

# Geometric Sequences

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Q Quick Review

A **geometric sequence** is a list of numbers where you *multiply* by the same value each step. That fixed multiplier is the **common ratio**  $r$  — find it by dividing any term by the one before it. To reach the  $n$ th term, use  $a_n = a_1 \cdot r^{n-1}$ , where  $a_1$  is the first term. For example, in 2, 6, 18, 54, ... the common ratio is  $r = 3$ , and the 5th term is  $a_5 = 2 \cdot 3^4 = 2 \cdot 81 = 162$ . Unlike arithmetic sequences, geometric ones grow (or shrink) faster and faster — they are nonlinear.

◊ **Example:** Find the 5th term of the geometric sequence 2, 6, 18, 54, ...  
 ⇒ First find the common ratio by dividing:  $6 \div 2 = 3$ , and  $18 \div 6 = 3$ , so  $r = 3$ . The first term is  $a_1 = 2$ . Now use  $a_n = a_1 \cdot r^{n-1}$  with  $n = 5$ :  $a_5 = 2 \cdot 3^{5-1} = 2 \cdot 3^4 = 2 \cdot 81 = 162$ . So the 5th term is 162. Notice how quickly it grows — that's the power of multiplying!

**Answer:**  $a_5 = 162$

## PRACTICE

Find the requested term of each geometric sequence.

- |                                |       |  |       |
|--------------------------------|-------|--|-------|
| 1. 2, 6, 18, 54, ... ; $a_5$   | _____ | 11. 1, 3, 9, 27, ... ; $a_6$             | _____ |
| 2. 5, 10, 20, 40, ... ; $a_6$  | _____ | 12. 4, 8, 16, 32, ... ; $a_7$            | _____ |
| 3. 3, 6, 12, 24, ... ; $a_8$   | _____ | 13. 3, 15, 75, 375, ... ; $a_4$          | _____ |
| 4. 1, 4, 16, 64, ... ; $a_5$   | _____ | 14. 81, 27, 9, 3, ... ; $a_6$            | _____ |
| 5. 64, 32, 16, 8, ... ; $a_7$  | _____ | 15. 10, 20, 40, 80, ... ; $a_6$          | _____ |
| 6. 7, 21, 63, 189, ... ; $a_4$ | _____ | 16. 2, 4, 8, 16, ... ; $a_8$             | _____ |
| 7. 2, 10, 50, 250, ... ; $a_5$ | _____ | 17. 1, 5, 25, 125, ... ; $a_5$           | _____ |
| 8. 1, 2, 4, 8, ... ; $a_{10}$  | _____ | 18. Find $r$ for 3, 12, 48, 192, ...     | _____ |
| 9. 100, 20, 4, ... ; $a_4$     | _____ | 19. Find $a_1$ if $a_3 = 45$ and $r = 3$ | _____ |
| 10. 6, 12, 24, 48, ... ; $a_9$ | _____ | 20. Is 64 a term of 1, 2, 4, 8, ... ?    | _____ |

## ◆ Word Problems

21. A type of bacteria doubles every hour. A dish starts with 3 bacteria. How many are there at the start of the 8th hour (counting the start as hour 1)? \_\_\_\_\_
22. A ball is dropped and each bounce reaches half the previous height. The first bounce is 64 inches. How high is the 7th bounce? \_\_\_\_\_
23. An investment triples every year. It begins at \$2. What is it worth at the start of year 5 (counting the start as year 1)? \_\_\_\_\_
24. A rumor spreads so that each round it reaches 5 times as many new people. In round 1 it reaches 2 people. How many new people hear it in round 5? \_\_\_\_\_



## Answer Keys

- |                  |                   |
|------------------|-------------------|
| 1. 162           | 13. 375           |
| 2. 160           | 14. $\frac{1}{3}$ |
| 3. 384           | 15. 320           |
| 4. 256           | 16. 256           |
| 5. 1             | 17. 625           |
| 6. 189           | 18. 4             |
| 7. 1250          | 19. 5             |
| 8. 512           | 20. yes           |
| 9. $\frac{4}{5}$ | 21. 384 bacteria  |
| 10. 1536         | 22. 1 inch        |
| 11. 243          | 23. \$162         |
| 12. 256          | 24. 1250 people   |

### Step-by-Step Explanations

- |   |   |
|---|---|
| <p>1. Here <math>r = 3</math> and <math>a_1 = 2</math>, so <math>a_5 = 2 \cdot 3^4 = 2 \cdot 81 = 162</math>.</p> <p>2. Here <math>r = 2</math> and <math>a_1 = 5</math>, so <math>a_6 = 5 \cdot 2^5 = 5 \cdot 32 = 160</math>.</p> <p>3. Here <math>r = 2</math> and <math>a_1 = 3</math>, so <math>a_8 = 3 \cdot 2^7 = 3 \cdot 128 = 384</math>.</p> <p>4. Here <math>r = 4</math> and <math>a_1 = 1</math>, so <math>a_5 = 1 \cdot 4^4 = 256</math>.</p> <p>5. Here <math>r = \frac{1}{2}</math> and <math>a_1 = 64</math>, so <math>a_7 = 64 \cdot \left(\frac{1}{2}\right)^6 = \frac{64}{64} = 1</math>.</p> <p>6. Here <math>r = 3</math> and <math>a_1 = 7</math>, so <math>a_4 = 7 \cdot 3^3 = 7 \cdot 27 = 189</math>.</p> <p>7. Here <math>r = 5</math> and <math>a_1 = 2</math>, so <math>a_5 = 2 \cdot 5^4 = 2 \cdot 625 = 1250</math>.</p> <p>8. Here <math>r = 2</math> and <math>a_1 = 1</math>, so <math>a_{10} = 1 \cdot 2^9 = 512</math>.</p> <p>9. Here <math>r = \frac{1}{5}</math> and <math>a_1 = 100</math>, so <math>a_4 = 100 \cdot \left(\frac{1}{5}\right)^3 = \frac{100}{125} = \frac{4}{5}</math>.</p> <p>10. Here <math>r = 2</math> and <math>a_1 = 6</math>, so <math>a_9 = 6 \cdot 2^8 = 6 \cdot 256 = 1536</math>.</p> <p>11. Here <math>r = 3</math> and <math>a_1 = 1</math>, so <math>a_6 = 1 \cdot 3^5 = 243</math>.</p> <p>12. Here <math>r = 2</math> and <math>a_1 = 4</math>, so <math>a_7 = 4 \cdot 2^6 = 4 \cdot 64 = 256</math>.</p> <p>13. Here <math>r = 5</math> and <math>a_1 = 3</math>, so <math>a_4 = 3 \cdot 5^3 = 3 \cdot 125 = 375</math>.</p> <p>14. Here <math>r = \frac{1}{3}</math> and <math>a_1 = 81</math>, so <math>a_6 = 81 \cdot \left(\frac{1}{3}\right)^5 = \frac{81}{243} = \frac{1}{3}</math>.</p> | <p>15. Here <math>r = 2</math> and <math>a_1 = 10</math>, so <math>a_6 = 10 \cdot 2^5 = 10 \cdot 32 = 320</math>.</p> <p>16. Here <math>r = 2</math> and <math>a_1 = 2</math>, so <math>a_8 = 2 \cdot 2^7 = 2 \cdot 128 = 256</math>.</p> <p>17. Here <math>r = 5</math> and <math>a_1 = 1</math>, so <math>a_5 = 1 \cdot 5^4 = 625</math>.</p> <p>18. Divide consecutive terms: <math>12 \div 3 = 4</math>, so the common ratio is <math>r = 4</math>.</p> <p>19. Use <math>a_3 = a_1 \cdot r^2</math>: <math>45 = a_1 \cdot 9</math>, so <math>a_1 = 5</math>.</p> <p>20. This sequence is the powers of 2, and <math>64 = 2^6</math>, so 64 is the 7th term — yes.</p> <p>21. This is geometric with <math>a_1 = 3</math> and <math>r = 2</math>. At hour 8 there are <math>a_8 = 3 \cdot 2^7 = 3 \cdot 128 = 384</math> bacteria.</p> <p>22. The heights are geometric with <math>a_1 = 64</math> and <math>r = \frac{1}{2}</math>. The 7th bounce is <math>a_7 = 64 \cdot \left(\frac{1}{2}\right)^6 = \frac{64}{64} = 1</math> inch.</p> <p>23. This is geometric with <math>a_1 = 2</math> and <math>r = 3</math>. At year 5 the value is <math>a_5 = 2 \cdot 3^4 = 2 \cdot 81 = 162</math> dollars.</p> <p>24. The counts are geometric with <math>a_1 = 2</math> and <math>r = 5</math>. Round 5 reaches <math>a_5 = 2 \cdot 5^4 = 2 \cdot 625 = 1250</math> new people.</p> |
|---|---|



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