

3.4

Find and Use Slopes of Lines

Goal • Find and compare slopes of lines.

Your Notes

VOCABULARY

Slope The slope of a nonvertical line is the ratio of vertical change (rise) to horizontal change (run) between any two points on the line.

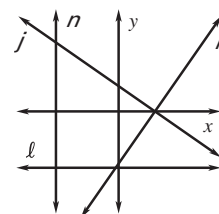
SLOPE OF LINES IN THE COORDINATE PLANE

Negative slope: falls from left to right, as in line *j*

Positive slope: rises from left to right, as in line *k*

Undefined slope: vertical, as in line *n*

Zero slope (slope of 0): horizontal, as in line *l*



Slope
 $m = \frac{\text{rise}}{\text{run}}$
 $= \frac{y_2 - y_1}{x_2 - x_1}$

Example 1 Find slopes of lines in a coordinate plane

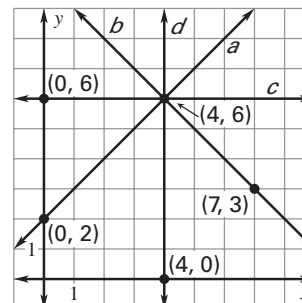
Find the slope of line *a* and line *c*.

Slope of line *a*:

$$m = \frac{6 - 2}{4 - 0} = \frac{4}{4} = 1$$

Slope of line *c*:

$$m = \frac{6 - 6}{4 - 0} = \frac{0}{4} = 0$$



✓ **Checkpoint** Use the graph in Example 1. Find the slope of the line.

1. line *b*

−1

2. line *d*

undefined

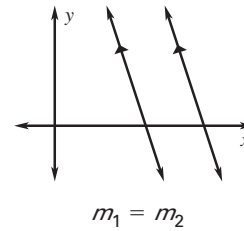
Your Notes

If the product of two numbers is -1 , then the numbers are called *negative reciprocals*.

POSTULATE 17 SLOPES OF PARALLEL LINES

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

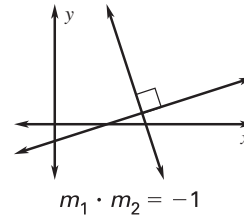
Any two vertical lines are parallel.



POSTULATE 18 SLOPES OF PERPENDICULAR LINES

In a coordinate plane, two nonvertical lines are perpendicular if and only if the product of their slopes is -1 .

Horizontal lines are perpendicular to vertical lines.



Example 2 Identify parallel lines

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

Solution

Find the slope of k_1 .

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

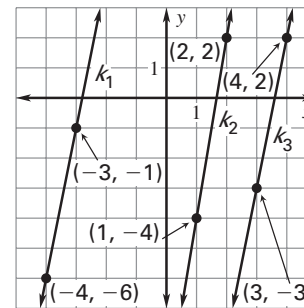
Find the slope of k_2 .

$$m = \frac{2 - (-4)}{2 - 1} = \underline{6}$$

Find the slope of k_3 .

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

Compare the slopes. Because k_1 and k_3 have the same slope, they are parallel. The slope of k_2 is different, so k_2 is not parallel to the other lines.



Checkpoint Complete the following exercise.

3. Line c passes through $(2, -2)$ and $(5, 7)$. Line d passes through $(-3, 4)$ and $(1, -8)$. Are the two lines parallel? *Explain* how you know.

No; the slope of c is not equal to the slope of d .

Your Notes

Given a point on a line and the line's slope, you can use the rise and run to find a second point and draw the line.

Example 3 Draw a perpendicular line

Line h passes through $(1, -2)$ and $(5, 6)$. Graph the line perpendicular to h that passes through the point $(2, 5)$.

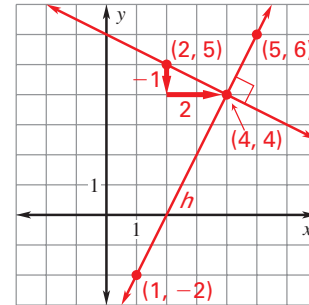
Step 1 Find the slope m_1 of h through $(1, -2)$ and $(5, 6)$.

$$m_1 = \frac{6 - (-2)}{5 - 1} = \frac{8}{4} = 2$$

Step 2 Find the slope m_2 of a line perpendicular to h .

$$\begin{aligned} 2 \cdot m_2 &= -1 \\ m_2 &= -\frac{1}{2} \end{aligned}$$

Step 3 Use the rise and run to graph the line.



Example 4 Analyze graphs

Delivery A trucker made three deliveries. The graph shows the trucker's distance to the destination from the starting time to the arrival time for each delivery. Use slopes to make a statement about the deliveries.



The rate at which the trucker drives is represented by the slope of the segments. Segments a and c have the same slope, so deliveries a and c were driven at the same rate.

✔ **Checkpoint** Complete the following exercises.

Homework

4. Line n passes through $(1, 6)$ and $(8, 4)$. Line m passes through $(0, 5)$ and $(2, 12)$. Is $n \perp m$? Explain.

Yes, the product of the slopes equals -1 .

5. In Example 4, which delivery included the fastest rate of travel?

delivery b