

# Arithmetic Sequences as Linear Functions

Name: \_\_\_\_\_

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## Q Quick Review

An **arithmetic sequence** adds the same number — the **common difference**  $d$  — to get from one term to the next. **Explicit formula:**  $a_n = a_1 + (n - 1)d$ , where  $a_1$  is the first term and  $n$  is the term number. **Recursive formula:**  $a_1 =$  first term;  $a_n = a_{n-1} + d$  for  $n \geq 2$ . Arithmetic sequences are **linear functions** of the term number: plot  $n$  on the  $x$ -axis and  $a_n$  on the  $y$ -axis, and the points sit on a straight line. The common difference  $d$  is the *slope*, and  $a_1 - d$  (term “zero”) is the  $y$ -intercept.

## PRACTICE

Find  $d$ , write the explicit formula, or find the indicated term.

- |  |       |  |       |
|--|-------|--|-------|
| 1. 2, 9, 16, 23, ...; $d$ , $a_n$      | _____ | 11. $a_3 = 10$ , $a_7 = 26$ ; $d$            | _____ |
| 2. 20, 15, 10, 5, ...; $d$ , $a_n$     | _____ | 12. 4, 11, 18, 25, ...; $f(n)$               | _____ |
| 3. -4, -1, 2, 5, ...; $a_{10}$         | _____ | 13. $a_1 = 12$ , $d = 4$ ; $a_{20}$          | _____ |
| 4. $a_1 = 3$ , $d = 7$ ; $a_8$         | _____ | 14. -3, 1, 5, 9, ...; $d$                    | _____ |
| 5. $a_1 = 50$ , $d = -4$ ; $a_{12}$    | _____ | 15. $a_n = 2n + 11$ ; $a_1$                  | _____ |
| 6. $a_5 = 22$ , $d = 3$ ; $a_1$        | _____ | 16. 5, 2, -1, -4, ...; $a_{12}$              | _____ |
| 7. 1, 1.5, 2, 2.5, ...; $a_{20}$       | _____ | 17. $a_4 = 21$ , $d = -2$ ; $a_1$            | _____ |
| 8. $a_1 = 100$ , $d = -10$ ; recursive | _____ | 18. $a_1 = 0$ , $d = \frac{1}{2}$ ; $a_{20}$ | _____ |
| 9. 6, 6, 6, 6, ...; $d$                | _____ | 19. Which term of 3, 8, 13, ... is 58?       | _____ |
| 10. $a_1 = -8$ , $d = 5$ ; $a_{15}$    | _____ | 20. Slope of the line for $a_n = 4n - 7$     | _____ |

## ◆ VISUAL PRACTICE

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

21. Use the table to write the rule.

|       |   |   |    |    |
|-------|---|---|----|----|
| $n$   | 1 | 2 | 3  | 4  |
| $a_n$ | 4 | 9 | 14 | 19 |

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

22. Use the table to write the sequence rule.

|       |   |    |    |    |
|-------|---|----|----|----|
| $n$   | 1 | 2  | 3  | 4  |
| $a_n$ | 7 | 10 | 13 | 16 |

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

## ◆ Word Problems

23. A theater has 20 seats in row 1. Each row behind has 3 more. How many seats in row 15? \_\_\_\_\_
24. Maria saves: week 1 \$45, week 2 \$60, week 3 \$75. Find the explicit formula and how much she'll have at week 10.  
\_\_\_\_\_
25. A construction crew lays 40 bricks the first day and 8 more each day after. How many bricks on day 20? \_\_\_\_\_
26. A diver descends 5 feet per second from the surface. Write a function for depth  $d(t)$  in feet after  $t$  seconds (depth downward), and find the depth at 30 seconds. \_\_\_\_\_



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## Answer Keys

- |   |  |
|---|--|
| <p>1. <math>d = 7, a_n = 7n - 5</math></p> <p>2. <math>d = -5, a_n = -5n + 25</math></p> <p>3. 23</p> <p>4. 52</p> <p>5. 6</p> <p>6. 10</p> <p>7. 10.5</p> <p>8. <math>a_n = a_{n-1} - 10</math></p> <p>9. <math>d = 0</math>; yes, arithmetic</p> <p>10. 62</p> <p>11. <math>d = 4, a_1 = 2</math></p> <p>12. <math>f(n) = 7n - 3</math></p> <p>13. 88</p> | <p>14. <math>d = 4</math></p> <p>15. 13</p> <p>16. -28</p> <p>17. 27</p> <p>18. <math>\frac{19}{2}</math></p> <p>19. <math>n = 12</math></p> <p>20. 4</p> <p>21. <math>a_n = 5n - 1</math></p> <p>22. <math>a_n = 3n + 4</math></p> <p>23. <math>a_{15} = 62</math></p> <p>24. <math>a_n = 15n + 30</math>; \$180</p> <p>25. <math>a_{20} = 192</math></p> <p>26. <math>d(t) = 5t</math>; 150 ft</p> |
|---|--|

### Step-by-Step Tutor Notes

1. Take it one clear step at a time and keep the original question in mind. Difference:  $9 - 2 = 7$ . Explicit:  $a_n = 2 + (n - 1)(7) = 7n - 5$ . So the answer is  $d = 7, a_n = 7n - 5$ .
2. Going down by 5 each time:  $d = -5, a_n = 20 + (n - 1)(-5) = -5n + 25$ .
3. Focus on the main idea of the problem, then simplify carefully.  $d = 3, a_{10} = -4 + (10 - 1)(3) = -4 + 27 = 23$ . So the answer is 23.
4. Use the clue in the question first, then let the arithmetic finish the job.  $a_8 = 3 + (8 - 1)(7) = 3 + 49 = 52$ . So the answer is 52.
5. Start with the definition the problem is testing, then apply it directly.  $a_{12} = 50 + (12 - 1)(-4) = 50 - 44 = 6$ . So the answer is 6.
6. Use the clue in the question first, then let the arithmetic finish the job.  $a_5 = a_1 + 4d$ , so  $22 = a_1 + 12$ , giving  $a_1 = 10$ . So the answer is 10.
7. Start with the definition the problem is testing, then apply it directly.  $d = 0.5, a_{20} = 1 + (19)(0.5) = 1 + 9.5 = 10.5$ . So the answer is 10.5.
8. Use the clue in the question first, then let the arithmetic finish the job. Recursive form: previous term minus 10. So the answer is  $a_n = a_{n-1} - 10$ .
9. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Common difference is 0. Technically arithmetic — adding 0 is a valid common difference. After simplifying, the answer is  $d = 0$ ; yes, arithmetic.
10. This is a good place to slow down, check the notation, and simplify cleanly.  $a_{15} = -8 + (14)(5) = -8 + 70 = 62$ . So the answer is 62.
11. Between  $a_3$  and  $a_7$  are 4 steps:  $26 - 10 = 16 = 4d$ , so  $d = 4$ . Then  $a_1 = a_3 - 2d = 10 - 8 = 2$ .
12. Use the clue in the question first, then let the arithmetic finish the job.  $d = 7, a_1 = 4$ . So  $f(n) = 4 + (n - 1)(7) = 7n - 3$ . So the answer is  $f(n) = 7n - 3$ .
13. Focus on the main idea of the problem, then simplify carefully.  $a_{20} = 12 + (19)(4) = 12 + 76 = 88$ . So the answer is 88.
14. This is a good place to slow down, check the notation, and simplify cleanly.  $1 - (-3) = 4$ . Confirm:  $5 - 1 = 4, 9 - 5 = 4$ . Yes,  $d = 4$ . So the answer is  $d = 4$ .
15. The first term is found at  $n = 1$ . Evaluate  $a_1 = 2(1) + 11 = 13$ . The coefficient 2 also tells you the sequence increases by 2 each step.
16. Use the clue in the question first, then let the arithmetic finish the job.  $d = -3, a_1 = 5, a_{12} = 5 + (11)(-3) = 5 - 33 = -28$ . So the answer is -28.
17. Use the clue in the question first, then let the arithmetic finish the job.  $a_4 = a_1 + 3d$ , so  $21 = a_1 - 6$ , giving  $a_1 = 27$ . So the answer is 27.
18. Start with the definition the problem is testing, then apply it directly.  $a_{20} = 0 + (19)(\frac{1}{2}) = \frac{19}{2}$ . So the answer is  $\frac{19}{2}$ .
19.  $d = 5$ . Set  $a_n = 58$ :  $3 + (n - 1)(5) = 58$ , so  $5(n - 1) = 55, n - 1 = 11, n = 12$ .
20. Compare the change in output to the change in input, because slope is a rate of change. The coefficient of  $n$  is the common difference, which is the slope: 4. So the requested value is 4.
21. The common difference is 5. Since  $a_1 = 4$ , the rule is  $a_n = 4 + 5(n - 1) = 5n - 1$ .
22. The common difference is 3, and the rule that gives 7 at  $n = 1$  is  $a_n = 3n + 4$ .
23. Set up the model from the story, then calculate carefully.  $a_1 = 20, d = 3, a_{15} = 20 + (14)(3) = 20 + 42 = 62$  seats.
24.  $d = 15, a_1 = 45, a_n = 45 + (n - 1)(15) = 15n + 30$ . At  $n = 10$ :  $a_{10} = 15(10) + 30 = \$180$ .
25. Set up the model from the story, then calculate carefully.  $a_1 = 40, d = 8, a_{20} = 40 + (19)(8) = 40 + 152 = 192$  bricks.
26. At  $t = 0$  the diver is at depth 0 (surface), and depth grows by 5 ft/sec. So  $d(t) = 5t$ . At  $t = 30$ :  $d(30) = 150$  feet.



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