3.3 Exercises

In Exercises 1-6, perform each of the following tasks for the given linear function.

i. Set up a coordinate system on a sheet of graph paper. Label and scale each axis. Remember to draw all lines with a ruler.
ii. Identify the slope and y-intercept of the graph of the given linear function.
iii. Use the slope and y-intercept to draw the graph of the given linear function on your coordinate system. Label the y-intercept with its coordinate and the graph with its equation.

1. \( f(x) = 2x + 1 \)
2. \( f(x) = -2x + 3 \)
3. \( f(x) = 3 - x \)
4. \( f(x) = 2 - 3x \)
5. \( f(x) = -\frac{3}{4}x + 3 \)
6. \( f(x) = \frac{2}{3}x - 2 \)

In Exercises 7-12, perform each of the following tasks.

i. Make a copy of the given graph on a sheet of graph paper.
ii. Label the y-intercept with its coordinates, then draw a right triangle and label the sides to help identify the slope.
iii. Label the line with its equation.

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10. \( \begin{array}{c}
\text{graph}\n\end{array} \)

Kate makes $39,000 per year and gets a raise of $1000 each year. Since her salary depends on the year, let time \( t \) represent the year, with \( t = 0 \) being the present year, and place it along the horizontal axis. Let salary \( S \), in thousands of dollars, be the dependent variable and place it along the vertical axis.

We will assume that the rate of increase of $1000 per year is constant, so we can model this situation with a linear function.

a) On a sheet of graph paper, make a graph to model this situation, going as far as \( t = 10 \) years.

b) What is the \( S \)-intercept?

c) What is the slope?

d) Suppose we want to predict Kate’s salary in 20 years or 30 years. We cannot use the graphical model because it only shows up to \( t = 10 \) years. We could draw a larger graph, but what if we then wanted to predict 50 years into the future? The point is that a graphical model is limited to what it shows. A model algebraic function, however, can be used to predict for any year!

Find the slope-intercept form of the linear function that models Kate’s salary.

e) Write the function using function notation, which emphasizes that \( S \) is a function of \( t \).

f) Now use the algebraic model from (e) to predict Kate’s salary 10 years, 20 years, 30 years, and 50 years into the future.

g) Compute \( S(40) \).

h) In a complete sentence, explain what the value of \( S(40) \) from part (g) means in the context of the problem.

11. \( \begin{array}{c}
\text{graph}\n\end{array} \)

12. \( \begin{array}{c}
\text{graph}\n\end{array} \)

13. Kate makes $39,000 per year and gets a raise of $1000 each year. Since her salary depends on the year, let time \( t \) represent the year, with \( t = 0 \) being the present year, and place it along the horizontal axis. Let salary \( S \), in thousands of dollars, be the dependent variable and place it along the vertical axis.

We will assume that the rate of increase of $1000 per year is constant, so we can model this situation with a linear function.

a) On a sheet of graph paper, make a graph to model this situation, going as far as \( t = 10 \) years.

b) What is the \( S \)-intercept?

c) What is the slope?

d) Suppose we want to predict Kate’s salary in 20 years or 30 years. We cannot use the graphical model because it only shows up to \( t = 10 \) years. We could draw a larger graph, but what if we then wanted to predict 50 years into the future? The point is that a graphical model is limited to what it shows. A model algebraic function, however, can be used to predict for any year!

Find the slope-intercept form of the linear function that models Kate’s salary.

e) Write the function using function notation, which emphasizes that \( S \) is a function of \( t \).

f) Now use the algebraic model from (e) to predict Kate’s salary 10 years, 20 years, 30 years, and 50 years into the future.

g) Compute \( S(40) \).

h) In a complete sentence, explain what the value of \( S(40) \) from part (g) means in the context of the problem.

14. For each DVD that Blue Charles Co. sells, they make 5¢ profit. Profit depends on the number of DVD’s sold,
so let number sold \( n \) be the independent variable and profit \( P \), in \$, be the dependent variable.

\textbf{a)} On a sheet of graph paper, make a graph to model this situation, going as far as \( n = 15 \).

\textbf{b)} Use the graph to predict the profit if \( n = 10 \) DVD’s are sold.

\textbf{c)} The graphical model is limited to predicting for values of \( n \) on your graph. Any larger value of \( n \) necessitates a larger graph, or a different kind of model. To begin finding an algebraic model, identify the \( P \)-intercept of the graph.

\textbf{d)} What is the slope of the line in your graphical model?

\textbf{e)} Find a slope-intercept form of a linear function that models Blue Charles Co.’s sales.

\textbf{f)} Write the function using function notation.

\textbf{g)} Explain why this model does not have the same limitation as the graphical model.

\textbf{h)} Find \( P(100), P(1000), \) and \( P(10000) \).

\textbf{i)} In complete sentences, explain what the values of \( P(100), P(1000), \) and \( P(10000) \) mean in the context of the problem.

\textbf{15.} Enrique had $1,000 saved when he began to put away an additional $25 each month.

\textbf{a)} Let \( t \) represent time, in months, and \( S \) represent Enrique’s savings, in $$. Identify which should be the independent and dependent variables.

\textbf{b)} To begin finding a linear function to model this situation, identify the \( S \)-intercept and slope.

\textbf{c)} Find a slope-intercept form of a linear function to model Enrique’s savings over time.

\textbf{d)} Write the linear function in function notation.

\textbf{e)} Use the function model to predict how much will be in his savings in one year.

\textbf{f)} Use the function model to predict when will he have $2000 saved.

\textbf{g)} Graph the function on a coordinate system.

\textbf{h)} At the same time, Anne-Marie also begins to save $25 per month, but she begins with $1200 already in her savings. Make a graphical model of her situation and place it on the same coordinate system as the graphical model for Enrique’s savings. Label it appropriately.

\textbf{i)} How do the lines compare to each other? Say something about their slopes.

\textbf{j)} Find a slope-intercept form of a linear function that models Anne-Marie’s savings. Use the same variables as you did for Enrique’s model.

\textbf{k)} Write the function using function notation.

\textbf{l)} Prove that the graphs of the two functions are parallel lines.

\textbf{m)} For Anne-Marie, looking at the graphs, do you think it will take her more time or less time than Enrique to save up $2000?
n) Use the linear function model for Anne-Marie to predict how long it will take her to save $2000. Does this agree with your expectation from (m)?

16. Jose is initially 400 meters away from the bus stop. He starts running toward the stop at a rate of 5 meters per second.

a) Express Jose’s distance $d$ from the bus stop as a function of time $t$.

b) Use your model to determine Jose’s distance from the bus stop after one minute.

c) Use your model to determine the time it will take Jose to reach the bus stop.

17. A ball is dropped from rest above the surface of the earth. As it falls, its speed increases at a constant rate of 32 feet per second per second.

a) Express the speed $v$ of the ball as a function of time $t$.

b) Use your model to determine the speed of the ball after 5 seconds.

c) Use your model to determine the time it will take for the ball to achieve a speed of 256 feet per second.

18. A ball is thrown into the air with an initial speed of 200 meters per second. It immediately begins to lose speed at a rate of 9.5 meters per second per second.

a) Express the speed $v$ of the ball as a function of time $t$.

b) Use your model to determine the speed of the ball after 5 seconds.

In Exercises 19-24, a linear function is given in standard form $Ax + By = C$. In each case, solve the given equation for $y$, placing the equation in slope-intercept form. Use the slope and intercept to draw the graph of the equation on a sheet of graph paper.

19. $3x - 2y = 6$

20. $3x + 5y = 15$

21. $3x + 2y = 6$

22. $4x - y = 4$

23. $x - 3y = -3$

24. $x + 4y = -4$

In Exercises 25-30, you are given a linear function in slope-intercept form. Place the linear function in standard form $Ax + By = C$, where $A$, $B$, and $C$ are integers and $A > 0$.

25. $y = \frac{2}{3}x - 5$

26. $y = \frac{5}{6}x + 1$

27. $y = -\frac{4}{5}x + 3$

28. $y = -\frac{3}{7}x + 2$

29. $y = -\frac{2}{5}x - 3$

30. $y = -\frac{1}{4}x + 2$
31. What is the $x$-intercept of the line?

32. What is the $y$-intercept of the line?

33. What is the $y$-intercept of the line?

34. What is the $x$-intercept of the line?

In Exercises 35-40, find the $x$- and $y$-intercepts of the linear function that is given in standard form. Use the intercepts to plot the graph of the line on a sheet of graph paper.

35. $3x - 2y = 6$
36. $4x + 5y = 20$
37. $x - 2y = -2$
38. $6x + 5y = 30$
39. $2x - y = 4$
40. $8x - 3y = 24$

41. Sketch the graph of the horizontal line that passes through the point $(3, -3)$. Label the line with its equation.

42. Sketch the graph of the horizontal line that passes through the point $(-9, 9)$. Label the line with its equation.

43. Sketch the graph of the vertical line that passes through the point $(2, -1)$. Label the line with its equation.
44. Sketch the graph of the vertical line that passes through the point \((15, -16)\). Label the line with its equation.

In Exercises 45-48, find the domain and range of the given linear function.

45. \(f(x) = -37x - 86\)
46. \(f(x) = 98\)
47. \(f(x) = -12\)
48. \(f(x) = -2x + 8\)
3.3 **Answers**

1. Slope = 2, y-intercept = (0, 1)

   ![Graph](image1.png)

2. 

   ![Graph](image2.png)

3. Slope = -1, y-intercept = (0, 3)

   ![Graph](image3.png)

4. 

   ![Graph](image4.png)

5. Slope = -3/4, y-intercept = (0, 3)

   ![Graph](image5.png)

7. 

   ![Graph](image6.png)

8. 

   ![Graph](image7.png)

9. 

   ![Graph](image8.png)

10. 

    ![Graph](image9.png)

11. 

    ![Graph](image10.png)

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13.
a) 

salary \( S \) (thousands of dollars)

b) \((0, 39)\)

c) 1

d) \( S = t + 39 \)

e) \( S(t) = t + 39 \)

f) \$49000, \$59000, \$69000, \text{ and } \$89000

g) 79

h) If the current rate of increase continues, in 40 years Kate’s salary will be \$79,000.

15.
a) \( t \) should be the independent variable and \( S \) should be the dependent variable.

b) \( S\)-intercept = \((0, 1000)\); slope = 25

c) \( S = 25t + 1000 \)

d) \( S(t) = 25t + 1000 \)

e) 1300

f) It will take 40 months for him to reach \$2000.

h) 

i) The lines have the same slope; they are parallel.

j) \( S = 25t + 1200 \)

k) \( S(t) = 25t + 1200 \)

l) They are lines because they are in the \( y = mx + b \) form. They are parallel because their slopes are equal (both are 25).

m) It should take her less time.

n) It will take 32 months for her to reach \$2000. This agrees with our expectation from (m).

17.
a) \( v = 32t \)

b) \( v = 160 \text{ feet per second} \)

c) \( t = 8 \text{ seconds} \)
19. \( y = \frac{3}{2}x - 3 \)

21. \( y = -\frac{3}{2}x + 3 \)

23. \( y = \frac{1}{3}x + 1 \)

25. \( 2x - 3y = 15 \)

27. \( 4x + 5y = 15 \)

29. \( 2x + 5y = -15 \)

31. \( (-4, 0) \)
41. 

\[ y = -3 \]

43. 

\[ x = 2 \]

45. Domain\(= (-\infty, \infty)\) and Range\(= (-\infty, \infty)\)

47. Domain\(= (-\infty, \infty)\) and Range\(= \{-12\}\)