In Algebra I we discovered that a function is considered to be linear if the independent variable increases or decreases at a constant rate. Graphically, a function that graphs out to be a line is a linear function.

**Vocabulary**

x – This is the independent variable and is graphed on the horizontal axis.

y – This is the dependent variable and is the output of the function resulting when an x-value is put into the linear equation.

x-intercept – The location where a line crosses the x-axis.

y-intercept – The location where a line crosses the y-axis.

**Linear equations**

1. Standard Form: \( Ax + By = C \)
2. Slope-Intercept Form: \( y = mx + b \)
3. Point-Slope Form: \( y - y_1 = m(x - x_1) \)
4. Slope of a line: \( m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}} \)

Remember!!!: y-intercept has the form \((0,y)\)  
                      x-intercept has the form \((x,0)\)

Example:

state the x and y intercepts for the graph at the right.

**rate of change** – the measure of the steepness of the line. It is ratio of the vertical change over the horizontal change between two points. The rate of change is also called the **slope**:

\[
\text{rate of change} = \text{slope} = m = \frac{\text{change in } f(x)}{\text{change in } x} = \frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}
\]

Example: Does the xy table have a constant rate of change? Does the table model a linear function? Check all the points!

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>-2</td>
<td>0</td>
<td>6</td>
<td>16</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>3</td>
<td>7</td>
<td>9</td>
<td>13</td>
<td>15</td>
</tr>
</tbody>
</table>

What is the slope of a line passing through the points \((0, -3)\) and \((7, -9)\)
**Point-Slope Formula**

A line passing through point \((x_1, y_1)\) with a slope \(m\) has the equation:

\[ y - y_1 = m(x - x_1) \]

<table>
<thead>
<tr>
<th>Write in standard form the equation of each line: slope 2, through ((4, -2))</th>
<th>Write in point slope form the equation of the line that passes through the points ((5, 1)) and ((-4, -3))</th>
</tr>
</thead>
</table>

**Graphing given a point and a slope**

A slope makes graphing a line from a given point very easy.

Graph a line through \((-1, -2)\) with a slope of \(\frac{2}{3}\).

**Slope-Intercept Form**

Combining the ideas about slope and intercept lead to a general equation form for a line called the slope-intercept form: \(y = mx + b\), where \(m\) is the slope and \(b\) is the y-intercept. The slope-intercept form allows one to graph almost any linear equation in just a few seconds WITHOUT the use of a graphing calculator.

Find the slope using slope-intercept form:

\[3x + 2y = 1\]
We need to readily recognize whether the sign of the slope is positive or negative or something else!

**Relationship between special linear systems and their slopes**

**Parallel lines:**

\[ y = mx + b \]

**Perpendicular lines:**

\[ y = -\frac{1}{m}x + c \]

We are able to find an equation of a line passing through a point and perpendicular to another line if we are given the reference line and the point. Also, we can find a line parallel to another if given the same information.

\[
\begin{align*}
(-1, 3) & \text{ and perpendicular to the line } y = 5x - 3 \\
(2, 1) & \text{ and parallel to the line } y = \frac{2}{3}x + \frac{5}{8}
\end{align*}
\]