



# Geometric Sequences and Series

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## Learning Objectives

- Identify geometric sequences and find the common ratio
- Apply the explicit formula for the  $n$ th term of a geometric sequence
- Find specified terms of a geometric sequence
- Compute finite and infinite geometric series sums

Solve each problem, showing all work and writing your final answer in simplest form.

**1. Determine whether the sequence is geometric. If yes, state the common ratio.**

3, 6, 12, 24, 48, ...

Answer: \_\_\_\_\_

**2. Find the common ratio of the geometric sequence.**

81, 27, 9, 3, ...

Answer: \_\_\_\_\_

**3. Write the explicit formula for the  $n$ th term of the geometric sequence with first term 5 and common ratio 2.**

$a_1 = 5, r = 2$

Answer: \_\_\_\_\_

**4. Find the 8th term of the geometric sequence.**

$a_1 = 2, r = 3$

Answer: \_\_\_\_\_

**5. Find the 6th term of the geometric sequence.**

4, -8, 16, -32, ...

Answer: \_\_\_\_\_

**6. Find the first term of a geometric sequence given the common ratio and the 5th term.**

$r = 2, a_5 = 48$

Answer: \_\_\_\_\_

**7. Find the sum of the first 7 terms of the geometric sequence.**

$a_1 = 3, r = 2$

Answer: \_\_\_\_\_



**8. Find the sum of the first 5 terms of the geometric sequence.**

6, 12, 24, 48, ...

Answer: \_\_\_\_\_

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**9. Evaluate the infinite geometric series.**

$$\sum_{n=1}^{\infty} 8\left(\frac{1}{2}\right)^{n-1}$$

Answer: \_\_\_\_\_

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**10. Find the sum of the infinite geometric series, if it exists.**

$$27 + 9 + 3 + 1 + \frac{1}{3} + \dots$$

Answer: \_\_\_\_\_





This worksheet covers Part 2 of sequences and series: identifying geometric sequences, finding the common ratio  $r$ , using the explicit formula  $a_n = a_1 r^{(n-1)}$ , finding specific terms, computing finite geometric series sums with  $S_n = a_1(1 - r^n)/(1 - r)$ , and evaluating infinite geometric series sums  $S = a_1/(1 - r)$  when  $|r| < 1$ .

## Solutions

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1. Determine whether the sequence is geometric. If yes, state the common ratio.

3, 6, 12, 24, 48, ...

→ Divide each term by the previous term to test for a constant ratio.

→ Six divided by three equals two, twelve divided by six equals two, twenty-four divided by twelve equals two.

→ Because the ratio is constant, the sequence is geometric with common ratio two.

**Answer:** Geometric,  $r = 2$

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2. Find the common ratio of the geometric sequence.

81, 27, 9, 3, ...

→ Divide the second term by the first term.

→ Twenty-seven divided by eighty-one equals one third.

→ The common ratio is one third.

**Answer:**  $r = \frac{1}{3}$

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3. Write the explicit formula for the  $n$ th term of the geometric sequence with first term 5 and common ratio 2.

$a_1 = 5$ ,  $r = 2$

→ Recall the explicit formula for a geometric sequence: a sub  $n$  equals a sub one times  $r$  raised to the  $n$  minus one.

→ Substitute a sub one equals five and  $r$  equals two.

→ The formula is a sub  $n$  equals five times two to the  $n$  minus one.

**Answer:**  $a_n = 5 \cdot 2^{n-1}$

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4. Find the 8th term of the geometric sequence.

$a_1 = 2$ ,  $r = 3$

→ Use the formula a sub  $n$  equals a sub one times  $r$  raised to the  $n$  minus one.

→ Substitute a sub one equals two,  $r$  equals three, and  $n$  equals eight.

→ Two times three to the seventh power equals two times two thousand one hundred eighty-seven, which is four thousand three hundred seventy-four.

**Answer:**  $a_8 = 4374$

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5. Find the 6th term of the geometric sequence.

4, -8, 16, -32, ...

→ Find the common ratio by dividing negative eight by four to get negative two.

→ Apply a sub  $n$  equals a sub one times  $r$  raised to the  $n$  minus one with a sub one equals four,  $r$  equals negative two, and  $n$  equals six.

→ Four times negative two to the fifth power equals four times negative thirty-two, which is negative one hundred twenty-eight.

**Answer:**  $a_6 = -128$

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6. Find the first term of a geometric sequence given the common ratio and the 5th term.

$r = 2$ ,  $a_5 = 48$

→ Use a sub five equals a sub one times  $r$  to the fourth power.

→ Substitute forty-eight equals a sub one times two to the fourth, which is sixteen.

→ Divide both sides by sixteen to get a sub one equals three.

**Answer:**  $a_1 = 3$

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7. Find the sum of the first 7 terms of the geometric sequence.

$a_1 = 3$ ,  $r = 2$

→ Use the finite geometric series formula  $S$  sub  $n$  equals a sub one times the quantity one minus  $r$  to the  $n$ , divided by one minus  $r$ .

→ Substitute a sub one equals three,  $r$  equals two, and  $n$  equals seven: three times the quantity one minus one hundred twenty-eight, divided by one minus two.

→ Simplify the numerator to three times negative one hundred twenty-seven and divide by negative one to get three hundred eighty-one.

**Answer:**  $S_7 = 381$

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8. Find the sum of the first 5 terms of the geometric sequence.

6, 12, 24, 48, ...

→ Identify a sub one equals six and  $r$  equals two.

→ Apply the finite geometric series formula with  $n$  equals five.

→ Six times the quantity one minus thirty-two, divided by one minus two, gives six times thirty-one, which equals one hundred eighty-six.

**Answer:**  $S_5 = 186$

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9. Evaluate the infinite geometric series.

$$\sum_{n=1}^{\infty} 8\left(\frac{1}{2}\right)^{n-1}$$

→ Identify the first term a sub one equals eight and the common ratio  $r$  equals one half.

→ Because the absolute value of  $r$  is less than one, the series converges; use  $S$  equals a sub one divided by one minus  $r$ .

→ Eight divided by one minus one half equals eight divided by one half, which equals sixteen.

**Answer:**  $S = 16$

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10. Find the sum of the infinite geometric series, if it exists.

$$27 + 9 + 3 + 1 + \frac{1}{3} + \dots$$

→ The first term is twenty-seven and the common ratio is one third.

→ Since the absolute value of the common ratio is less than one, the sum converges.

→ Apply  $S$  equals a sub one divided by one minus  $r$ : twenty-seven divided by two thirds equals eighty-one over two.

**Answer:**  $S = \frac{81}{2}$

