A sequence of numbers such as 2, 4, 8, 16, 32,... forms a **geometric sequence**. Each number in a geometric sequence increases or decreases by a common factor \( r \), called the **common ratio**.

### Geometric Sequence

A geometric sequence can be written in the form of \( a, ar, ar^2, ar^3, \ldots \) where \( r \neq 0 \) or 1.

### Calculating the \( n \)th term

The \( n \)th term of a geometric series with initial term \( a_1 \) and common ratio \( r \) is calculated by \( a_n = a_1 \cdot r^{n-1} \).

### Examples

**a. Determine if the sequence is geometric.**

\(-1, 3, -9, 27, \ldots\)

\[
\frac{27}{-9} = -3
\]

Find the common ratio.

\((-1)(-3), 3(-3)\)

Test for each element.

Yes, the sequence is geometric.

**b. Find the 12th term of the sequence 4, 16, 64, 256, \ldots**

\[
a_n = a_1 \cdot r^{n-1} \quad \text{Formula for the } n\text{th term.}
\]

\[
\frac{16}{4} = 4
\]

Find the common ratio.

\[
a_{12} = 4 \cdot 4^{12-1}
\]

Substitute.

\[
a_{12} = 4 \cdot 4^{11}
\]

Simplify.

\[
a_{12} = 4 \cdot 4,194,304
\]

Multiply.

\[
a_{12} = 16,777,216
\]

Multiply.

### Practice

Find the next three terms in each sequence.

1. \( \frac{1}{2}, -\frac{1}{2}, \frac{4}{2}, -\frac{13}{2}, \ldots \)

2. \(-2, -15, -112, 5, -843, \ldots \)

3. 1, 6, 36, 216, \ldots

4. 56, 28, 14, 7, \ldots

5. 64, -48, 36, -27, \ldots

6. 2, 22, 242, 2662, \ldots

7. Find the 10th term of the geometric sequence whose first term is 3 and common ratio is -2.

8. Find the 9th term of 25, 12.5, 6.25, 3.125, \ldots

9. A geometric sequence begins with 5 and has a common ratio of \( -\frac{1}{4} \). What is the sequence's 4th term?

10. **Standardized Test Practice** The 15th term of a geometric sequence is 32,768. Which choice shows the possible first term and the possible common ratio?

   A 2, 2
   B 4, 3
   C 15, 4
   D 8, -4