

# Building Linear Functions

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

## Q Quick Review

To **build** a linear function  $y = mx + b$ , you need two things: the **slope**  $m$  and the  **$y$ -intercept**  $b$ . The slope is the rate of change,  $m = \frac{\text{change in } y}{\text{change in } x}$ . The  $y$ -intercept is the output when  $x = 0$ . If you are given two points, first find the slope from them, then substitute one point into  $y = mx + b$  to solve for  $b$ . If one of the points already has  $x = 0$ , that point hands you  $b$  for free!

◊ **Example:** Write the linear function through  $(0, 3)$  and  $(2, 11)$ .

⇒ Start with the slope: from  $(0, 3)$  to  $(2, 11)$  the output goes up  $11 - 3 = 8$  while the input goes up  $2 - 0 = 2$ , so  $m = \frac{8}{2} = 4$ . Now the intercept: the point  $(0, 3)$  has  $x = 0$ , so it tells us directly that  $b = 3$ . Put the pieces together:  $y = 4x + 3$ . You can check with the other point:  $4(2) + 3 = 11$ . It works!

**Answer:**  $y = 4x + 3$

## PRACTICE

Write the linear function  $y = mx + b$  from the given information.

- |   |       |  |       |
|---|-------|--|-------|
| 1. slope 5, $y$ -intercept 2              | _____ | 11. slope 7, through $(0, 0)$              | _____ |
| 2. slope $-3$ , $y$ -intercept 8          | _____ | 12. slope 2, through $(1, 9)$              | _____ |
| 3. slope 1, $y$ -intercept $-7$           | _____ | 13. slope $-4$ , through $(2, 1)$          | _____ |
| 4. slope $\frac{2}{3}$ , $y$ -intercept 0 | _____ | 14. slope $\frac{1}{2}$ , through $(4, 5)$ | _____ |
| 5. through $(0, 3)$ and $(2, 11)$         | _____ | 15. through $(1, -2)$ and $(4, 7)$         | _____ |
| 6. through $(1, 5)$ and $(3, 11)$         | _____ | 16. through $(0, 0)$ and $(6, 9)$          | _____ |
| 7. through $(0, -4)$ and $(5, 6)$         | _____ | 17. through $(2, 1)$ and $(5, 10)$         | _____ |
| 8. through $(2, 7)$ and $(4, 13)$         | _____ | 18. through $(0, 12)$ and $(4, 4)$         | _____ |
| 9. through $(0, 9)$ and $(3, 0)$          | _____ | 19. slope 6, through $(3, 20)$             | _____ |
| 10. through $(-1, 1)$ and $(1, 7)$        | _____ | 20. slope $-1$ , through $(5, 5)$          | _____ |

### ◆ Word Problems

21. A gym charges a \$25 sign-up fee plus \$15 per month. Write a linear function for the total cost  $y$  after  $x$  months. \_\_\_\_\_
22. A candle is 20 cm tall and burns down 4 cm every hour. Write a linear function for the candle's height  $y$  after  $x$  hours. \_\_\_\_\_
23. A water tank holds 30 gallons at the start and gains 5 gallons per minute. After 2 minutes it holds 40 gallons. Write a linear function for the amount  $y$  after  $x$  minutes. \_\_\_\_\_
24. A taxi driver records two fares: after 3 miles the fare is \$11, and after 7 miles it is \$19. Write a linear function for the fare  $y$  after  $x$  miles. \_\_\_\_\_



## Answer Keys

- |   |  |
|---|--|
| <p>1. <math>y = 5x + 2</math></p> <p>2. <math>y = -3x + 8</math></p> <p>3. <math>y = x - 7</math></p> <p>4. <math>y = \frac{2}{3}x</math></p> <p>5. <math>y = 4x + 3</math></p> <p>6. <math>y = 3x + 2</math></p> <p>7. <math>y = 2x - 4</math></p> <p>8. <math>y = 3x + 1</math></p> <p>9. <math>y = -3x + 9</math></p> <p>10. <math>y = 3x + 4</math></p> <p>11. <math>y = 7x</math></p> <p>12. <math>y = 2x + 7</math></p> | <p>13. <math>y = -4x + 9</math></p> <p>14. <math>y = \frac{1}{2}x + 3</math></p> <p>15. <math>y = 3x - 5</math></p> <p>16. <math>y = \frac{3}{2}x</math></p> <p>17. <math>y = 3x - 5</math></p> <p>18. <math>y = -2x + 12</math></p> <p>19. <math>y = 6x + 2</math></p> <p>20. <math>y = -x + 10</math></p> <p>21. <math>y = 15x + 25</math></p> <p>22. <math>y = -4x + 20</math></p> <p>23. <math>y = 5x + 30</math></p> <p>24. <math>y = 2x + 5</math></p> |
|---|--|

### Step-by-Step Explanations

1. Drop the slope into  $m$  and the intercept into  $b$ :  $y = 5x + 2$ .
2. With  $m = -3$  and  $b = 8$ , the function is  $y = -3x + 8$ .
3. Slope 1 is just written as  $x$ , and  $b = -7$ , giving  $y = x - 7$ .
4. With  $b = 0$  the intercept term vanishes, leaving  $y = \frac{2}{3}x$ .
5. Slope =  $\frac{11-3}{2-0} = 4$ , and  $(0, 3)$  gives  $b = 3$ , so  $y = 4x + 3$ .
6. Slope =  $\frac{11-5}{3-1} = 3$ . Using  $(1, 5)$ :  $5 = 3(1) + b$ , so  $b = 2$ . Thus  $y = 3x + 2$ .
7. Slope =  $\frac{6-(-4)}{5-0} = \frac{10}{5} = 2$ , and  $(0, -4)$  gives  $b = -4$ , so  $y = 2x - 4$ .
8. Slope =  $\frac{13-7}{4-2} = 3$ . Using  $(2, 7)$ :  $7 = 3(2) + b$ , so  $b = 1$ . Thus  $y = 3x + 1$ .
9. Slope =  $\frac{0-9}{3-0} = -3$ , and  $(0, 9)$  gives  $b = 9$ , so  $y = -3x + 9$ .
10. Slope =  $\frac{7-1}{1-(-1)} = \frac{6}{2} = 3$ . Using  $(1, 7)$ :  $7 = 3(1) + b$ , so  $b = 4$ . Thus  $y = 3x + 4$ .
11. The point  $(0, 0)$  gives  $b = 0$ , so with slope 7 the function is  $y = 7x$ .
12. Substitute into  $y = 2x + b$ :  $9 = 2(1) + b$ , so  $b = 7$ . Thus  $y = 2x + 7$ .
13. Substitute into  $y = -4x + b$ :  $1 = -4(2) + b$ , so  $b = 9$ . Thus  $y = -4x + 9$ .
14. Substitute:  $5 = \frac{1}{2}(4) + b = 2 + b$ , so  $b = 3$ . Thus  $y = \frac{1}{2}x + 3$ .
15. Slope =  $\frac{7-(-2)}{4-1} = \frac{9}{3} = 3$ . Using  $(1, -2)$ :  $-2 = 3(1) + b$ , so  $b = -5$ . Thus  $y = 3x - 5$ .
16. Slope =  $\frac{9-0}{6-0} = \frac{9}{6} = \frac{3}{2}$ , and  $(0, 0)$  gives  $b = 0$ , so  $y = \frac{3}{2}x$ .
17. Slope =  $\frac{10-1}{5-2} = \frac{9}{3} = 3$ . Using  $(2, 1)$ :  $1 = 3(2) + b$ , so  $b = -5$ . Thus  $y = 3x - 5$ .
18. Slope =  $\frac{4-12}{4-0} = \frac{-8}{4} = -2$ , and  $(0, 12)$  gives  $b = 12$ , so  $y = -2x + 12$ .
19. Substitute:  $20 = 6(3) + b = 18 + b$ , so  $b = 2$ . Thus  $y = 6x + 2$ .
20. Substitute:  $5 = -1(5) + b = -5 + b$ , so  $b = 10$ . Thus  $y = -x + 10$ .
21. The \$15 per month is the rate of change (slope), and the \$25 sign-up fee is the starting value paid at  $x = 0$  (the  $y$ -intercept). So  $y = 15x + 25$ .
22. The candle loses 4 cm per hour, so the slope is  $-4$ . It starts at 20 cm when  $x = 0$ , so the intercept is 20. The function is  $y = -4x + 20$ .
23. The rate of change is 5 gallons per minute, so the slope is 5. The starting amount at  $x = 0$  is 30 gallons, so  $b = 30$ . Check:  $5(2) + 30 = 40$ . The function is  $y = 5x + 30$ .
24. Slope =  $\frac{19-11}{7-3} = \frac{8}{4} = 2$  dollars per mile. Using  $(3, 11)$ :  $11 = 2(3) + b$ , so  $b = 5$ . The function is  $y = 2x + 5$ .



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