

# Using a Linear Model

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

## Quick Review

Once you have a linear model  $y = mx + b$  for real data, you can use it to make predictions and interpret it. To **predict**, substitute a value of  $x$  and compute  $y$ . The **slope**  $m$  is a **rate**: it tells how much  $y$  changes for each 1-unit increase in  $x$  (and its sign tells the direction). The  **$y$ -intercept**  $b$  is the **starting value** of  $y$  when  $x = 0$ . Always keep the real-world units in mind — a slope might be “dollars per hour” or “cm per week.” Predictions inside the data range are usually trustworthy; far outside it, be cautious.

◇ **Example:** A pool is filling by the model  $y = 15x + 40$ , where  $x$  is minutes and  $y$  is gallons. Interpret the slope and intercept, and predict the water after 20 minutes.

⇒ Let’s read the model like a sentence. The slope is 15, so the pool gains 15 **gallons every minute** — that is the filling rate. The intercept is 40, so when  $x = 0$  (before we start timing) there were already 40 **gallons** in the pool. To predict the water after 20 minutes, substitute  $x = 20$ :  $y = 15(20) + 40 = 300 + 40 = 340$ . So we expect about 340 gallons.

**Answer:** slope = 15 gal/min, intercept = 40 gal;  $y = 340$

## PRACTICE

Use each linear model to predict or interpret. Show your substitution.

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| 1. $y = 3x + 2$ , find $y$ when $x = 10$ _____           | 11. $y = 2x + 1$ , find $x$ when $y = 15$ _____          |
| 2. $y = 5x + 3$ , find $y$ when $x = 6$ _____            | 12. $y = 3x - 5$ , find $x$ when $y = 16$ _____          |
| 3. $y = 2x + 1$ , find $y$ when $x = 8$ _____            | 13. $y = -x + 12$ , find $x$ when $y = 4$ _____          |
| 4. $y = -2x + 20$ , find $y$ when $x = 7$ _____          | 14. In $y = 8x + 50$ , what does the slope 8 mean? _____ |
| 5. $y = 4x - 1$ , find $y$ when $x = 9$ _____            | 15. In $y = 8x + 50$ , what does 50 mean? _____          |
| 6. $y = 10x$ , find $y$ when $x = 12$ _____              | 16. $y = 1.5x + 2$ , find $y$ when $x = 10$ _____        |
| 7. $y = 6x + 5$ , find $y$ when $x = 0$ _____            | 17. $y = -4x + 100$ , find $y$ when $x = 15$ _____       |
| 8. $y = -3x + 30$ , find $y$ when $x = 10$ _____         | 18. $y = 5x + 3$ , find $x$ when $y = 28$ _____          |
| 9. $y = 7x + 4$ , find $y$ when $x = 5$ _____            | 19. $y = 12x + 60$ , find $y$ when $x = 4$ _____         |
| 10. $y = \frac{1}{2}x + 6$ , find $y$ when $x = 8$ _____ | 20. $y = -2x + 9$ , find $x$ when $y = 1$ _____          |

## Word Problems

21. A plumber charges by  $y = 45x + 60$ , where  $x$  is hours and  $y$  is dollars. What does each number mean, and what is the cost of a 3-hour job? \_\_\_\_\_
22. A snowpack melts by  $y = -3x + 48$ , where  $x$  is days and  $y$  is depth in inches. After how many days will the snow be gone? \_\_\_\_\_
23. A reading app models pages read as  $y = 25x + 10$ , where  $x$  is days. Predict the total pages after 2 weeks. \_\_\_\_\_
24. A car’s value follows  $y = -1500x + 24000$ , where  $x$  is years owned. In how many years will the car be worth \$9000? \_\_\_\_\_



## Answer Keys

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| <ol style="list-style-type: none"> <li>1. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">32</span></li> <li>2. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">33</span></li> <li>3. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">17</span></li> <li>4. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">6</span></li> <li>5. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">35</span></li> <li>6. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">120</span></li> <li>7. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">5</span></li> <li>8. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">0</span></li> <li>9. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">39</span></li> <li>10. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">10</span></li> <li>11. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;"><math>x = 7</math></span></li> <li>12. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;"><math>x = 7</math></span></li> </ol> | <ol style="list-style-type: none"> <li>13. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;"><math>x = 8</math></span></li> <li>14. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;"><math>y</math> rises 8 per unit <math>x</math></span></li> <li>15. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">starting value of <math>y</math> at <math>x = 0</math></span></li> <li>16. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">17</span></li> <li>17. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">40</span></li> <li>18. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;"><math>x = 5</math></span></li> <li>19. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">108</span></li> <li>20. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;"><math>x = 4</math></span></li> <li>21. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">\$60 service fee, \$45 per hour; <math>y = \\$195</math></span></li> <li>22. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">16 days</span></li> <li>23. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">360 pages</span></li> <li>24. <span style="border: 1px solid black; border-radius: 5px; padding: 2px 5px;">10 years</span></li> </ol> |
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### Step-by-Step Explanations

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| <ol style="list-style-type: none"> <li>1. Substitute: <math>y = 3(10) + 2 = 30 + 2 = 32</math>.</li> <li>2. Substitute: <math>y = 5(6) + 3 = 30 + 3 = 33</math>.</li> <li>3. Substitute: <math>y = 2(8) + 1 = 16 + 1 = 17</math>.</li> <li>4. Substitute: <math>y = -2(7) + 20 = -14 + 20 = 6</math>.</li> <li>5. Substitute: <math>y = 4(9) - 1 = 36 - 1 = 35</math>.</li> <li>6. Substitute: <math>y = 10(12) = 120</math>.</li> <li>7. At <math>x = 0</math>, <math>y = 6(0) + 5 = 5</math> — that is just the <math>y</math>-intercept.</li> <li>8. Substitute: <math>y = -3(10) + 30 = -30 + 30 = 0</math>.</li> <li>9. Substitute: <math>y = 7(5) + 4 = 35 + 4 = 39</math>.</li> <li>10. Substitute: <math>y = \frac{1}{2}(8) + 6 = 4 + 6 = 10</math>.</li> <li>11. Set <math>2x + 1 = 15</math>, so <math>2x = 14</math> and <math>x = 7</math>.</li> <li>12. Set <math>3x - 5 = 16</math>, so <math>3x = 21</math> and <math>x = 7</math>.</li> <li>13. Set <math>-x + 12 = 4</math>, so <math>-x = -8</math> and <math>x = 8</math>.</li> <li>14. The slope is the rate of change: <math>y</math> goes up by 8 for every 1-unit increase in <math>x</math>.</li> </ol> | <ol style="list-style-type: none"> <li>15. The <math>y</math>-intercept 50 is the value of <math>y</math> when <math>x = 0</math> — the starting amount.</li> <li>16. Substitute: <math>y = 1.5(10) + 2 = 15 + 2 = 17</math>.</li> <li>17. Substitute: <math>y = -4(15) + 100 = -60 + 100 = 40</math>.</li> <li>18. Set <math>5x + 3 = 28</math>, so <math>5x = 25</math> and <math>x = 5</math>.</li> <li>19. Substitute: <math>y = 12(4) + 60 = 48 + 60 = 108</math>.</li> <li>20. Set <math>-2x + 9 = 1</math>, so <math>-2x = -8</math> and <math>x = 4</math>.</li> <li>21. The intercept \$60 is a flat service fee charged before any work, and the slope \$45 is the hourly rate. For 3 hours: <math>y = 45(3) + 60 = 135 + 60 = 195</math> dollars.</li> <li>22. The snow is gone when <math>y = 0</math>: set <math>-3x + 48 = 0</math>, so <math>3x = 48</math> and <math>x = 16</math> days. The slope <math>-3</math> means it melts 3 inches per day.</li> <li>23. Two weeks is <math>x = 14</math> days. Substitute: <math>y = 25(14) + 10 = 350 + 10 = 360</math> pages. The slope 25 is pages per day.</li> <li>24. Set <math>-1500x + 24000 = 9000</math>, so <math>-1500x = -15000</math> and <math>x = 10</math> years. The slope <math>-1500</math> means it loses \$1500 of value each year.</li> </ol> |
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