Chapter 3

Perpendicular and Parallel Lines

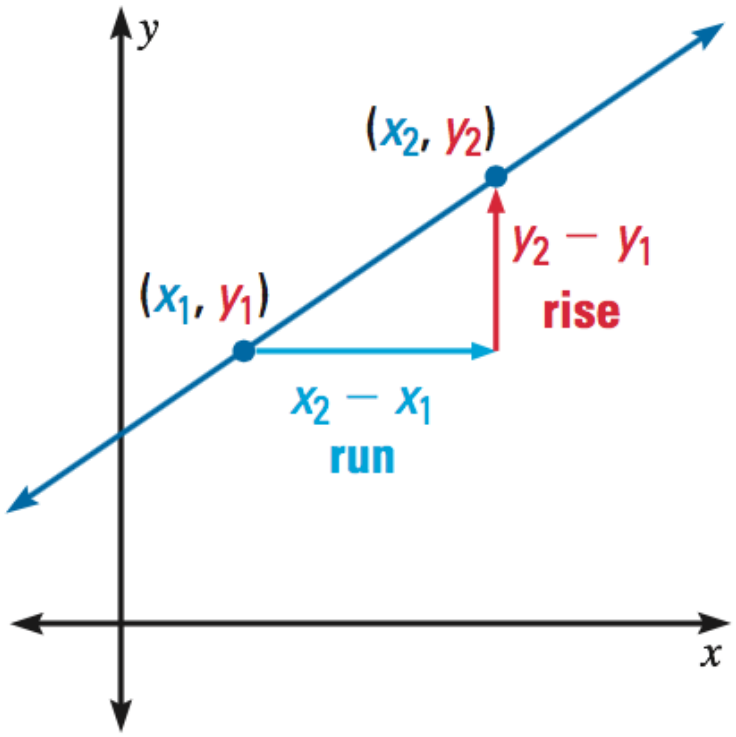
Section 6
Parallel Lines in the Coordinate Plane

GOAL 1: Slope of Parallel Lines

In algebra, you learned that the slope of a nonvertical line is the ratio of the vertical change (the rise) to the horizontal change (the run). If the line passes through the points (x_1, y_1) and (x_2, y_2), then the slope is given by

$$\text{Slope} = \frac{\text{rise}}{\text{run}}$$

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

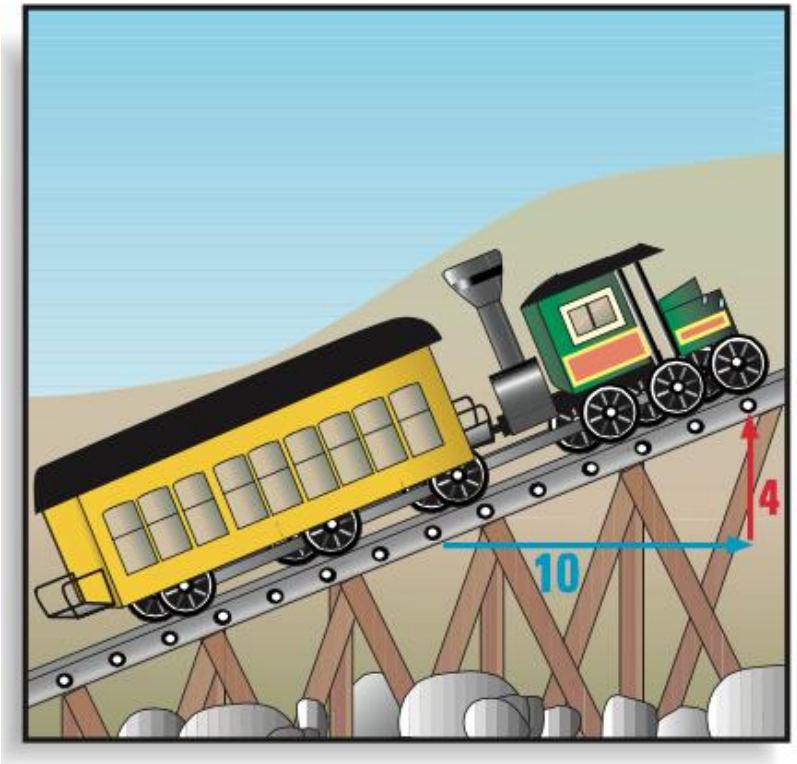


Slope is usually represented by the variable *m*.

Example 1: Finding the Slope of Train Tracks

COG RAILWAY A cog railway goes up the side of Mount Washington, the tallest mountain in New England. At the steepest section, the train goes up about 4 feet for each 10 feet it goes forwards. What is the slope of this section?

$$\frac{\text{rise}}{\text{run}} \rightarrow \frac{4}{10} \rightarrow \boxed{\frac{2}{5}}$$



Example 2: Finding the Slope of a Line

Find the slope of the line that passes through the points (0, 6) and (5, 2).

$$\frac{6-2}{0-5} \rightarrow \frac{4}{-5}$$

$$\frac{2-6}{5-0} \rightarrow \frac{-4}{5}$$

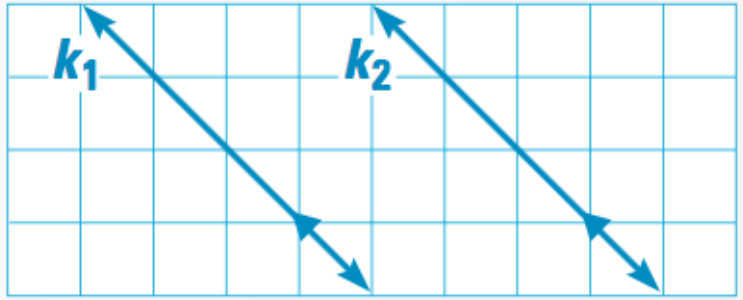
You can use the slopes of two lines to tell whether the lines are parallel.

*Horizontal = 0; Vertical = undefined

POSTULATE

POSTULATE 17 ***Slopes of Parallel Lines***

In a coordinate plane, two nonvertical lines are parallel if and only if they have the same slope. Any two vertical lines are parallel.



Lines k_1 and k_2 have the same slope.

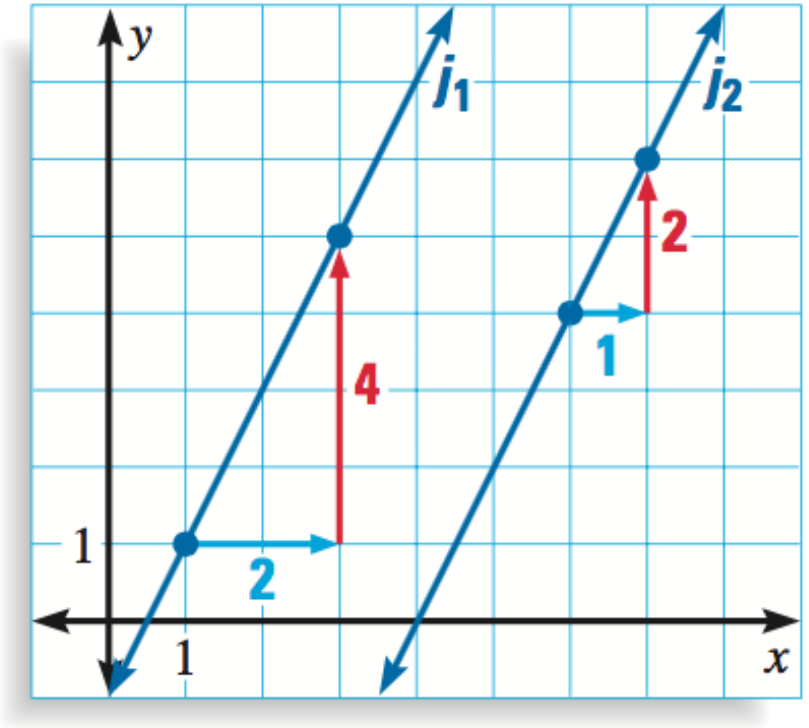
Example 3: Deciding Whether Lines are Parallel

Find the slope of each line. Is $j_1 \parallel j_2$?

$j_1 \rightarrow \frac{4}{2} \rightarrow \frac{2}{1} \rightarrow 2$

$j_2 \rightarrow \frac{2}{1} \rightarrow 2$

yes, $j_1 \parallel j_2$



Example 4: Identifying Parallel Lines

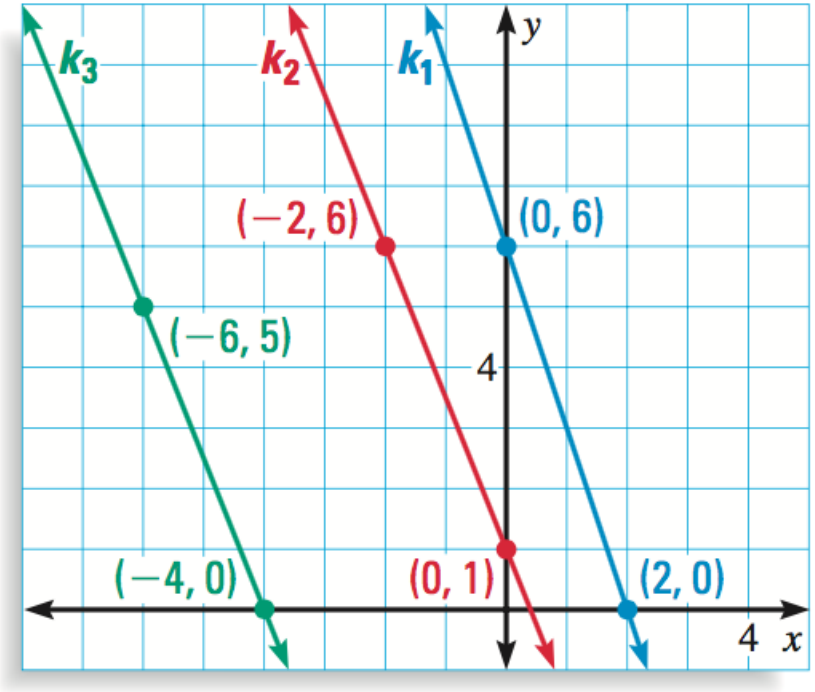
Find the slope of each line. Which lines are parallel?

$K_1 \rightarrow \frac{6-0}{0-2} \rightarrow \frac{6}{-2} \rightarrow -3$

$K_2 \rightarrow \frac{6-1}{-2-0} \rightarrow \frac{5}{-2}$

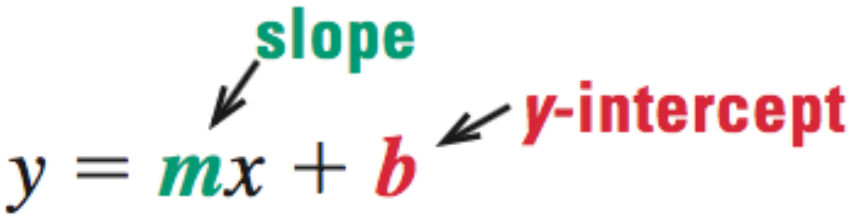
$K_3 \rightarrow \frac{5-0}{-6-4} \rightarrow \frac{5}{-2}$

$\Rightarrow K_2 \parallel K_3$



GOAL 2: Writing Equations of Parallel Lines

In algebra, you learned that you can use the slope *m* of a nonvertical line to write an equation of the line in *slope-intercept form.*



The y-intercept is the y-coordinate of the point where the line crosses the y-axis.

Example 5: Writing an Equation of a Line

Write an equation of the line through the point (2, 3) that has a slope of 5.

$y = mx + b$

$3 = 5(2) + b$

$3 = 10 + b$

$-10 \quad -10$

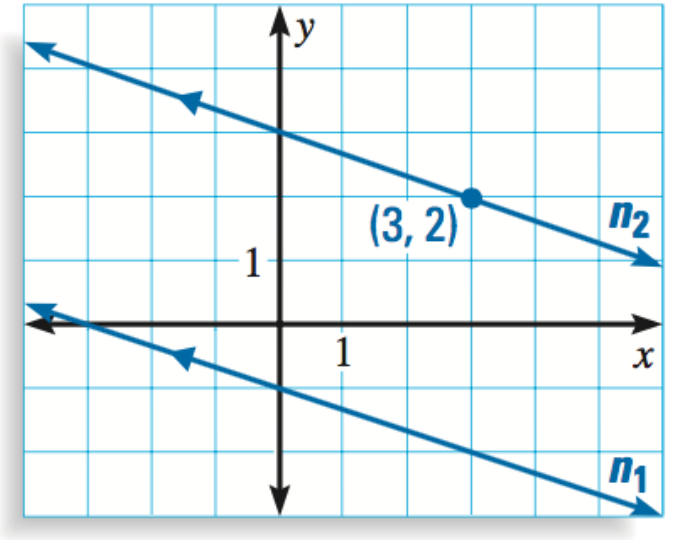
$-7 = b$

$\Rightarrow y = 5x - 7$

Example 6: Writing an Equation of a Parallel Line

Line n_1 has the equation $y = -\frac{1}{3}x - 1$.

Line n_2 is parallel to n_1 and passes through the point (3, 2).
Write an equation for n_2.



m = -1/3

$y = mx + b$

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

$2 = -1 + b$

$+1 \quad +1$

$3 = b$

$\Rightarrow y = -1/3x + 3$