

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

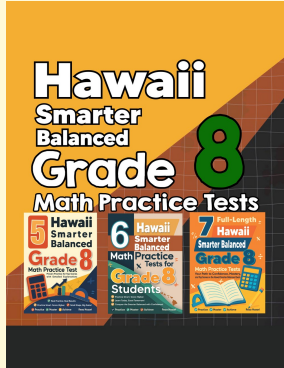
- | | |
|--|---|
| <ol style="list-style-type: none"> 1. $y = 5x + 2$ 2. $y = -3x + 8$ 3. $y = x - 7$ 4. $y = \frac{2}{3}x$ 5. $y = 4x + 3$ 6. $y = 3x + 2$ 7. $y = 2x - 4$ 8. $y = 3x + 1$ 9. $y = -3x + 9$ 10. $y = 3x + 4$ 11. $y = 7x$ 12. $y = 2x + 7$ | <ol style="list-style-type: none"> 13. $y = -4x + 9$ 14. $y = \frac{1}{2}x + 3$ 15. $y = 3x - 5$ 16. $y = \frac{3}{2}x$ 17. $y = 3x - 5$ 18. $y = -2x + 12$ 19. $y = 6x + 2$ 20. $y = -x + 10$ 21. $y = 15x + 25$ 22. $y = -4x + 20$ 23. $y = 5x + 30$ 24. $y = 2x + 5$ |
|--|---|

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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