# Linear Relations

Find the equation of a line passing through two points.

When solving for the equation of a line you can only use points that appear on the line itself. Points A(-5, 4) and B(-3, 10) are two given points on a line.

Step1: *Label two coordinates on the line.*
Example: if your first point is A(-5,4) and your second point is B(-3,10), you would label them the coordinates as follows:

A (-5, 4) B (-3, 10)

$x_1$ $y_1$ $x_2$ $y_2$

Step2: *Solve for the slope.*
Write the formula for the slope. Replace all the variables with the values stated above and solve for the slope.

Example:

$$\boldsymbol{a = \frac{y_2 - y_1}{x_2 - x_1}}$$

$$a = \frac{10 - (4)}{(-3) - (-5)}$$

$$a = \frac{10 - 4}{-3 + 5}$$

$$a = \frac{6}{2}$$

$$a = 3$$

Step 3: *Solve for the y-intercept.*
Write the equation of a line replacing the variable "a" with the slope you found in step2.
In order to solve for "b" you must replace the x and y variables with values from ***one and only one*** of the given points. **Do NOT mix-and-match** between points on the line.

Example:

$$\boldsymbol{y = ax + b}$$

$$y = 3x + b$$
$$(4) = 3(-5) + b \quad \leftarrow$$
$$4 = -15 + b$$
$$4 + 15 = b$$
$$19 = b$$

We will plug in coordinate A(-5, 4)

Step 4: Write the equation of the line.

Example: $y = 3x + 19$

Eg (1) Determine the equation of the line passing through two the two given points.
A(-3, 2) B (-1, 14)

$$\boldsymbol{a = \frac{y_2 - y_1}{x_2 - x_1}}$$

$$a = \frac{(14) - (2)}{(-1) - (-3)}$$

$$= \frac{14 - 2}{-1 + 3}$$

$$= \frac{12}{2}$$

$$= 6$$

$$\boldsymbol{y = ax + b}$$
$$y = 6x + b$$
$$(2) = 6(-3) + b$$
$$2 = -18 + b$$
$$2 + 18 = b$$
$$20 = b$$
$$y = 6x + 20$$

Eg (2) Determine the equation of the line passing through two the two given points.
E(2, 8) F(4, -10)

$$\boldsymbol{a = \frac{y_2 - y_1}{x_2 - x_1}}$$

$$a = \frac{(-10) - (8)}{(4) - (2)}$$

$$= \frac{-18}{2}$$

$$= -9$$

$$\boldsymbol{y = ax + b}$$
$$y = -9x + b$$
$$(8) = -9(2) + b$$
$$8 = -18 + b$$
$$8 + 18 = b$$
$$26 = b$$
$$y = -9x + 26$$

Eg (3) Determine the equation of the line passing through two the two given points.
C(-4, 7) D(1, -6)

$$\boldsymbol{a = \frac{y_2 - y_1}{x_2 - x_1}}$$

$$a = \frac{(-6) - (7)}{(1) - (-4)}$$

$$= \frac{-6 - 7}{1 + 4}$$

$$= \frac{-13}{5}$$

$$\boldsymbol{y = ax + b}$$

$$y = \frac{-13}{5}x + b$$

$$7 = \frac{-13}{5}(-4) + b$$

$$7 = \frac{52}{5} + b$$

$$\frac{7}{1} - \frac{52}{5} = b$$

$$\frac{35}{5} - \frac{52}{5} = b$$

$$-\frac{17}{5} = b$$

$$y = \frac{-13}{5}x - \frac{17}{5}$$