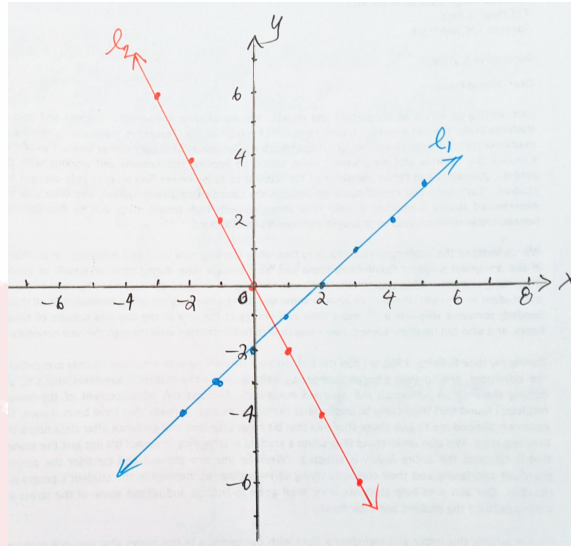# Equation of a Line

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2021

Equation of a Line

A line can be thought of as the extension o a set of points that when joined create a straight line segment.

We have two lines l_1 and l_2. What are the slopes of l_1 and l_2, respectively? We need to find two points on l_1 and then calculate the *rise* and *run*. Two points on l_1: $(x_0, y_0) = (1, -1)$ and $(x_1, y_1) = (4, 2)$.

$$slope = \frac{rise}{run} = \frac{y_1 - y_0}{x_1 - x_0} = \frac{2 - (-1)}{4 - 1} = \frac{3}{3} = 1$$

Therefore, the slope of line l_1 is 1. We usually represent the slope by m. So let's let the slope of l_1 be $m_1 = 1$.

Calculuate slope of l_2. Two points on l_2: $(x_0, y_0) = (-1, 2)$ and $(x_1, y_1) = (2, -4)$.

$$slop \ of \ l_2 = m_2 = \frac{y_1 - y_0}{x_1 - x_0} = \frac{-4 - 2}{2 - (-1)} = \frac{-6}{3} = -2$$

Therefore, the slope of line l_2 is $m_2 = -2$.

The *equation of a line* in general is given by,

$$y = mx + b$$

where m is the slope of the line and b is the y-interceiptof the line.

0.1 What is the y-interceipt?

The y-intercept is the point where the line crosses the y-axis. It casn also be calculated by sustituting $x = 0$ into the equation of a line. We can also find the y-interceipt by plugging the coordinates of a point on the line into the equation for the line.

Let's try and find the y-interceipt of l_1. We have the slope for l_1 as $m_1 = 1$. The equation of line l_1 so far is,

$$y = m_1 x + b_1 = x + b_1$$

where b_1 s the y-interceipt of l_1. Let's take a point on l_1 $(1, -1)$ and plug it into l_1.

$$
\begin{aligned}
y &= x + b_1 \\
-1 &= 1 + b_1 \\
-2 &= b_1
\end{aligned}
$$

Now we have the y-intercept and the equation of the line l_1 is

$$
\begin{aligned}
l_1 : y &= m_1 x + b_1 \\
y &= x - 2
\end{aligned}
$$

Let's find the complete equation for the line l_2. We already have that the slope is $m_2 = -2$. One point on line l_2 is $(x_0, y_0) = (-1, 2)$. Let's use this point to find the y-intercept.

$$
\begin{aligned}
y &= -2x + b_2 \\
2 &= -2(-1) + b_2 \\
\therefore 0 &= b_2
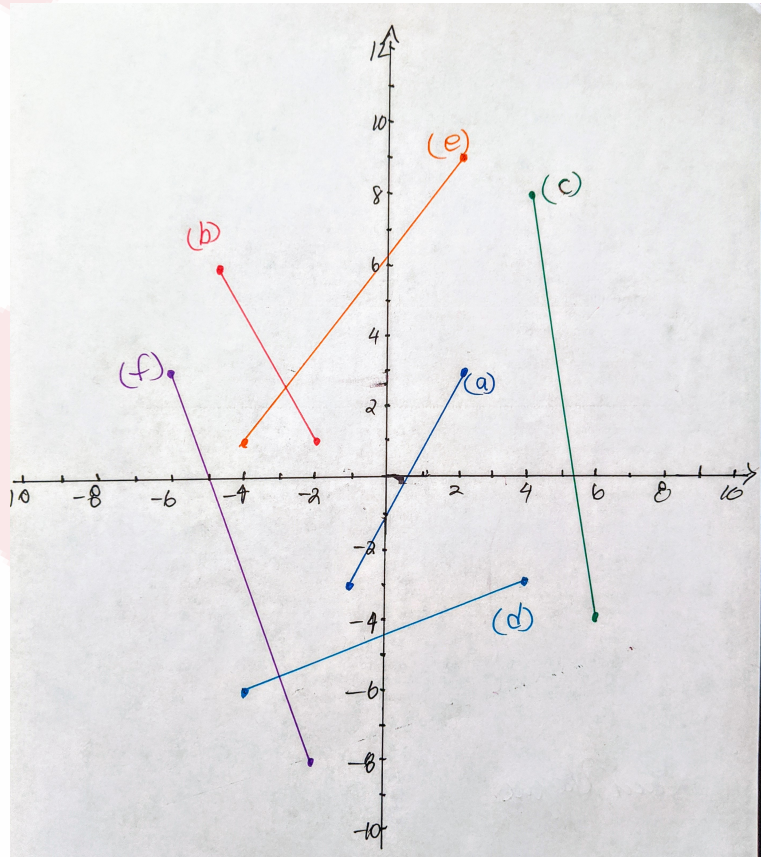\end{aligned}
$$

Now we have the equation for line l_2 as,

$$
\begin{aligned}
l_2 : y &= m_2 x + b_2 \\
y &= -2x + 0 \\
y &= -2x
\end{aligned}
$$

Exercises

1. Find the slope of each line segment.

2. Find the y-interceipt for each line extrapolated from the line segments above.

3. Write the equation for each line above.