Geometric Sequences

Name: ______________________ Date: ______________ Score: _____ / 26

Quick Review

A **geometric sequence** multiplies by the same number — the **common ratio** r — to get from one term to the next. **Explicit formula**: $a_n = a_1 \cdot r^{n-1}$. **Recursive**: a_1 = first term; $a_n = r \cdot a_{n-1}$. If $r > 1$, the sequence *grows* (exponential growth). If $0 < r < 1$, it *shrinks* toward zero (exponential decay). If $r < 0$, signs alternate. **Arithmetic vs. geometric**: arithmetic *adds*; geometric *multiplies*. Check by dividing consecutive terms — if you get the same ratio every time, it's geometric.

PRACTICE

Find r, write the explicit formula, or find the indicated term.

1. $3, 15, 75, 375, \ldots;\ r,\ a_n$ ________
2. $1000, 200, 40, 8, \ldots;\ r,\ a_n$ ________
3. $-2, 6, -18, 54, \ldots;\ a_5$ ________
4. $a_1 = 7,\ r = 2;\ a_6$ ________
5. $a_1 = 800,\ r = \frac{1}{2};\ a_5$ ________
6. $a_1 = 1,\ r = -3;\ a_4$ ________
7. $5, 10, 20, 40, \ldots;$ growth or decay? ________
8. $256, 64, 16, 4, \ldots;$ growth or decay? ________
9. $a_1 = 6,\ r = 10;\ a_4$ ________
10. $a_3 = 18,\ r = 3;\ a_1$ ________
11. $4, 8, 12, 16, \ldots;$ type? ________
12. $4, 8, 16, 32, \ldots;$ type? ________
13. $2, 6, 18, 54, \ldots;\ a_8$ ________
14. $a_1 = 1,\ r = \frac{1}{2};\ a_{10}$ ________
15. $81, 27, 9, 3, \ldots;\ r$ ________
16. $a_1 = 5,\ r = 2;\ a_n$ ________
17. $a_2 = 12,\ a_4 = 48;\ r$ ________
18. $100 \cdot (0.9)^{n-1};\ a_1$ ________
19. Is $1, 3, 6, 10, 15$ geometric? ________
20. $a_n = 4 \cdot (-2)^{n-1};\ a_4$ ________

VISUAL PRACTICE

Use the graph, table, chart, or diagram to answer the question.

21. Find the common ratio from the table.

n	1	2	3	4
a_n	6	12	24	48

Answer: __________

22. Find the common ratio from the table.

n	1	2	3	4
a_n	5	15	45	135

Answer: __________

Word Problems

23. A bacterium culture doubles every hour. Starting with 500 at time 0, how many after 8 hours? __________

24. A ball dropped from 80 ft rebounds to $\frac{3}{4}$ of its previous height each bounce. Height after the 4th bounce? __________

25. A car worth $25,000 loses 15% of its value each year. Value after 5 years? __________

26. A scholarship fund is worth $\$5000$ now and is expected to grow by 4% each year. Write an exponential model and use it to estimate the fund's value after 10 years. __________

Answer Keys

1. $r = 5,\ a_n = 3 \cdot 5^{n-1}$
2. $r = \frac{1}{5},\ a_n = 1000 \cdot (\frac{1}{5})^{n-1}$
3. -162
4. 224
5. 50
6. -27
7. growth
8. decay
9. 6000
10. 2
11. arithmetic
12. geometric
13. 4374
14. $\frac{1}{512}$
15. $\frac{1}{3}$
16. $a_n = 5 \cdot 2^{n-1}$
17. $r = 2$ or $r = -2$
18. 100
19. no
20. -32
21. 2
22. 3
23. $128{,}000$
24. ≈ 25.3 ft
25. $\approx \$11{,}092$
26. $\approx \$7{,}401$

Step-by-Step Tutor Notes

1. Use the clue in the question first, then let the arithmetic finish the job. $\frac{15}{3} = 5$. Each term multiplies by 5. So the answer is $r = 5,\ a_n = 3 \cdot 5^{n-1}$.
2. This is a good place to slow down, check the notation, and simplify cleanly. $\frac{200}{1000} = \frac{1}{5}$. Shrinking sequence. So the answer is $r = \frac{1}{5},\ a_n = 1000 \cdot (\frac{1}{5})^{n-1}$.
3. Use the clue in the question first, then let the arithmetic finish the job. $r = -3$ (alternating signs). $a_5 = -2 \cdot (-3)^4 = -2 \cdot 81 = -162$. So the answer is -162.
4. Take it one clear step at a time and keep the original question in mind. $a_6 = 7 \cdot 2^5 = 7 \cdot 32 = 224$. So the answer is 224.
5. This is a good place to slow down, check the notation, and simplify cleanly. $a_5 = 800 \cdot (\frac{1}{2})^4 = 800 \cdot \frac{1}{16} = 50$. So the answer is 50.
6. Focus on the main idea of the problem, then simplify carefully. $a_4 = 1 \cdot (-3)^3 = -27$. So the answer is -27.
7. For a table question, slow down and locate the exact row, column, or cell before calculating. $r = 2 > 1$, so terms grow. Exponential growth. This gives growth.
8. Use the clue in the question first, then let the arithmetic finish the job. $r = \frac{1}{4} < 1$, so terms shrink. Exponential decay. So the answer is decay.
9. Take it one clear step at a time and keep the original question in mind. $a_4 = 6 \cdot 10^3 = 6 \cdot 1000 = 6000$. So the answer is 6000.
10. Use the clue in the question first, then let the arithmetic finish the job. $a_3 = a_1 \cdot r^2$, so $18 = a_1 \cdot 9$, giving $a_1 = 2$. So the answer is 2.
11. Differences: $4, 4, 4$. But ratios: $2, \frac{3}{2}, \frac{4}{3}$ — not constant. So arithmetic, not geometric.
12. Ratios: $2, 2, 2$ — constant. Geometric with $r = 2$. (And differences are $4, 8, 16$ — not constant, so not arithmetic.).
13. Focus on the main idea of the problem, then simplify carefully. $r = 3$. $a_8 = 2 \cdot 3^7 = 2 \cdot 2187 = 4374$. So the answer is 4374.
14. Take it one clear step at a time and keep the original question in mind. $a_{10} = 1 \cdot (\frac{1}{2})^9 = \frac{1}{512}$. So the answer is $\frac{1}{512}$.
15. Use the clue in the question first, then let the arithmetic finish the job. $\frac{27}{81} = \frac{1}{3}$. Confirm: $\frac{9}{27} = \frac{1}{3}$. Decaying sequence. So the answer is $\frac{1}{3}$.
16. The first term is 5 and the common ratio is 2. In $a_n = a_1 r^{n-1}$, that gives $a_n = 5 \cdot 2^{n-1}$.
17. Take it one clear step at a time and keep the original question in mind. $\frac{a_4}{a_2} = r^2 = \frac{48}{12} = 4$, so $r = \pm 2$. So the answer is $r = 2$ or $r = -2$.
18. Focus on the main idea of the problem, then simplify carefully. At $n = 1$: $100 \cdot (0.9)^0 = 100 \cdot 1 = 100$. So the answer is 100.
19. Ratios: $3, 2, \frac{5}{3}, \frac{3}{2}$. Not constant, so not geometric. (These are triangular numbers — differences increase.).
20. Take it one clear step at a time and keep the original question in mind. $a_4 = 4 \cdot (-2)^3 = 4 \cdot (-8) = -32$. So the answer is -32.
21. Each term is multiplied by 2 to get the next term, so the common ratio is 2.
22. Start with the definition the problem is testing, then apply it directly. Each term is multiplied by 3 to get the next term. So the answer is 3.
23. $N(t) = 500 \cdot 2^t$. At $t = 8$: $500 \cdot 2^8 = 500 \cdot 256 = 128{,}000$ bacteria.
24. First bounce: $80 \cdot \frac{3}{4} = 60$. After n bounces: $h_n = 60 \cdot (\frac{3}{4})^{n-1}$. At $n = 4$: $h_4 = 60 \cdot (\frac{3}{4})^3 = 60 \cdot \frac{27}{64} = \frac{1620}{64} \approx 25.3$ feet.
25. Losing 15% keeps 85%, so $r = 0.85$. $V(t) = 25000 \cdot 0.85^t$. At $t = 5$: $25000 \cdot 0.85^5 \approx 25000 \cdot 0.4437 = \$11{,}092$.
26. $r = 1.04$. $V(t) = 5000 \cdot 1.04^t$. At $t = 10$: $5000 \cdot 1.04^{10} \approx 5000 \cdot 1.4802 = \$7{,}401$.

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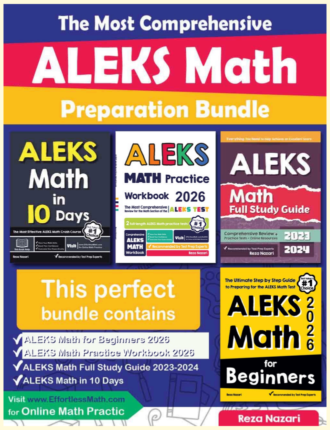

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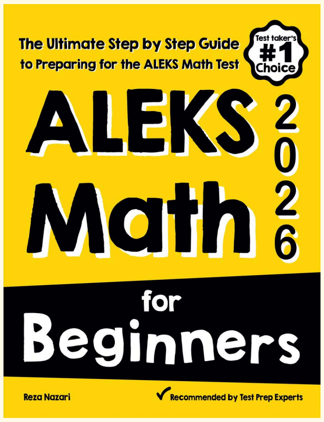

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