

Linear or First-Degree Function

When we think of the graph of a line we usually consider two things:

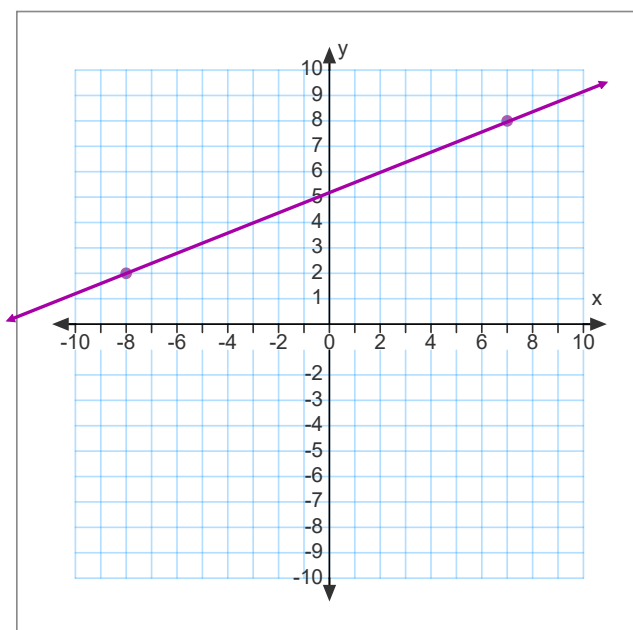
1. The initial value, or y-intercept - the value of y when $x = 0$.
2. The rate of change or slope (m).

The line either increases or decreases. There is a pattern: as the x -values change, the y -values go up or down at a constant rate.

A rate of change is a ratio that compares how much the dependent variable changes as a result of changing the independent variable.

The formula: $m = \frac{\text{rise}}{\text{run}}$ or $m = \frac{\Delta y}{\Delta x} \longrightarrow m = \frac{y_2 - y_1}{x_2 - x_1}$

What is the slope of \overleftrightarrow{AB} ?

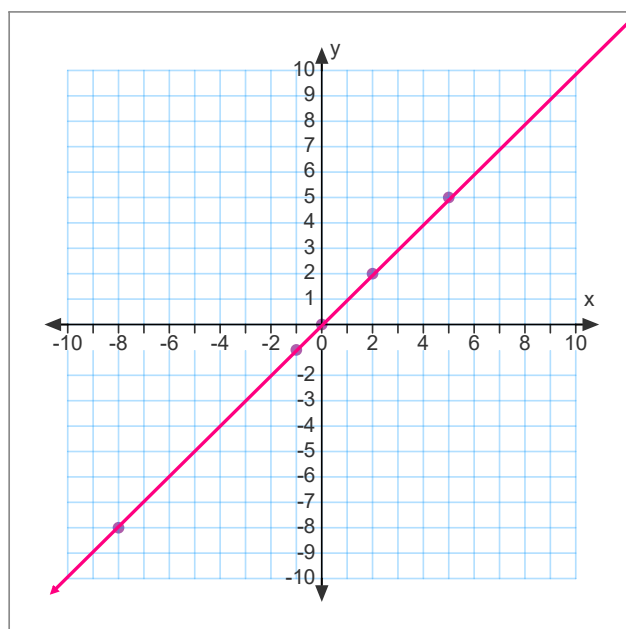


What is the slope of the line that passes through points $Q(-4,6)$ and $R(11,-1)$?

Basic Linear Function

Rule: $y = x$

x	y



Parameter m (rate of change)

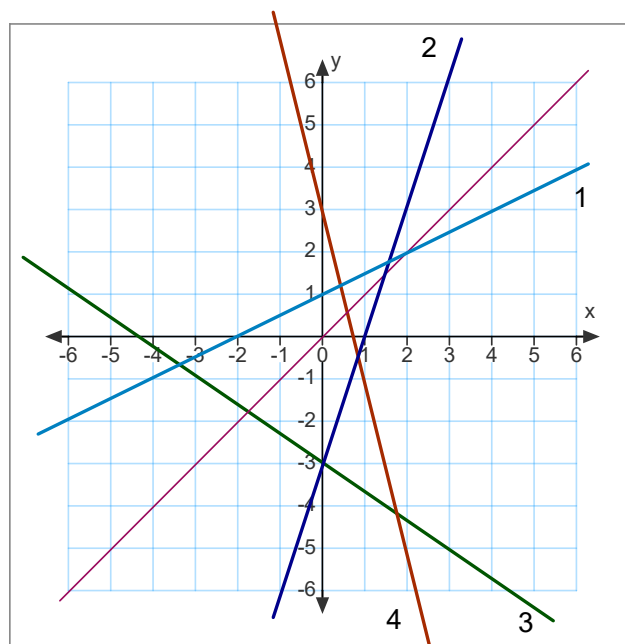
The value of m determines the slope, or steepness of the line. The bigger $|m|$ is, the steeper the line.

1) $m = \frac{1}{2}$ 2) $m = 3$

If m is positive, then the line is increasing.

If m is negative, then the line is decreasing.

3) $m = -\frac{2}{3}$ 4) $m = -4$



Equation of a Line

When we know the y -intercept and the slope we can determine the equation of the line.

Equation of a line: $y = mx + b$

y is the dependent variable
 x is the independent variable

where

m is the slope or rate of change, and
 b is the y -intercept or initial value

This form of a line is known as standard or functional form.

Also: $f(x) = mx + b$

Find the Rule

- Given two points

Example: Determine the equation of the line that passes through the points $A(-2, 7)$ and $B(2, 9)$.

Step 1: Determine the slope (*m*)

$$A(-2, 7) \quad B(2, 9)$$

$$\begin{aligned} m &= \frac{y_2 - y_1}{x_2 - x_1} \\ &= \frac{9 - 7}{2 - (-2)} \\ &= \frac{2}{4} \text{ or } 0.5 \end{aligned}$$

Step 2: Determine the value of b , the initial value.

-- Choose one of the points, A or B.

A(-2, 7) B(2, 9)

A: $x = -2$ and $y = 7$

B: $x = 2$ and $y = 9$

-- Fill in x , y and a in the equation and solve for b .

$$y = mx + b$$

$$y = 0.5x + b$$

$$= 0.5(\quad) + b$$

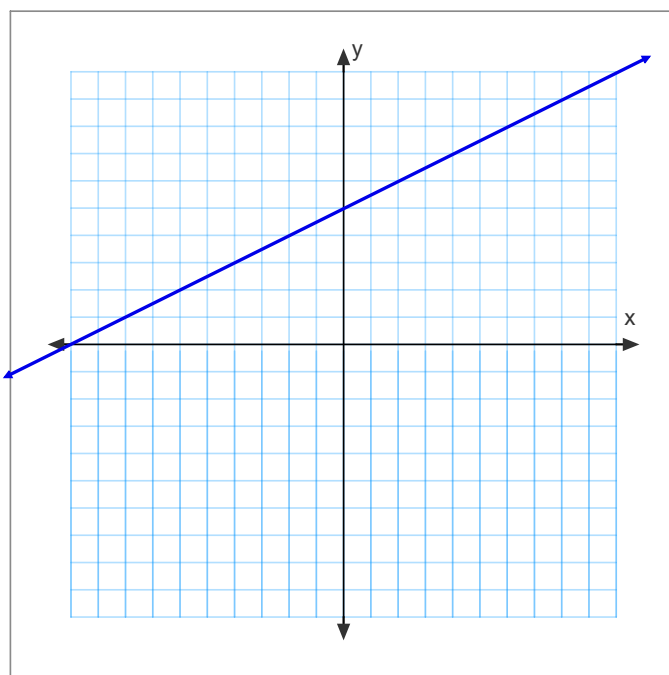
$$= \quad + b$$

$$8 = b$$

Step 3: Put your m and b into the equation.

$$y = 0.5x + 8$$

Example: Determine the equation of the line shown below.



Example: Determine the equation of the line that passes through points $K(1,12)$ and $L(9,2)$.

Example: Last week, John worked 30 hours and earned \$600. This week, he worked 22 hours and earned \$480. How much will John earn if he works 40 hours next week?

This story provides 2 points: (30, 600) and (22, 480).

- 1) Determine m
- 2) Determine b

1

$$m = \frac{\quad}{\quad}$$

$$m = \underline{\quad}$$

$$m =$$

2

$$\begin{aligned} y &= mx + b \\ &= 15(\quad) + b \\ &= \quad + b \\ &= \quad + b \\ &= b \end{aligned}$$

$$y = 15x + 150$$

John's earnings next week:

$$\text{Let } x = 40$$

$$y = 15(40) + 150$$

$$y = 600 + 150$$

$$y = 750$$

John will earn \$750.

Graphing a Linear Function

Given an equation $y = mx + b$

Method 1: Make a table of values

Choose a value for x . Calculate the value of y for this x .

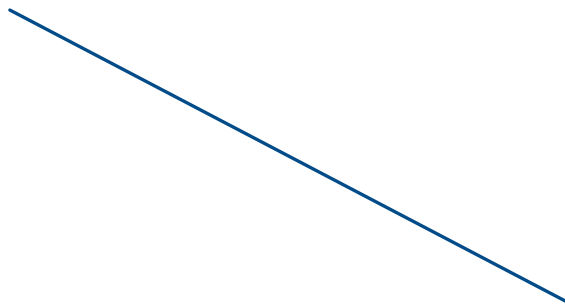
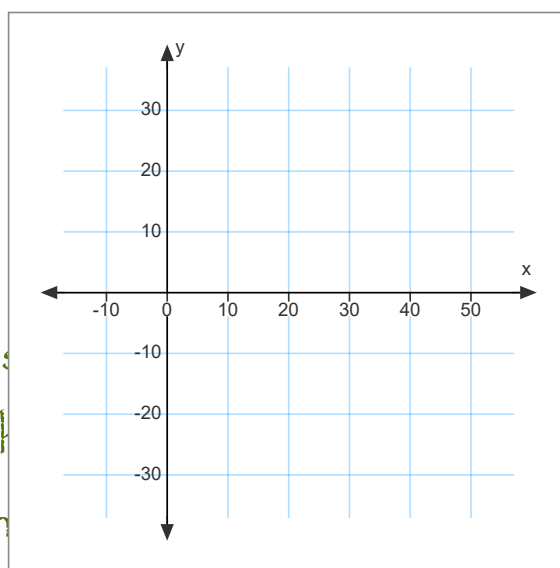
Repeat for another two values of x .

Plot the points on the Cartesian plane.

Example: $y = -\frac{1}{2}x + 30$

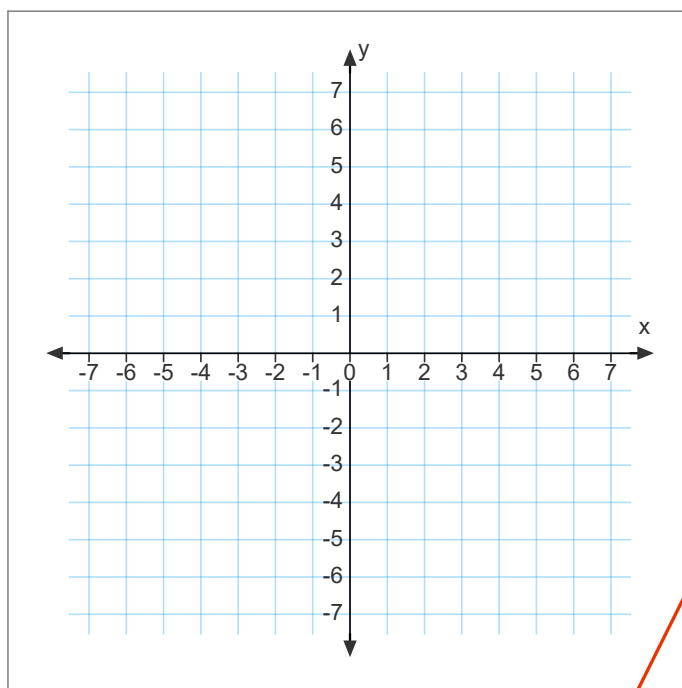
x	y

Each pair of values represents a point. Plot each point on a Cartesian plane and connect the points.



Example: $y = 2x - 3$

x	y



b) Method 2: Using the slope and y -intercept

$$y = mx + b$$

In the equation, b represents the y -intercept, so we already know a point on the graph: $(0, b)$.

Plot it on the Cartesian plane.

Next, use the rate of change (or slope) - how it tells us how y moves when x moves - to generate more points.

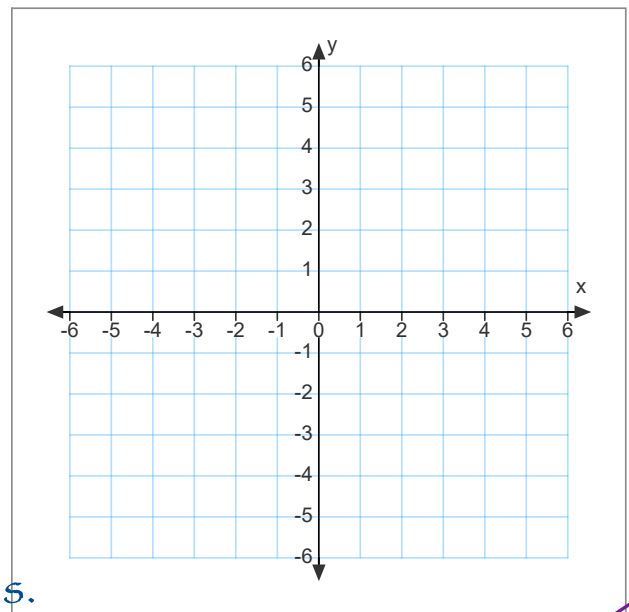
$$m = \frac{\text{rise}}{\text{run}} \quad \text{or} \quad \frac{\Delta y}{\Delta x}$$

Example: $y = \frac{2}{3}x - 1$

$b = -1$, so $(0, -1)$ is our first point.

The slope $\frac{2}{3}$ tells us that if x moves 3 places to the right then y should move up 2 places.

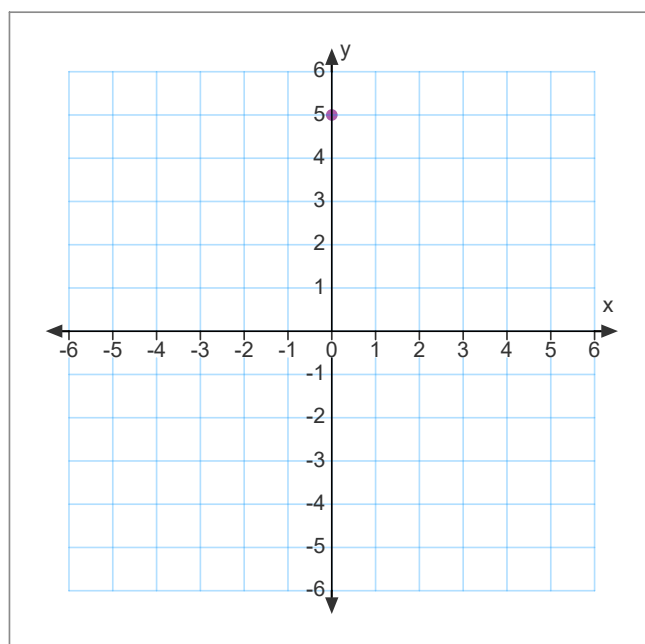
Do this, starting at b , to find a second point.
Continue the pattern until you have a few points.



Example: $y = -3x + 5$

$b =$

$m =$



Example: $y = -0.6x + 4$

$b =$

$m =$

