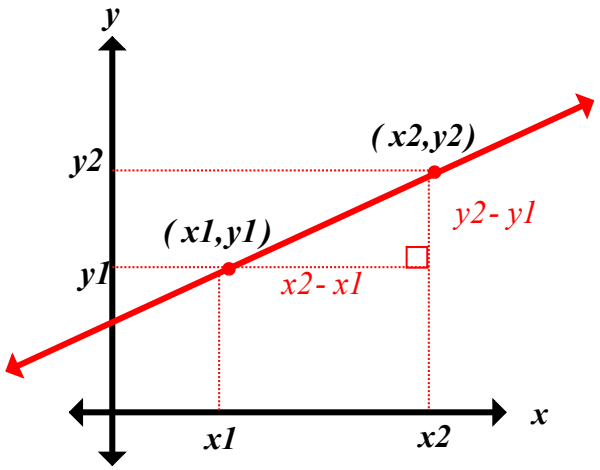
Chapter 1 - Functions & Their Graphs

1.1 Lines in the Plane



Slope of a Line

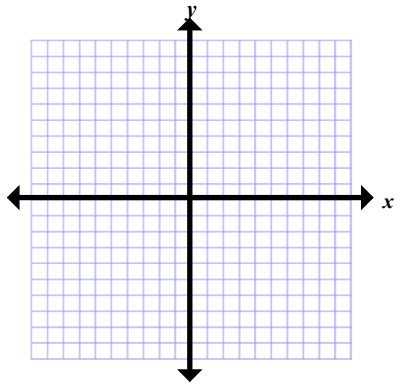
The slope of the nonvertical line through ($x1, y1$) and (x2, y2) is

$$m = \frac{y2 - y1}{x2 - x1} = \frac{\text{change in } y}{\text{change in } x}$$

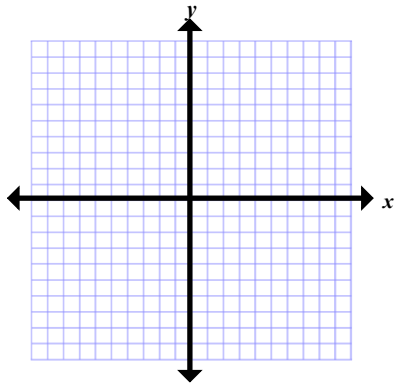
where $x1 \neq x2$

Example 1 - Finding the slope of a line given 2 points

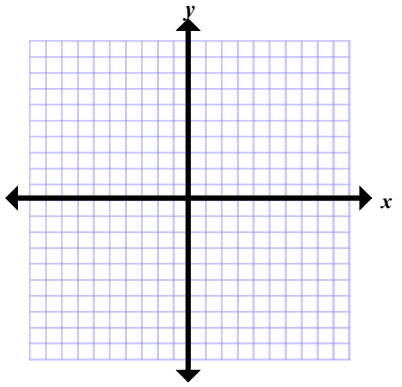
a.) **(-2, 0) and (3, 1)**



b.) **(-1, 2) and (2, 2)**

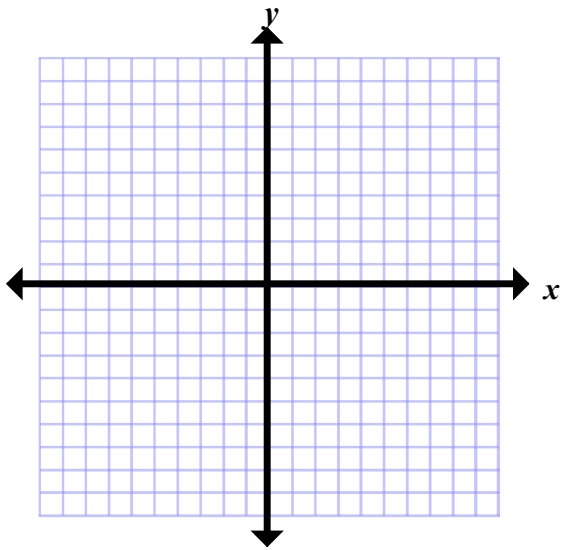


c.) **(0, 4) and (1, -1)**



Definition of slope does not apply to vertical lines!

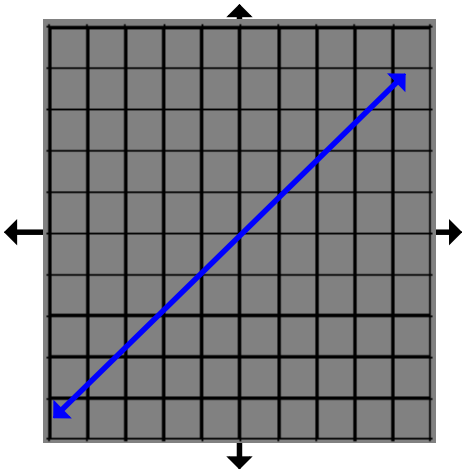
Find the slope of the line passing though (3, 4) and (3, 1)



*** Special Graphing utility to graph a vertical line**

Positive Slope

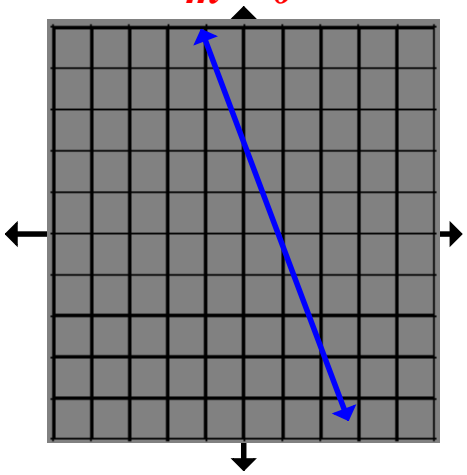
$m > 0$



Rising from Left to Right

Negative Slope

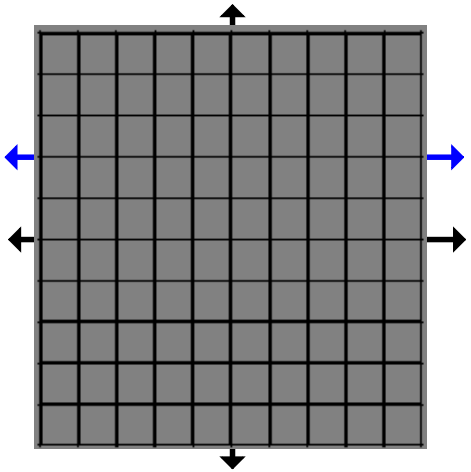
$m < 0$



Falling from Left to Right

Zero Slope

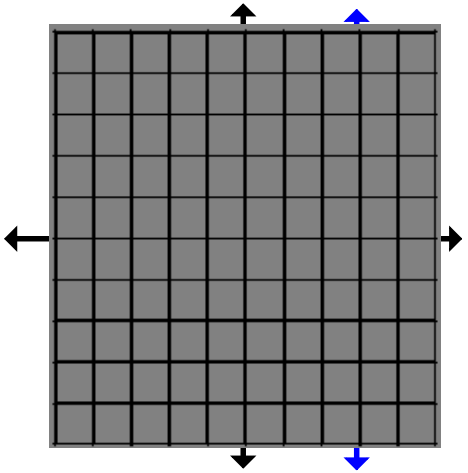
$m = 0$



Horizontal Line

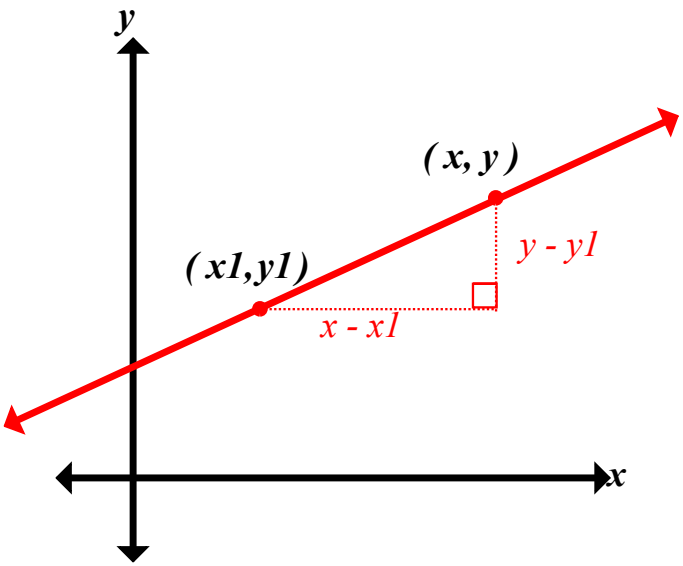
Undefined Slope

m is undefined



Vertical Line

Point-Slope Form



$$y - y1 = m\,(x - x1)$$

Example 2 - Find the equation of the line that passes through the point (1, -2) and has a slope of 3.

2 - Point Form

The point-slope form can be used to find an equation of a nonvertical line passing through two points ($x1, y1$) and ($x2, y2$).
First find slope, then use the point-slope form.

$$y - y1 = \frac{y2 - y1}{x2 - x1}(x - x1)$$

Example 3 - A linear model for Sales Prediction

During 2000, Nike's net sales were $9.0 billion, and in 2001 net sales were $9.5 billion.
Write a linear equation giving the net sales *y* in terms of the year *x*.
Then use the equation to predict the net sales for 2002.
(Source: Nike, Inc.)

Solution

Let $x = 0$ represent 2000.

Let (0, 9.0) and (1, 9.5) be two points on the line representing net sales.

1.) Find slope :

2.) Use point-slope form to write the equation of the line :

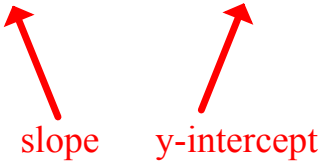
3.) Answer the question. Predict sales for 2002 (x = 2)

Annual Salary

**A jeweler's salary was $28,500 in 2000 and $32,900 in 2002.
The jeweler's salary follows a linear growth pattern.
What will the jeweler's salary be in 2006?**

Slope-Intercept Form

$$y = mx + b$$



Example 4 - Using Slope-Intercept Form

a.) $x + y = 2$

b.) $y = 2$

From the slope-intercept form of the the equation of a line,
you can see that a horizontal line *(m = 0)*
has an equation of the form $y = b$.
Each point on a horizontal line through *(0, b)*
has a *y*-coordinate of *b*.

Similarly, each point on a vertical ine through *(a, 0)* has an *x*-coordinate of *a*.
So a vertical ine has an equation of the form $x = a$.
This equation cannot be written in slope-intercept form
since slope of a vertical line is undefined.

Every line can be written in GENERAL FORM :

$$Ax + By + C = 0$$

Where A snd B are not *both* zero

Summary of 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	$y - y1 = m(x - x1)$

Parallel & Perpendicular Lines

Parallel Lines

Two distinct nonvertical lines are parallel if and only if their slopes are equal.

$$m1 = m2$$

Example 6 - Find the slope-intercept form of the equation of the line that passes through the point (2, -1) and is parallel to the line $2x - 3y = 5$.

1.) Find the slope of the line

2. Use point-slope form to write the equation.

Perpendicular lines

Two nonvertical lines are perpendicular if and oly if their slopes are negative reciprocals of each other.

$$m1 = -\frac{1}{m}$$

Example 7 - Find the slope-intercept form of the equation of the line the passes through the point (2, -1) and is perpendicular to the line $2x - 3y = 5$.

1.) Find the slope of the line

2.) Change slope to negative reciprocal

3.) Use point-slope form to find equation of line.

Activities:

1. **Write an equation (in General Form) of the line that passes through the points (2, 1) and (3, 2).**

2. **Find the slope of the line that is perpendicular to the line $4x - 7y = 12$**

3. **Write the equations of the vertical line that passes through the point (3, 2)**