

Arithmetic Sequences

Name: _____ Date: _____ Score: _____ / 28

Q Quick Review

An **arithmetic sequence** is a list of numbers where the gap between any two neighbors is the same. That gap has a name: the **common difference** d . Find it by subtracting any term from the one right after it $- d = a_{n+1} - a_n$, and the answer has to be the same every time you check.

Two formulas you'll use over and over. The **explicit** formula goes straight to the n th term: $a_n = a_1 + (n - 1)d$. Think of it as "start at a_1 and then take $n - 1$ steps of size d ." The **recursive** form spells out the step-by-step idea instead: a_1 is given and $a_n = a_{n-1} + d$.

The off-by-one trap. The number of steps from term 1 to term n is $n - 1$, not n . The first term costs you zero steps – you're already standing on it. So a_{15} uses 14 steps of d , not 15. Forgetting this is the most common mistake on every arithmetic-sequence problem ever written.

Two terms given, find d . If you know a_p and a_q with $p < q$, there are $q - p$ steps between them, so $d = (a_q - a_p)/(q - p)$. Then back-solve for a_1 with the explicit formula.

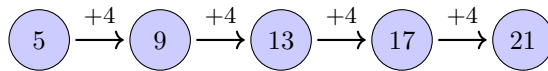
Why does this look linear? Plot (n, a_n) on a graph and you get a row of dots on a straight line with slope d and y -intercept $a_1 - d$. Arithmetic sequences are just discrete linear functions in disguise.

Common slips. Using n instead of $n - 1$ as the multiplier. Mixing up d and a_1 when two terms are given. Assuming d has to be positive – it can be negative (the sequence decreases) or zero (every term the same).

PRACTICE

Find common differences, terms, and explicit rules. Read patterns off the dot diagrams; trust the formula $a_n = a_1 + (n - 1)d$.

1. Find the common difference of the sequence below. _____



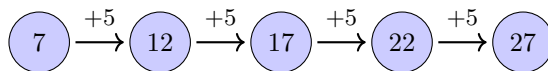
2. Find the 20th term of the sequence 7, 11, 15, 19, ... _____

3. An arithmetic sequence has $a_4 = 13$ and $a_{10} = 37$. Find d . _____

4. Which sequence is arithmetic? $A : 2, 5, 8, 11, \dots$ $B : 2, 4, 8, 16, \dots$ $C : 1, 4, 9, 16, \dots$ _____

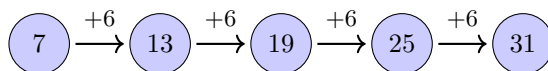
5. An arithmetic sequence has $a_8 = 50$ and common difference $d = 6$. Find a_1 . _____

6. Find the explicit formula for the sequence shown. _____



7. Write the explicit formula for an arithmetic sequence with $a_1 = -3$ and $d = 5$. _____

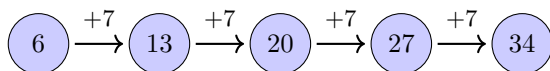
8. Find a_{15} for the sequence shown. _____



9. An arithmetic sequence has $a_5 = 18$ and $a_{12} = 46$. Write the explicit formula. _____



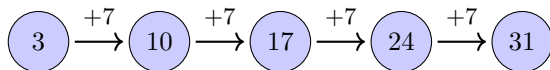
10. Find a_{18} for the sequence shown.



11. The first three terms of an arithmetic sequence are $-4, -1, 2, \dots$. Find a_{30} .

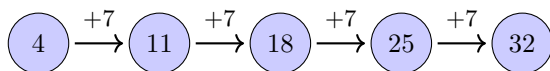
12. True or False: every arithmetic sequence has a positive common difference.

13. Find the explicit formula for the sequence below.

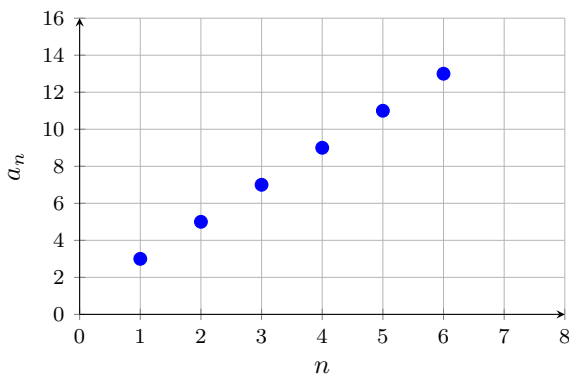


14. An arithmetic sequence has explicit formula $a_n = 4n - 9$. Find a_1 and d .

15. Find a_{12} for the sequence shown.



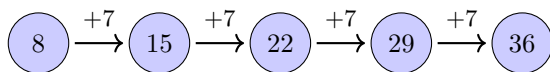
16. Plot the first six terms of $a_n = 2n + 1$ as points (n, a_n) . What pattern do they form?



17. An arithmetic sequence has $a_1 = 20$ and $d = -3$. Find a_7 .

18. Two terms of an arithmetic sequence: $a_3 = 11$ and $a_8 = 26$. Find a_{20} .

19. Find the common difference and the explicit formula of the sequence shown.



20. An arithmetic sequence has $a_2 = 9$ and $d = -4$. Find a_{10} .



◆ Word Problems

21. A student saves \$18 in week 1 and adds \$7 more each week (\$25 in week 2, \$32 in week 3, and so on). _____
How much does she save in week 12?
22. An auditorium has 24 seats in row 1, 28 seats in row 2, 32 seats in row 3, and so on. How many seats are _____
in row 15?



23. Tickets are sold for a concert. The first ticket sells for \$45, and each later ticket costs \$3 more than the _____
one before. What does the 28th ticket cost?
24. A drone hovers 200 feet above the ground, then descends 14 feet each minute. Let h_n be the height (in _____
feet) at the start of minute n , so $h_1 = 200$. What is h_{10} ?

Additional Practice

25. Find the next term: 4, 9, 14, 19, ... _____
26. Find a_{10} if $a_1 = 3$ and $d = 5$. _____
27. Find the next term: 2, 6, 18, 54, ... _____
28. Find a_6 if $a_1 = 5$ and $r = 2$. _____



Answer Keys

<p>1. $d = 4$</p> <p>2. 83</p> <p>3. $d = 4$</p> <p>4. A</p> <p>5. $a_1 = 8$</p> <p>6. $a_n = 5n + 2$</p> <p>7. $a_n = 5n - 8$</p> <p>8. $a_{15} = 91$</p> <p>9. $a_n = 4n - 2$</p> <p>10. $a_{18} = 125$</p> <p>11. $a_{30} = 83$</p> <p>12. False</p> <p>Additional Practice Answers</p> <p>25. 24</p> <p>26. 48</p>	<p>13. $a_n = 7n - 4$</p> <p>14. $a_1 = -5, d = 4$</p> <p>15. $a_{12} = 81$</p> <p>16. collinear (slope 2)</p> <p>17. $a_7 = 2$</p> <p>18. $a_{20} = 62$</p> <p>19. $d = 7, a_n = 7n + 1$</p> <p>20. $a_{10} = -23$</p> <p>21. $\\$95$</p> <p>22. 80 seats</p> <p>23. $\\$126$</p> <p>24. 74 ft</p> <p>27. 162</p> <p>28. 160</p>
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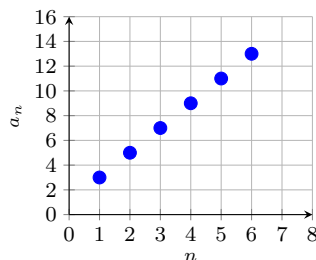
Additional Practice: Answers for all numbered items, including the added practice, are shown in the grid above.

Step-by-Step Explanations

1. Subtract neighbors: $9 - 5 = 4, 13 - 9 = 4, 17 - 13 = 4, 21 - 17 = 4$. Same every time, so $d = 4$ (matching the labeled arrows).
2. Read $a_1 = 7$ and $d = 11 - 7 = 4$. Use $a_n = a_1 + (n - 1)d$ with $n = 20$: $a_{20} = 7 + (20 - 1)(4) = 7 + 76 = 83$. Notice the 19 - twenty terms only need nineteen steps.
3. From term 4 to term 10 is $10 - 4 = 6$ steps. Total change is $37 - 13 = 24$, so $6d = 24$ and $d = 4$. (Quick sanity check: $a_{10} = a_4 + 6d = 13 + 24 = 37$ ✓.)
4. Start with the key idea: A has constant difference 3. B multiplies by 2 each step (that's geometric, not arithmetic). C is the perfect squares - the gaps grow, so no constant difference. That gives a quick check on the answer.
5. From $a_n = a_1 + (n - 1)d$: $50 = a_1 + (8 - 1)(6) = a_1 + 42$, so $a_1 = 8$. Work backwards: term 8 minus seven steps of 6 lands you at the start.
6. From the diagram, $a_1 = 7$ and $d = 5$. So $a_n = 7 + (n - 1)(5) = 7 + 5n - 5 = 5n + 2$. Check: $a_1 = 5(1) + 2 = 7$ ✓, $a_2 = 5(2) + 2 = 12$ ✓.
7. One steady path is: $a_n = -3 + (n - 1)(5) = -3 + 5n - 5 = 5n - 8$. Quick check: $a_1 = 5(1) - 8 = -3$ ✓. Always confirm a_1 in the simplified form. That gives a quick check on the answer.
8. The picture starts at $a_1 = 7$ and each arrow adds 6, so $d = 6$. Then $a_{15} = a_1 + (15 - 1)d = 7 + 14(6) = 7 + 84 = 91$. Notice the 14: fourteen steps of 6 carry you from term 1 to term 15, not fifteen - skipping this is the classic off-by-one slip.
9. Steps from 5 to 12: seven. Change: $46 - 18 = 28$. So $d = 28/7 = 4$. Now $a_5 = a_1 + 4d \Rightarrow 18 = a_1 + 16 \Rightarrow a_1 = 2$. Formula: $a_n = 2 + (n - 1)(4) = 4n - 2$.
10. Read off the diagram: it starts at $a_1 = 6$ and the arrows add 7 each step, so $d = 7$. Use $a_n = a_1 + (n - 1)d$ with $n = 18$: $a_{18} = 6 + (18 - 1)(7) = 6 + 17 \cdot 7 = 6 + 119 = 125$. Seventeen jumps to reach term 18, not eighteen - term 1 is the starting point.
11. Differences: $-1 - (-4) = 3, 2 - (-1) = 3$. So $d = 3, a_1 = -4$. Then $a_{30} = -4 + 29(3) = -4 + 87 = 83$. (Starting negative is fine - the formula doesn't care.)
12. Start with the key idea: d can be negative (the terms decrease, like 20, 17, 14, ...) or zero (a constant sequence like 7, 7, 7, ...). All three signs are allowed. That gives a quick check on the answer.
13. The arrows show +7 each step, so $d = 7$, and the first dot gives $a_1 = 3$. Plug into $a_n = a_1 + (n - 1)d$: $a_n = 3 + (n - 1)(7) = 3 + 7n - 7 = 7n - 4$. Always confirm a_1 in the simplified form: $a_1 = 7(1) - 4 = 3$ ✓.
14. Plug in $n = 1$: $a_1 = 4(1) - 9 = -5$. The coefficient of n is the slope, which equals d , so $d = 4$. (For any explicit form $a_n = dn + c$, you read d off the coefficient and $a_1 = d + c$.)
15. The dots start at $a_1 = 4$ and step up by 7, so $d = 7$. Then $a_{12} = 4 + (12 - 1)(7) = 4 + 11 \cdot 7 = 4 + 77 = 81$. Eleven steps reach term 12, not twelve.

16. The points sit on a straight line because $a_n = 2n + 1$ is linear in n . The slope is the common difference, $d = 2$. Every arithmetic sequence makes a row of collinear dots.

Answer graph

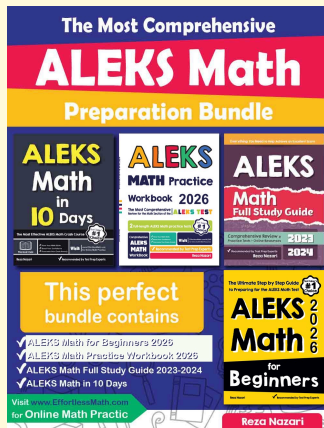


17. Negative d just means the sequence drops. $a_7 = 20 + (7 - 1)(-3) = 20 - 18 = 2$. The terms are 20, 17, 14, 11, 8, 5, 2, ...
18. Steps from 3 to 8: five. Change: $26 - 11 = 15$, so $d = 3$. $a_3 = a_1 + 2d \Rightarrow 11 = a_1 + 6 \Rightarrow a_1 = 5$. Then $a_{20} = 5 + 19(3) = 5 + 57 = 62$.
19. Subtract neighbors from the diagram: $15 - 8 = 7, 22 - 15 = 7$ - constant, so $d = 7$ and $a_1 = 8$. Build the rule with $a_n = a_1 + (n - 1)d = 8 + (n - 1)(7) = 8 + 7n - 7 = 7n + 1$. Check the start: $a_1 = 7(1) + 1 = 8$ ✓.
20. Step back to find a_1 : $a_1 = a_2 - d = 9 - (-4) = 13$. Then $a_{10} = 13 + (10 - 1)(-4) = 13 - 36 = -23$. (Or skip a_1 : from a_2 , there are 8 more steps, so $a_{10} = 9 + 8(-4) = -23$.)
21. The weekly amount is arithmetic with $a_1 = 18$ and $d = 7$. In week 12, $a_{12} = 18 + (12 - 1)(7) = 18 + 77 = 95$. So she saves \$95 that week. (Word-problem watch: this is the amount in week 12, not the running total - that would be a series, coming up later.)
22. Row count is arithmetic with $a_1 = 24$ and $d = 4$. Row 15: $a_{15} = 24 + (15 - 1)(4) = 24 + 56 = 80$ seats. (Fourteen jumps of 4, not fifteen - row 1 is the start, no jump needed.)
23. Ticket prices form an arithmetic sequence with $a_1 = 45$ and $d = 3$. $a_{28} = 45 + (28 - 1)(3) = 45 + 81 = 126$, so the 28th ticket costs \$126. (Sanity check: a price like this is plausible - positive whole dollars, climbing steadily.)
24. Heights form an arithmetic sequence with $h_1 = 200$ and $d = -14$ (descent makes d negative). $h_{10} = 200 + (10 - 1)(-14) = 200 - 126 = 74$ feet. Quick reality check: the drone is still above the ground at minute 10, which makes sense - it would hit the ground around minute $200/14 \approx 15$, so $h_{10} = 74$ is plausible.



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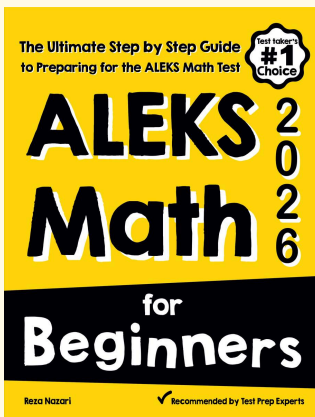
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