Finite Mathematics and Its Applications 13th edition Goldstein Solutions Manual

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Instructor's Solutions Manual

Finite Mathematics and Its Applications

Thirteenth Edition

Larry J. Goldstein

Goldstein Educational Technologies

David I. Schneider

University of Maryland

Martha J. Siegel

Towson University

Pearson

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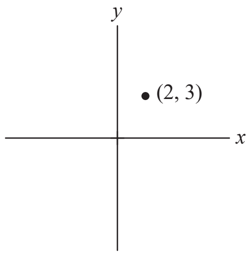
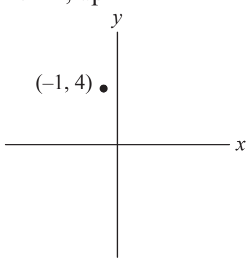
Chapter 1

Exercises 1.1

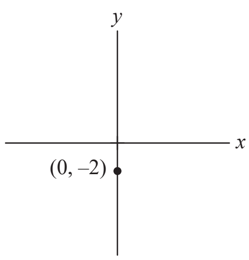
1. Right 2, up 3



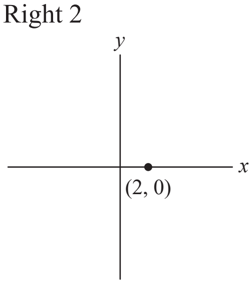
2. Left 1, up 4



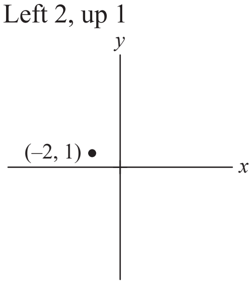
3. Down 2



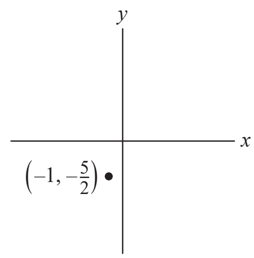
4. Right 2



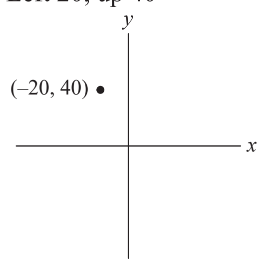
5. Left 2, up 1



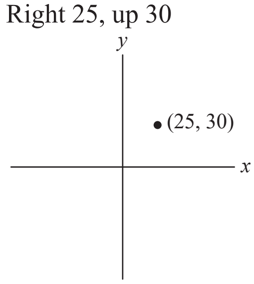
6. Left 1, down $\frac{5}{2}$



7. Left 20, up 40



8. Right 25, up 30



9. Point Q is 2 units to the left and 2 units up or $(-2, 2)$.

10. Point P is 3 units to the right and 2 units down or $(3, -2)$.

11. $-2(1)+\frac{1}{3}(3)=-2+1=-1$ so yes the point is on the line.

12. $-2(2)+\frac{1}{3}(6)=-1$ is false, so no the point is not on the line

13. $-2x+\frac{1}{3}y=-1$ Substitute the x and y coordinates of the point into the equation:
$\left(\frac{1}{2},3\right)\rightarrow -2\left(\frac{1}{2}\right)+\frac{1}{3}(3)=-1\rightarrow -1+1=-1$ is a false statement. So no the point is not on the line.

14. $-2\left(\frac{1}{3}\right)+\left(\frac{1}{3}\right)(-1)=-1$ is true so yes the point is on the line.

15. $m = 5$, $b = 8$

16. m = –2 and b = –6

17. $y = 0x + 3$; $m = 0$, $b = 3$

18. $y=\frac{2}{3}x+0$; $m=\frac{2}{3}$, $b=0$

19.
$$14x+7y=21$$
$$7y=-14x+21$$
$$y=-2x+3$$

20.
$$x-y=3$$
$$-y=-x+3$$
$$y=x-3$$

21.
$$3x=5$$
$$x=\frac{5}{3}$$

22.
$$-\frac{1}{2}x+\frac{2}{3}y=10$$
$$\frac{2}{3}y=\frac{1}{2}x+10$$
$$y=\frac{3}{4}x+15$$

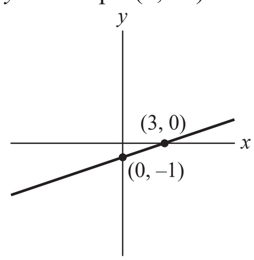
23.
$$0=-4x+8$$
$$4x=8$$
$$x=2$$
x-intercept: (2, 0)
$y = –4(0) + 8$
$y = 8$
y-intercept: (0, 8)

24. 0 = 5
no solution
x-intercept: none
When $x = 0$, $y = 5$
y-intercept: (0, 5)

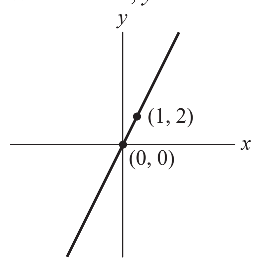
25. When $y = 0$, $x = 7$
x-intercept: (7, 0)
0 = 7
no solution
y-intercept: none

26. $0 = –8x$
$x = 0$
x-intercept: (0, 0)
$y = –8(0)$
$y = 0$
y-intercept: (0, 0)

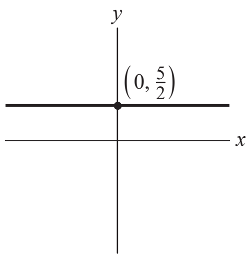
27. $0=\frac{1}{3}x-1$
$x = 3$
x-intercept: (3, 0)
$y=\frac{1}{3}(0)-1$
$y = –1$
y-intercept: (0, –1)



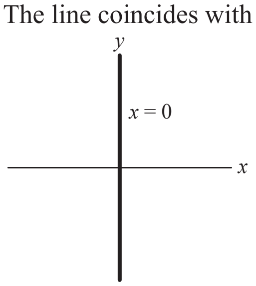
28. When $x = 0$, $y = 0$.
When $x = 1$, $y = 2$.



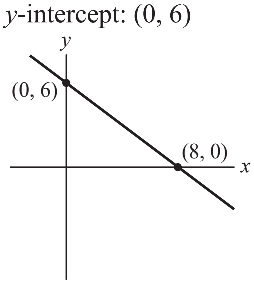
29. $0 = \frac{5}{2}$
no solution
x-intercept: none
When $x = 0$, $y = \frac{5}{2}$
y-intercept: $\left(0, \frac{5}{2}\right)$



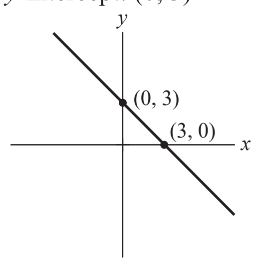
30. The line coincides with the y-axis.



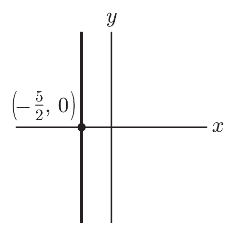
31. $3x + 4(0) = 24$
$x = 8$
x-intercept: (8, 0)
$3(0) + 4y = 24$
$y = 6$
y-intercept: (0, 6)



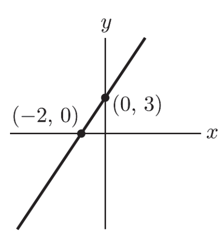
32. $x + 0 = 3$
$x = 3$
x-intercept: (3, 0)
$0 + y = 3$
$y = 3$
y-intercept: (0, 3)



33. $x = -\frac{5}{2}$



34. $\frac{1}{2}x - \frac{1}{3}(0) = -1$
$x = -2$
x intercept (–2, 0)
$\frac{1}{2}(0) - \frac{1}{3}y = -1$
$y = 3$
y intercept (0, 3)



35. $2x+3y=6$

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

a. $4x+6y=12$

$$6y=-4x+12$$
$$y=-\frac{2}{3}x+2$$

Yes

b. Yes

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

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

Yes

d. $6-2x-y=0$

$$y=6-2x=-2x+6$$

No

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

Yes

f. $x+y=1$

$$y=-x+1$$

No

36. $\frac{1}{2}x-5y=1$

$$-5y=-\frac{1}{2}x+1$$
$$y=\frac{1}{10}x-\frac{1}{5}$$

a. $2x-\frac{1}{5}y=1$

$$-\frac{1}{5}y=-2x+1$$
$$y=10x-5$$

No

b. $x=5y+2$

$$5y=x-2$$
$$y=\frac{1}{5}x-\frac{2}{5}$$

No

c. $2-5x+10y=0$

$$-10y=-5x+2$$
$$y=\frac{1}{2}x-\frac{1}{5}$$

No

d. $y=.1(x-2)$

$$y=.1x-.2$$
$$y=\frac{1}{10}x-\frac{1}{5}$$

Yes

e. $10y-x=-2$

$$10y=x-2$$
$$y=\frac{1}{10}x-\frac{1}{5}$$

Yes

f. $1+.5x=2+5y$

$$5y=.5x-1$$
$$y=\frac{1}{10}x-\frac{1}{5}$$

Yes

37. a. $x+y=3$

$y=-x+3$

$m=-1, b=3$

L_3

b. $2x-y=-2$

$-y=-2x-2$

$y=2x+2$

$m=2, b=2$

L_1

c. $x=3y+3$

$3y=x-3$

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

$m=\frac{1}{3},\ b=-1$

L_2

38. a. No; $5+4\neq 3$

b. No; $2\neq 1-1$

c. Yes; $2(2)=1+3$ and $2(4)=5+3$

39. $y=30x+72$

a. When x = 0, y = 72. This is the temperature of the water at time = 0 before the kettle is turned on.

b. $y=30(3)+72$

$y=162^\circ F$

c. Water boils when y = 212 so we have $212=30x+72.$ Solving for x gives $x=4\frac{2}{3}$ minutes or 4 minutes 40 seconds.

40. a. A person born in 1960 has a life expectancy of 70 years.

b. $75=\left(\frac{1}{6}\right)x+70$

$5=\left(\frac{1}{6}\right)x$

$x=30$

$1960+30=1990$

c. $2004-1960=44$

$y=\left(\frac{1}{6}\right)(44)+70$

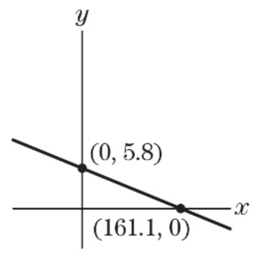
$y=7.33+70$

$y=77.33$

A person born in 2004 has a life expectancy of 77.3 years.

41. a. x-intercept: $\left(161\frac{1}{9},\ 0\right)$

y-intercept: (0, 5.8)



b. In 2004, 5.8 trillion cigarettes were sold.

c. $5.5=-.036x+5.8$

$x=8.33$

$2004+8=2012$

d. $2028-2004=24$

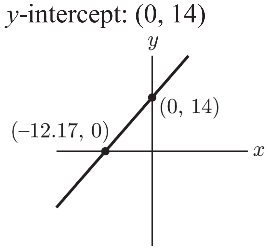
$y=-.036(24)+5.8$

$y=4.936$

4.9 trillion

42. a. x-intercept: (–12.17, 0)

y-intercept: (0, 14)



b. In 2010 the income from ecotourism was $14,000.

c. $20=1.15x+14$

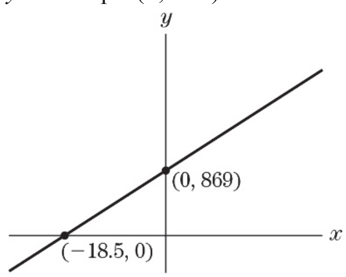
$x\approx 5.22$

$2010+5.22=2015.22$

The year 2015 should have had $20,000 in ecotourism income.

d. $2032 - 2010 = 22$
$y = 1.15(22) + 14$
$y = 39.3$
\$39,300

43. a. x-intercept: $(-18.5, 0)$
y-intercept: $(0, 869)$

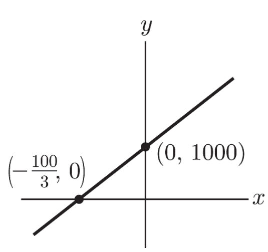


b. In 2014 the car insurance rate for a small car was \$869.

c. $2017 - 2014 = 3$
$y = 47(3) + 869$
$y = 1010$
\$1010

d.
$$1480 = 47x + 869$$
$$611 = 47x$$
$$x = 13$$
$2014 + 13 = 2027$
The yearly rate will be \$1480 in 2027.

44. a. x-intercept: $\left(-\frac{100}{3}, 0\right)$
y-intercept: $(0, 1000)$



b.
$$y = 30(2) + 1000$$
$$y = 60 + 1000$$
$$y = 1060$$
\$1060 will be in the account after 2 years.

c.
$$1180 = 30x + 1000$$
$$180 = 30x$$
$$x = 6$$
The balance will be \$1180 after 6 years.

45. a. In 2010, 6.1% of entering college freshmen intended to major in biology.

b. $2019 - 2010 = 9$
$$y = \tfrac{1}{6}(9) + 6.1$$
$$y = 7.6$$
7.6% of college freshmen in 2019 intended to major in biology.

c.
$$6.8 = \tfrac{1}{6}x + 6.1$$
$$0.7 = \tfrac{1}{6}x$$
$$x = 4.2$$
$2010 + 4 = 2014$
In 2014, the percent of college freshmen who intended to major in biology was 6.8%.

46. a. In 2010, 46.4% of college freshmen considered themselves middle-of-the-road politically.

b. $2016 - 2010 = 6$
$$y = 46.4 - 0.31(6)$$
$$y = 44.54$$
44.5% of college freshmen considered themselves middle-of-the-road politically in 2016.

c.
$$43.9 = 46.4 - 0.31x$$
$$-2.5 = -0.31x$$
$$x \approx 8$$
$2010 + 8 = 2018$
In 2018, the percent of college freshmen that considered themselves middle-of-the-road was 43.9%.

47. a. $2018 - 2012 = 6$
$$y = 433(6) + 21{,}593$$
$$y = 24{,}191$$
\$24,191 was the approximate average tuition in 2018.

b. $28,600 = 433x + 21,593$
$7007 = 433x$
$x \approx 16.2$
$2012 + 16 = 2028$
In 2028, the approximate average cost of tuition will be more than \$28,600.

48. a. $2015 - 2011 = 4$
$y = 1121(4) + 17,182$
$y = 21,666$
Approximately 21,666 bachelor's degrees in mathematics and statistics were awarded in 2015.

b. $34,000 = 1121x + 17,182$
$16,818 = 1121x$
$x \approx 15.002$
$2011 + 15 = 2026$
In 2026, there will be more than 34,000 bachelor's degrees in mathematics and statistics awarded.

49. $y = mx + b$
$8 = m(0) + b$
$b = 8$
$0 = m(16) + 8$
$m = -\frac{1}{2}$
$y = -\frac{1}{2}x + 8$

50. $y = mx + b$
$0.9 = m(0) + b$
$b = 0.9$
$0 = m(0.6) + 0.9$
$m = -1.5$
$y = -1.5x + 0.9$

51. $y = mx + b$
$5 = m(0) + b$
$b = 5$
$0 = m(4) + 5$
$m = -\frac{5}{4}$
$y = -\frac{5}{4}x + 5$

52. Since the equation is parallel to the y axis, it will be in the form x = a. Therefore, the equation will be x = 5.

53. On the x-axis, $y = 0$.

54. No, because two straight lines (the graphed line and the x-axis) cannot intersect more than once.

55. The equation of a line parallel to the y axis will be in the form x = a**.**

56. y = b is an equation of a line parallel to the x-axis.

57. $2x - y = -3$

58. $-3x + y = -4$

59. $\frac{2}{3}x + y = -5$
$2x + 3y = -15$

60. $4x - y = \frac{5}{6}$
$24x - 6y = 5$

61. Since (a,0) and (0,b) are points on the line the slope of the line is (b-0)/(0-a) = -b/a. Since the y intercept is (0,b), the equation of the line is $y = -(b/a)x + b$ or $ay = -bx + ab.$ In general form, the equation is bx + ay = ab.

62. If (5, 0) and (0, 6) are on the line, then a = 5 and b = 6. Substituting these values into the equation bx + ay = ab gives 6x + 5y = 30.

63. One possible equation is $y = x - 9.$

64. One possible equation is $y = x + 10.$

65. One possible equation is $y = x + 7.$

66. One possible equation is $y = x - 6.$

67. One possible equation is $y = x + 2.$

68. One possible equation is $y = x.$

69. One possible equation is $y = x + 9.$

70. One possible equation is $y = x - 5$.

71. The x – intercept has a y coordinate of 0, therefore the x coordinate of the first equation is:

$$0 = \frac{2}{3}x - 2$$
$$2 = \frac{2}{3}x$$
$$3 = x$$

Using this x coordinate in the second equation will find the value of c.

$$0 = -4(3) + c$$
$$0 = -12 + c$$
$$12 = c$$

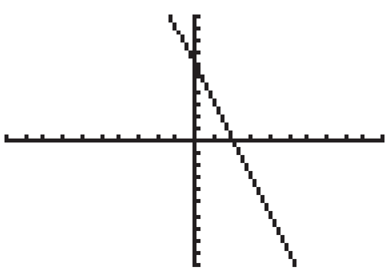
72. The y – intercept has a x coordinate of 0, therefore the y coordinate of the first equation is:

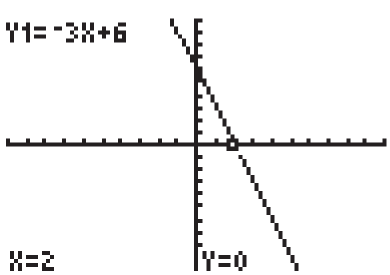
$$6(0) - 3y = 9$$
$$-3y = 9$$
$$y = -3$$

Using this y coordinate in the second equation will find the value of b.

$$-3 = 4(0) + b$$
$$-3 = b$$

73. **a.** y = –3x + 6

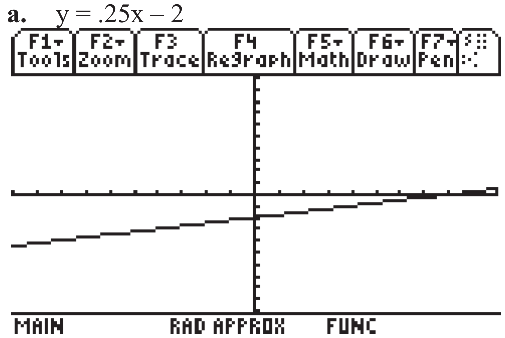




b. The intercepts are at the points (2, 0) and (0, 6)

c. When $x = 2$, $y = 0$

74. **a.** y = .25x – 2

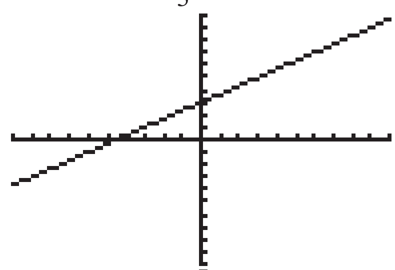


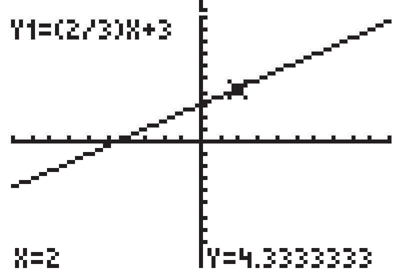
b. (0, –2) and (8,0) are intercepts

c. When x = 2, y = –1.5.

75. **a.** $3y - 2x = 9$

$$3y = 2x + 9$$
$$y = \frac{2}{3}x + 3$$

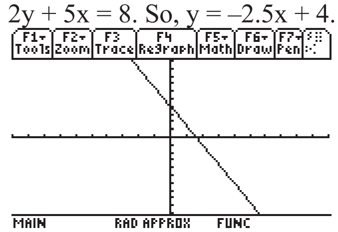




b. The intercepts are at the points (–4.5, 0) and (0, 3).

c. When $x = 2$, $y = 4.33$ or 13 / 3.

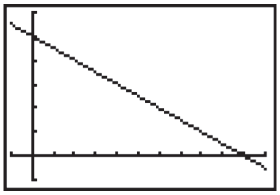
76. **a.** 2y + 5x = 8. So, y = –2.5x + 4.



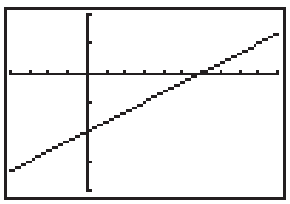
b. The intercepts are (0, 4) and (1.6, 0).

c. When x = 2 then y = –1.

77. 2y + x = 100. When y = 0, x = 100, and when x = 0, y = 50. An appropriate window might be [-10, 110] and [-10,60]. Other answers are possible.



78. x – 3y = 60. When x = 0, then y = - 20 and when y = 0 x = 60. An appropriate window might be [-40, 100] and [-40 , 20] but other answers are equally correct.



Exercises 1.2

1. $m = \frac{2}{3}$

2. $y = 0x - 4$
$m = 0$

3. $y - 3 = 5(x + 4)$
$y = 5x + 23$
$m = 5$

4. $7x + 5y = 10$

$$y = -\frac{7}{5}x + 2$$

$$m = -\frac{7}{5}$$

5. $\frac{x}{5} + \frac{y}{4} = 6$

$$\frac{4x}{5} + y = 24$$

$$y = -\frac{4}{5}x + 24$$

$$m = -\frac{4}{5}$$

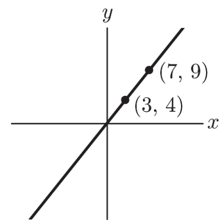
6. $\frac{x}{7} - \frac{y}{8} = 1$

$$\frac{8x}{7} - y = 8$$

$$y = \frac{8}{7}x - 8$$

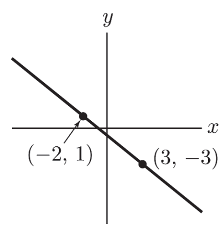
$$m = \frac{8}{7}$$

7.



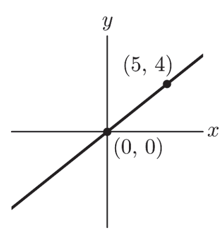
$$m = \frac{9-4}{7-3} = \frac{5}{4}$$

8.

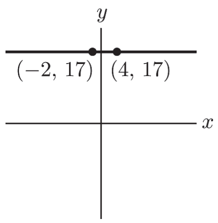


$$m = \frac{-3-1}{3-(-2)} = -\frac{4}{5}$$

9.



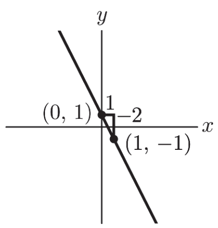
$$m = \frac{4-0}{5-0} = \frac{4}{5}$$

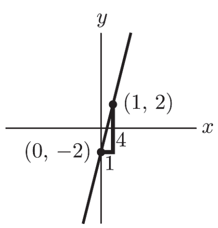
10. 

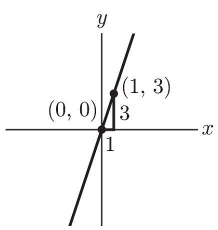
$m = \dfrac{17-17}{-2-4} = 0$

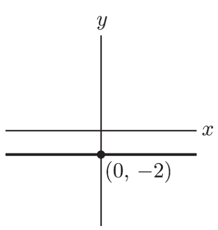
11. The slope of a vertical line is undefined.

12. The slope of a vertical line is undefined.

13. 

14. 

15. 

16. 

17. $m = \dfrac{-2}{1} = -2$

$y - 3 = -2(x - 2)$

$y = -2x + 7$

18. $m = \dfrac{\frac{1}{2}}{1} = \dfrac{1}{2}$

$y - 1 = \dfrac{1}{2}(x - 3)$

$y = \dfrac{1}{2}x - \dfrac{1}{2}$

19. $m = \dfrac{0-2}{2-1} = -2$

$y - 0 = -2(x - 2)$

$y = -2x + 4$

20. $m = \dfrac{2-\frac{1}{2}}{1-(-1)} = \dfrac{3}{4}$

$y - 2 = \dfrac{3}{4}(x - 1)$

$y = \dfrac{3}{4}x + \dfrac{5}{4}$

21. $m = -\dfrac{1}{-4} = \dfrac{1}{4}$

$y - 2 = \dfrac{1}{4}(x - 2)$

$y = \dfrac{1}{4}x + \dfrac{3}{2}$

22. $m = \dfrac{1}{3}$

$y - 3 = \dfrac{1}{3}(x - 5)$

$y = \dfrac{1}{3}x + \dfrac{4}{3}$

23. $m = -1$

$y - 0 = -1(x - 0)$

$y = -x$

24. $m = -\dfrac{1}{-\frac{1}{2}} = 2$

$y - (-1) = 2(x - 2)$

$y = 2x - 5$

25. $m = \dfrac{-1-1}{1-0} = \dfrac{-2}{1} = -2$

$y - (1) = -2(x - 0)$

$y = -2x + 1$

26. $m = \frac{-2-1}{0-1} = \frac{-3}{-1} = 3$
$y - (1) = 3(x - 1)$
$y = 3x - 2$

27. $m = \frac{0-2}{-4-0} = \frac{-2}{-4} = \frac{1}{2}$

$y - 0 = \frac{1}{2}(x + 4)$
$y = \frac{1}{2}x + 2$

28. $m = \frac{0-1}{3-0} = \frac{-1}{3} = -\frac{1}{3}$
$y - 0 = -\frac{1}{3}(x - 3)$
$y = -\frac{1}{3}x + 1$

29. $m = 0$
$y - 3 = 0(x - 2)$
$y = 3$

30. m = undefined, therefore the equation is of the form $x = a$.
$x = 2$

31. $y - 6 = \frac{3}{5}(x - 5)$
$y = \frac{3}{5}x + 3$
y-intercept: (0, 3)

32. $m = \frac{6-3}{4-(-1)} = \frac{3}{5}$

$y - 6 = \frac{3}{5}(x - 4)$
$y - 6 = \frac{3}{5}x - \frac{12}{5}$
$y = \frac{3}{5}x + \frac{18}{5}$
y-intercept: $(0, \frac{18}{5})$

33. m = undefined, therefore the equation is of the form $x = a$.
$x = 0$

34. $m = \frac{4-4}{0-1} = 0$

$y - 4 = 0(x - 0)$
$y = 4$

35. Let y = cost in dollars.
$y = 9x + 3100$

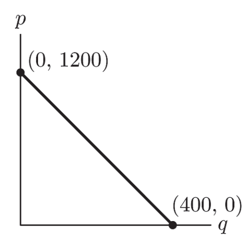
36. a. p-intercept: (0, 1200); at \$1200 no one will buy the item.

b. $0 = -3q + 1200$
$q = 400$ units
q-intercept: (400, 0); even if the item is given away, only 400 will be taken.

c. –3; to sell an additional item, the price must be reduced by \$3.

d. $p = -3(350) + 1200 = \$150$

e. $300 = -3q + 1200$
$q = 300$ items

f.


37. a. Let x = altitude and y = boiling point.
$m = \frac{212-202.8}{0-5000} = -0.00184$
$y - 212 = -0.00184(x - 0)$
$y = -0.00184x + 212$

b. $y \approx -0.00184x + 212$
$y \approx -0.00184(29029) + 212$
$y \approx 158.6^\circ \text{F}$

38. a. $m = \frac{172-124}{80-68} = 4$
$c - 124 = 4(F - 68)$
$c = 4F - 148$

b. $F = \frac{1}{4}c + 37,$ so add 37 to the number of chirps counted in 15 seconds $\left(\frac{1}{4} \text{ of a minute}\right).$

39. a. Let x = quantity and y = cost.

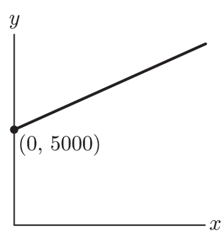
$$m = \frac{9500 - 6800}{50 - 20} = 90$$

$$y - 6800 = 90(x - 20)$$
$$y = 90x + 5000$$

b. \$5000

c. \$90

d.



40. a. $y = 40(100) + 2400 = \$6400$

b. $3600 = 40x + 2400$
$x = 30$ coats

c. $y = 40(0) + 2400 = \$2400$
(0, 2400); even if no coats are made there is a cost for having the ability to make them.

d. 40; each additional coat costs \$40 to make.

41. a. 100(300) = \$30,000

b. $6000 = 100x$
$x = 60$ coats

c. $y = 100(0) = 0$
(0, 0); if no coats are sold, there is no revenue.

d. 100; each additional coat yields an additional \$100 in revenue.

42. a. Profit = revenue – cost
$y = 100x - (40x + 2400)$
$y = 60x - 2400$

b. (0, –2400); if no coats are sold, \$2400 will be lost.

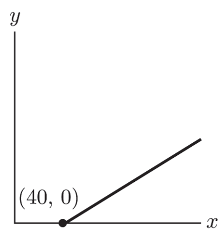
c. $0 = 60x - 2400$
$x = 40$
(40, 0); the break-even point is 40 coats. Less than 40 coats sold yields a loss, more than 40 yields a profit.

d. 60; each additional coat sold yields an additional \$60 profit.

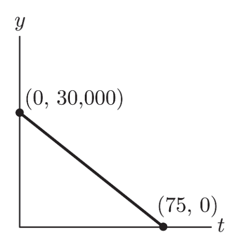
e. $y = 60(80) - 2400 = \$2400$

f. $6000 = 60x - 2400$
$x = 140$ coats

g.



43. a.



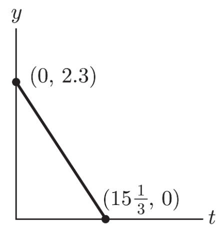
b. On February 1, 31 days have elapsed since January 1. The amount of oil y = 30,000 – 400(31) = 17,600 gallons.

c. On February 15, 45 days have elapsed since January 1. Therefore, the amount of oil would be y = 30,000- 400(45) = 12,000 gallons.

d. The significance of the y-intercept is that amount of oil present initially on January 1. This amount is 30,000 gallons.

e. The t-intercept is (75,0) and corresponds to the number of days at which the oil will be depleted.

44. a.



b. $y = 2.3 - 0.15(15) = \$0.05$ million
$50,000

c. (0, 2.3); $2.3 million is the amount of cash reserves on July 1.

d. $0 = 2.3 - 0.15t$

$t = 15\frac{1}{3}$

$\left(15\frac{1}{3}, 0\right)$; the cash reserves will be depleted after $15\frac{1}{3}$ days.

e. $y = 2.3 - 0.15(3) = \$1.85$ million

f. $0.8 = 2.3 - 0.15t$
$t = 10$
After 10 days, on July 11

45. a. $y = 0.10x + 310$

b. $y = 0.10(4000) + 310$
$y = 710$

c. $920 = 0.10x + 310$
$x = \$6100$

46. Each unit sold yields a commission of $5. In addition, she receives $60 per week base pay.

47. $m = -\frac{1}{2},\ b = 0$

$y = -\frac{1}{2}x$

48. $m = 3, b = -1$
$y = 3x - 1$

49. $m = -\frac{1}{3}$

$y - (-2) = -\frac{1}{3}(x - 6)$

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

50. $m = 1$
$y - 2 = 1(x - 1)$
$y = x + 1$

51. $m = \frac{1}{2}$

$y - (-3) = \frac{1}{2}(x - 2)$

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

52. $m = -7$
$y - 0 = -7(x - 5)$
$y = -7x + 35$

53. $m = -\frac{2}{5}$

$y - 5 = -\frac{2}{5}(x - 0)$

$y = -\frac{2}{5}x + 5$

54. $m = 0$
$y - 4 = 0(x - 7)$
$y = 4$

55. $m = \frac{3 - (-3)}{-1 - 5} = -1$
$y - 3 = -1[x - (-1)]$
$y = -x + 2$

56. $m = \frac{2 - 1}{4 - 2} = \frac{1}{2}$

$y - 1 = \frac{1}{2}(x - 2)$

$y = \frac{1}{2}x$

57. $m = \frac{-1 - (-1)}{3 - 2} = 0$
$y - (-1) = 0(x - 2)$
$y = -1$

58. $m = \frac{-2-0}{1-0} = -2$

$y = -2x$

59. Changes in x-coordinate: 1, –1, –2
Changes in y-coordinate are m times that or 2, –2, –4: new y values are 5, 1, –1

60. Change in x coordinates are 1, 2, –1.
Change in y coordinates are m times that or –3, –6, 3. New y values are –1, –4, 5.

61. The slope is $\frac{-1}{4}$ Changes in x coordinates are 1, 2, –1. Changes in y coordinates are m times the x coordinate changes. New y coordinates are

$\frac{-5}{4}, \frac{-3}{2}, \frac{-3}{4}$

62. Changes in x-coordinate: 1, 2, 3
Changes in y-coordinate are m times that:

$\frac{1}{3}, \frac{2}{3}, 1$

y-coordinates:

$2+\frac{1}{3}=\frac{7}{3},\ 2+\frac{2}{3}=\frac{8}{3},\ 2+1=3$

$\frac{7}{3}; \frac{8}{3}; 3$

63. **a.** $x + y = 1$

$y = -x + 1$

(C)

b. $x - y = 1$

$y = x - 1$

(B)

c. $x + y = -1$

$y = -x - 1$

(D)

d. $x - y = -1$

$y = x + 1$

(A)

64. $m = \frac{4.8-3.6}{4.9-4.8} = 12;$

$y - 6 = 12(x - 5)$

$y = 12x - 54$

$b = -54$

65. One possible equation is $y = x + 1$.

66. One possible equation is $y = -x + 1$.

67. One possible equation is $y = 5$.

68. One possible equation is $x = 2$.

69. One possible equation is $y = -\frac{2}{3}x$.

70. One possible equation is $y = \frac{6}{5}x$.

71. $m = \frac{212-32}{100-0} = \frac{9}{5}$

$F - 32 = \frac{9}{5}(C - 0)$

$F = \frac{9}{5}C + 32$

72. Let x = years B.C. and y = feet.

$m = \frac{8-4}{2100-1500} = \frac{1}{150}$

$y - 4 = \frac{1}{150}(x - 1500)$

$y = \frac{1}{150}x - 6$

$y = \frac{1}{150}(3000) - 6 = 14\,ft$

73. Let 2010 correspond to x = 0. So in 2018, x = 8. When x = 0, tuition is 7132. When x = 8, tuition is 9212. Using (0,7132) and (8,9212) as ordered pairs, find the slope of the line containing these points: $\frac{9212-7132}{8-0} = \frac{2080}{8}$. Since the y-intercept is 7132, the equation becomes $y = 260x + 7132$. Therefore, in 2016 when x = 6, the tuition should approximately be $y = 260(6) + 7132 = \$8692$.

74. Let 2012 correspond to x = 0. So in 2018, x = 6. When x = 0, enrollment was 7.2 million. When x = 6, enrollment was 5.7 million. Using (0,7.2) and (6,5.7) as ordered pairs, find the slope of the line containing these points:

$\frac{5.7-7.2}{6-0} = \frac{-1.5}{6} = -0.25$. Since the y-intercept is 7.2, the equation becomes $y = -0.25x + 7.2$.

Therefore, the enrollment was at 6.4 million when $y = 6.4$ in $y = -0.25x + 7.2$

$6.4 = -0.25x + 7.2$

$3.2 = x$

Since x is the number of years after 2012, the enrollment was 6.4 million around 2015.

75. Let x = number of pounds tires are under inflated. When x = 0, the miles per gallon (y) is 25. When x = 1, mpg decreases to 24.5. The equation is $y = -\frac{1}{2}x + 25$. Thus, when x = 8 pounds the miles per gallon will be $y = -\frac{1}{2}(8) + 25 = 21$ mpg.

76. The slope is $\frac{4,599,200 - 3,439,700}{10} = 115,950$.
The equation is y = 115,950x + 3,439,700. When x = 6 (2025), y = 115,950(6) + 3,439,700 =4,135,400.

77. Let 2014 correspond to x = 0 and 2019 correspond to x = 5. Then, the two ordered pairs are on the line: (0, 358132) and (5,390564). The slope of the line is $\frac{390,564 - 358,132}{5 - 0} = 6486.4$ The equation of the line is therefore $y = 6486.4x + 358,132$. In the year 2026, x = 12, so the number of Bachelor's degrees awarded can be estimated as $y = 6486.4(12) + 358,132 = 435,969$.

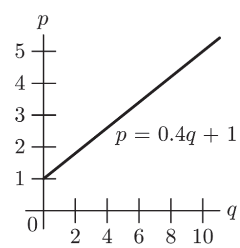
78. The slope is $\frac{6355 - 4929}{10} = 142.6$. The equation is $y = 142.6x + 4929$. Find x when y = 7355. We have $7355 = 142.6x + 4929$. Solving for x gives x about 17.01 years or in the year 2027.

79. Let 2016 correspond to x = 0 and 2021 correspond to x = 5. Then, the two ordered pairs are on the line: (0, 4.8) and (5,5.5). The slope of the line is $\frac{5.5 - 4.8}{5 - 0} = \frac{0.7}{5} = \frac{7}{50}$. The equation of the line is therefore $y = \frac{7}{50}x + 4.8$. In the year 2019, x = 3, so the cost of a 30-second advertising slot (in millions) can be estimated as $y = \frac{7}{50}(3) + 4.8 \approx \$5.2$ million.

80. The slope is $\frac{500 - 3000}{4 - 0} = -625$. The equation is $y = -625x + 3000$.

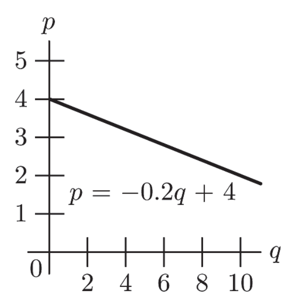
81. The slope is $\frac{3.4 - 3}{6 - 5} = 0.4$

$$\begin{aligned} p - p_1 &= m(q - q_1) \\ p - 3 &= 0.4(q - 5) \\ p - 3 &= 0.4q - 2 \\ p &= 0.4q + 1 \end{aligned}$$



82. The slope is $\frac{3.1 - 3}{4.5 - 5} = \frac{0.1}{-0.5} = -0.2$

$$\begin{aligned} p - p_1 &= m(q - q_1) \\ p - 3 &= -0.2(q - 5) \\ p - 3 &= -0.2q + 1 \\ p &= -0.2q + 4 \end{aligned}$$



83. $m_1 = \frac{4 - 3}{2 - 1} = 1$

$m_2 = \frac{-1 - 4}{3 - 2} = -5$

$m_1 \neq m_2$

84. Set two slopes equal:

$$\frac{7-5}{2-1}=\frac{k-7}{3-2}$$
$$2=k-7$$
$$k=9$$

85. Set slopes equal:

$$\frac{-3.1-1}{2-a}=\frac{2.4-0}{3.8-(-1)}$$
$$\frac{-4.1}{2-a}=\frac{1}{2}$$
$$-8.2=2-a$$
$$a=10.2$$

86. Make slopes negative inverses of each other:

$$\frac{-3.1-1}{2-a}=-\frac{1}{\frac{2.4-0}{3.8-(-1)}}$$
$$\frac{-4.1}{2-a}=-2$$
$$4.1=4-2a$$
$$a=-.05$$

87. Solve $mx+b=m'x+b'$

$$(m-m')x=b'-b$$
$$x=\frac{b'-b}{m-m'},$$

which is defined if and only if $m\neq m'$.

88. $l_1: y=m_1x$

$l_2: y=m_2x$

So the vertical segment lies on $x = 1$.

Then

$$1^2+m_1^2=a^2$$
$$1^2+(-m_2)^2=b^2$$

Add equations and rearrange:

$$a^2+b^2-(m_1^2+m_2^2)=2$$

l_1 and l_2 are perpendicular if and only if

$$a^2+b^2=(m_1-m_2)^2=m_1^2+m_2^2-2m_1m_2$$

or $a^2+b^2-(m_1^2+m_2^2)=-2m_1m_2$

Substitute: $2=-2m_1m_2$

Therefore, the product of the slopes are –1.

89. Let x = Centigrade temperature
y = Fahrenheit temperature

$$m=\frac{212-32}{100-0}=1.8$$
$$y=1.8x+32$$
$$y=1.8(30)+32=86°\text{F}$$

90. Let x = weight
y = cost

$$m=\frac{38-5}{60-0}=\frac{11}{20}$$
$$y=\frac{11}{20}x+5$$
$$y=\frac{11}{20}(20)+5=\$16.00$$

91. Let x = number of T-shirts

profit = revenue – cost

$$65,000=12.50x-(8x+25,000)$$
$$90,000=4.50x$$
$$x=20,000$$

So 20,000 T-shirts must be produced and sold.

92. Let x = number of units

profit = revenue – cost

$$2,000,000=130x-(100x+1,000,000)$$
$$3,000,000=30x$$
$$x=100,000 \text{ units}$$

93. $q=800-4(150)$

$=200$ bikes

revenue = 150(200) = $30,000

94. $n=2200-25(8)$

$=2000$ cameras

revenue = 8(2000) = $16,000

95. Let x = variable costs

For 2021: profit = revenue – cost

$$400,000=100(50,000)-(50,000x+600,000)$$
$$50,000x=4,000,000$$
$$x=\$80 \text{ per unit}$$

For 2022:
Let y = 2022 price
profit = revenue – cost

$$400{,}000 = 50{,}000y - [80(50{,}000) + 600{,}000 + 200{,}000]$$
$$5{,}200{,}000 = 50{,}000y$$
$$y = \$104$$

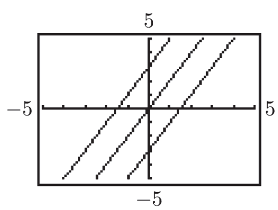
96. Let x = variable costs
For 2015: profit = revenue – costs

$$300{,}000 = 100(50{,}000) - (50{,}000x + 800{,}000)$$
$$50{,}000x = 3{,}900{,}000$$
$$x = \$78 \text{ per unit}$$

For 2016:
Let y = 2016 price
profit = revenue – cost

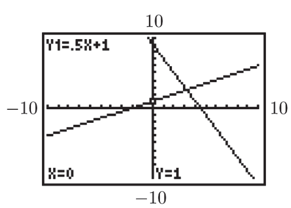
$$300{,}000 = 50{,}000y - [78(50{,}000) + 800{,}000 + 200{,}000]$$
$$5{,}200{,}000 = 50{,}000y$$
$$y = \$104$$

97

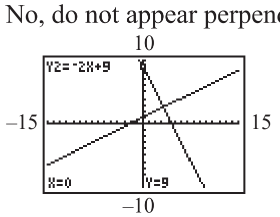


From left to right the lines are $y = 2x + 3$, $y = 2x$, and $y = 2x - 3$.
The lines are distinguished by their y-intercepts, which appear as b in the form $y = mx + b$.

98.

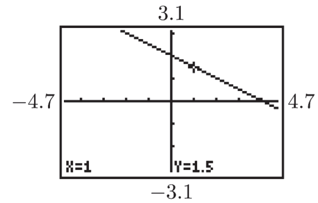


No, do not appear perpendicular



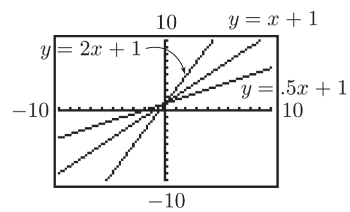
Do appear perpendicular

99.



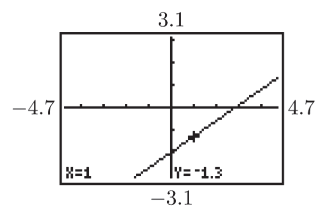
Since the slope equals $-\frac{1}{2}$, moving 2 units to the right requires moving $2 \cdot \left(-\frac{1}{2}\right) = -1$ unit up, or 1 unit down.

100.



The steeper the line, the greater the slope m in $y = mx + b$ form.

101.



Since the slope equals 0.7, moving 2 units to the right requires moving $2 \cdot 0.7 = 1.4$ units up.

Exercises 1.3

1. $4x - 5 = -2x + 7$
$6x = 12$
$x = 2$
$y = 4(2) - 5 = 3$
(2, 3)

2. $3x - 15 = -2x + 10$
$5x = 25$
$x = 5$
$y = 3(5) - 15 = 0$
(5, 0)

3. $x = 4y - 2$
$x = -2y + 4$
$4y - 2 = -2y + 4$
$6y = 6$

$y = 1$
$x = 4(1) - 2 = 2$
(2, 1)

4. $\begin{cases} 2x - 3y = 3 \\ \qquad\ \ y = 3 \end{cases}$

$x = \frac{3}{2}y + \frac{3}{2} = \frac{3}{2}(3) + \frac{3}{2} = 6$
(6, 3)

5. $y = \frac{1}{3}(12) - 1 = 3$
(12, 3)

6. $\begin{cases} 2x - 3y = 3 \\ \qquad\ \ x = 6 \end{cases}$

$y = \frac{2}{3}x - 1 = \frac{2}{3}(6) - 1 = 3$
(6, 3)

7. $\begin{cases} 6 - 3(4) = -6 \\ 3(6) - 2(4) = 10 \end{cases}$

$\begin{cases} -6 = -6 \\ 10 = 10 \end{cases}$
Yes

8. $\begin{cases} 4 = \frac{1}{3}(12) - 1 \\ 12 = 12 \end{cases}$

$\begin{cases} 4 = 3 \\ 12 = 12 \end{cases}$
No

9. $\begin{cases} y = -2x + 7 \\ y = x - 3 \end{cases}$

$-2x + 7 = x - 3$
$-3x = -10$
$x = \frac{10}{3}$
$y = \frac{10}{3} - 3 = \frac{1}{3}$
$x = \frac{10}{3},\ y = \frac{1}{3}$

10. $\begin{cases} y = -\frac{1}{2}x + 2 \\ y = -x + 6 \end{cases}$

$-\frac{1}{2}x + 2 = -x + 6$
$\frac{1}{2}x = 4$
$x = 8$
$y = -(8) + 6 = -2$
$x = 8, y = -2$

11. $\begin{cases} y = \frac{5}{2}x - \frac{1}{2} \\ y = -2x - 4 \end{cases}$

$\frac{5}{2}x - \frac{1}{2} = -2x - 4$
$\frac{9}{2}x = -\frac{7}{2}$
$x = -\frac{7}{9}$
$y = -2\left(-\frac{7}{9}\right) - 4 = -\frac{22}{9}$
$x = -\frac{7}{9},\ y = -\frac{22}{9}$

12. $\begin{cases} y = -\frac{1}{2}x + 3 \\ y = 3x - 12 \end{cases}$

$-\frac{1}{2}x + 3 = 3x - 12$
$-\frac{7}{2}x = -15$
$x = \frac{30}{7}$
$y = -\frac{1}{2}\left(\frac{30}{7}\right) + 3 = \frac{6}{7}$
$x = \frac{30}{7},\ y = \frac{6}{7}$

13. $\begin{cases} x = 3 \\ 2x + 3y = 18 \end{cases}$

$y = -\frac{2}{3}x + 6 = -\frac{2}{3}(3) + 6 = 4$

$A = (3, 4)$

$\begin{cases} y = 2 \\ 2x + 3y = 18 \end{cases}$

$x = -\frac{3}{2}y + 9 = -\frac{3}{2}(2) + 9 = 6$

$B = (6, 2)$

14. $\begin{cases} y = -\frac{1}{3}x + 7 \\ x = 0 \end{cases}$

$y = -\frac{1}{3}(0) + 7 = 7$

$A = (0, 7)$

$\begin{cases} y = -\frac{1}{3}x + 7 \\ y = -x + 9 \end{cases}$

$-\frac{1}{3}x + 7 = -x + 9$

$\frac{2}{3}x = 2$

$x = 3$

$y = -(3) + 9 = 6$

$B = (3, 6)$

$\begin{cases} y = -x + 9 \\ y = -3x + 19 \end{cases}$

$-x + 9 = -3x + 19$

$2x = 10$

$x = 5$

$y = -(5) + 9 = 4$

$C = (5, 4)$

$\begin{cases} y = -3x + 19 \\ y = 0 \end{cases}$

$-3x + 19 = 0$

$-3x = -19$

$x = \frac{19}{3}$

$D = \left(\frac{19}{3}, 0\right)$

Point E is the origin (0,0).

15. $A = (0, 0)$

$\begin{cases} y = 2x \\ y = \frac{1}{2}x + 3 \end{cases}$

$2x = \frac{1}{2}x + 3$

$x = 2$

$y = 2(2) = 4$

$B = (2, 4)$

$\begin{cases} y = \frac{1}{2}x + 3 \\ x = 5 \end{cases}$

$y = \frac{1}{2}(5) + 3 = \frac{11}{2}$

$C = \left(5, \frac{11}{2}\right)$

$D = (5, 0)$

16. $\begin{cases} x = 0 \\ 2x + y = 14 \end{cases}$

$y = -2x + 14 = -2(0) + 14 = 14$

$A = (0, 14)$

$\begin{cases} 2x + y = 14 \\ 3x + 2y = 24 \end{cases}$

$\begin{cases} y = -2x + 14 \\ y = -\frac{3}{2}x + 12 \end{cases}$

$-2x + 14 = -\frac{3}{2}x + 12$

$-\frac{1}{2}x = -2$

$x = 4$

$y = -2(4) + 14 = 6$

$B = (4, 6)$

$\begin{cases} 3x + 2y = 24 \\ x + 2y = 12 \end{cases}$

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

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

$-x = -6$

$x = 6$

$y = -\frac{1}{2}(6) + 6 = 3$

$C = (6, 3)$

$\begin{cases} x + 2y = 12 \\ y = 0 \end{cases}$

$x = -2y + 12 = -2(0) + 12 = 12$

$D = (12, 0)$

17. a. $p = 0.0001(19{,}500) + 0.05$
$= \$2.00$

b. $p = 0.0001(0) + 0.05$
$= \$0.05$

No units will be supplied for \$0.05 or less.

18. a. $p = -0.001(31{,}500) + 32.5$
$= \$1.00$

b. $-0.001q + 32.5 = 0$
$q = 32{,}500$ units

Quantities of 32,500 or more.

19. $\begin{cases} p = 0.0001q + 0.05 \\ p = -0.001q + 32.5 \end{cases}$

$$0.0001q + 0.05 = -0.001q + 32.5$$
$$0.0011q = 32.45$$
$$q = 29{,}500 \text{ units}$$
$$p = 0.0001(29{,}500) + 0.05$$
$$p = \$3.00$$

20. $p = \frac{1}{300}q + 13$

$$p = -0.03q + 19$$
$$\frac{1}{300}q + 13 = -0.03q + 19$$
$$\frac{1}{30}q = 6$$
$$q = 180 \text{ books}$$
$$p = -0.03(180) + 19$$
$$p = \$13.60$$

21. a. $p = -0.15q + 6.925$

$$5.80 = -0.15q + 6.925$$
$$-1.125 = -0.15q$$
$$7.5 = q$$

$$p = 0.2q + 3.6$$
$$5.80 = 0.2q + 3.6$$
$$2.2 = 0.2q$$
$$11 = q$$

Demand will be 7.5 billion bushels and supply will be 11 billion bushels

b. The equilibrium point occurs when supply is the same as demand. Therefore,

$$-0.15q + 6.925 = 0.2q + 3.6$$
$$-0.35q = -3.325$$
$$q = 9.5$$

To find the equilibrium price, substitute the value into either equation.

$$p = -0.15(9.5) + 6.925$$
$$p = -1.425 + 6.925$$
$$p = 5.5$$

Equilibrium occurs when 9.5 billion bushels are produced and sold for \$5.50 per bushel.

22. a. $p = -2.2q + 19.36$

$$16.50 = -2.2q + 19.36$$
$$-2.86 = -2.2q$$
$$1.3 = q$$

$$p = 1.5q + 9$$
$$16.50 = 1.5q + 9$$
$$7.50 = 1.5q$$
$$5 = q$$

Demand will be 1.3 billion bushels and supply will be 5 billion bushels.

b. The equilibrium point occurs when supply is the same as demand. Therefore,

$$-2.2q + 19.36 = 1.5q + 9$$
$$-3.7q = -10.36$$
$$q = 2.8$$

To find the equilibrium price, substitute the value into either equation.

$$p = -2.2(2.8) + 19.36$$
$$p = -6.16 + 19.36$$
$$p = 13.20$$

Equilibrium occurs when 2.8 billion bushels are produced and sold for $13.20 per bushel

23. Let $C = F$, then

$$C = \frac{5}{9}(F - 32)$$
$$F = \frac{5}{9}(F - 32)$$
$$\frac{9F}{5} = F - 32$$
$$\frac{4F}{5} = -32$$
$$F = -40$$

Therefore, when the temperature is -40°, it will be the same on both temperature scales.

24. a. $F = \frac{9}{5}(5) + 32$

$F = 41$

$F = 2(5) + 30$

$F = 40$

The two temperatures differ by 1° F.

b. $F = \frac{9}{5}(20) + 32$

$F = 68$

$F = 2(20) + 30$

$F = 70$

The two temperatures differ by 2° F.

c. $2C + 30 = \frac{9}{5}C + 32$

$\frac{1}{5}C = 2$

$C = 10$

When the temperature is 10 degrees Celsius, the two formulas will give the same Fahrenheit temperature.

25. Let x = numbers of shirts and y = cost of manufacture.

$$\begin{cases} y = 30x + 1200 \\ y = 35x + 500 \end{cases}$$

$$30x + 1200 = 35x + 500$$
$$-5x = -700$$
$$x = 140$$
$$y = 30x + 1200$$
$$y = 30(140) + 1200$$
$$y = 4200 + 1200$$
$$y = 5400$$

The manufactures will charge the same $5400 if they produce 140 shirts.

26. Let x = hours working and y = hours supervising.

$$\begin{cases} x + y = 40 \\ 24x + 30y = 1008 \end{cases}$$

$$\begin{cases} y = -x + 40 \\ y = -\frac{4}{5}x + \frac{168}{5} \end{cases}$$

$$-x + 40 = -\frac{4}{5}x + \frac{168}{5}$$
$$-\frac{1}{5}x = -\frac{32}{5}$$
$$x = 32$$

$y = -32 + 40 = 8$

Working: 32; supervising: 8

27. Method A: $y = .45 + .01x$

Method B: $y = .035x$

Intersection point:

$$\begin{aligned} .45 + .01x &= .035x \\ .45 &= .025x \\ 18 &= x \end{aligned}$$

For a call lasting 18 minutes, the costs for either method will be the same, $y = .035(18) = 63$. The cost will be 63cents.

28. Let x = numbers of miles towed and y = cost of the tow.

$$\begin{cases} y = 3x + 50 \\ y = 2.5x + 60 \end{cases}$$

$$\begin{aligned} 3x + 50 &= 2.5x + 60 \\ 0.5x &= 10 \\ x &= 20 \end{aligned}$$

$$\begin{aligned} y &= 3x + 50 \\ y &= 3(20) + 50 \\ y &= 60 + 50 \\ y &= 110 \end{aligned}$$

The two companies will charge the same \$110 if they tow a car 20 miles.

29. $\begin{cases} 3x - y = 3 \\ x + y = 5 \\ y = 0 \end{cases}$

$$\begin{cases} y = 3x - 3 \\ y = -x + 5 \\ y = 0 \end{cases}$$

$$\begin{cases} y = 3x - 3 \\ y = -x + 5 \end{cases} \Rightarrow (2, 3)$$

$$\begin{cases} y = -x + 5 \\ y = 0 \end{cases} \Rightarrow (5, 0)$$

$$\begin{cases} y = 3x - 3 \\ y = 0 \end{cases} \Rightarrow (1, 0)$$

Based on the above points of intersection, the base of the triangle is $5 - 1 = 4$ and the height is 3. Therefore the area of the triangle, in square units, is:

$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2}(4)(3)$$

$$A = 6$$

30. $\begin{cases} 3x + 4y = 24 \\ 2x - 4y = -4 \\ x = 0 \end{cases}$

$$\begin{cases} y = -\frac{3}{4}x + 6 \\ y = \frac{1}{2}x + 1 \\ x = 0 \end{cases}$$

$$\begin{cases} y = -\frac{3}{4}x + 6 \\ y = \frac{1}{2}x + 1 \end{cases} \Rightarrow (4, 3)$$

$$\begin{cases} y = -\frac{3}{4}x + 6 \\ x = 0 \end{cases} \Rightarrow (0, 6)$$

$$\begin{cases} y = \frac{1}{2}x + 1 \\ x = 0 \end{cases} \Rightarrow (0, 1)$$

Based on the above points of intersection, the base of the triangle is $6 - 1 = 5$ and the height is 4. Therefore the area of the triangle, in square units is:

$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2}(5)(4)$$

$$A = 10$$

31. Let x = weight of first contestant

y = weight of second contestant

$$\begin{cases} x + y = 700 \\ 2x = 275 + y \end{cases}$$

$$\begin{cases} y = 700 - x \\ y = 2x - 275 \end{cases}$$

$$\begin{aligned} 700 - x &= 2x - 275 \\ 975 &= 3x \\ x &= 325 \text{ pounds} \end{aligned}$$

32. Let x = number of 43” TVs sold and
y = number of 55” TVs sold

$$\begin{cases} y = x + 5 \\ 400x + 730y = 26250 \end{cases}$$

$$\begin{cases} y = x + 5 \\ y = -\frac{40}{73}x + \frac{2625}{73} \end{cases}$$

$$x + 5 = -\frac{40}{73}x + \frac{2625}{73}$$

$$\frac{113}{73}x = \frac{2260}{73}$$

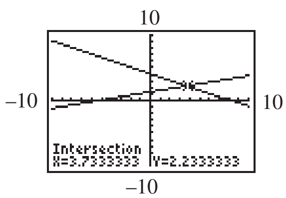
$$x = 20 \text{ TV sets}$$

$$y = 20 + 5$$

$$= 25 \text{ TV sets}$$

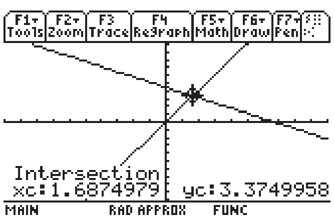
Total = 20 + 25 = 45 TV sets

33.



(3.73, 2.23)

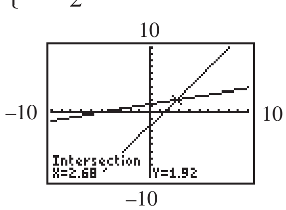
34.



(1.69, 3.38)

35.
$$\begin{cases} x - 4y = -5 \\ 3x - 2y = 4.2 \end{cases}$$

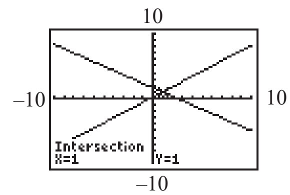
$$\begin{cases} y = \frac{1}{4}x + \frac{5}{4} \\ y = \frac{3}{2}x - 2.1 \end{cases}$$



(2.68, 1.92)

36.
$$\begin{cases} 2x + 3y = 5 \\ -4x + 5y = 1 \end{cases}$$

$$\begin{cases} y = -\frac{2}{3}x + \frac{5}{3} \\ y = \frac{4}{5}x + \frac{1}{5} \end{cases}$$



(1, 1)

Exercises 1.4

1.

Data Point	Point on Line	Vertical Distance
(1, 3)	(1, 4)	1
(2, 6)	(2, 7)	1
(3, 11)	(3, 10)	1
(4, 12)	(4, 13)	1

$1^2 + 1^2 + 1^2 + 1^2 = 4$

2.

Data Point	Point on Line	Vertical Distance
(1, 11)	(1, 10)	1
(2, 7)	(2, 8)	1
(3, 5)	(3, 6)	1
(4, 5)	(4, 4)	1

$E = 1^2 + 1^2 + 1^2 + 1^2 = 4$

3.
$$E_1^2 = [1.1(1) + 3 - 3]^2 = 1.21$$
$$E_2^2 = [1.1(2) + 3 - 6]^2 = .64$$
$$E_3^2 = [1.1(3) + 3 - 8]^2 = 2.89$$
$$E_4^2 = [1.1(4) + 3 - 6]^2 = 1.96$$
E = 1.21 + .64 + 2.89 + 1.96 = 6.70

4. $E_1^2 = [-1.3(1)+8.3-8]^2 = 1.00$
$E_2^2 = [-1.3(2)+8.3-5]^2 = 0.49$
$E_3^2 = [-1.3(3)+8.3-3]^2 = 1.96$
$E_4^2 = [-1.3(4)+8.3-4]^2 = 0.81$
$E_5^2 = [-1.3(5)+8.3-2]^2 = 0.04$
$E = 1.00 + 0.49 + 1.96 + 0.81 + 0.04 = 4.3$

5.

x	y	xy	x^2
1	7	7	1
2	6	12	4
3	4	12	9
4	3	12	16
$\sum x = 10$	$\sum y = 20$	$\sum xy = 43$	$\sum x^2 = 30$

$$m = \frac{4\cdot 43 - 10\cdot 20}{4\cdot 30 - 10^2} = -1.4$$
$$b = \frac{20-(-1.4)(10)}{4} = 8.5$$

6.

x	y	xy	x^2
1	2	2	1
2	4	8	4
3	7	21	9
4	9	36	16
5	12	60	25
$\sum x = 15$	$\sum y = 34$	$\sum xy = 127$	$\sum x^2 = 55$

$$m = \frac{5\cdot 127 - 15\cdot 34}{5\cdot 55 - 15^2} = 2.5$$
$$b = \frac{34-(2.5)(15)}{5} = -0.7$$

7. $\sum x = 6,\ \sum y = 18,\ \sum xy = 45,\ \sum x^2 = 14$
$$m = \frac{3\cdot 45 - 6\cdot 18}{3\cdot 14 - 6^2} = 4.5$$
$$b = \frac{18-(4.5)(6)}{3} = -3$$
$y = 4.5x - 3$

8. $\sum x = 7,\ \sum y = 15,\ \sum xy = 28,\ \sum x^2 = 21$
$$m = \frac{3\cdot 28 - 7\cdot 15}{3\cdot 21 - 7^2} = -1.5$$
$$b = \frac{15-(-1.5)(7)}{3} = 8.5$$
$y = -1.5x + 8.5$

9. $\sum x = 10, \sum y = 26, \sum xy = 55,$
$\sum x^2 = 30$
$$m = \frac{4\cdot 55 - 10\cdot 26}{4\cdot 30 - 10^2} = -2$$
$$b = \frac{26-(-2)(10)}{4} = 11.5$$
$y = -2x + 11.5$

10. $\sum x = 10, \sum y = 28, \sum xy = 77, \quad \sum x^2 = 30$
$$m = \frac{4\cdot 77 - 10\cdot 28}{4\cdot 30 - 10^2} = 1.4$$
$$b = \frac{28-(1.4)(10)}{4} = 3.5$$
$y = 1.4x + 3.5$

11. **a.** $\sum x = 12, \sum y = 7, \sum xy = 41,$
$\sum x^2 = 74$
$$m = \frac{2\cdot 41 - 12\cdot 7}{2\cdot 74 - 12^2} = -0.5$$
$$b = \frac{7-(-.5)(12)}{2} = 6.5$$
$y = -0.5x + 6.5$

b. $m = \frac{4-3}{5-7} = -\frac{1}{2} = -0.5$
$y - 3 = -0.5(x-7)$
$y = -0.5x + 6.5$

c. The least–squares error for the line in (b) is E=0.

12. The least–squares error for the line E=0.

13. **a.** $\sum x = 7, \sum y = 20, \sum xy = 90,$
$\sum x^2 = 37$
$$m = \frac{2\cdot 90 - 7\cdot 20}{2\cdot 37 - 7^2} = 1.6 = \frac{8}{5}$$
$$b = \frac{20-(1.6)(7)}{2} = 4.4 = \frac{22}{5}$$
$$y = \frac{8}{5}x + \frac{22}{5}$$

b. $E = [1.6(4) + 4.4 - 5]^2 = 33.64$

14. **a.** $\sum x = 10, \sum y = 19, \sum xy = 104,$
$\sum x^2 = 52$
$$m = \frac{2\cdot 104 - 10\cdot 19}{2\cdot 52 - 10^2} = 4.5 = \frac{9}{2}$$
$$b = \frac{19-(4.5)(10)}{2} = -13$$
$$y = \frac{9}{2}x - 13$$

b. $E = [4.5(1) - 13 - 6]^2 = 210.25$

15. **a.** Let x represent city and y represent highway, then $\sum x = 200, \sum y = 186, \sum xy = 9388,$
$\sum x^2 = 10{,}118$
$$m = \frac{4\cdot 9388 - 200\cdot 186}{4\cdot 10{,}118 - 200^2} \approx 0.7458$$
$$b = \frac{186-(0.7458)(200)}{4} \approx 9.21$$
$y = 0.7458x + 9.21$

b. $y = 0.7458(54) + 9.21$
$y \approx 49.48$ mpg

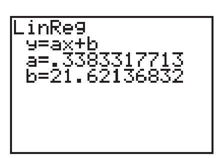
c. $50 = 0.7458x + 9.21$
$x \approx 54.69$ mpg

16. **a.** Let x represent stores (in thousands) and y represent sales (in millions), then
$\sum x = 15.576, \sum y = 12{,}595, \sum xy = 65357.19,$
$\sum x^2 = 81.836394$
$$m = \frac{4\cdot 65357.19 - 15.576\cdot 12595}{4\cdot 81.836394 - 15.576^2} \approx 770.0$$
$$b = \frac{12595-(770.05)(15.576)}{4} \approx 150.2$$
$y = 770.0x + 150.2$

b. $y = 770.0(4) + 150.2$
$y = 3230.2$ million
$y = \$3{,}230{,}200{,}000$

c. $2500 = 770.0x + 150.2$
$x = 3.052$ thousand
$x = 3052$

17. **a.**



$y = .338x + 21.6$

b. $0.338(1100) + 21.6 = 393.4$
There will be about 393 deaths per million males

18. a. $y = 1.913 + 55.489$

b. $1.913(18) + 55.489 = 90.0$
About 90% of the 2018 US adults used the internet.

c. $80 = 1.913 + 55.489$
$x \approx 12.81$
Approximately 80% of adults used the internet in the year 2000 + 13 = 2013.

19. a. Let x be the number of years after 1994, then $y = 0.521x + 22.3$

b. $0.521(23) + 22.3 = 34.3$
About 34.3% completed four or more years of college

c. $41.1 = 0.521x + 22.3$
$x \approx 36.08$
Approximately 41.1% of persons 25 years and over will have completed 4 or more years of college in the year 1994 + 36 = 2030.

20. a. Let x be the number of years after 2010, then $y = 0.59x + 13.72$

b. $0.59(7) + 13.72 = 17.85$
The average cost in 2017 will be approximately $17.9 thousand or $17,900.

c. $25 = 0.59x + 13.72$
$x \approx 19.1$
The cost will be approximately $25,00 early in the year 2010 + 19 = 2029.

21. a. $y = 0.124x + 77.34$

b. $0.124(30) + 77.34 = 81.06$
A 30 – year old US male has a life expectancy of about 81.06 years

c. $0.124(50) + 77.34 = 83.54$
A 50 – year old US male has a life expectancy of about 83.54 years

d. $0.124(90) + 77.34 = 88.5$
Life expectancy will be about 88.5 years (This is an example of a fit that is not capable of extrapolating beyond the given data)

22. a.

```
LinReg
 y=ax+b
 a=-1.274070723
 b=5.791532836
```

$y = -1.274x + 5.792$

b. The higher the independence, the lower the inflation rate.

c. $-1.274(.6) + 5.792 = 5.0276$
About 5.0%

d. $6.8 = -1.274x + 5.792$
$x \approx -.791$
About –0.8

23. a. Let x be the number of years after 2005, then $y = 0.03025x + 0.802$

b. $0.03025(14) + 0.802 \approx 1.23$
In the year 2019, the price of a pound of spaghetti was about $1.23.

c. $1.47 = 0.03025x + 0.802$
$x \approx 22.08$
The price per pound of spaghetti will be $1.47 in the year 2005 + 22 = 2027.

24. a. $y = 1.875x + 336.8$

b. The year 2012 is 32 years after the base year of 1980, therefore:
$1.875(32) + 336.8 = 396.8$
396.8; It is close to the actual value.

c. $425 = 1.875x + 336.8$
$x \approx 47.04$
The year is 47 years after 1980 or 2027.