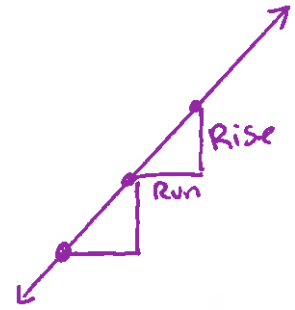


## Equations of Lines

"steepness"

Slope of a line through the points  $(x_1, y_1)$  and  $(x_2, y_2)$ :

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



**Example:** Find the slope of the line through the points  $(4, 8)$  and  $(-2, -1)$ .

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 8}{-2 - 4} = \frac{-9}{-6} = \frac{3}{2}$$

### Equation of a Line (2 Forms)

#### Slope-Intercept Form

$$y = mx + b$$

#### Point-Slope Form

$$y - y_1 = m(x - x_1)$$

**Example:** Find an equation for the line passing through the point  $(1, -2)$  with a slope of  $3/2$ .

$m = \frac{3}{2}$   
Point =  $(1, -2)$

Point-Slope  $\rightarrow y - (-2) = \frac{3}{2}(x - 1)$

$\rightarrow y + 2 = \frac{3}{2}x - \frac{3}{2}$

Slope-Intercept  $\rightarrow y = \frac{3}{2}x - \frac{7}{2}$

**Example:** Find the equation of the line passing through the points  $(4, 8)$  and  $(-2, -1)$ .

$m = \frac{-1 - 8}{-2 - 4} = \frac{-9}{-6} = \frac{3}{2}$

pick either pt  $\rightarrow$  Point-Slope  $\rightarrow y - 8 = \frac{3}{2}(x - 4)$  or  $y + 1 = \frac{3}{2}(x + 2)$

$y - 8 = \frac{3}{2}x - 6$

Slope-Intercept  $\rightarrow y = \frac{3}{2}x + 2$

$y + 1 = \frac{3}{2}x + 3$

$y = \frac{3}{2}x + 2$

## Parallel and Perpendicular Lines

(Parallel) Theorem: parallel lines have = slopes.

(Perpendicular) Theorem: perpendicular lines have negative reciprocal slopes.

**Example:** Find the equations of a line parallel and a line perpendicular to the line  $-3x + 2y = 4$ , each passing through the point  $(3,0)$ .

First: find the slope:  $-3x + 2y = 4$   
 $2y = 3x + 4$   
 $y = \frac{3}{2}x + 2$  slope

**Parallel Line:**

$m = 3/2$   
point =  $(3,0)$

$y - 0 = \frac{3}{2}(x - 3)$  ← pt-slope

or  
 $y = \frac{3}{2}x - \frac{9}{2}$  ← slope intercept

**Perpendicular Line:**

$m = -\frac{2}{3}$  ← neg. reciprocal

point =  $(3,0)$

pt slope →  $y - 0 = -\frac{2}{3}(x - 3)$

or  
slope intercept →  $y = -\frac{2}{3}x + 2$

## Vertical & Horizontal Lines

**Horizontal**



"Zero" slope.

$y = \#$

**Example:** Write the equation of the line through the points  $(2, 3)$  and  $(5, 3)$ .

$m = \frac{3-3}{5-2} = \frac{0}{3} = 0$  ← horiz. line.

$y = 3$

**Vertical**



"No" slope.

$x = \#$

**Example:** Write the equation of the line through the points  $(-3, 4)$  and  $(-3, 1)$ .

$m = \frac{1-4}{-3-(-3)} = \frac{-3}{0} = \text{undefined}$  ← vert. line ↓

$x = -3$