Chapter 4
Linear Functions
4.1 Linear Functions

Verbal

1. Terry is skiing down a steep hill. Terry's elevation, $E(t)$, in feet after t seconds is given by $E(t)=3000-70t$. Write a complete sentence describing Terry’s starting elevation and how it is changing over time.
   Terry starts at an elevation of 3000 feet and descends 70 feet per second.
2. -
3. A boat is 100 miles away from the marina, sailing directly toward it at 10 miles per hour. Write an equation for the distance of the boat from the marina after *t* hours.
   $d(t)=100-10t$
4. -
5. If a horizontal line has the equation $f(x)=a$ and a vertical line has the equation $x=a$, what is the point of intersection? Explain why what you found is the point of intersection.
   The point of intersection is $(a,\ a)$. This is because for the horizontal line, all of the y coordinates are a and for the vertical line, all of the x coordinates are a. The point of intersection is on both lines and therefore will have these two characteristics.

Algebraic

For the following exercises, determine whether the equation of the curve can be written as a linear function.

6. -
7. $y=3x-5$
   Yes
8. -
9. $3x+5y=15$
   Yes
10. -
11. $3x+5y^2=15$
    No
12. -
13. $-\dfrac{x-3}{5}=2y$
    Yes

For the following exercises, determine whether each function is increasing or decreasing.

14. -
15. $g(x) = 5x + 6$

    Increasing
16. -
17. $b(x) = 8 - 3x$

    Decreasing
18. -
19. $k(x) = -4x + 1$

    Decreasing
20. -
21. $p(x) = \frac{1}{4}x - 5$

    Increasing
22. -
23. $m(x) = -\frac{3}{8}x + 3$

    Decreasing

For the following exercises, find the slope of the line that passes through the two given points.

24. -
25. $(1,\ 5)$ and $(4,\ 11)$

    2
26. -
27. $(8,\ -2)$ and $(4,\ 6)$

    –2
28. -

For the following exercises, given each set of information, find a linear equation satisfying the conditions, if possible.

29. $f(-5) = -4$, and $f(5) = 2$

    $y = \frac{3}{5}x - 1$
30. -

31. Passes through $(2,\ 4)$ and $(4,\ 10)$

$y = 3x - 2$

32. -

33. Passes through $(-1,\ 4)$ and $(5,\ 2)$

$y = -\frac{1}{3}x + \frac{11}{3}$

34. -

35. *x* intercept at $(-2,\ 0)$ and *y* intercept at $(0,\ -3)$

$y = -1.5x - 3$

36. -

For the following exercises, determine whether the lines given by the equations below are parallel, perpendicular, or neither.

37.
$4x - 7y = 10$
$7x + 4y = 1$
perpendicular

38. -

39.
$3y + 4x = 12$
$-6y = 8x + 1$
parallel

40. -

For the following exercises, find the *x*- and *y*-intercepts of each equation.

41. $f(x) = -x + 2$

$f(0) = -(0) + 2$

$f(0) = 2$

$y - \text{int} : (0,2)$

$0 = -x + 2$

$x - \text{int} : (2,0)$

42. -

43. $h(x) = 3x - 5$

$h(0) = 3(0) - 5$

$h(0) = -5$

$y - \text{int}: (0, -5)$

$0 = 3x - 5$

$x - \text{int}: \left(\frac{5}{3}, 0\right)$

44. -

45. $-2x + 5y = 20$

$-2x + 5y = 20$

$-2(0) + 5y = 20$

$5y = 20$

$y = 4$

$y - \text{int}: (0, 4)$

$-2x + 5(0) = 20$

$x = -10$

$x - \text{int}: (-10, 0)$

46. -

For the following exercises, use the descriptions of each pair of lines given below to find the slopes of Line 1 and Line 2. Is each pair of lines parallel, perpendicular, or neither?

47. Line 1: Passes through $(0, 6)$ and $(3, -24)$
    Line 2: Passes through $(-1, 19)$ and $(8, -71)$
    Line 1: $m = -10$ Line 2: $m = -10$ Parallel
48. -
49. Line 1: Passes through $(2, 3)$ and $(4, -1)$
    Line 2: Passes through $(6, 3)$ and $(8, 5)$
    Line 1: $m = -2$ Line 2: $m = 1$ Neither
50. -
51. Line 1: Passes through $(2, 5)$ and $(5, -1)$
    Line 2: Passes through $(-3, 7)$ and $(3, -5)$
    Line 1: $m = -2$ Line 2: $m = -2$ Parallel

For the following exercises, write an equation for the line described.

52. -
53. Write an equation for a line parallel to $g(x) = 3x - 1$ and passing through the point $(4, 9)$.
    $y = 3x - 3$

54. -

55. Write an equation for a line perpendicular to $p(t) = 3t + 4$ and passing through the point (3, 1).

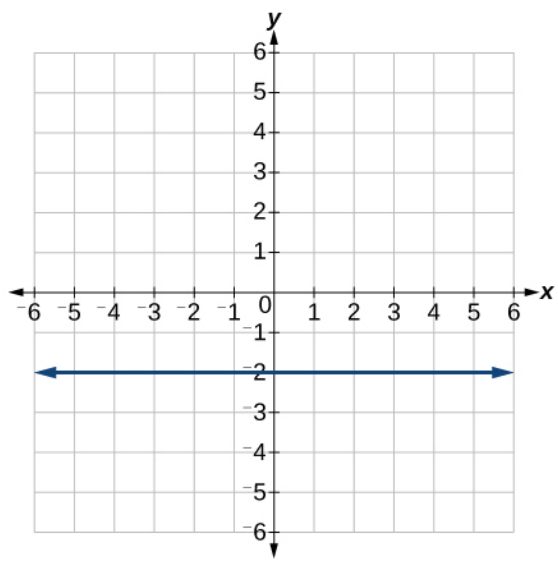
$$y = -\frac{1}{3}t + 2$$

Graphical

For the following exercises, find the slope of the line graphed.

56. -

57.

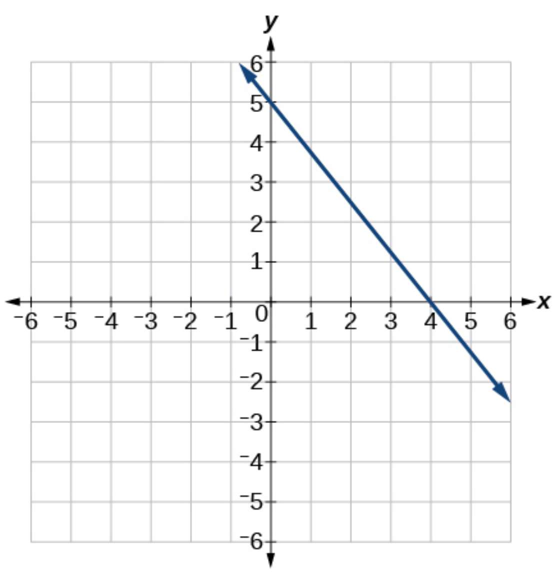


Slope is 0.

For the following exercises, write an equation for the line graphed.

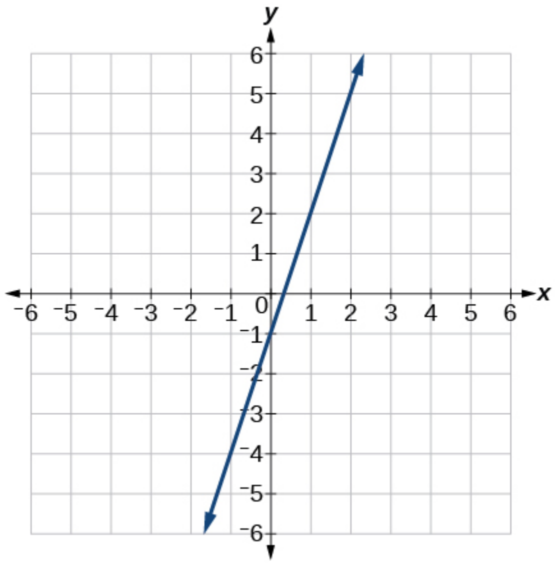
58. -

59.



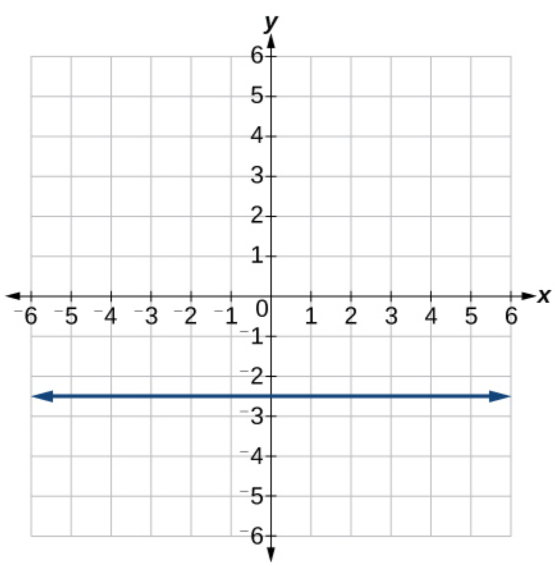
$$y = -\frac{5}{4}x + 5$$

60. -
61.



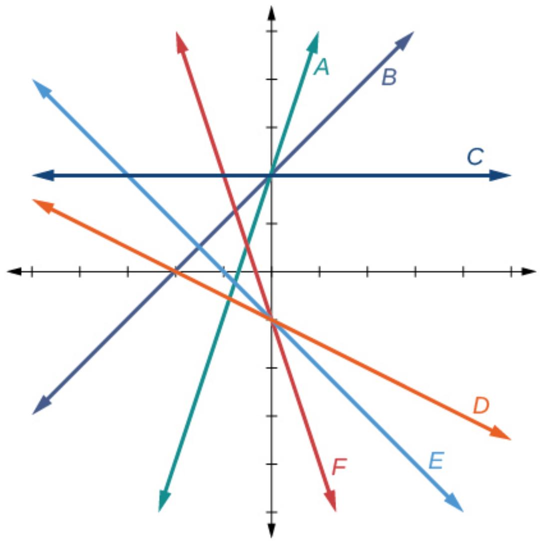
$y = 3x - 1$

62. -
63.



$y = -2.5$

For the following exercises, match the given linear equation with its graph in the figure.



64. -

65. $f(x) = -2x - 1$

    F

66. -

67. $f(x) = 2$

    C

68. -

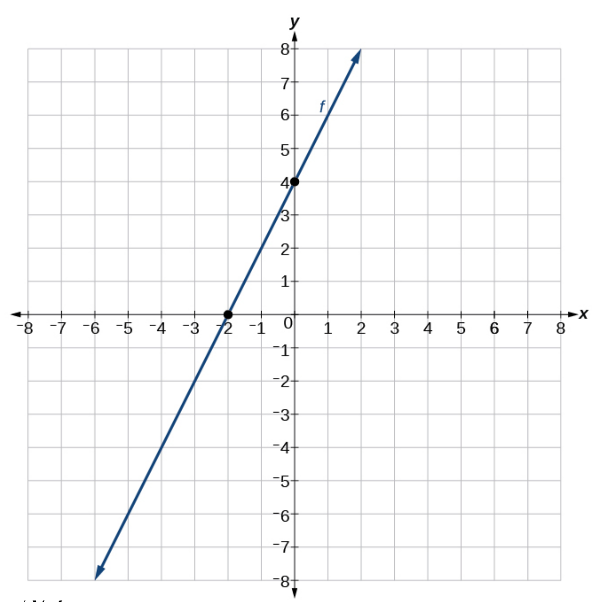
69. $f(x) = 3x + 2$

    A

For the following exercises, sketch a line with the given features.

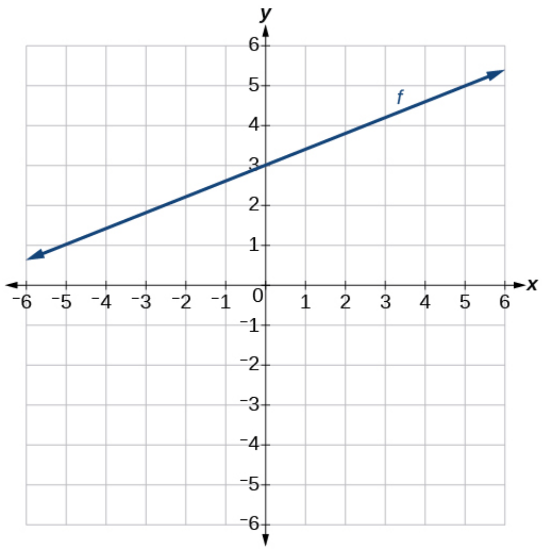
70. -

71. An x-intercept of $(-2,\ 0)$ and y-intercept of $(0,\ 4)$



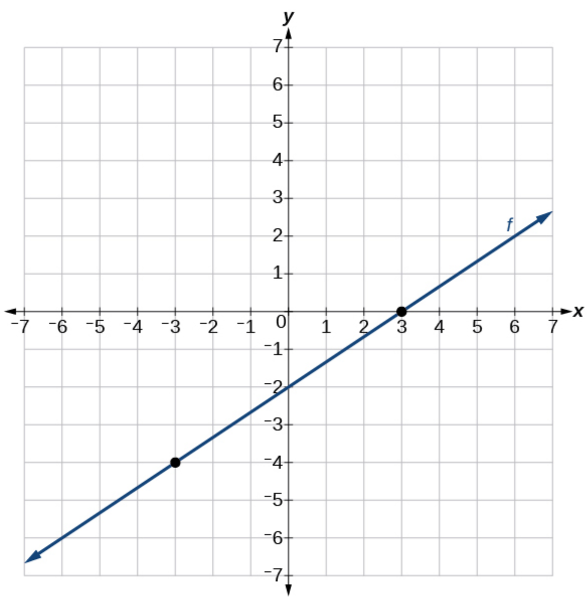
72. -

73. A y-intercept of $(0,\ 3)$ and slope $\dfrac{2}{5}$



74. -

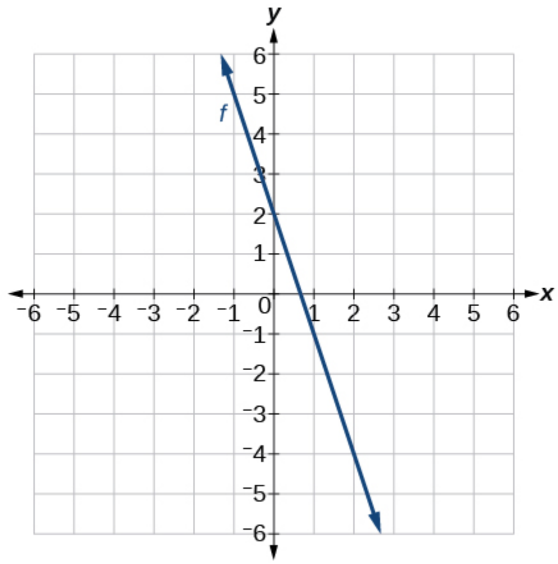
75. Passing through the points $(-3,\ -4)$ and $(3,\ 0)$



For the following exercises, sketch the graph of each equation.

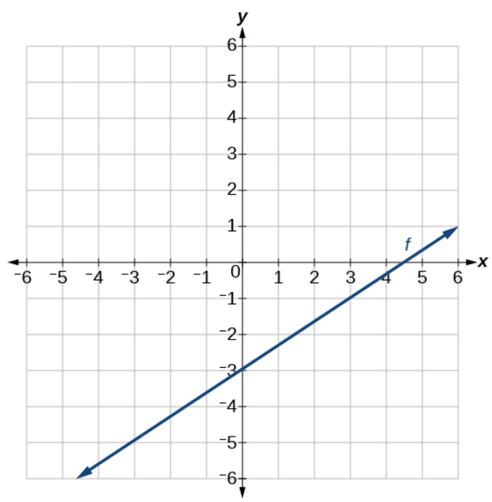
76. -

77. $f(x) = -3x + 2$



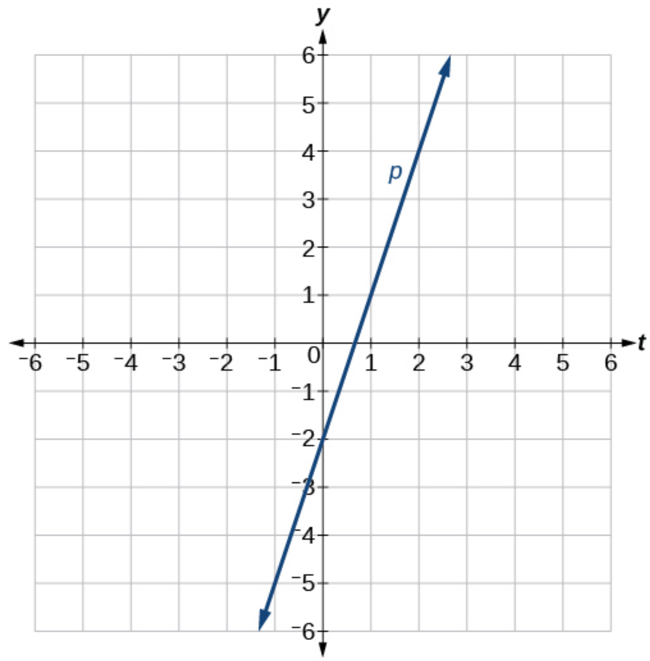
78. -

79. $f(x) = \frac{2}{3}x - 3$



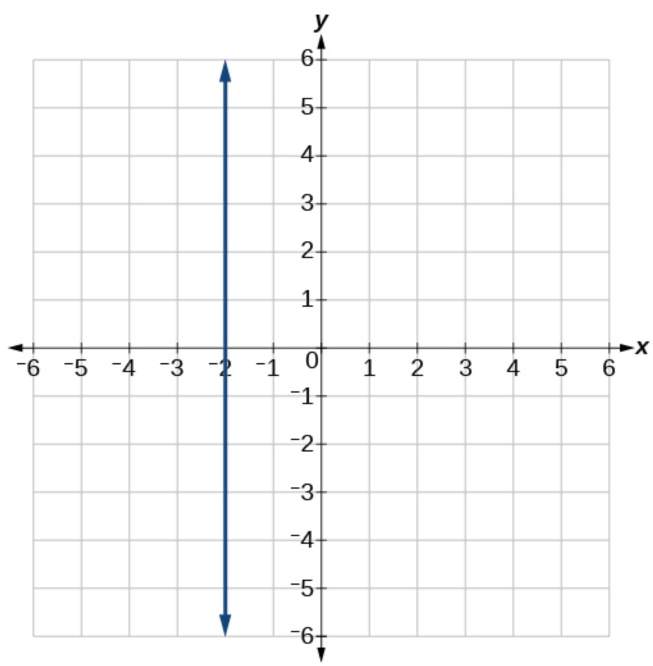
80. -

81. $p(t) = -2 + 3t$



82. -

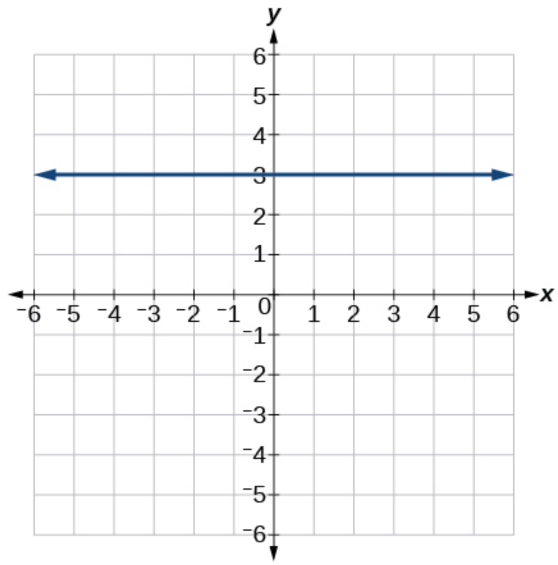
83. $x = -2$



84. -

For the following exercises, write the equation of the line shown in the graph.

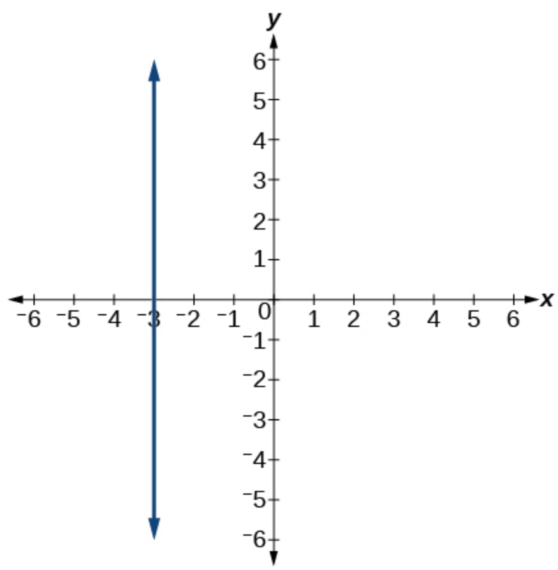
85.



$y = 3$

86. -

87.



$x = -3$

88. -

Numeric

For the following exercises, which of the tables could represent a linear function? For each that could be linear, find a linear equation that models the data.

89.

x	0	5	10	15
$g(x)$	5	–10	–25	–40

Linear, $g(x) = -3x + 5$

90. -

91.

x	0	5	10	15
$f(x)$	–5	20	45	70

Linear, $f(x) = 5x - 5$

92. -

93.

x	0	2	4	6
$g(x)$	6	–19	–44	–69

Linear, $g(x) = -\frac{25}{2}x + 6$

94. -

95.

x	2	4	6	8
$f(x)$	–4	16	36	56

Linear, $f(x) = 10x - 24$

96. -

Technology

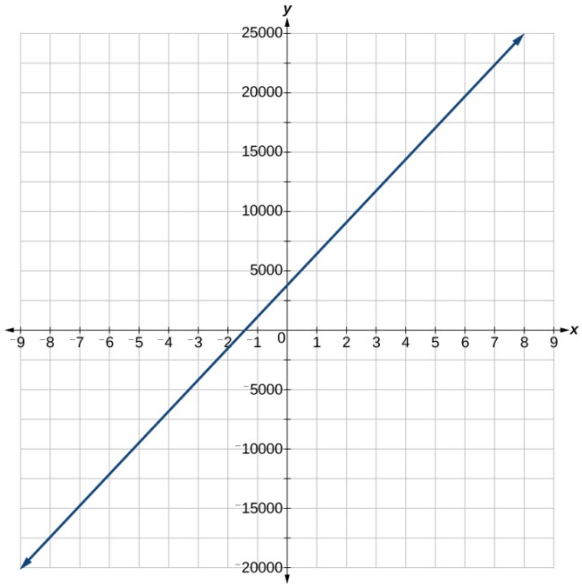
For the following exercises, use a calculator or graphing technology to complete the task.

97. If f is a linear function, $f(0.1) = 11.5$, and $f(0.4) = -5.9$, find an equation for the function.

$f(x) = -58x + 17.3$

98. -

99. Graph the function f on a domain of $[-10,10]$: $f(x)=2,500x+4,000$



100. –

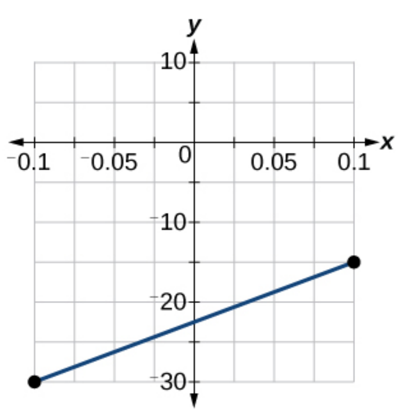
101. The table shows the input, p, and output, q, for a linear function q. a. Fill in the missing values of the table. b. Write the linear function k.

p	0.5	0.8	12	b
q	400	700	a	1,000,000

a. $a=11,900$; $b=1001.1$ b. $q(p)=1000p-100$

102. -

103. Graph the linear function f on a domain of $[-0.1,0.1]$ for the function whose slope is 75 and y-intercept is -22.5. Label the points for the input values of -0.1 and 0.1.



104. -

Extensions

105. Find the value of x if a linear function goes through the following points and has the following slope: $(x,2),(-4,6),m=3$

$x=-\frac{16}{3}$

106. -

107. Find the equation of the line that passes through the following points:

$(a,\ b)$ and $(a,\ b+1)$

$x=a$

108. -

109. Find the equation of the line that passes through the following points:

$(a,\ 0)$and $(c,\ d)$

$y=\frac{d}{c-a}x-\frac{ad}{c-a}$

110. -

111. Find the equation of the line perpendicular to the line $g(x)=-0.01x+2.01$ through the point (1, 2).

$y=100x-98$

For the following exercises, use the functions $f(x)=-0.1x+200$ and $g(x)=20x+0.1$.

112. -

113. Where is $f(x)$ greater than $g(x)$? Where is $g(x)$ greater than $f(x)$?

$x<\frac{1999}{201};\ x>\frac{1999}{201}$

Real-World Applications

114. -

115. A gym membership with two personal training sessions costs \$125, while gym membership with five personal training sessions costs \$260. What is cost per session?

\$45 per training session

116. -

117. A phone company charges for service according to the formula: $C(n)=24+0.1n$, where n is the number of minutes talked, and $C(n)$ is the monthly charge, in dollars. Find and

interpret the rate of change and initial value.
The rate of change is 0.1. For every additional minute talked, the monthly charge increases by \$0.1 or 10 cents. The initial value is 24. When there are no minutes talked, initially the charge is \$24.

118. -

119. A city's population in the year 1960 was 287,500. In 1989 the population was 275,900. Compute the rate of growth of the population and make a statement about the population rate of change in people per year.
The slope is -400. This means for every year between 1960 and 1989, the population dropped by 400 per year in the city.

120. -

121. Suppose that average annual income (in dollars) for the years 1990 through 1999 is given by the linear function: $I(x)=1054x+23,286$, where x is the number of years after 1990. Which of the following interprets the slope in the context of the problem?
a. As of 1990, average annual income was \$23,286.
b. In the ten-year period from 1990–1999, average annual income increased by a total of \$1,054.
c. Each year in the decade of the 1990s, average annual income increased by \$1,054.
d. Average annual income rose to a level of \$23,286 by the end of 1999.
C

122. -

Chapter 4
Linear Functions
4.2 Modeling with Linear Functions

Verbal

1. Explain how to find the input variable in a word problem that uses a linear function.
   Determine the independent variable. This is the variable upon which the output depends.
2. -
3. Explain how to interpret the initial value in a word problem that uses a linear function.
   To determine the initial value, find the output when the input is equal to zero.
4. -

Algebraic

5. Find the area of a parallelogram bounded by the *y*-axis, the line $x=3$, the line $f(x)=1+2x$, and the line parallel to $f(x)$ passing through $(2,\ 7)$.
   6 square units
6. -
7. Find the area of a triangle bounded by the *y*-axis, the line $f(x)=9-\frac{6}{7}x$, and the line perpendicular to $f(x)$ that passes through the origin.
   20.01 square units
8. -

For the following exercises, consider this scenario: A town's population has been decreasing at a constant rate. In 2010 the population was 5,900. By 2012 the population had dropped 4,700. Assume this trend continues.

9. Predict the population in 2016.
   2,300
10. -

For the following exercises, consider this scenario: A town's population has been increased at a constant rate. In 2010 the population was 46,020. By 2012 the population had increased to 52,070. Assume this trend continues.

11. Predict the population in 2016.
    64,170
12. -

For the following exercises, consider this scenario: A town has an initial population of 75,000. It grows at a constant rate of 2,500 per year for 5 years.

13. Find the linear function that models the town's population P as a function of the year, t, where t is the number of years since the model began.

    $P(t)=75{,}000+2500t$

14. -
15. If the function P is graphed, find and interpret the x- and y-intercepts.

    (–30, 0) Thirty years before the start of this model, the town had no citizens. (0, 75,000) Initially, the town had a population of 75,000.

16. -
17. When will the population reach 100,000?

    Ten years after the model began

18. -

For the following exercises, consider this scenario: The weight of a newborn is 7.5 pounds. The baby gained one-half pound a month for its first year.

19. Find the linear function that models the baby's weight W as a function of the age of the baby, in months, t.

    $W(t)=0.5t+7.5$

20. -
21. If the function W is graphed, find and interpret the x- and y-intercepts.

    $(-15,\ 0)$: The x-intercept is not a plausible set of data for this model because it means the baby weighed 0 pounds 15 months prior to birth. $(0,\ 7.5)$: The baby weighed 7.5 pounds at birth.

22. -
23. When did the baby weigh 10.4 pounds?

    At age 5.8 months

24. -

For the following exercises, consider this scenario: The number of people afflicted with the common cold in the winter months steadily decreased by 205 each year from 2005 until 2010. In 2005, 12,025 people were inflicted.

25. Find the linear function that models the number of people inflicted with the common cold C as a function of the year, t.

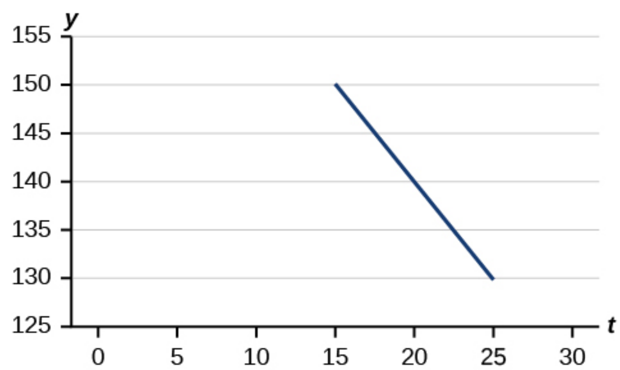
    $C(t)=12{,}025-205t$

26. -

27. If the function C is graphed, find and interpret the x- and y-intercepts.
    $(58.7,\ 0)$: In roughly 59 years, the number of people inflicted with the common cold would be 0. $(0,\ 12,025)$: Initially there were 12,025 people afflicted by the common cold.
28. -
29. When will the output reach 0?
    2063
30. -

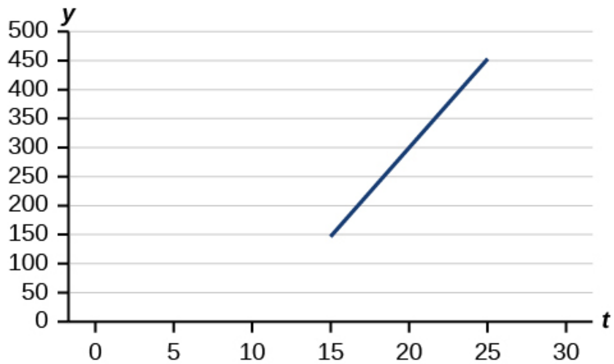
Graphical

For the following exercises, use the graph, which shows the profit, y, in thousands of dollars, of a company in a given year, t, where t represents the number of years since 1980.



31. Find the linear function y, where y depends on t, the number of years since 1980.
    $y = -2t + 180$
32. -
33. Find and interpret the x-intercept.
    In 2070, the company’s profit will be zero.
34. -

For the following exercises, use the graph, which shows the profit, y, in thousands of dollars, of a company in a given year, t, where t represents the number of years since 1980.



35. Find the linear function y, where y depends on t, the number of years since 1980.

$$y = 30t - 300$$

36. -
37. Find and interpret the x-intercept.

    (10, 0); In 1990, the profit earned zero profit.
38. -

Numeric

For the following exercises, use the median home values in Mississippi and Hawaii (adjusted for inflation) shown in the table. Assume that the house values are changing linearly.

Year	Mississippi	Hawaii
1950	$25,200	$74,400
2000	$71,400	$272,700

39. In which state have home values increased at a higher rate?

    Hawaii
40. -
41. If we assume the linear trend existed before 1950 and continues after 2000, the two states' median house values will be (or were) equal in what year? (The answer might be absurd.)

    During the year 1933

For the following exercises, use the median home values in Indiana and Alabama (adjusted for inflation) shown in the table. Assume that the house values are changing linearly.

Year	Indiana	Alabama
1950	$37,700	$27,100
2000	$94,300	$85,100

42. -

43. If these trends were to continue, what would be the median home value in Indiana in 2010?
    $105,620

44. -

Real-World Applications

45. In 2004, a school population was 1001. By 2008 the population had grown to 1697. Assume the population is changing linearly.
    a. How much did the population grow between the year 2004 and 2008?
    b. How long did it take the population to grow from 1001 students to 1697 students?
    c. What is the average population growth per year?
    d. What was the population in the year 2000?
    e. Find an equation for the population, P, of the school t years after 2000.
    f. Using your equation, predict the population of the school in 2011.

    a. 696 people
    b. 4 years
    c. 174 people per year
    d. 305 people
    e. $P(t) = 305 + 174t$
    f. 2219 people

46. -

47. A phone company has a monthly cellular plan where a customer pays a flat monthly fee and then a certain amount of money per minute used on the phone. If a customer uses 410 minutes, the monthly cost will be $71.50. If the customer uses 720 minutes, the monthly cost will be $118.
    a. Find a linear equation for the monthly cost of the cell plan as a function of x, the number of monthly minutes used.
    b. Interpret the slope and y-intercept of the equation.
    c. Use your equation to find the total monthly cost if 687 minutes are used.

    a. $C(x) = 0.15x + 10$ b. The flat monthly fee is $10 and there is an additional $0.15 fee for each additional minute used c. $113.05

48. -

49. In 1991, the moose population in a park was measured to be 4,360. By 1999, the population was measured again to be 5,880. Assume the population continues to change linearly.
    a. Find a formula for the moose population, P since 1990.
    b. What does your model predict the moose population to be in 2003?

a. $P(t) = 190t + 4360$ b. 6640 moose

50. -
51. The Federal Helium Reserve held about 16 billion cubic feet of helium in 2010 and is being depleted by about 2.1 billion cubic feet each year.
    a. Give a linear equation for the remaining federal helium reserves, R, in terms of t, the number of years since 2010.
    b. In 2015, what will the helium reserves be?
    c. If the rate of depletion doesn't change, in what year will the Federal Helium Reserve be depleted?

    a. $R(t) = 16 - 2.1t$ b. 5.5 billion cubic feet c. During the year 2017
52. -
53. You are choosing between two different prepaid cell phone plans. The first plan charges a rate of 26 cents per minute. The second plan charges a monthly fee of $19.95 *plus* 11 cents per minute. How many minutes would you have to use in a month in order for the second plan to be preferable?

    More than 133 minutes
54. -
55. When hired at a new job selling jewelry, you are given two pay options:
    Option A: Base salary of $17,000 a year with a commission of 12% of your sales
    Option B: Base salary of $20,000 a year with a commission of 5% of your sales
    How much jewelry would you need to sell for option A to produce a larger income?

    More than $42,857.14 worth of jewelry
56. -
57. When hired at a new job selling electronics, you are given two pay options:
    Option A: Base salary of $20,000 a year with a commission of 12% of your sales
    Option B: Base salary of $26,000 a year with a commission of 3% of your sales
    How much electronics would you need to sell for option A to produce a larger income?

    $66,666.67
58. -

Chapter 4
Linear Functions
4.3 Fitting Linear Models to Data

Verbal

1. Describe what it means if there is a model breakdown when using a linear model.
   When our model no longer applies, after some value in the domain, the model itself doesn't hold.
2. -
3. What is extrapolation when using a linear model?
   We predict a value outside the domain and range of the data.
4. -
5. Explain how to interpret the absolute value of a correlation coefficient.
   The closer the number is to 1, the less scattered the data, the closer the number is to 0, the more scattered the data.

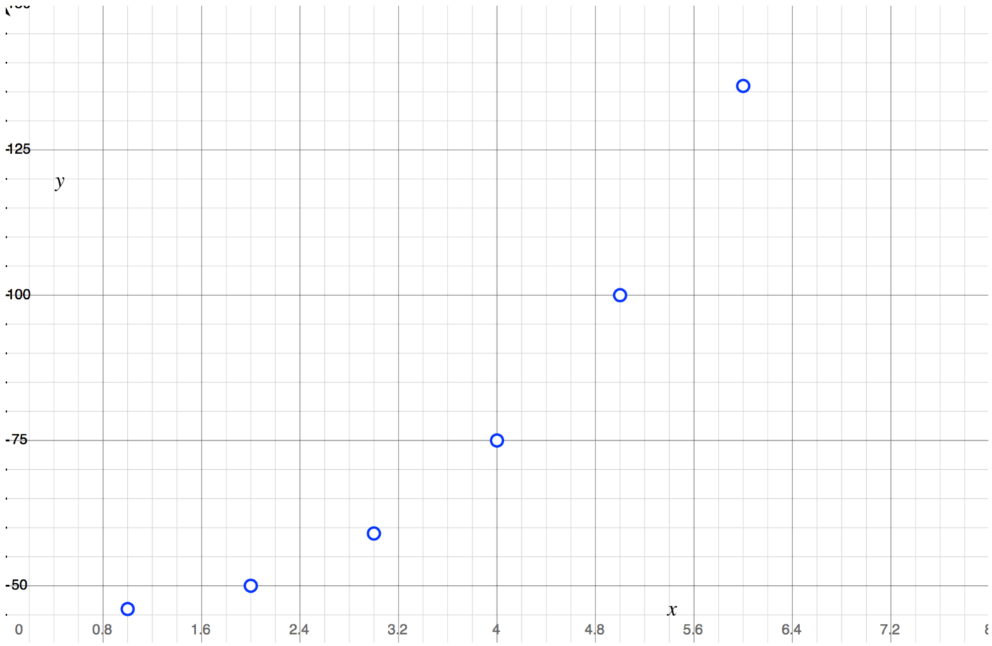
Algebraic

6. -
7. A regression was run to determine whether there is a relationship between the diameter of a tree (x, in inches) and the tree's age (y, in years). The results of the regression are given below. Use this to predict the age of a tree with diameter 10 inches.
   $y = ax + b$
   $a = 6.301$
   $b = -1.044$
   $r = -0.970$
   61.966 years

For the following exercises, draw a scatter plot for the data provided. Does the data appear to be linearly related?

8. -
9.

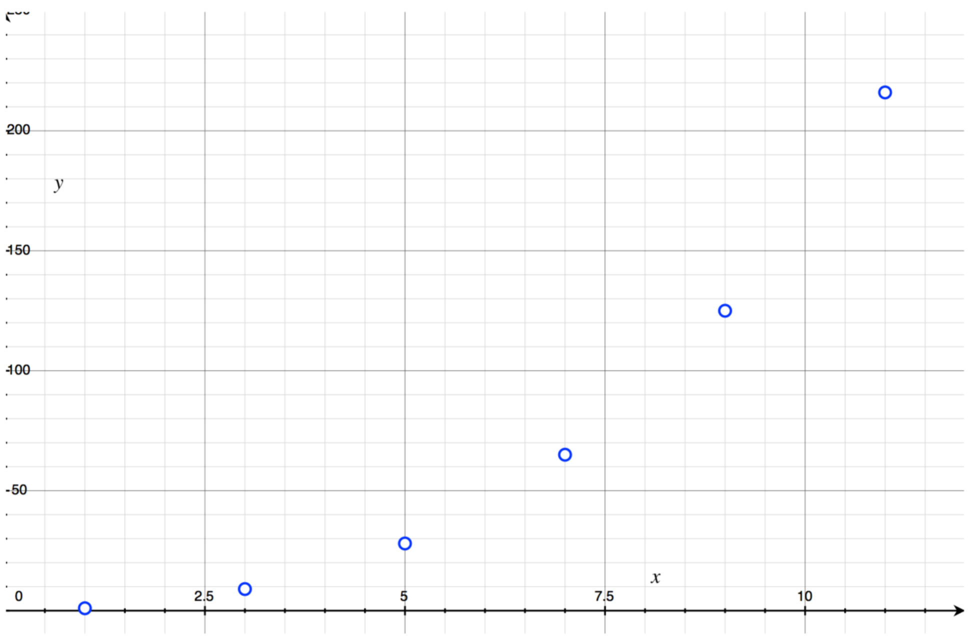
1	2	3	4	5	6
46	50	59	75	100	136



No.

10. -
11.

1	3	5	7	9	11
1	9	28	65	125	216

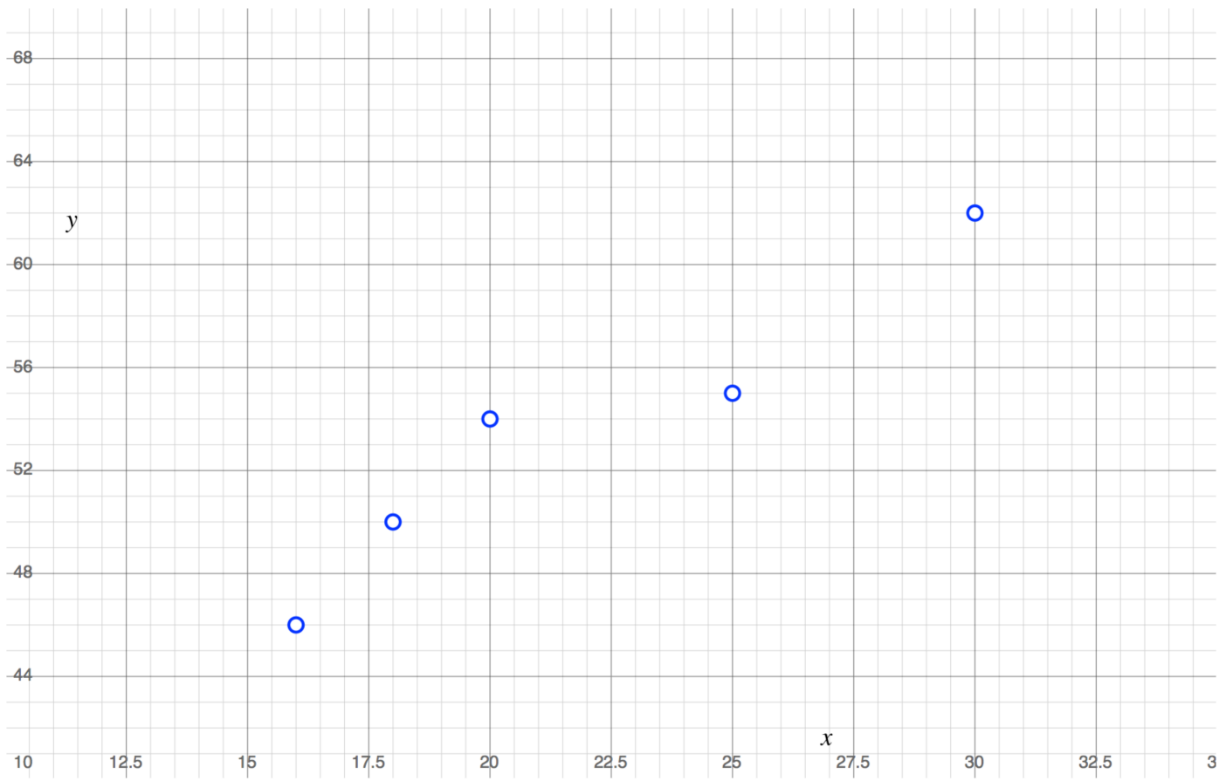


No.

12. -

13. For the following data, draw a scatter plot. If we wanted to know when the temperature would reach 28°F, would the answer involve interpolation or extrapolation? Eyeball the line and estimate the answer.

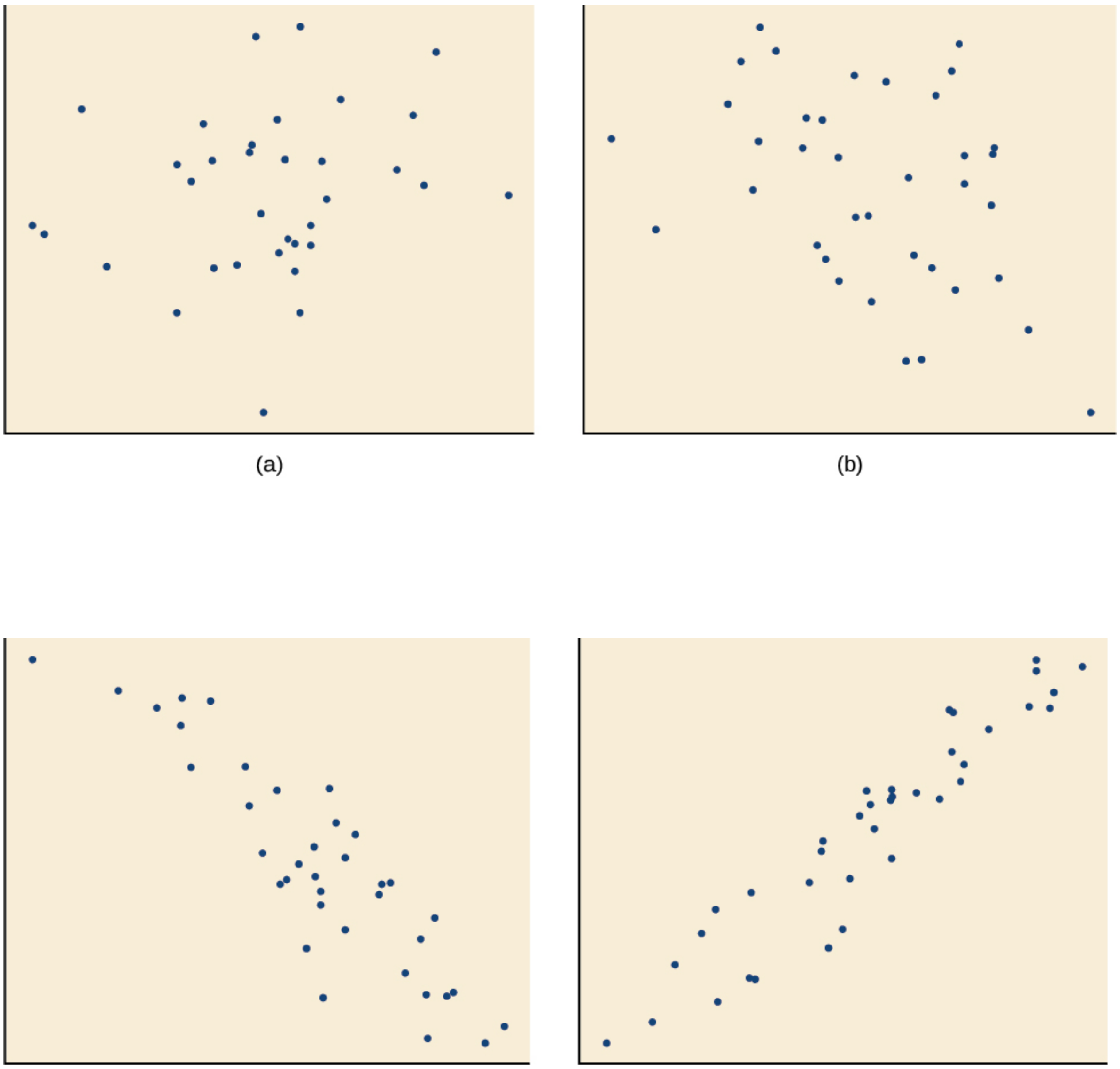
Temperature, °F	16	18	20	25	30
Time, seconds	46	50	54	55	62



Interpolation. About 60° F.

Graphical

For the following exercises, match each scatterplot with one of the four specified correlations**.**



(a) (b) (c) (d)

14. -
15. $r = -0.89$

This value of r indicates a strong negative correlation or slope, so C

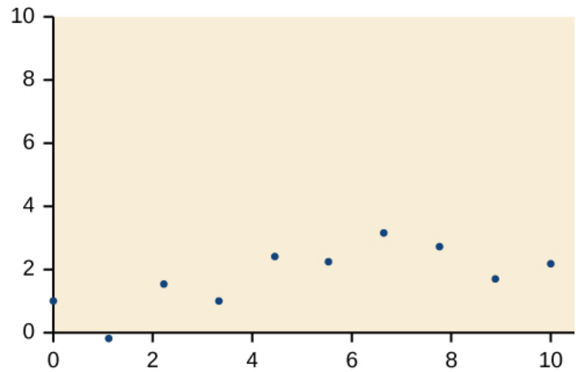
16. -
17. $r = -0.39$

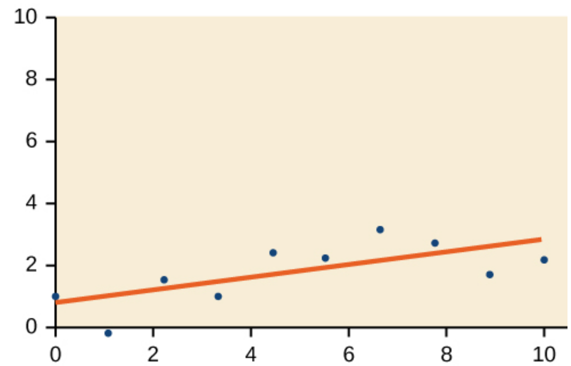
This value of r indicates a weak negative correlation, so B

For the following exercises, draw a best-fit line for the plotted data.

18. -

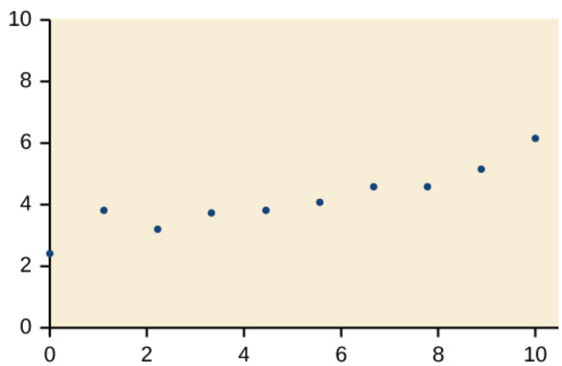
19.

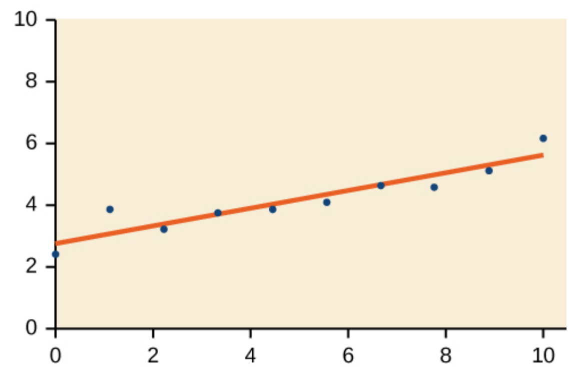




20. -

21.





Numeric

22. -

23. The U.S. import of wine (in hectoliters) for several years is given in the table. Determine whether the trend appears linear. If so, and assuming the trend continues, in what year will imports exceed 12,000 hectoliters?

Year	1992	1994	1996	1998	2000	2002	2004	2006	2008	2009
Imports	2665	2688	3565	4129	4584	5655	6549	7950	8487	9462

Yes, trend appears linear because $r = 0.985$ and will exceed 12,000 near midyear, 2016, 24.6 years since 1992.

24. -

Technology

For the following exercises, use each set of data to calculate the regression line using a calculator or other technology tool, and determine the correlation coefficient to 3 decimal places of accuracy.

25.

x	8	15	26	31	56
y	23	41	53	72	103

$y = 1.640x + 13.800,\ r = 0.987$

26. -

27.

x	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
y	21.9	22.22	22.74	22.26	20.78	17.6	16.52	18.54	15.76	13.68	14.1	14.02	11.94	12.76	11.28	9.1

$y = -0.962x + 26.86,\ \ r = -0.965$

28. -

29.

x	21	25	30	31	40	50
y	17	11	2	–1	–18	–40

$y = -1.981x + 60.197$; $r = -0.998$

30. -

31.

x	900	988	1000	1010	1200	1205
y	70	80	82	84	105	108

$y = 0.121x - 38.841, r = 0.998$

Extensions

32. -

33. Graph $f(x) = -2x - 10$. Pick a set of five ordered pairs using inputs $x = -2,\ 1,\ 5,\ 6,\ 9$ and use linear regression to verify the function.

$(-2,\ -6),\ (1,\ -12),\ (5,\ -20),\ (6,\ -22),\ (9,\ -28)$; Yes, the function is a good fit.

For the following exercises, consider this scenario: The profit of a company decreased steadily over a ten-year span. The following ordered pairs shows dollars and the number of units sold in hundreds and the profit in thousands of over the ten-year span, (number of units sold, profit) for specific recorded years:

$$(46,\ 1{,}600),(48,\ 1{,}550),(50,\ 1{,}505),(52,\ 1{,}540),(54,\ 1{,}495).$$

34. -
35. Find to the nearest tenth and interpret the x-intercept.
    $(189.8, 0)$ If 18,980 units are sold, the company will have a profit of zero dollars.
36. -

Real-World Applications

For the following exercises, consider this scenario: The population of a city increased steadily over a ten-year span. The following ordered pairs shows the population and the year over the ten-year span, (population, year) for specific recorded years:

$$(2500, 2000),(2650, 2001),(3000, 2003),(3500, 2006),(4200, 2010)$$

37. Use linear regression to determine a function y, where the year depends on the population. Round to three decimal places of accuracy.
    $y = 0.00587x + 1985.41$
38. -

For the following exercises, consider this scenario: The profit of a company increased steadily over a ten-year span. The following ordered pairs show the number of units sold in hundreds and the profit in thousands of over the ten year span, (number of units sold, profit) for specific recorded years:

$$(46,\ 250),(48,\ 305),(50,\ 350),(52,\ 390),(54,\ 410).$$

39. Use linear regression to determine a function y, where the profit in thousands of dollars depends on the number of units sold in hundreds.
    $y = 20.25x - 671.5$
40. -

For the following exercises, consider this scenario: The profit of a company decreased steadily over a ten-year span. The following ordered pairs show dollars and the number of units sold in hundreds and the profit in thousands of over the ten-year span (number of units sold, profit) for specific recorded years:

$$(46,\ 250),(48,\ 225),(50,\ 205),(52,\ 180),(54,\ 165).$$

41. Use linear regression to determine a function y, where the profit in thousands of dollars depends on the number of units sold in hundreds.
    $y = -10.75x + 742.50$
42. –

Chapter 4 Review Exercises

Section 4.1

1. Determine whether the algebraic equation is linear. $2x+3y=7$

   Yes
2. -
3. **Determine** whether the function is increasing or decreasing.

   $f\left(x\right)=7x-2$

   Increasing
4. -
5. Given each set of information, find a linear equation that satisfies the given conditions, if possible.

   Passes through $\left(7,5\right)$ and $\left(3,17\right)$

   $m=\dfrac{17-5}{3-7}$

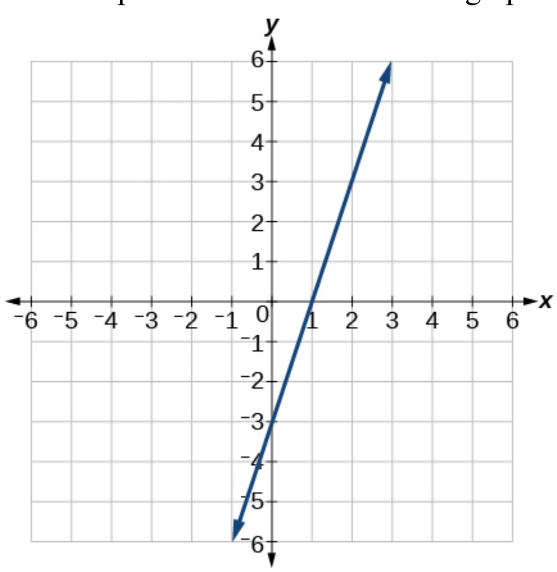
   $m=\dfrac{12}{-4}$

   $m=-3$

   $y-5=-3(x-7)$

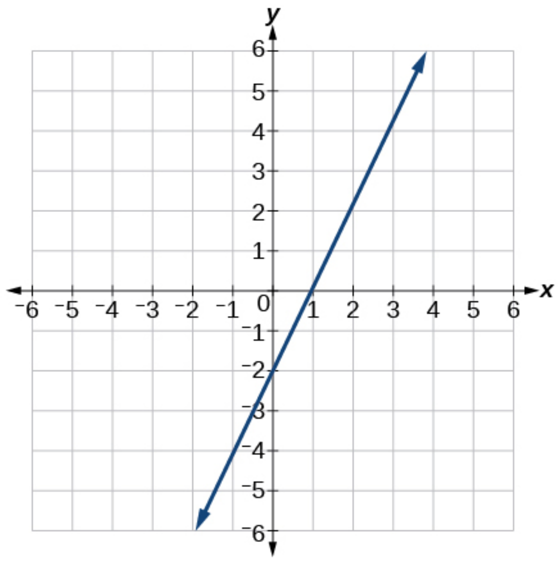
   $y-5=-3x+21$

   $y=-3x+26$
6. -
7. Find the slope of the line shown in the graph.



   3
8. -

9. Write an equation in slope-intercept form for the line shown.



$y = 2x - 2$

10. -

11. Does the following table represent a linear function? If so, find the linear equation that models the data.

x	6	8	12	26
***g*(*x*)**	–8	–12	–18	–46

Not linear.

12. -

For the following exercises, determine whether the lines given by the equations below are parallel, perpendicular, or neither parallel nor perpendicular:

13. $2x - 6y = 12$

$-x + 3y = 1$

$$2x-6y=12$$
$$-6y=12-2x$$
$$y=\frac{12}{-6}-\frac{2x}{-6}$$
$$y=-2+\frac{1}{3}x$$
$$-x+3y=1$$
$$3y=1+x$$
$$y=\frac{1}{3}+\frac{1}{3}x$$

parallel

14. -

For the following exercises, find the *x*- and *y*- intercepts of the given equation.

15. $7x+9y=-63$

$$7x+9y=-63$$
$$9y=-7x-63$$
$$y=\frac{-7}{9}x-\frac{63}{9}$$
$$y=-\frac{7}{9}x-7$$
$$y=-\frac{7}{9}(0)-7$$
$$y=-7$$
$$0=-\frac{7}{9}x-7$$
$$7=-\frac{7}{9}x$$
$$-63=7x$$
$$-9=x$$

(–9, 0); (0,–7)

16. -

For the following exercises, use the descriptions of the pairs of lines to find the slopes of Line 1 and Line 2. Is each pair of lines parallel, perpendicular, or neither?

17. Line 1: Passes through $(5,11)$ and $(10,1)$
Line 2: Passes through $(-1,3)$ and $(-5,11)$

$$m_1 = \frac{1-11}{10-5}$$
$$m_1 = \frac{-10}{5}$$
$$m_1 = -2$$
$$m_2 = \frac{11-3}{-5-(-1)}$$
$$m_2 = \frac{8}{-4}$$
$$m_2 = -2$$

Line 1: $m = -2$; Line 2: $m = -2$; Parallel

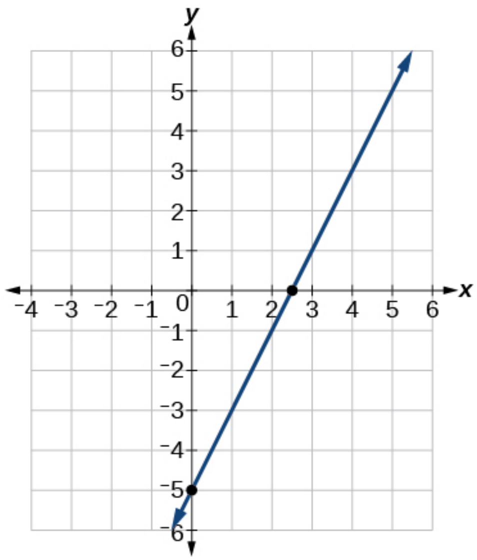
18. -

19. Write an equation for a line perpendicular to $f(x) = 5x - 1$ and passing through the point (5, 20).

$$m = -\frac{1}{5}$$
$$y - 20 = -\frac{1}{5}(x-5)$$
$$y - 20 = -\frac{1}{5}x + 1$$
$$y = -\frac{1}{5}x + 21$$
$$y = -0.2x + 21$$

20. -

21. Sketch a graph of the linear function $f(t) = 2t - 5$.



22. -
23. A car rental company offers two plans for renting a car.
    Plan A: 25 dollars per day and 10 cents per mile
    Plan B: 50 dollars per day with free unlimited mileage
    How many miles would you need to drive for plan B to save you money?

    $A = 0.1m + 25$

    $B = 50$

    $0.1m + 25 = 50$

    $0.1m = 25$

    $m = \frac{25}{0.1}$

    $m = 250$

    More than 250

Section 4.2

24. -
25. A town's population increases at a constant rate. In 2010 the population was 55,000. By 2012 the population had increased to 76,000. If this trend continues, predict the population in 2016.

$(0, 55000)$ and $(2, 76000)$

$m = \dfrac{76000 - 55000}{2 - 0}$

$m = \dfrac{21000}{2}$

$m = 10500$

$y = 10500x + 55000$

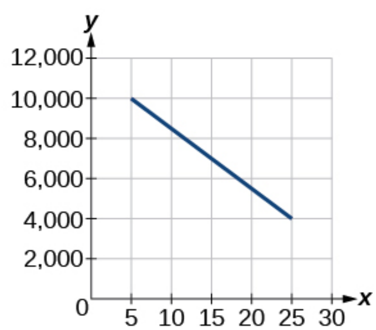
$y = 10500(6) + 55000$

$y = 118000$

118,000

26. -

For the following exercises, use the graph showing the profit, y, in thousands of dollars, of a company in a given year, x, where x represents years since 1980.



27. Find the linear function y, where y depends on x, the number of years since 1980.

    $y = -300x + 11,500$

28. -

For the following exercise, consider this scenario: In 2004, a school population was 1,700. By 2012 the population had grown to 2,500.

29. Assume the population is changing linearly.

    a. How much did the population grow between the year 2004 and 2012?
    b. What is the average population growth per year?
    c. Find an equation for the population, P, of the school t years after 2004.

    a) 800 b) 100 students per year c) $P(t) = 100t + 1700$

For the following exercises, consider this scenario: In 2000, the moose population in a park was measured to be 6,500. By 2010, the population was measured to be 12,500. Assume the population continues to change linearly.

30. -
31. What does your model predict the moose population to be in 2020?
    18,500

For the following exercises, consider this scenario: The median home values in subdivisions Pima Central and East Valley (adjusted for inflation) are shown in the table. Assume that the house values are changing linearly.

Year	**Pima Central**	**East Valley**
1970	32,000	120,250
2010	85,000	150,000

32. -
33. If these trends were to continue, what would be the median home value in Pima Central in 2015?

$y = 1325x + 32000$

$y = 1325(45) + 32000$ \$91,625

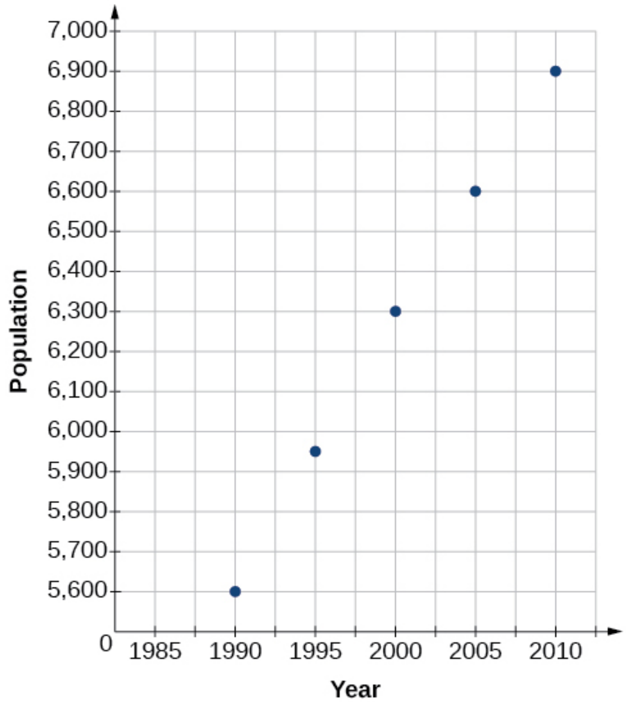
$y = 91625$

Section 4.3

34. -
35. Draw a scatter plot for the data in the table. If we wanted to know when the population would reach 15,000, would the answer involve interpolation or extrapolation?

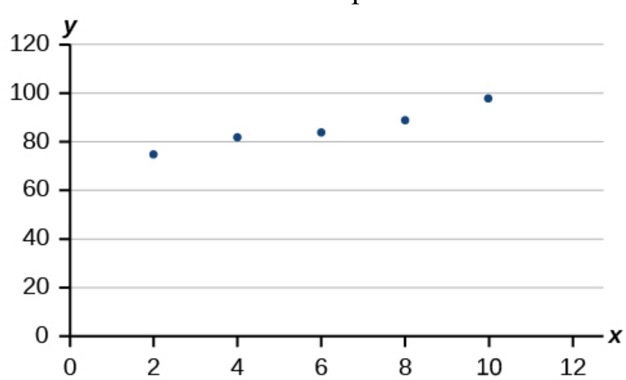
Year	1990	1995	2000	2005	2010
Population	5,600	5,950	6,300	6,600	6,900

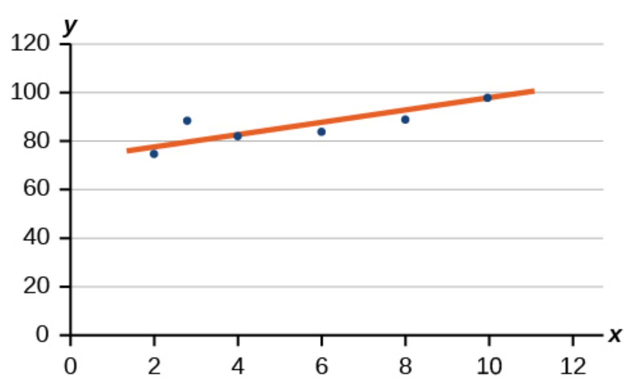
Extrapolation



36. -

37. Draw a best-fit line for the plotted data.





For the following exercises, consider the data in the table, which shows the percent of unemployed in a city of people 25 years or older who are college graduates is given below, by year.

Year	2000	2002	2005	2007	2010
Percent Graduates	6.5	7.0	7.4	8.2	9.0

38. -
39. In what year will the percentage exceed 12%?
    2023
40. -
41. Based on the set of data given in the table, calculate the regression line using a calculator or other technology tool, and determine the correlation coefficient to three decimal places.

x	10	12	15	18	20
y	36	34	30	28	22

$y = -1.294x + 49.412;\ \ r = -0.974$

For the following exercises, consider this scenario: The population of a city increased steadily over a ten-year span. The following ordered pairs show the population and the year over the ten-year span (population, year) for specific recorded years:

$(3{,}600,\ 2000);\ (4{,}000,\ 2001);\ (4{,}700,\ 2003);\ (6{,}000,\ 2006)$

42. -
43. Predict when the population will hit 12,000.
    2027
44. -
45. According to the model, what is the population in 2014?
    7,660

CHAPTER 4 PRACTICE TEST

1. Determine whether the following algebraic equation can be written as a linear function.

$2x + 3y = 7$

Yes

2. -

3. Determine whether the following function is increasing or decreasing. $f(x) = 7x + 9$

Increasing

4. -

5. Find a linear equation, that has an *x* intercept at (–4, 0) and a *y*-intercept at (0, –6), if possible.

$m = \dfrac{-6 - 0}{0 - (-4)}$

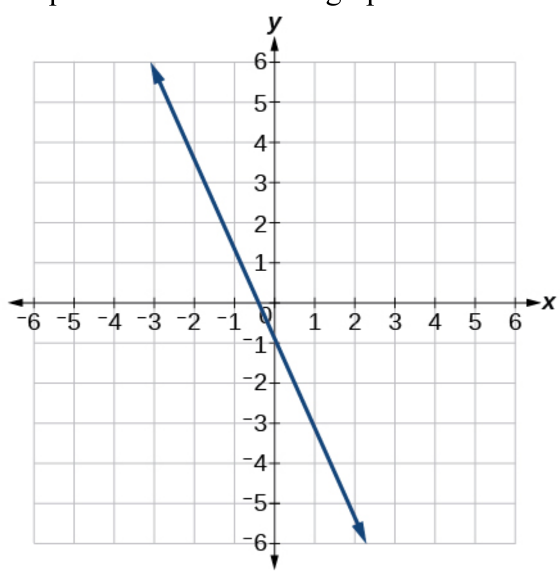
$m = \dfrac{-6}{4}$

$m = -\dfrac{3}{2}$

$y = -1.5x - 6$

6. -

7. Write an equation for line in the graph.



$y = -2x - 1$

8. -

9. Does the table represent a linear function? If so, find a linear equation that models the data.

x	1	3	7	11
$g(x)$	4	9	19	12

No

10. –

For the following exercises, determine whether the lines given by the equations below are parallel, perpendicular, or neither parallel nor perpendicular.

11.

$$y = \frac{3}{4}x - 9$$
$$-4x - 3y = 8$$

$$y = \frac{3}{4}x - 9$$
$$-4x - 3y = 8$$
$$-3y = 8 + 4x$$
$$y = \frac{8}{-3} + \frac{4}{-3}x$$
$$y = \frac{4}{3}x - \frac{8}{3}$$

Perpendicular

12. -

13. Find the x- and y-intercepts of the equation $2x + 7y = -14$.

$$2x + 7y = -14$$
$$7y = -14 - 2x$$
$$y = \frac{-14}{7} - \frac{2x}{7}$$
$$y = \frac{-2}{7}x - 2$$
$$y = \frac{-2}{7}(0) - 2$$
$$y = -2$$
$$0 = \frac{-2}{7}x - 2$$
$$2 = \frac{-2}{7}x$$
$$-7 = x$$
$$(-7,0);\ (0,-2)$$

14. -

15. Write an equation for a line perpendicular to $f(x) = 4x + 3$ and passing through the point $(8,\ 10)$.

$m = -\frac{1}{4}$

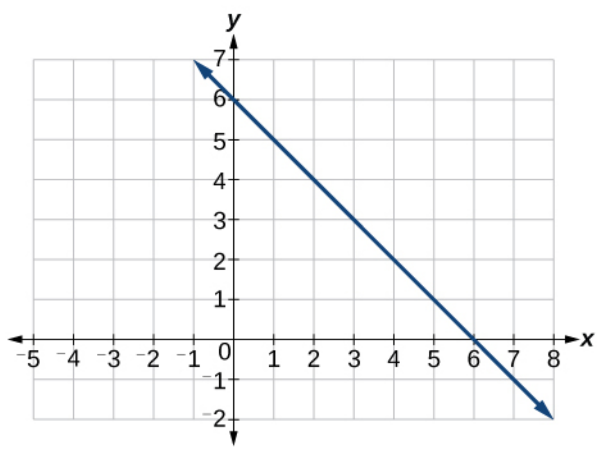
$y - 10 = -\frac{1}{4}(x - 8)$

$y - 10 = -\frac{1}{4}x + 2$

$y = -0.25x + 12$

16. -

17. Graph the linear function $f(x) = -x + 6$.



18. -

19. A car rental company offers two plans for renting a car.
Plan A: $25 per day and $0.10 per mile
Plan B: $40 per day with free unlimited mileage
How many miles would you need to drive for plan B to save you money?

$A = 0.1m + 25$

$B = 40$

$40 = 0.1m + 25$

$15 = 0.1m$

$m = \frac{15}{0.1}$

$m = 150$

More than 150

20. -

21. A town's population increases at a constant rate. In 2010 the population was 65,000. By 2012 the population had increased to 90,000. Assuming this trend continues, predict the population in 2018.

$(0, 65000)$ and $(2,90000)$

$m = \dfrac{90000 - 65000}{2 - 0}$

$m = \dfrac{25000}{2}$

$m = 12500$

$y = 12500x + 65000$

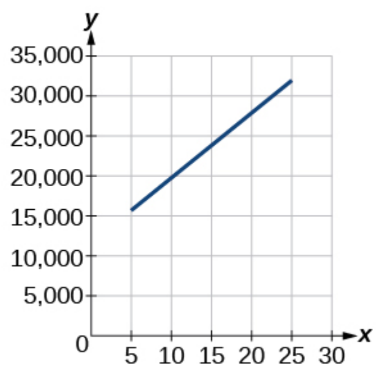
$y = 12500(8) + 65000$

$y = 165000$

165,000

22. –

For the following exercises, use the graph showing the profit, y, in thousands of dollars, of a company in a given year, x, where x represents years since 1980.



23. Find the linear function y, where y depends on x, the number of years since 1980.

$y = 875x + 10,675$

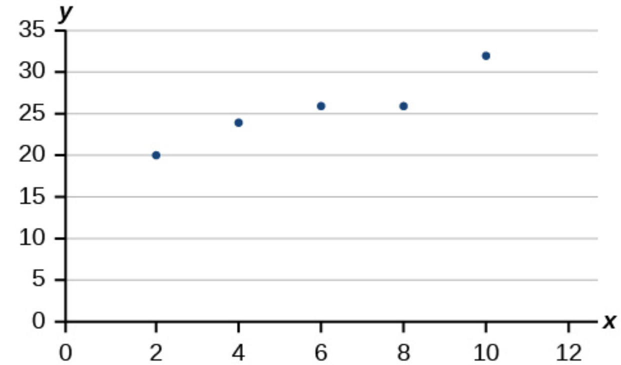
24. -

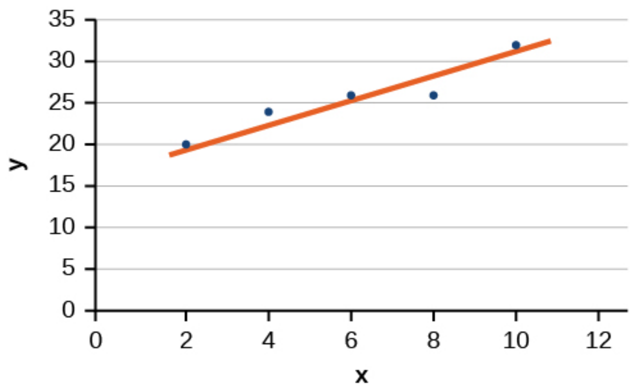
25. In 2004, a school population was 1250. By 2012 the population had dropped to 875. Assume the population is changing linearly.
    a. How much did the population drop between the year 2004 and 2012?
    b. What is the average population decline per year?
    c. Find an equation for the population, P, of the school t years after 2004.

a) 375 b) dropped an average of 46.875, or about 47 people per year c) $y = -46.875t + 1250$

26. -

27. Draw a best-fit line for the plotted data.

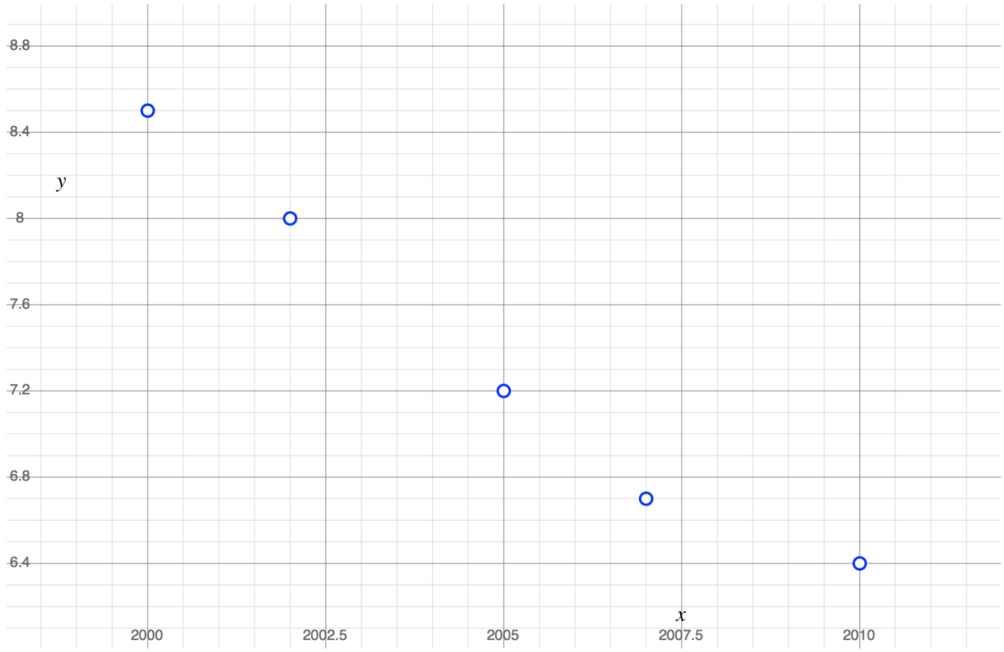




For the following exercises, use the table, which shows the percent of unemployed persons 25 years or older who are college graduates in a particular city, by year.

Year	2000	2002	2005	2007	2010
Percent Graduates	8.5	8.0	7.2	6.7	6.4

28. -



$y = -0.219x + 445.990$

Yes, linear.

29. In what year will the percentage drop below 4%?

Early in 2018

30. -

For the following exercises, consider this scenario: The population of a city increased steadily over a ten-year span. The following ordered pairs shows the population (in hundreds) and the year over the ten-year span, (population, year) for specific recorded years:

$(4{,}500,\ 2000);\ (4{,}700,\ 2001);\ (5{,}200,\ 2003);\ (5{,}800,\ 2006)$

31. Use linear regression to determine a function y, where the year depends on the population. Round to three decimal places of accuracy.

$y = 0.00455x + 1979.5$

32. -

33. What is the correlation coefficient for this model?

$r = 0.999$