Geometry 3.3
Calculate slopes of lines*
Use slope to identify parallel and perpendicular lines**

$\ell \perp n \qquad m /\!/ \rho$

$m = \begin{cases} \text{slope} \\ \text{rate of change} \end{cases}$ $= \dfrac{vert}{horiz} = \dfrac{rise}{run}$

$\|$ parallel $\quad m_1 = m_2$

$\perp$ perpendicular $\quad$ opp + recip $\quad m_1 \cdot m_2 = -1$
slope song
whiteboards $\qquad \dfrac{2}{5} \rightarrow \dfrac{-5}{2}$

$\oplus$ $\ominus$ horiz
OK

vert.

Slope Song

(Turkey in the Straw)

Slope is rise over run as we all know.
With the Y's on the top and the X's below.
Subtract the terms to get it right.
Simplify last for a wonderful sight.

(Chorus)
Rise over run, Y's over X.
Rise over run, Y's over X.
Subtract the terms to get it right.
Simplify last for a wonderful sight!

● Ski resorts assign ratings to their ski trails according to their difficulty. A primary factor in determining this rating is a trail's steepness or *slope gradient.* A trail with a 6% or $\frac{6}{100}$ grade falls 6 feet vertically for every 100 feet traveled horizontally.

The easiest trails, labeled ●, have slopes ranging from 6% to 25%, while more difficult trails, labeled ♦ or ♦♦, have slopes of 40% or greater.

$$\text{slope} = \frac{\text{vertical rise}}{\text{horizontal run}}$$

vertical rise

horizontal run

KeyConcept Slope of a Line

In a coordinate plane, the **slope** of a line is the ratio of the change along the y-axis to the change along the x-axis between any two points on the line.

The slope m of a line containing two points with coordinates (x_1, y_1) and (x_2, y_2) is given by the formula

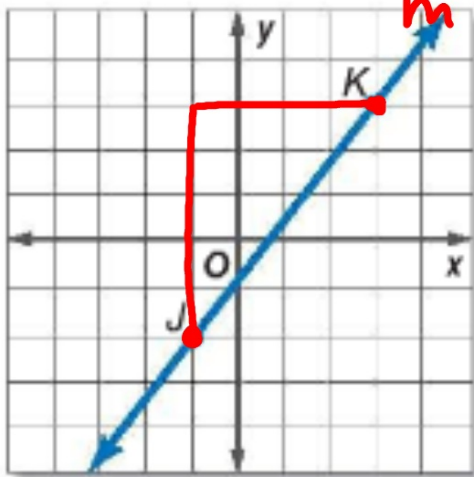$$m = \frac{y_2 - y_1}{x_2 - x_1}, \text{ where } x_1 \neq x_2.$$

rise: $y_2 - y_1$

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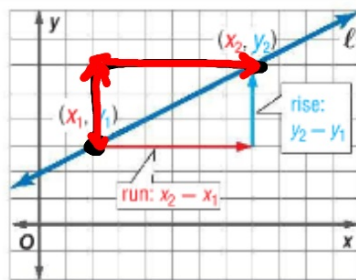
$$m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

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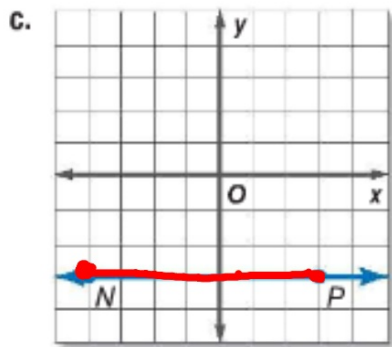## Example 1 Find the Slope of a Line

Find the slope of each line.

a.

$m = \dfrac{5}{4}$

b.

$$\frac{-6}{3} = \frac{-2}{1} = -2$$

c.

$$\frac{0}{7} = 0$$
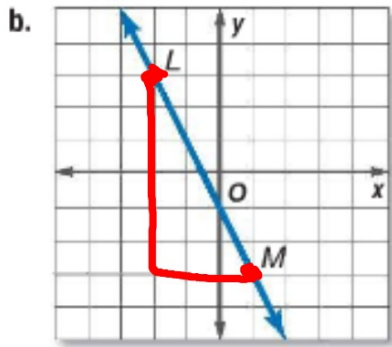
Fact family:

3x2=6
6/3=2
6/2=3

$$3 \cdot 2 = 6$$

$$\frac{6}{3} = 2 \qquad \frac{6}{2} = 3$$

If you multiply the two factors, you get a product.

6/0= ???
So 0 x ??? = 6
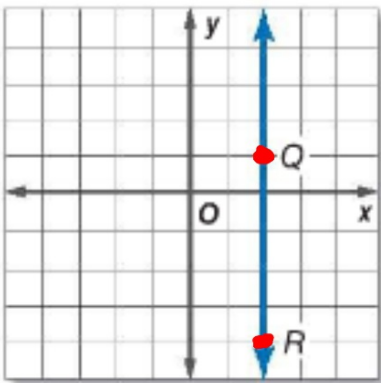
$$\frac{6}{0} = ? \qquad \frac{7}{0} \quad \frac{8}{0}$$

$$0 \cdot ? = 6$$
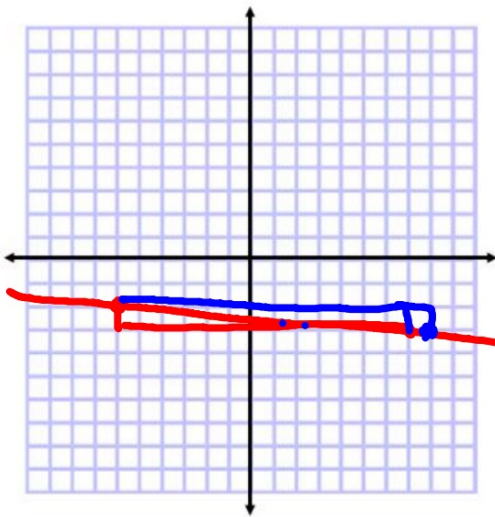
d.

Vertical lines

undefined

$$\frac{5}{0}$$

$$\frac{y}{x}$$

Alg. 1 Ch. 4

$$\frac{1}{-13} \qquad \frac{-1}{13} - 2 + 5 \qquad \frac{3}{9} = \frac{1}{3}$$

and

d (4, −3)

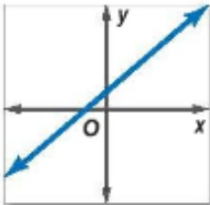**1B.** the line containing (8, −3) and (−6, −2)

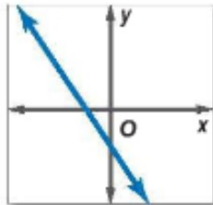**1D.** the line containing (−3, 3) and (4, 3)
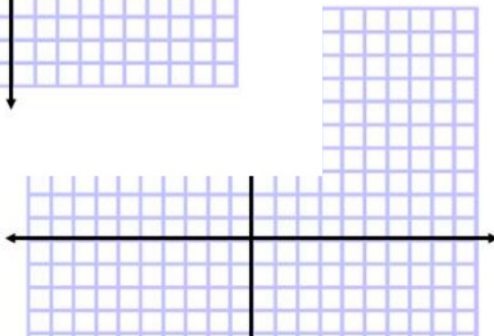
ConceptSummary **Classifying Slopes**

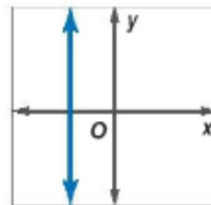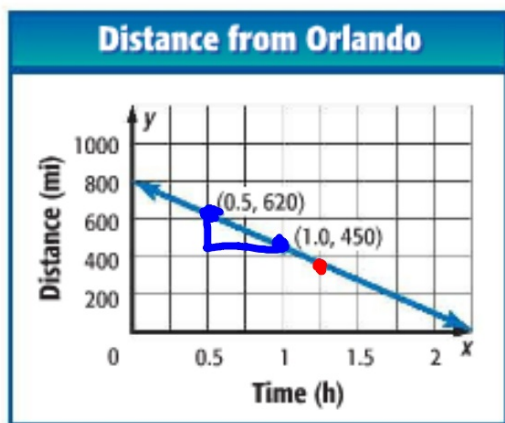| Positive Slope	Negative Slope	Zero Slope	Undefined Slope

OK
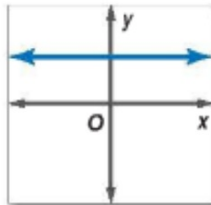
TRAVEL A pilot flies a plane from Columbus, Ohio, to Orlando, Florida. After 0.5 hour, the plane reaches its cruising altitude and is 620 miles from Orlando. Half an hour later, the plane is 450 miles from Orlando. How far was the plane from Orlando 1.25 hours after takeoff?

Distance from Orlando

Distance (mi)

1000
800 (0.5, 620)
600
400 (1.0, 450)
200

0   0.5   1   1.5   2   x

Time (h)

$$\frac{-0.5 \times 2}{170 \times 2} = \frac{-1}{340}$$

$$1.25(340)$$

Postulates Parallel and Perpendicular Lines

3.2 Slopes of Parallel Lines Two nonvertical lines have the same slope if and only if they are parallel. All vertical lines are parallel.

Example Parallel lines ℓ and m have the same slope, 4.

3.3 Slopes of Perpendicular Lines Two nonvertical lines are perpendicular if and only if the product of their slopes is -1. Vertical and horizontal lines are perpendicular.

Example line $m \perp$ line p
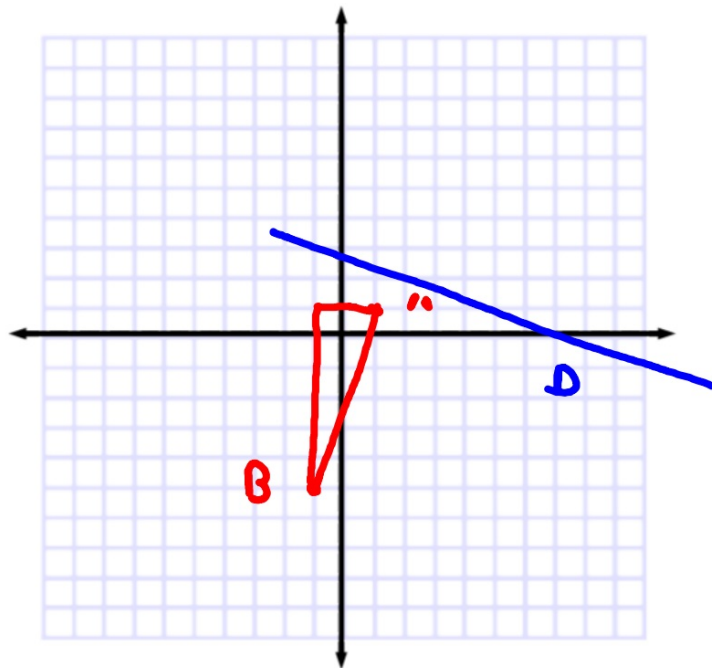product of slopes $= 4 \cdot -\dfrac{1}{4}$ or -1

slope $= 4$

slope $= -\dfrac{1}{4}$

slope $= 4$
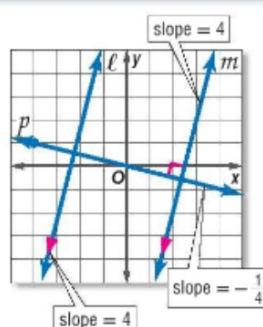
Desmos

Example 3 Determine Line Relationships

Determine whether **3** and $\frac{1}{3}$ are *parallel, perpendicular,* or *neither* for $A(1, 1)$, $B(-1, -5)$, $C(3, 2)$, and $D(6, 1)$. Graph each line to verify your answer.

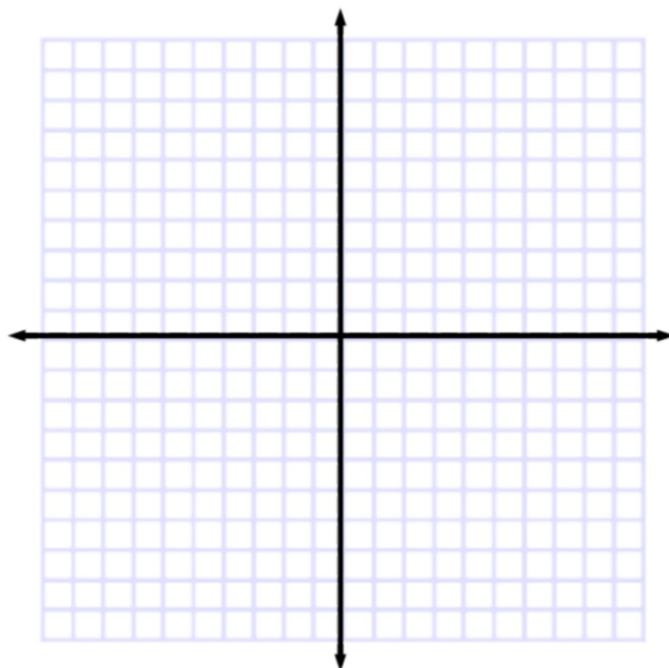$$m = \frac{6}{2} = 3$$

$$m = -\frac{1}{3}$$

$$\left.\right\} \perp$$

Determine whether $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ are *parallel, perpendicular,* **or** *neither.*
Graph each line to verify your answer.

3A. $A(14, 13), B(-11, 0), C(-3, 7), D(-4, -5)$

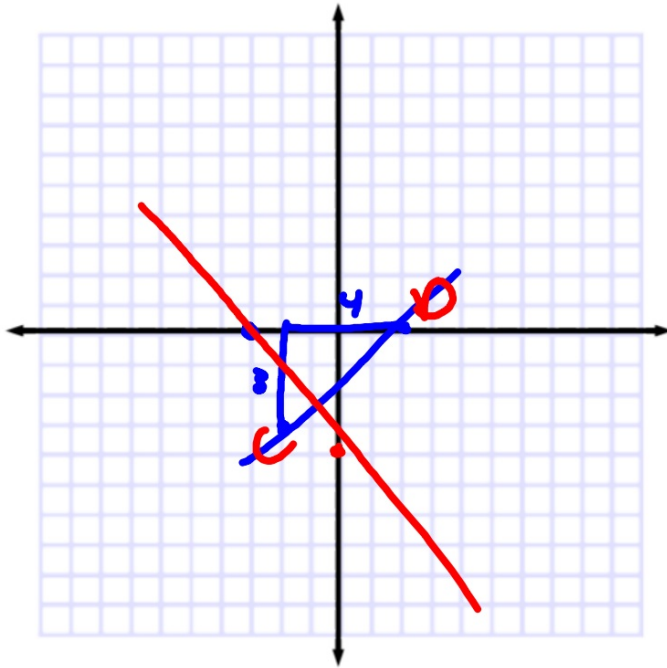**3B.** $A(3, 6), B(-9, 2), C(5, 4), D(2, 3)$
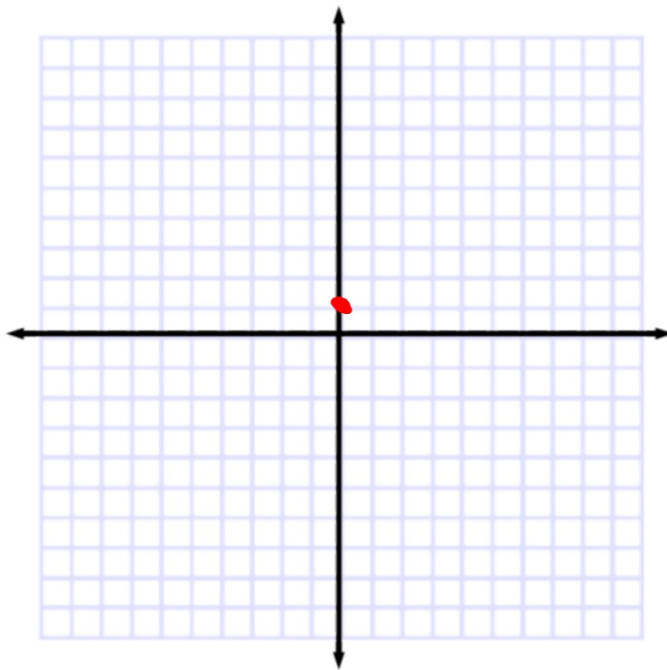
Example 4 Use Slope to Graph a Line

Graph the line that contains *A*(−3, 0) and is perpendicular to $\overleftrightarrow{CD}$ with *C*(−2, −3) and *D*(2, 0).

$\dfrac{3}{4}$

$\dfrac{-4}{3}$

4. Graph the line that contains $P(0, 1)$ and is perpendicular to $\overleftrightarrow{QR}$ with $Q(-6, -2)$ and $R(0, -6)$.

53. p^{193}

13-490