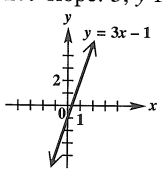
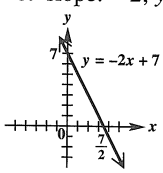
2.4 Exercises

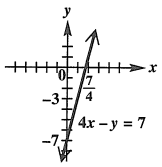
1. D 2. B 3. C 4. A
5. $2x + y = 5$ 6. $x + y = 6$
7. $3x + 2y = -7$
8. $3x - 4y = -24$ 9. $x = -8$
10. $y = 1$ 11. $y = \frac{1}{4}x + \frac{13}{4}$
12. $y = -x + 7$
13. $y = \frac{2}{3}x - 2$
14. $y = 2x + 4$
15. $x = -6$ (cannot be written in slope-intercept form) 16. $y = 7$
17. $y = 5x + 15$
18. $y = -2x + 12$
19. $y = -\frac{2}{3}x - \frac{4}{5}$
20. $y = -\frac{5}{8}x - \frac{1}{3}$ 21. $y = \frac{3}{2}$
22. $x = -\frac{5}{4}$ (cannot be written in slope-intercept form)
23. -2; does not; undefined; $\frac{1}{2}$; does not; 0
24. (a) D (b) B (c) A (d) C
25. (a) B (b) D (c) A (d) C
26. (a) 3 (b) -5 (c) $y = 3x - 5$
27. slope: 3; y-intercept: -1



28. slope: -2; y-intercept: 7



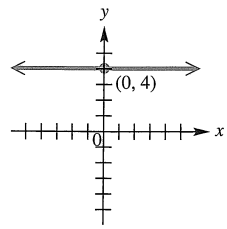
29. slope: 4; y-intercept: -7



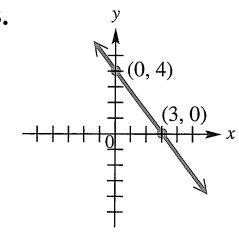
Concept Check *Match each equation in Exercises 1–4 to the correct graph in A–D.*

1. $y = \frac{1}{4}x + 2$
2. $4x + 3y = 12$
3. $y - (-1) = \frac{3}{2}(x - 1)$
4. $y = 4$

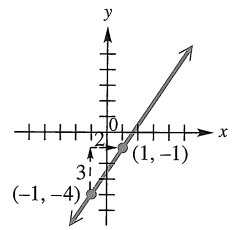
A.



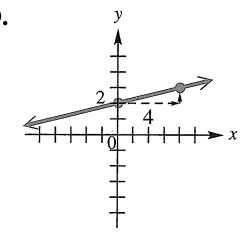
B.



C.



D.



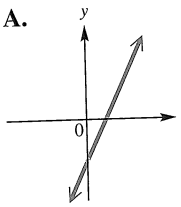
In Exercises 5–22, write an equation for the line described. Give answers in standard form for Exercises 5–10 and in slope-intercept form (if possible) for Exercises 11–22. See Examples 1–3.

5. through $(1, 3)$, $m = -2$
6. through $(2, 4)$, $m = -1$
7. through $(-5, 4)$, $m = -\frac{3}{2}$
8. through $(-4, 3)$, $m = \frac{3}{4}$
9. through $(-8, 4)$, undefined slope
10. through $(5, 1)$, $m = 0$
11. through $(-1, 3)$ and $(3, 4)$
12. through $(8, -1)$ and $(4, 3)$
13. x-intercept 3, y-intercept -2
14. x-intercept -2, y-intercept 4
15. vertical, through $(-6, 4)$
16. horizontal, through $(2, 7)$
17. $m = 5, b = 15$
18. $m = -2, b = 12$
19. $m = -\frac{2}{3}, b = -\frac{4}{5}$
20. $m = -\frac{5}{8}, b = -\frac{1}{3}$
21. slope 0, y-intercept $\frac{3}{2}$
22. undefined slope, x-intercept $-\frac{5}{4}$
23. *Concept Check* Fill in each blank with the appropriate response: The line $x + 2 = 0$ has x-intercept _____. It _____ (does/does not) have a y-intercept. The slope of this line is _____ (0/undefined). The line $4y = 2$ has y-intercept _____. It _____ (does/does not) have an x-intercept. The slope of this line is _____ (0/undefined).

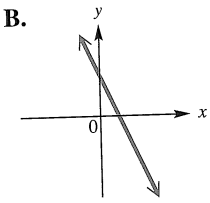
24. *Concept Check* Match each equation with the line that would most closely resemble its graph. (*Hint:* Consider the signs of m and b in the slope-intercept form.)

(a) $y = 3x + 2$ **(b)** $y = -3x + 2$ **(c)** $y = 3x - 2$ **(d)** $y = -3x - 2$

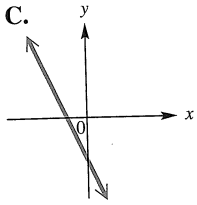
A.



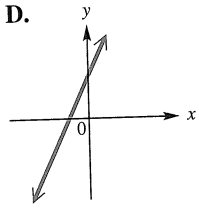
B.



C.



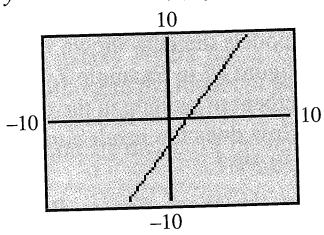
D.



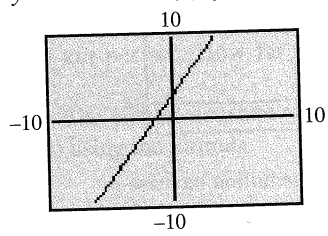
25. *Concept Check* Match each equation with its calculator graph. The standard viewing window is used in each case, but no tick marks are shown.

(a) $y = 2x + 3$ **(b)** $y = -2x + 3$ **(c)** $y = 2x - 3$ **(d)** $y = -2x - 3$

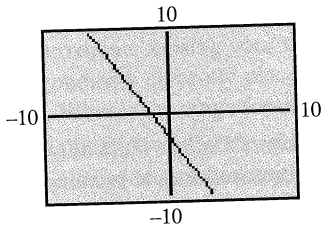
A.



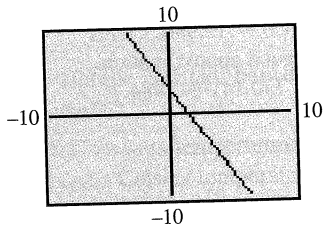
B.



C.



D.



26. *Concept Check* The table represents a linear function f.

(a) Find the slope of the line defined by $y = f(x)$.
(b) Find the y-intercept of the line.
(c) Find the equation for this line in slope-intercept form.

x	y
−2	−11
−1	−8
0	−5
1	−2
2	1
3	4

Give the slope and y-intercept of each line and graph it. See Example 4.

27. $y = 3x - 1$ **28.** $y = -2x + 7$ **29.** $4x - y = 7$

30. $2x + 3y = 16$ **31.** $4y = -3x$ **32.** $2y - x = 0$

33. $x + 2y = -4$ **34.** $x + 3y = -9$

In Exercises 35–42, write an equation **(a)** *in standard form and* **(b)** *in slope-intercept form for the line described. See Example 5.*

35. through $(-1, 4)$, parallel to $x + 3y = 5$

36. through $(3, -2)$, parallel to $2x - y = 5$

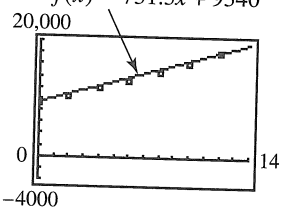
37. through $(1, 6)$, perpendicular to $3x + 5y = 1$

38. through $(-2, 0)$, perpendicular to $8x - 3y = 7$

39. through $(4, 1)$, parallel to $y = -5$

40. through $(-2, -2)$, parallel to $y = 3$

41. (a) $y = 6$ (b) $y = 6$
42. (a) $y = -4$ (b) $y = -4$
43. (a) $-\frac{1}{2}$ (b) $-\frac{7}{2}$
44. (a) 2 (b) -6
45. $y = .624x - 1185.98$; 59.5%; This figure is very close to the actual figure.
46. $y = .548x - 1036$; 57.8%; This figure is reasonably close to the actual figure.
47. (a) $f(x) \approx 731.3x + 9340$

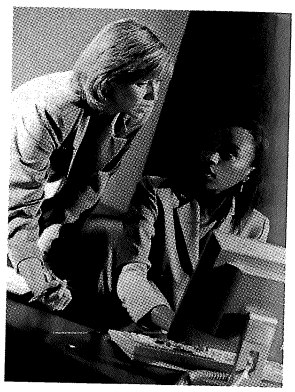


The average tuition increase is about \$731 per year for the period, because this is the slope of the line. (b) $f(5) \approx 12{,}996.5$; This is a fairly good approximation. (c) $f(x) \approx 730.14x + 8984.71$

41. through $(-5, 6)$, perpendicular to $x = -2$
42. through $(4, -4)$, perpendicular to $x = 4$
43. Find k so that the line through $(4, -1)$ and $(k, 2)$ is
    (a) parallel to $3y + 2x = 6$;
    (b) perpendicular to $2y - 5x = 1$.
44. Find r so that the line through $(2, 6)$ and $(-4, r)$ is
    (a) parallel to $2x - 3y = 4$;
    (b) perpendicular to $x + 2y = 1$.

(Modeling) Solve each problem. See Examples 6 and 7.

45. *Women in the Work Force* Use the data points $(1970, 43.3)$ and $(1995, 58.9)$ to find a linear equation that models the data shown in the table accompanying Figure 47 in Example 7. Then use it to predict the percent of women in the civilian labor force in 1996. How does the result compare to the actual figure of 59.3%?
46. *Women in the Work Force* Repeat Exercise 45 using the data points for the years 1975 and 2000.



47. *Cost of Private College Education* The table lists the average annual cost (in dollars) of tuition and fees at private 4-year colleges for selected years.

Year	Tuition and Fees (in dollars)
1990	9,340
1992	10,448
1994	11,719
1996	12,994
1998	14,709
2000	16,233
2002	18,116

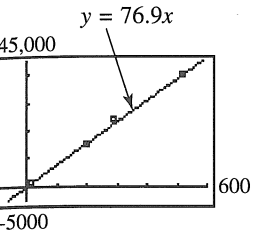
Source: The College Board.

(a) Determine a linear function defined by $f(x) = mx + b$ that models the data, where $x = 0$ represents 1990, $x = 1$ represents 1991, and so on. Use the points $(0, 9340)$ and $(12, 18{,}116)$. Graph f and a scatter diagram of the data on the same coordinate axes. (You may wish to use a graphing calculator.) What does the slope of the graph of f indicate?

(b) Use this function to approximate tuition and fees in 1995. Compare your approximation to the actual value of \$12,143.

(c) Use the linear regression feature of a graphing calculator to find the equation of the line of best fit.

a) See the graph in the
er to part (b). It seems to be
. (b) $y = 76.9x$



proximately 780 megaparsecs
proximately 12.35 billion yr
50) $\approx 1.9 \times 10^{10}$,
) $\approx 9.5 \times 10^{9}$; between
llion and 19 billion yr
a) $F = \frac{9}{5}C + 32$
$= \frac{5}{9}(F - 32)$ (c) $-40°$
a) $p(x) = .0292x + 1$
proximately
tmospheres
a) $C = -.6797I + 8359$
.6797
a) $y = -3x + 9$
(c) $\{3\}$
a) $y = 2x - 2$ (b) 1 (c) $\{1\}$
a) $y = 4x + 2$ (b) $-.5$
.5}
a) $y = 2x - 8$ (b) 4 (c) $\{4\}$
57. (a) $\{12\}$
he Pythagorean theorem and
nverse
$\sqrt{x_1^2 + m_1^2 x_1^2}$
$\sqrt{x_2^2 + m_2^2 x_2^2}$
$\sqrt{(x_2 - x_1)^2 + (m_2 x_2 - m_1 x_1)^2}$
$2x_1x_2(m_1m_2 + 1) = 0$
ince $x_1 \neq 0$, $x_2 \neq 0$, we
$m_1m_2 + 1 = 0$, implying
$_1m_2 = -1$.
f two nonvertical lines are
ndicular, then the product of
opes of these lines is -1.
es 69. yes 70. no

48. *Distances and Velocities of Galaxies* The table lists the distances (in megaparsecs; 1 megaparsec $= 3.085 \times 10^{24}$ cm and 1 megaparsec $= 3.26$ million light-years) and velocities (in kilometers per second) of four galaxies moving rapidly away from Earth.

Galaxy	Distance	Velocity
Virgo	15	1600
Ursa Minor	200	15,000
Corona Borealis	290	24,000
Bootes	520	40,000

Source: Acker, A., and C. Jaschek, *Astronomical Methods and Calculations,* John Wiley & Sons, 1986. Karttunen, H. (editor), *Fundamental Astronomy,* Springer-Verlag, 2003.

(a) Plot the data using distances for the x-values and velocities for the y-values. What type of relationship seems to hold between the data?

(b) Find a linear equation in the form $y = mx$ that models these data using the points (520, 40,000) and (0, 0). Graph your equation with the data on the same coordinate axes.

(c) The galaxy Hydra has a velocity of 60,000 km per sec. How far away is it according to the model in part (b)?

(d) The value of m is called the *Hubble constant.* The Hubble constant can be used to estimate the age of the universe A (in years) using the formula

$$A = \frac{9.5 \times 10^{11}}{m}.$$

Approximate A using your value of m.

(e) Astronomers currently place the value of the Hubble constant between 50 and 100. What is the range for the age of the universe A?

49. *Celsius and Fahrenheit Temperatures* When the Celsius temperature is 0°, the corresponding Fahrenheit temperature is 32°. When the Celsius temperature is 100°, the corresponding Fahrenheit temperature is 212°. Let C represent the Celsius temperature and F the Fahrenheit temperature.

(a) Express F as an exact linear function of C.

(b) Solve the equation in part (a) for C, thus expressing C as a function of F.

(c) For what temperature is $F = C$?

50. *Water Pressure on a Diver* The pressure p of water on a diver's body is a linear function of the diver's depth, x. At the water's surface, the pressure is 1 atmosphere. At a depth of 100 ft, the pressure is about 3.92 atmospheres.

(a) Find the linear function that relates p to x.

(b) Compute the pressure at a depth of 10 fathoms (60 ft).

51. *Consumption Expenditures* Economists frequently use linear models as approximations for more complicated models. In Keynesian macroeconomic theory, total consumption expenditure on goods and services, C, is assumed to be a linear function of national income, I. The table gives the values of C and I for 1990 and 1997 in the United States.

Year	1990	1997
Total consumption (C)	3839	5494
National income (I)	6650	4215

Source: The Wall Street Journal Almanac; New York Times Almanac.

(a) Find the formula for C as a function of I.

(b) The slope of the linear function is called the *marginal propensity to consume.* What is the marginal propensity to consume for the United States from 1990–1997?