

b) Complete the pattern:

2, 3, 5, 8, 12, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \end{array}$

c) Complete the pattern:

3, 5, 9, 15, ,
 $\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$

d) Complete the pattern:

1, 3, 7, 13, ,
 $\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$

e) Complete the pattern:

0, 3, 9, 18, 30, ,

f) Complete the pattern:

49, 48, 45, 40, 33, ,

g) Complete the pattern:

1, 4, 8, 13, 19, ,

h) Complete the pattern:

5, 6, 9, 14, 21, ,

i) Complete the pattern:

1, 4, 10, 19, ,

j) Complete the pattern:

30, 28, 24, 18, 10, ,

Skill 15.3 Completing number patterns by adding or subtracting the same positive number to integers.

MM5.2 11 22 33 44
MM10 11 22 33 44

- Look at consecutive terms of the pattern.
- Find the operation used to get from one term to the next.
Hint: Every number pattern is created by adding or subtracting the same positive integer.
- Define the rule (operation) of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

$-25, -17, -9, -1, 7, \boxed{\quad, \quad}$

Note that the value of each term in the pattern is increasing. Then find by how much.

A. $-25, -17, -9, -1, 7, \boxed{\quad, \quad}$
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +8 & +8 & +8 & +8 \end{array}$

Rule: Add 8 to each term.

$7 + 8 = 15$

$15 + 8 = 23$

$-25, -17, -9, -1, 7, \underline{15}, \underline{23}$

a) Complete the pattern:

$35, 20, 5, -10, \boxed{\quad, \quad}$
 $\begin{array}{cccc} \curvearrowleft & \curvearrowleft & \curvearrowleft & \curvearrowleft \\ -15 & -15 & -15 & -15 \end{array}$
 $-10 - 15 = -25 \quad -25 - 15 = -40$

b) Complete the pattern:

$8, 5, 2, -1, -4, \boxed{\quad, \quad}$

c) Complete the pattern:

$-20, -14, -8, -2, 4, \boxed{\quad, \quad}$

d) Complete the pattern:

$-16, -11, -6, -1, 4, \boxed{\quad, \quad}$

e) Complete the pattern:

$9, 5, 1, -3, -7, \boxed{\quad, \quad}$

f) Complete the pattern:

$10, 7, 4, 1, -2, \boxed{\quad, \quad}$

g) Complete the pattern:

$-35, -28, -21, -14, -7, \boxed{\quad, \quad}$

h) Complete the pattern:

$-19, -15, -11, -7, -3, \boxed{\quad, \quad}$

i) Complete the pattern:

$16, 10, 4, -2, -8, \boxed{\quad, \quad}$

j) Complete the pattern:

$12, 7, 2, -3, -8, \boxed{\quad, \quad}$

k) Complete the pattern:

$46, 34, 22, 10, -2, \boxed{\quad, \quad}$

l) Complete the pattern:

$-20, -11, -2, 7, 16, \boxed{\quad, \quad}$

Skill 15.4 Completing number patterns by multiplying by the same integer.

MM5.2 11 2 33 44
MM10 11 2 33 44

- Look at consecutive terms of the pattern.
- Find the number and operation (in this case multiplication) used to get from one term to the next.
- Define the rule (operation) of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

$$-5, 15, -45, 135, \boxed{\quad, \quad}$$

Note that the value of each term in the pattern is increasing, but the signs are changing.

A. $-5, 15, -45, 135, \quad, \quad$
 $\times (-3) \times (-3) \times (-3)$

Rule: Multiply each term

by -3 .

$$135 \times (-3) = -405$$

$$-405 \times (-3) = 1215$$

$$-5, 15, -45, 135, \underline{-405}, \underline{1215}$$

a) Complete the pattern:

$$1, 3, 9, 27, 81, \boxed{\quad, \quad}$$

$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \times 3 & \times 3 & \times 3 & \times 3 & \times 3 & \end{array}$

$$81 \times 3 = 243$$

$$243 \times 3 = 729$$

b) Complete the pattern:

$$3, 6, 12, 24, 48, \boxed{\quad, \quad}$$

$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \times 2 & \times 2 & \times 2 & \times 2 & \times 2 & \end{array}$

$$48 \times 2 =$$

c) Complete the pattern:

$$2, 6, 18, 54, 162, \boxed{\quad, \quad}$$

d) Complete the pattern:

$$1, 5, 25, 125, \boxed{\quad, \quad}$$

e) Complete the pattern:

$$\frac{1}{36}, \frac{1}{6}, 1, 6, \boxed{\quad, \quad}$$

$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \times 6 & \times 6 & \times 6 & \times 6 & \times 6 & \end{array}$

f) Complete the pattern:

$$\frac{1}{25}, \frac{1}{5}, 1, 5, \boxed{\quad, \quad}$$

g) Complete the pattern:

$$\frac{5}{2}, 5, 10, 20, 40, \boxed{\quad, \quad}$$

h) Complete the pattern:

$$\frac{1}{49}, \frac{1}{7}, 1, 7, 49, \boxed{\quad, \quad}$$

i) Complete the pattern:

$$2, -4, 8, -16, 32, \boxed{\quad, \quad}$$

j) Complete the pattern:

$$1, -4, 16, -64, \boxed{\quad, \quad}$$

k) Complete the pattern:

$$-3, 9, -27, 81, \boxed{\quad, \quad}$$

l) Complete the pattern:

$$4, -20, 100, -500, \boxed{\quad, \quad}$$

Skill 15.5 Completing number patterns by dividing by the same integer.

MM5.2 11 22 33 44
MM10 11 22 33 44

- Look at consecutive terms of the pattern.
- Find the number and operation (in this case division) used to get from one term to the next.
- Define the rule (operation) of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

-1215 , 405 , -135 , 45 , ,

NB: The value of each term in the pattern is decreasing, but the signs are changing.

A. -1215 , 405 , -135 , 45 , ,
 $\div (-3) \quad \div (-3) \quad \div (-3)$

Rule: Divide each term by -3.

$$45 \div (-3) = -9$$

$$-9 \div (-3) = 3$$

-1215 , 405 , -135 , 45 , -9 , 3

a) Complete the pattern:

288 , -144 , 72 , -36 , 18 , ,

$$\div (-2) \quad \div (-2) \quad \div (-2) \quad \div (-2) \quad \div (-2) \quad \div (-2)$$

$$18 \div (-2) = -9 \quad -9 \div (-2) = 4.5$$

b) Complete the pattern:

1458 , 486 , 162 , 54 , 18 , ,

c) Complete the pattern:

3125 , 625 , 125 , 25 , ,

d) Complete the pattern:

1600 , 800 , 400 , 200 , 100 , ,

e) Complete the pattern:

-200 000 , 20 000 , -2000 , 200 , ,

f) Complete the pattern:

310 000 , -31 000 , 3100 , -310 , ,

g) Complete the pattern:

-6250 , 1250 , -250 , 50 , ,

h) Complete the pattern:

-64 , 32 , -16 , 8 , ,

i) Complete the pattern:

112 , 56 , 28 , 14 , 7 , ,

j) Complete the pattern:

54 , 18 , 6 , 2 , ,

k) Complete the pattern:

375 , 75 , 15 , 3 , ,

l) Complete the pattern:

7203 , 1029 , 147 , 21 , 3 , ,

Skill 15.6 Finding a random term in a number pattern.

MM5.2 11 22 3 44
MM10 11 22 3 44

- Draw a table and list the given terms and the position each term occupies in the pattern.
- Look for a relationship between consecutive terms and/or between the term and its position in the pattern.
- Based on this relationship, find the requested term in the pattern.

Q. Find the 15th term in the pattern

5, 7, 9, 11, 13,

A.

position	1 st	2 nd	3 rd	4 th	5 th	.....	15 th
term	5	7	9	11	13		?
relationship	$1 \times 2 + 3$	$2 \times 2 + 3$	$3 \times 2 + 3$	$4 \times 2 + 3$	$5 \times 2 + 3$		$15 \times 2 + 3$

Relationship:

each term = twice its position plus 3

The 15th term of the pattern is:

$$15 \times 2 + 3 = \mathbf{33}$$

a) Find the 30th term in the pattern

2, 4, 6, 8, 10,

position	1 st	2 nd	3 rd	4 th	5 th	.....	30 th
term	2	4	6	8	10		?
relationship	1×2	2×2	3×2	4×2	5×2		30×2

Relationship: term =

30th term = =

b) Find the 18th term in the pattern

5, 10, 15, 20, 25,

position	1 st	2 nd	3 rd	4 th	5 th	.....	18 th
term	5	10					?
relationship							

Relationship: term =

18th term = =

c) Find the 20th term in the pattern

8, 13, 18, 23, 28,

position	1 st	2 nd	3 rd	4 th	5 th	20 th
term							?
relationship							

Relationship: term =

20th term = =

d) Find the 25th term in the pattern

4, 6, 8, 10, 12,

position	1 st	2 nd	3 rd	4 th	5 th	25 th
term							?
relationship							

Relationship: term =

25th term = =

e) Find the 20th term in the pattern

1, 4, 7, 10, 13,

position	1 st	2 nd	3 rd	4 th	5 th	20 th
term							?
relationship							

Relationship: term =

20th term = =

f) Find the 8th term in the pattern

1, 2, 4, 8, 16,

position	1 st	2 nd	3 rd	4 th	5 th	8 th
term							?
relationship							

Relationship: term =

8th term = =

Skill 15.7 Finding a particular term of a sequence given its general rule.

MM5.2 11 22 33 44
MM10 11 22 33 44

- Substitute the value of n in the formula for the general rule of the sequence.
- Calculate the value of the required term.

Q. If the general rule of a sequence is $\frac{n}{4} - 9$
find the 60th term ($n = 60$).

A. *the n th term of the sequence =*
 $= \frac{n}{4} - 9$ *substitute $n = 60$*

the 60th term of the sequence =
 $= \frac{60}{4} - 9$
 $= 15 - 9$
 $= 6$

a) If the general rule of a sequence is $5n - 4$
find the 30th term ($n = 30$).

30th term = $5 \times 30 - 4$
 $= 150 - 4$ $=$

b) If the general rule of a sequence is $4n - 7$
find the 15th term ($n = 15$).

15th term =
 $=$

c) If the general rule of a sequence is $8 - 5n$
find the 10th term ($n = 10$).

10th term =
 $=$

d) If the general rule of a sequence is $25 - n$
find the 40th term ($n = 40$).

40th term =
 $=$

e) If the general rule of a sequence is $15n$
find the 30th term ($n = 30$).

30th term =
 $=$

f) If the general rule of a sequence is $-40n$
find the 25th term ($n = 25$).

25th term =
 $=$

g) If the general rule of a sequence is $-\frac{2n}{7}$
find the 35th term.

35th term =
 $=$

h) If the general rule of a sequence is $\frac{n}{3} + 1$
find the 21st term.

21st term =
 $=$

i) If the general rule of a sequence is $-6(n - 3)$
find the 23rd term.

23rd term =
 $=$

j) If the general rule of a sequence is $3(n - 6)$
find the 24th term.

24th term =
 $=$

Skill 15.8 Finding the general rule of a pattern given a table of values for the pattern (2).

- c) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	8	10	12	14	16	....	$2n + 6$

$$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +2 & +2 & +2 & +2 \end{array}$$

common difference = 2

term $n = 2n \Rightarrow$ term 1 = $2 \times 1 = 2$ (false)

adjust term $n = 2n + 6 \Rightarrow$ term 1 = 8 (true)

- e) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	2	5	8	11	14	....

$$\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$$

common difference =

term n

adjust term n

- g) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	5	10	15	20	25	....

$$\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$$

common difference =

term n

adjust term n

- i) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	2	1	0	-1	-2	....

$$\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$$

common difference =

term n

adjust term n

- d) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	5	4	3	2	1	....

$$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ -1 & -1 & -1 & -1 \end{array}$$

common difference = -1

term $n = -n \Rightarrow$ term 1 = -1 (false)

adjust term $n = 6 - n \Rightarrow$ term 1 = 5 (true)

- f) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	5	9	13	17	21	....

$$\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$$

common difference =

term n

adjust term n

- h) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	7	10	13	16	19	....

$$\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$$

common difference =

term n

adjust term n

- j) Write an expression for the term in position n given the table of values for the sequence.

position	1	2	3	4	5	....	n
term	-3	-6	-9	-12	-15	....

$$\begin{array}{ccc} \curvearrowright & \curvearrowright & \curvearrowright \end{array}$$

common difference =

term n

adjust term n

- Look at consecutive terms of the pattern.
- Find the operation used to get from one term to the next.
Hint: Every number pattern is created by adding, subtracting, multiplying or dividing by rational numbers (whole numbers, fractions or decimals).
- Define the rule (operation) of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

$$\frac{5}{18}, \frac{1}{2}, \frac{13}{18}, \frac{17}{18}, 1\frac{1}{6}, \boxed{\quad, \quad}$$

A. $\frac{5}{18}, \frac{1}{2}, \frac{13}{18}, \frac{17}{18}, 1\frac{1}{6},$

Look at the 3rd and 4th terms: their difference is $\frac{4}{18}$

Rule: Add $\frac{4}{18}$ to each term.

$$1\frac{1}{6} + \frac{4}{18} = \frac{7}{6} + \frac{4}{18} = \frac{21}{18} + \frac{4}{18} = \frac{25}{18} = 1\frac{7}{18}$$

$$\frac{25}{18} + \frac{4}{18} = \frac{29}{18} = 1\frac{11}{18}$$

$$\frac{5}{18}, \frac{1}{2}, \frac{13}{18}, \frac{17}{18}, 1\frac{1}{6}, \underline{1\frac{7}{18}}, \underline{1\frac{11}{18}}$$

a) Complete the pattern:

$$1, 2, 3.5, 5.5, 8, \boxed{\quad, \quad}$$

$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +1 & +1.5 & +2 & +2.5 & +3 & +3.5 \end{array}$

$$8 + 3 = 11 \qquad 11 + 3.5 = 14.5$$

b) Complete the pattern:

$$0.8, 2, 3.4, 5, 6.8, \boxed{\quad, \quad}$$

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +1.2 & & & \end{array}$

c) Complete the pattern:

$$1.5, 3.5, 6, 9, 12.5, \boxed{\quad, \quad}$$

d) Complete the pattern:

$$4, 5.5, 7.5, 10, 13, \boxed{\quad, \quad}$$

e) Complete the pattern:

$$1.75, 3.5, 7, 14, \boxed{\quad, \quad}$$

f) Complete the pattern:

$$1\frac{1}{4}, 2\frac{1}{2}, 5, 10, \boxed{\quad, \quad}$$

g) Complete the pattern:

$$36, 18, 9, \frac{9}{2}, \frac{9}{4}, \boxed{\quad, \quad}$$

h) Complete the pattern:

$$32, 8, 2, \frac{1}{2}, \frac{1}{8}, \boxed{\quad, \quad}$$

i) Complete the pattern:

$$3\frac{1}{4}, 4, 4\frac{3}{4}, 5\frac{1}{2}, 6\frac{1}{4}, \boxed{\quad, \quad}$$

j) Complete the pattern:

$$\frac{8}{15}, \frac{4}{5}, 1\frac{1}{15}, 1\frac{1}{3}, 1\frac{3}{5}, \boxed{\quad, \quad}$$