

17. [Number Patterns]

Skill 17.1 Completing number patterns by adding the same number.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To find the rule to complete any number pattern, identify the number and operation used to get from one term to the next.

Q. 1, 3, 5, 7, 9, __, __

A. 1, 3, 5, 7, 9, **11**, **13**

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

First note that each term in the pattern is increasing.

To get from 1 to 3 add 2, from 3 to 5 add 2, from 5 to 7 add 2 and from 7 to 9 add 2, so the rule of the pattern is: "Add 2 to the previous term."

Apply the rule to the last given term and complete the number pattern.

$9 + 2 = 11$ $11 + 2 = 13$

a) 2, 4, 6, 8, 10, 12, 14
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +2 & +2 & +2 & +2 & +2 & +2 \end{array}$

b) 12, 15, 18, 21, 24,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ +3 & & & \end{array}$

c) 10, 15, 20, 25, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

d) 13, 21, 29, 37, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

e) 2, 11, 20, 29, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

f) 1, 7, 13, 19, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

g) 4, 9, 14, 19, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

h) 3, 11, 19, 27, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

i) 2, 9, 16, 23, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

j) 1, 10, 19, 28, ,
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ & & & \end{array}$

Q. 16, 13, 10, 7, __, __

A. 16, 13, 10, 7, 4, 1
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ -3 & -3 & -3 & -3 & -3 & \end{array}$

First note that each term in the pattern is decreasing.

To get from 16 to 13 subtract 3, from 13 to 10 subtract 3 and from 10 to 7 subtract 3, so the rule of the pattern is:

“Subtract 3 from the previous term.”

Apply the rule to the last given term and complete the number pattern.

$7 - 3 = 4$ $4 - 3 = 1$

a) 20, 18, 16, 14, 12, 10, 8
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ -2 & -2 & -2 & -2 & -2 & -2 \end{array}$

b) 21, 17, 13, 9, 5, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

c) 40, 35, 30, 25, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

d) 50, 42, 34, 26, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

e) 93, 87, 81, 75, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

f) 65, 54, 43, 32, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

g) 36, 31, 26, 21, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

h) 84, 77, 70, 63, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

i) 88, 73, 58, 43, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

j) 18, 14, 10, 6, __, __
 $\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \dots & \dots & \dots & \dots \end{array}$

Q. 1, 2, 4, 8, __, __

A. 1, 2, 4, 8, 16, 32
 $\times 2 \quad \times 2 \quad \times 2 \quad \times 2 \quad \times 2$

First note that each term in the pattern is increasing by a greater amount each time. This hints at multiplication by an unknown number.

To get from 1 to 2 multiply by 2, from 2 to 4 multiply by 2 and from 4 to 8 multiply by 2, so the rule of the pattern is:

“Multiply the previous term by 2.”

Apply the rule to the last given term and complete the number pattern.

$8 \times 2 = 16 \quad 16 \times 2 = 32$

a) 2, 4, 8, 16, 32, 64
 $\times 2 \quad \times 2 \quad \times 2 \quad \times 2 \quad \times 2$

b) 2, 6, 18, 54, 162, __
 $\times 3$

c) 1, 4, 16, 64, __, __

d) 1, 3, 9, 27, __, __

e) 1, 5, 25, 125, __, __

f) 0.3, 0.6, 1.2, 2.4, __, __

g) 4, 12, 36, 108, __, __

h) 0.1, 0.3, 0.9, 2.7, __, __

i) 3, 12, 48, 192, __, __

j) 0.2, 0.4, 0.8, 1.6, __, __

Q. 32, 16, 8, 4, __, __

A. 32, 16, 8, 4, 2, 1
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \div 2 & \div 2 & \div 2 & \div 2 & \div 2 & \end{array}$

First note that each term in the pattern is decreasing by a lesser amount each time. This hints at division by an unknown number.

To get from 32 to 16 divide by 2, from 16 to 8 divide by 2 and from 8 to 4 divide by 2, so the rule of the pattern is:

“Divide the previous term by 2.”

Apply the rule to the last given term and complete the number pattern.

$4 \div 2 = 2$ $2 \div 2 = 1$

a) 128, 64, 32, 16, 8, 4
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \div 2 & \div 2 & \div 2 & \div 2 & \div 2 & \end{array}$

b) 96, 48, 24, 12, 6,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \div 2 & & & & & \end{array}$

c) 1024, 256, 64, 16, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

d) 243, 81, 27, 9, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

e) 81, 27, 9, 3, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

f) 3210, 321.0, 32.1, 3.21, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

g) 486, 162, 54, 18, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

h) 972, 324, 108, 36, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

i) 3125, 625, 125, 25, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

j) 6.4, 3.2, 1.6, 0.8, ,
 $\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ & & & & & \end{array}$

Skill 17.5 Completing number patterns by adding or subtracting the same fraction.

Q. $\frac{1}{7}, \frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \underline{\quad}, \underline{\quad}$ **A.** $\frac{1}{7}, \frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}, \frac{6}{7}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ +\frac{1}{7} & +\frac{1}{7} & +\frac{1}{7} & +\frac{1}{7} & +\frac{1}{7} & \end{array}$$

First note that each term in the pattern is increasing.

Then subtract the first term from the second term and so on.

$$\frac{2}{7} - \frac{1}{7} = \frac{1}{7} \quad \frac{3}{7} - \frac{2}{7} = \frac{1}{7} \quad \frac{4}{7} - \frac{3}{7} = \frac{1}{7}$$

The rule of the pattern is:

“Add $\frac{1}{7}$ to the previous term.”

Apply the rule to the last given term and complete the number pattern.

$$\frac{4}{7} + \frac{1}{7} = \frac{5}{7} \quad \frac{5}{7} + \frac{1}{7} = \frac{6}{7}$$

a) $1, 1\frac{1}{3}, 1\frac{2}{3}, 2, 2\frac{1}{3}, 2\frac{2}{3}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ +\frac{1}{3} & +\frac{1}{3} & +\frac{1}{3} & +\frac{1}{3} & +\frac{1}{3} & \end{array}$$

b) $0, 1\frac{1}{2}, 3, 4\frac{1}{2}, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

c) $9, 8\frac{1}{3}, 7\frac{2}{3}, 7, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

d) $3\frac{1}{4}, 3\frac{3}{4}, 4\frac{1}{4}, 4\frac{3}{4}, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

e) $2, 2\frac{1}{3}, 2\frac{2}{3}, 3, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

f) $7, 6\frac{4}{7}, 6\frac{1}{7}, 5\frac{5}{7}, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

g) $1, 2\frac{1}{5}, 3\frac{2}{5}, 4\frac{3}{5}, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

h) $5, 4\frac{1}{4}, 3\frac{2}{4}, 2\frac{3}{4}, \underline{\quad}, \underline{\quad}$

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \dots & \dots & \dots & \dots & \dots & \dots \end{array}$$

Skill 17.6 Completing number patterns involving fractions by multiplying by the same number.

Q. $\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, 1, \underline{\quad}, \underline{\quad}$ A. $\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, 1, 2, 4$

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

First note that each term in the pattern is increasing by a greater amount each time. This hints at multiplication by an unknown number.

$\frac{1}{8} \times 2 = \frac{1}{4}$ $\frac{1}{4} \times 2 = \frac{1}{2}$ $\frac{1}{2} \times 2 = 1$

The rule of the pattern is:
"Multiply the previous term by 2."
Apply the rule to the last given term and complete the pattern.

$1 \times 2 = 2$ $2 \times 2 = 4$

a) $\frac{1}{4}, \frac{1}{2}, 1, 2, \underline{4}, \underline{8}$

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

b) $\frac{1}{3}, 1, 3, 9, \underline{\quad}, \underline{\quad}$

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

c) $\frac{1}{100}, \frac{1}{10}, 1, 10, \underline{\quad}, \underline{\quad}$

$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \times 10 & & & & & \end{array}$

d) $\frac{7}{100}, \frac{7}{10}, 7, 70, \underline{\quad}, \underline{\quad}$

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

e) $\frac{1}{25}, \frac{1}{5}, 1, 5, \underline{\quad}, \underline{\quad}$

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

f) $\frac{1}{16}, \frac{1}{4}, 1, 4, \underline{\quad}, \underline{\quad}$

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

g) $\frac{1}{36}, \frac{1}{6}, 1, 6, \underline{\quad}, \underline{\quad}$

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

h) $\frac{3}{49}, \frac{3}{7}, 3, 21, \underline{\quad}, \underline{\quad}$

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

Skill 17.7 Completing number patterns by using changing values in the rule.

Try to find a pattern in the numbers added or subtracted from each term (e.g. counting numbers, even numbers or odd numbers). When fractions are involved, consider patterns in the numerator (top line) or the denominator (bottom line).

Q. 1, 2, 5, 10, __, __

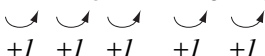
A. 1, 2, 5, 10, 17, 26



The rule of the number pattern is:
“Add 1, then 3, then 5, then 7, etc.
The sequence is formed by
adding consecutive odd numbers.”

Q. $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, __, __

A. $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$



The rule of the number pattern is:
“Keeping the numerator the same,
add 1 to the denominator.”

a) 2, 3, 5, 8, 12, __

b) 1, 3, 7, 13, 21, __

c) 42, 40, 36, 30, __, __

d) 1, 4, 10, 19, __, __

e) $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{8}$, __, __

f) 25, 19, 14, 10, __, __

g) 11, 13, 16, 20, __, __

h) 3, 5, 9, 15, __, __

i) $\frac{1}{9}$, $\frac{1}{8}$, $\frac{1}{7}$, $\frac{1}{6}$, __, __

j) 45, 35, 26, 18, __, __

Skill 17.8 Completing number patterns involving squared or cubed numbers.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

Q. 216, 125, 64, 27, __, __

A. 216, 125, 64, 27, 8, 1
 $6^3 \quad 5^3 \quad 4^3 \quad 3^3 \quad 2^3 \quad 1^3$

The rule of the number pattern is:
 "Each term is a cubed number,
 following the counting numbers in
 descending order."

a) 1, 8, 27, 64, 125, 216
 $1^3 \quad 2^3 \quad 3^3 \quad 4^3 \quad 5^3 \quad 6^3$

b) 4, 9, 16, 25, 36, __
 2^2

c) 343, 216, 125, 64, __, __

d) 25, 16, 9, 4, __, __

e) $\frac{1}{1}, \frac{1}{4}, \frac{1}{9}, \frac{1}{16},$ __, __

f) $\frac{1}{216}, \frac{1}{125}, \frac{1}{64}, \frac{1}{27},$ __, __

g) 1000, 729, 512, 343, __, __

h) 100, 81, 64, 49, __, __

i) $\frac{1}{1}, \frac{4}{8}, \frac{9}{27}, \frac{16}{64},$ __, __

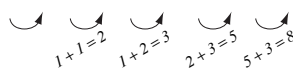
j) $\frac{216}{36}, \frac{125}{25}, \frac{64}{16}, \frac{27}{9},$ __, __

Fibonacci was the nickname of Leonardo de Pisa, an Italian mathematician. He is best known for a sequence of numbers that bears his name. The Fibonacci sequence begins with 1, 1. Each new number is then found by adding the two preceding numbers (see the example below).

The Fibonacci numbers are found in art, music and nature. You can find them in the number of spirals on a pine cone or a pineapple. The numbers of leaves or branches on many plants are Fibonacci numbers. The center of a sunflower has clockwise and anticlockwise spirals; the numbers of these spirals are consecutive Fibonacci numbers.

Q. 1, 1, 2, 3, __, __

A. 1, 1, 2, 3, 5, 8



The rule of the Fibonacci number pattern is:
“Each term, starting with the third, is the sum of the two previous terms.”

a) 1, 1, 2, 3, 5, 8, 13

b) 2, 2, 4, 6, 10, ,

c) 4, 4, 8, 12, 20, ,

d) 3, 3, 6, 9, 15, ,

Q. Find the 8th term in the sequence
2, 4, 6, 8,

A. 16

Look for a relationship between the term number and the term value.

In this case the term number, multiplied by 2 gives the term value (see table).

The 8th term in the sequence is $8 \times 2 = 16$

term number	1 st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
term value	2	4	6	8	10	12	14	16
relationship	1×2	2×2	3×2	4×2	5×2	6×2	7×2	8×2

Q. Find the 30th term in the sequence
3, 4, 5, 6,

A. 32

Look for a relationship between the term number and the term value.

In this case the term number, plus 2 gives the term value (see table).

The 30th term in the sequence is $30 + 2 = 32$

term number	1 st	2 nd	3 rd	4 th	5 th	29 th	30 th
term value	3	4	5	6	7	31	32
relationship	$1 + 2$	$2 + 2$	$3 + 2$	$4 + 2$	$5 + 2$	$29 + 2$	$30 + 2$

a) Find the 10th term in the sequence
5, 10, 15, 20, **50**

term number	1 st	2 nd	3 rd	4 th	10 th
term value	5	10	15	20	50
relationship	1×5	2×5	3×5	4×5	10×5

b) Find the 8th term in the sequence
5, 7, 9, 11,

term number	1 st	2 nd	3 rd	4 th	8 th
term value	5	7	9	11	.....
relationship	$1 \times 2 + 3$	$2 \times 2 + 3$	$3 \times 2 + 3$	$4 \times 2 + 3$	.....

c) Find the 8th term in the sequence
13, 23, 33, 43,

term number	1 st	2 nd	3 rd	4 th	8 th
term value	13	23	33	43	.....
relationship	$1 \times 10 + 3$	.....	.....	.....	.....

d) Find the 10th term in the sequence
4, 8, 12, 16,

term number	1 st	2 nd	3 rd	4 th	10 th
term value	4	8	12	16	.....
relationship	.....	.....	.....	.....	.....

e) Find the 50th term in the sequence
 $\frac{1}{50}, \frac{1}{49}, \frac{1}{48}, \frac{1}{47}, \dots$

term number	1 st	2 nd	3 rd	4 th	50 th
term value	$\frac{1}{50}$	$\frac{1}{49}$	$\frac{1}{48}$	$\frac{1}{47}$	.....

f) Find the 20th term in the sequence
1, 8, 27, 64,

term number	1 st	2 nd	3 rd	4 th	20 th
term value	1	8	27	64	.....
relationship	.....	.....	.....	.....	.....