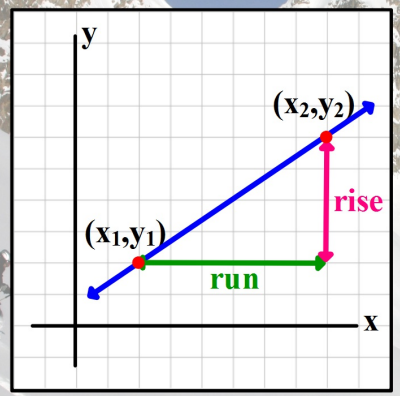
9.4 Slope and Rate of Change

Objectives:

- to find the slopes of lines and classify parallel and perpendicular lines
- to use slope to solve real-life problems

Slope is the ratio of vertical change (the rise) to horizontal change (the run).



Rise: $y_2 - y_1$

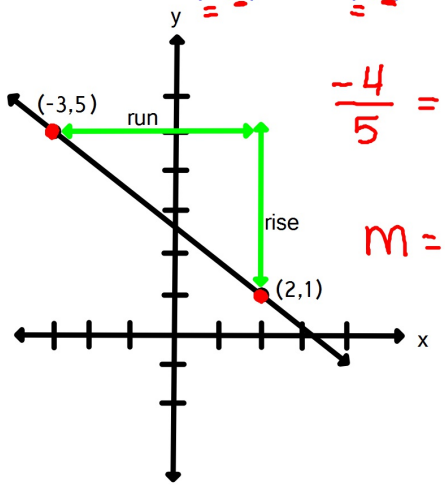
Run: $x_2 - x_1$

The slope of a line

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

Example 1: Finding the Slope of a Line

a. Find the slope of the line passing through (-3,5) and (2,1)



$$\frac{-4}{5} = \frac{4}{-5} = -\frac{4}{5}$$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1-5}{2-(-3)} = \frac{-4}{5}$$

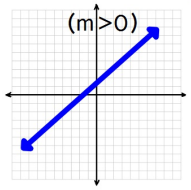
Now, on your own:

b. Find the slope of the line passing through (-2,-4) and (3,-1)

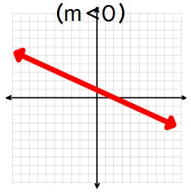
$$\frac{-1-(-4)}{3-(-2)} = \frac{-1+4}{3+2} = \frac{3}{5}$$

Classification of Lines by Slope

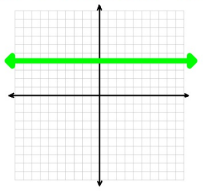
A line with a *positive* slope *rises* from left to right



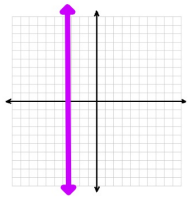
A line with a *negative* slope *falls* from left to right



A line with a slope of zero is *horizontal* (m=0)



A line with an *undefined* slope is *vertical* (m is undefined)



Example 2: Classifying Lines Using Slope

Without graphing , use the slope to tell if the line through the given points rises , falls , is horizontal or is vertical .

a. (3, -4), (1, -6)

$m = \frac{-6-(-4)}{1-3} = \frac{-6+4}{1-3} = \frac{-2}{-2} = 1$ RISES

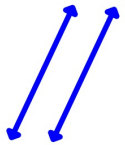
b. (2, -1), (2, 5)

$\frac{5-(-1)}{2-2} = \frac{5+1}{2-2} = \frac{6}{0}$ undefined VERTICAL

Slopes of Parallel and Perpendicular Lines

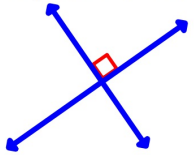
Parallel lines : Two lines are parallel if and only if they have the same slope.

$m_1 = m_2$



Perpendicular lines: Two lines are perpendicular if and only if their slopes are opposite reciprocals of each other.

$m_1 = -\frac{1}{m_2}$



Example 3:

Tell whether the lines are *parallel*, *perpendicular* , or *neither* .

a. Line 1: through (-3,3) and (3,-1)

Line 2: through (-2,-3) and (2,3)

Line 1: $\frac{-1-3}{3-(-3)} = \frac{-4}{6} = -\frac{2}{3}$ Line 2: $\frac{3-(-3)}{2-(-2)} = \frac{6}{4} = \frac{3}{2}$

Perpendicular

b. Line 1: through (-3,1) and (3,4)

Line 2: through (-4,-3) and (4,1)

Line 1: $\frac{4-1}{3-(-3)} = \frac{3}{6} = \frac{1}{2}$ Line 2: $\frac{1-(-3)}{4-(-4)} = \frac{4}{8} = \frac{1}{2}$

Parallel

Example 4: Using Slope in Real Life

In a home repair manual the following ladder safety guideline is given.

Adjust the ladder until the distance from the base of the ladder to the wall is at least one quarter of the height where the top of the ladder hits the wall. For example, a ladder that hits the wall at a height of 12 feet should have its base at least 3 feet from the wall.

Find the maximum recommended slope for a ladder

Find the minimum distance a ladder's base should be from the wall if you need the ladder to reach a height of 20ft.