b. Now let's use the line graph that shows the percentage of marriages ending in divorce when the wife is over 25 at the time of marriage. The graph is shown again in **Figure 1.12**. To find the percentage of marriages ending in divorce after 10 years:

- Locate 10 on the horizontal axis and locate the point above 10.
- Read across to the corresponding percent on the vertical axis.

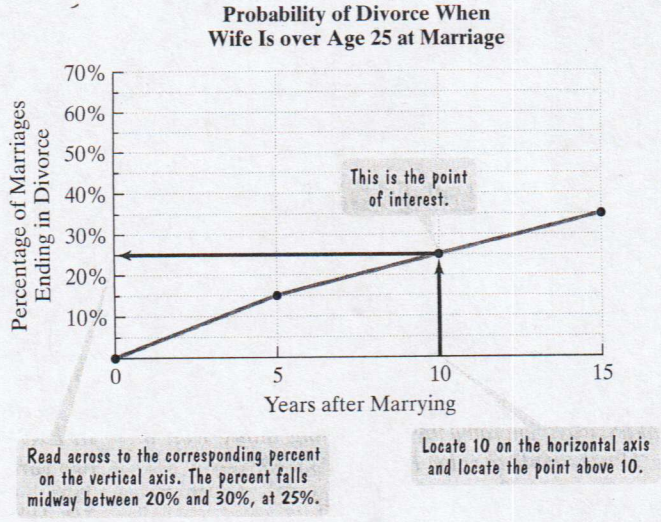


Figure 1.12

The actual data displayed by the graph indicate that 25% of these marriages end in divorce after 10 years.

c. The value obtained by evaluating the mathematical model, 24.5%, is close to, but slightly less than, the actual percentage of divorces, 25.0%. The difference between these percents is 25.0% − 24.5%, or 0.5%. The value given by the mathematical model, 24.5%, underestimates the actual percent, 25%, by only 0.5, providing a fairly accurate description of the data.

Check Point 6

a. Use the appropriate formula from Example 6 to determine the percentage of marriages ending in divorce after 15 years when the wife is under 18 at the time of marriage.

b. Use the appropriate line graph in **Figure 1.11** to determine the percentage of marriages ending in divorce after 15 years when the wife is under 18 at the time of marriage.

c. Does the value given by the mathematical model underestimate or overestimate the actual percentage of marriages ending in divorce after 15 years as shown by the graph? By how much?

Exercise Set 1.1

Practice Exercises

In Exercises 1–12, plot the given point in a rectangular coordinate system.

1. $(1, 4)$ **2.** $(2, 5)$ **3.** $(-2, 3)$

4. $(-1, 4)$ **5.** $(-3, -5)$ **6.** $(-4, -2)$

7. $(4, -1)$ **8.** $(3, -2)$ **9.** $(-4, 0)$

10. $(0, -3)$ **11.** $\left(\frac{7}{2}, -\frac{3}{2}\right)$ **12.** $\left(-\frac{5}{2}, \frac{3}{2}\right)$

Graph each equation in Exercises 13–28. Let $x = -3, -2, -1, 0, 1, 2,$ and 3.

13. $y = x^2 - 2$ **14.** $y = x^2 + 2$ **15.** $y = x - 2$

16. $y = x + 2$ **17.** $y = 2x + 1$ **18.** $y = 2x - 4$

19. $y = -\frac{1}{2}x$ **20.** $y = -\frac{1}{2}x + 2$ **21.** $y = 2|x|$

22. $y = -2|x|$ **23.** $y = |x| + 1$ **24.** $y = |x| - 1$

25. $y = 9 - x^2$ **26.** $y = -x^2$ **27.** $y = x^3$

28. $y = x^3 - 1$

In Exercises 29–32, match the viewing rectangle with the correct figure. Then label the tick marks in the figure to illustrate this viewing rectangle.

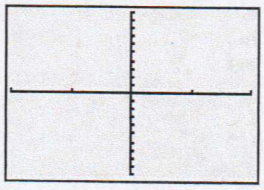
29. $[-5, 5, 1]$ by $[-5, 5, 1]$

30. $[-10, 10, 2]$ by $[-4, 4, 2]$

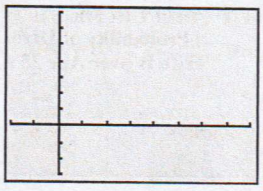
31. $[-20, 80, 10]$ by $[-30, 70, 10]$

32. $[-40, 40, 20]$ by $[-1000, 1000, 100]$

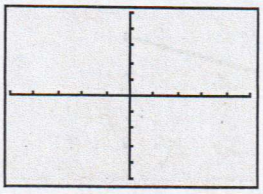
a.



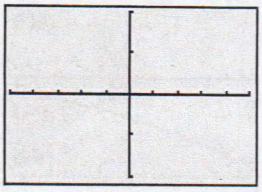
b.



c.



d.



The table of values was generated by a graphing utility with a TABLE feature. Use the table to solve Exercises 33–40.

X	Y_1	Y_2
-3	9	5
-2	4	4
-1	1	3
0	0	2
1	1	1
2	4	0
3	9	-1

X= -3

33. Which equation corresponds to Y_2 in the table?

a. $y_2 = x + 8$ **b.** $y_2 = x - 2$

c. $y_2 = 2 - x$ **d.** $y_2 = 1 - 2x$

34. Which equation corresponds to Y_1 in the table?

a. $y_1 = -3x$ **b.** $y_1 = x^2$

c. $y_1 = -x^2$ **d.** $y_1 = 2 - x$

35. Does the graph of Y_2 pass through the origin?

36. Does the graph of Y_1 pass through the origin?

37. At which point does the graph of Y_2 cross the x-axis?

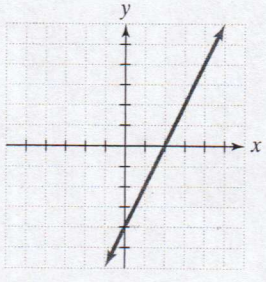
38. At which point does the graph of Y_2 cross the y-axis?

39. At which points do the graphs of Y_1 and Y_2 intersect?

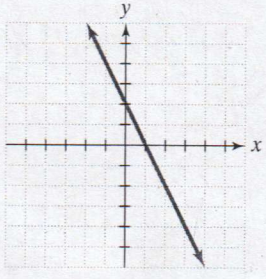
40. For which values of x is $Y_1 = Y_2$?

In Exercises 41–46, use the graph to **a.** *determine the x-intercepts, if any;* **b.** *determine the y-intercepts, if any. For each graph, tick marks along the axes represent one unit each.*

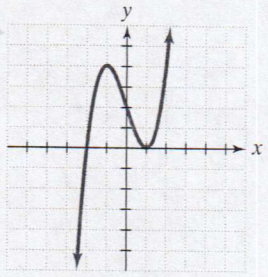
41.



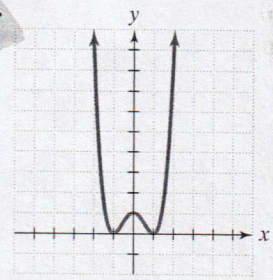
42.



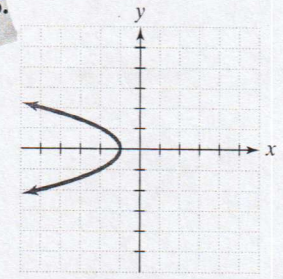
43.



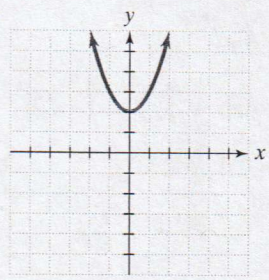
44.



45.



46.



Practice Plus

In Exercises 47–50, write each English sentence as an equation in two variables. Then graph the equation.

47. The y-value is four more than twice the x-value.

48. The y-value is the difference between four and twice the x-value.

49. The y-value is three decreased by the square of the x-value.

50. The y-value is two more than the square of the x-value.

In Exercises 51–54, graph each equation.

51. $y = 5$ (Let $x = -3, -2, -1, 0, 1, 2,$ and 3.)

52. $y = -1$ (Let $x = -3, -2, -1, 0, 1, 2,$ and 3.)

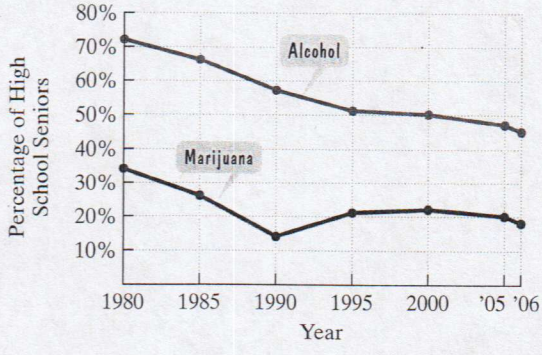
53. $y = \frac{1}{x}$ (Let $x = -2, -1, -\frac{1}{2}, -\frac{1}{3}, \frac{1}{3}, \frac{1}{2}, 1,$ and 2.)

54. $y = -\frac{1}{x}$ (Let $x = -2, -1, -\frac{1}{2}, -\frac{1}{3}, \frac{1}{3}, \frac{1}{2}, 1,$ and 2.)

Application Exercises

The graphs show the percentage of high school seniors who used alcohol or marijuana during the 30 days prior to being surveyed for the University of Michigan's Monitoring the Future *study.*

Alcohol and Marijuana Use by United States High School Seniors



Source: U.S. Department of Health and Human Services

The data can be described by the following mathematical models:

Percentage of seniors using alcohol: $A = -n + 70$

Percentage of seniors using marijuana: $M = -0.4n + 28.$

(Number of years after 1980)

Use this information to solve Exercises 55–56.

55. a. Use the appropriate line graph to determine the percentage of seniors who used marijuana in 2005.

b. Use the appropriate formula to determine the percentage of seniors who used marijuana in 2005. Does the formula underestimate or overestimate the actual percentage displayed by the graph? By how much?

c. Use the appropriate line graph to estimate the percentage of seniors who used alcohol in 2006.

d. Use the appropriate formula to determine the percentage of seniors who used alcohol in 2006. How does this compare with your estimate in part (c)?

e. For the period from 1980 through 2006, in which year was marijuana use by seniors at a minimum? Estimate the percentage of seniors who used marijuana in that year.

56. a. Use the appropriate line graph to determine the percentage of seniors who used alcohol in 2000.

b. Use the appropriate formula to determine the percentage of seniors who used alcohol in 2000. What do you observe?

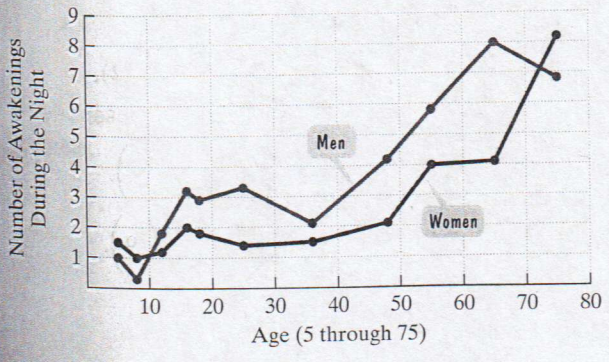
c. Use the appropriate line graph to estimate the percentage of seniors who used marijuana in 2000.

d. Use the appropriate formula to determine the percentage of seniors who used marijuana in 2000. How does this compare with your estimate in part (c)?

e. For the period from 1980 through 2006, in which year was alcohol use by seniors at a maximum? Estimate the percentage of seniors who used alcohol in that year.

Contrary to popular belief, older people do not need less sleep than younger adults. However, the line graphs show that they awaken more often during the night. The numerous awakenings are one reason why some elderly individuals report that sleep is less restful than it had been in the past. Use the line graphs to solve Exercises 57–60.

Average Number of Awakenings During the Night, by Age and Gender



Source: Stephen Davis and Joseph Palladino, *Psychology*, 5th Edition, Prentice Hall, 2007

57. At which age, estimated to the nearest year, do women have the least number of awakenings during the night? What is the average number of awakenings at that age?

58. At which age do men have the greatest number of awakenings during the night? What is the average number of awakenings at that age?

59. Estimate, to the nearest tenth, the difference between the average number of awakenings during the night for 25-year-old men and 25-year-old women.

60. Estimate, to the nearest tenth, the difference between the average number of awakenings during the night for 18-year-old men and 18-year-old women.

Writing in Mathematics

61. What is the rectangular coordinate system?

62. Explain how to plot a point in the rectangular coordinate system. Give an example with your explanation.

63. Explain why $(5, -2)$ and $(-2, 5)$ do not represent the same point.

64. Explain how to graph an equation in the rectangular coordinate system.

65. What does a $[-20, 2, 1]$ by $[-4, 5, 0.5]$ viewing rectangle mean?

Technology Exercise

66. Use a graphing utility to verify each of your hand-drawn graphs in Exercises 13–28. Experiment with the size of the viewing rectangle to make the graph displayed by the graphing utility resemble your hand-drawn graph as much as possible.

Critical Thinking Exercises

Make Sense? *In Exercises 67–70, determine whether each statement makes sense or does not make sense, and explain your reasoning.*

67. The rectangular coordinate system provides a geometric picture of what an equation in two variables looks like.

68. There is something wrong with my graphing utility because it is not displaying numbers along the x- and y-axes.

69. I used the ordered pairs $(-2, 2)$, $(0, 0)$, and $(2, 2)$ to graph a straight line.

70. I used the ordered pairs

(time of day, calories that I burned)

to obtain a graph that is a horizontal line.

In Exercises 71–74, determine whether each statement is true or false. If the statement is false, make the necessary change(s) to produce a true statement.

71. If the product of a point's coordinates is positive, the point must be in quadrant I.

72. If a point is on the x-axis, it is neither up nor down, so $x = 0$.

73. If a point is on the y-axis, its x-coordinate must be 0.

74. The ordered pair $(2, 5)$ satisfies $3y - 2x = -4$.