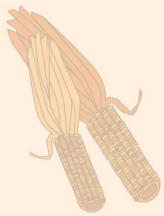
2.1 Linear Equations in Two Variables



Corn

Using Slope

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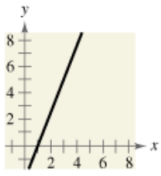
In Exercises 5–8, estimate the slope of the line.

6.



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The Slope-Intercept Form of the Equation of a Line

The graph of the equation

$$y = mx + b$$

is a line whose slope is m and whose y-intercept is $(0, b)$.

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Finding the Slope of a Line

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The Slope of a Line Passing Through Two Points

The **slope** m of the nonvertical line through (x_1, y_1) and (x_2, y_2) is

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

where $x_1 \neq x_2$.

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In Exercises 9–20, find the slope and y-intercept (if possible) of the equation of the line. Sketch the line.

16. $2x + 3y = 9$

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In Exercises 21–28, plot the points and find the slope of the line passing through the pair of points.

26. $\left(\frac{7}{8}, \frac{3}{4}\right), \left(\frac{5}{4}, -\frac{1}{4}\right)$

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In Exercises 29–38, use the point on the line and the slope of the line to find three additional points through which the line passes. (There are many correct answers.)

38. $(-1, -6)$ $\quad m = -\frac{1}{2}$

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Writing Linear Equations in Two Variables

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Point-Slope Form of the Equation of a Line

The equation of the line with slope m passing through the point (x_1, y_1) is

$$y - y_1 = m(x - x_1).$$

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Equations of Lines

1.	General form:	$Ax + By + C = 0$
2.	Vertical line:	$x = a$
3.	Horizontal line:	$y = b$
4.	Slope-intercept form:	$y = mx + b$
5.	Point-slope form:	$y - y_1 = m(x - x_1)$
6.	Two-point form:	$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$

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Parallel and Perpendicular Lines

1. Two distinct nonvertical lines are **parallel** if and only if their slopes are equal. That is, $m_1 = m_2$.
2. Two nonvertical lines are **perpendicular** if and only if their slopes are negative reciprocals of each other. That is, $m_1 = -1/m_2$.

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In Exercises 39–42, determine whether the lines L_1 and L_2 passing through the pairs of points are parallel, perpendicular, or neither.

40. L_1: $(-2, -1), (1, 5)$
L_2: $(1, 3), (5, -5)$

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42. L_1: $(4, 8), (-4, 2)$
L_2: $(3, -5), \left(-1, \frac{1}{3}\right)$

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Application

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44. ***Revenue*** The following are the slopes of lines representing daily revenues y in terms of time x in days. Use the slopes to interpret any change in daily revenues for a one-day increase in time.

(a) The line has a slope of $m = 400$.

(b) The line has a slope of $m = 100$.

(c) The line has a slope of $m = 0$.

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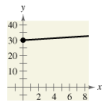
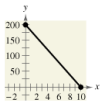
Graphical Interpretation **In Exercises 51–54, match the description of the situation with its graph. Also determine the slope of each graph and interpret the slope in the context of the situation. [The graphs are labeled (a), (b), (c), and (d).]**

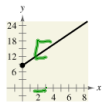
(a)



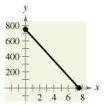
(b)



(c)



(d)



52. An employee is paid \$8.50 per hour plus \$2 for each unit produced per hour.

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In Exercises 55–66, find the slope-intercept form of the equation of the line that passes through the given point and has the indicated slope. Sketch the line.

56. $(0, 10)$ $m = -1$

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60. $(-2, -5)$ $m = \frac{3}{4}$

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62. $(-10, 4)$ m is undefined.

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64. $\left(-\frac{1}{2}, \frac{3}{2}\right)$ $m = 0$

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In Exercises 67–80, find the slope-intercept form of the equation of the line passing through the points. Sketch the line.

68. $(4, 3), (-4, -4)$

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70. $(-1, 4), (6, 4)$

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In Exercises 81–86, use the *intercept form* to find the equation of the line with the given intercepts. The intercept form of the equation of a line with intercepts $(a, 0)$ and $(0, b)$ is

$$\frac{x}{a} + \frac{y}{b} = 1, \quad a \neq 0, \quad b \neq 0.$$

84. x-intercept: $\left(\frac{2}{3}, 0\right)$
y-intercept: $(0, -2)$

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In Exercises 87–96, write the slope-intercept forms of the equations of the lines through the given point (a) parallel to the given line and (b) perpendicular to the given line.

88. $(-3, 2)$ $\quad x + y = 7$

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Graphical Interpretation In Exercises 97–100, identify any relationships that exist among the lines, and then use a graphing utility to graph the three equations in the same viewing window. Adjust the viewing window so that the slope appears visually correct—that is, so that parallel lines appear parallel and perpendicular lines appear to intersect at a right angle.

98. (a) $y = \frac{2}{5}x$ $\quad$ (b) $y = -\frac{3}{2}x$ $\quad$ (c) $y = \frac{2}{5}x + 2$

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In Exercises 101–104, find a relationship between x and y such that (x, y) is equidistant from the two points.

102. $(6, 5), (1, -8)$

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106. ***Number of Stores*** In 1996 there were 3927 J.C. Penney stores and in 2000 there were 3800 stores. Write a linear equation that gives the number of stores in terms of the year. Let $t = 0$ represent 1996. Then predict the numbers of stores for the years 2005 and 2010. (Source: J.C. Penney Co.)

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110. ***Depreciation*** A school district purchases a high- volume printer, copier, and scanner for $25,000. After 10 years, the equipment will have to be replaced. Its value at that time is expected to be $2000. Write a linear equation giving the value V of the equipment during the 10 years it will be in use.

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