Standard form of linear equations

Linear equations form straight lines when graphed on a coordinate plane. **Standard form** is one way to write the equation of a line. Equations in standard form follow this structure:

$$\boldsymbol{Ax + By = C}$$

In standard form, A and B cannot both be zero. Usually, standard form is written following these rules:

- A, B, and C are integers.
- A is greater than or equal to zero.
- A, B, and C have no common factors other than 1.

Here are some example of linear equations in standard form:

- $2x + 5y = 12$
- $x - 8y = 20$
- $3y = 4$

Fun Fact

Not everyone agrees on the rules that a standard form equation should follow. Some mathematicians allow A to be negative. Others don't require A, B, and C to be integers or to have 1 as their only common factor. So, if you're asked to write a linear equation in standard form, make sure to check which rules to follow!

Writing equations in standard form

Let's try it! Write $-2x + 4y = 16$ in standard form.

Notice that $-2x + 4y = 16$ is already written in $Ax + By = C$ form and A, B, and C are integers. However, A is less than zero, and A, B, and C have a common factor of 2.

Write the equation so that A is greater than or equal to zero and A, B, and C do not have a common factor other than 1.

Start by making A greater than or equal to zero. Multiply both sides of the equation by -1.

$$-2x + 4y = 16$$

$$\mathbf{-1}(-2x + 4y) = \mathbf{-1}(16) \quad \textit{Multiply both sides by -1.}$$

$$2x - 4y = -16$$

Next, write the equation so that A, B, and C do not have a common factor other than 1. The greatest common factor of A, B, and C is 2, so divide both sides of the equation by 2.

$$2x - 4y = -16$$

$$x - 2y = -8 \quad \textit{Divide both sides by 2.}$$

So, $-2x + 4y = 16$ written in standard form is $x - 2y = -8$.

Converting slope-intercept form to standard form

Let's try another example! Write $y = 4x + 9$ in standard form.

Notice that $y = 4x + 9$ is written in slope-intercept form. To convert an equation from slope-intercept form to standard form, move the x term to the opposite side of the equation and write the equation in $Ax + By = C$ form. Then check if the equation follows the other rules of standard form.

In the equation $y = 4x + 9$, the x term is $4x$. Start by subtracting $4x$ from both sides of the equation and writing the equation in $Ax + By = C$ form.

$$y = 4x + 9$$

$$-4x + y = 9 \quad \textit{Subtract 4x from both sides.}$$

Next, check if the equation follows the other rules of standard form. In the equation $-4x + y = 9$, A, B, and C are integers that do not have a common factor greater than 1. However, A is less than zero. Make A greater than or equal to zero by multiplying both sides of the equation by -1.

$-4x + y = 9$

$4x - y = -9$ *Multiply both sides by -1.*

So, $y = 4x + 9$ written in standard form is $4x - y = -9$.

Converting equations with fractions to standard form

Let's try one more example. Write $y = -\frac{2}{5}x + \frac{1}{4}$ in standard form.

Notice that $y = -\frac{2}{5}x + \frac{1}{4}$ is written in slope-intercept form. Move the x term to the opposite side of the equation and write the equation in $Ax + By = C$ form. Then adjust the equation to follow the other rules of standard form.

In the equation $y = -\frac{2}{5}x + \frac{1}{4}$, the x term is $-\frac{2}{5}x$. Start by adding $\frac{2}{5}x$ to both sides of the equation and writing the equation in $Ax + By = C$ form.

$y = -\frac{2}{5}x + \frac{1}{4}$

$\frac{2}{5}x + y = \frac{1}{4}$ *Add $\frac{2}{5}x$ to both sides.*

Next, check the other rules of standard form. In the equation $\frac{2}{5}x + y = \frac{1}{4}$, A is greater than zero. However, A and C are not integers. To make A and C integers, multiply both sides of the equation by the least common multiple (LCM) of the denominators. The LCM of 5 and 4 is 20. So, multiply both sides of the equation by 20.

$\frac{2}{5}x + y = \frac{1}{4}$

$\frac{40}{5}x + 20y = \frac{20}{4}$ *Multiply both sides by 20.*

$8x + 20y = 5$ *Simplify.*

Since A, B, and C have no common factors other than 1, the equation is written in standard form. So, $y = -\frac{2}{5}x + \frac{1}{4}$ written in standard form is $8x + 20y = 5$.

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Rewrite the following equation in standard form.

$y = 8x - 7$

Write equations in standard form ESP

Graphing equations in standard form

You can graph an equation in standard form by finding the x- and y-intercepts and drawing a line through those two points.

- Find the x-intercept by substituting $y = 0$ into the equation and solving for x.
- Find the y-intercept by substituting $x = 0$ into the equation and solving for y.

Let's try it! Graph $4x - y = -8$.

First, find the x-intercept. Substitute $y = \mathbf{0}$ into the equation and solve for x.

$$4x - y = -8$$

$$4x - \mathbf{0} = -8$$

$$4x = -8$$

$$x = -2$$

So, the x-intercept is -2.

Now, find the y-intercept. Substitute $x = \mathbf{0}$ into the equation and solve for y.

$$4x - y = -8$$

$$4(\mathbf{0}) - y = -8$$

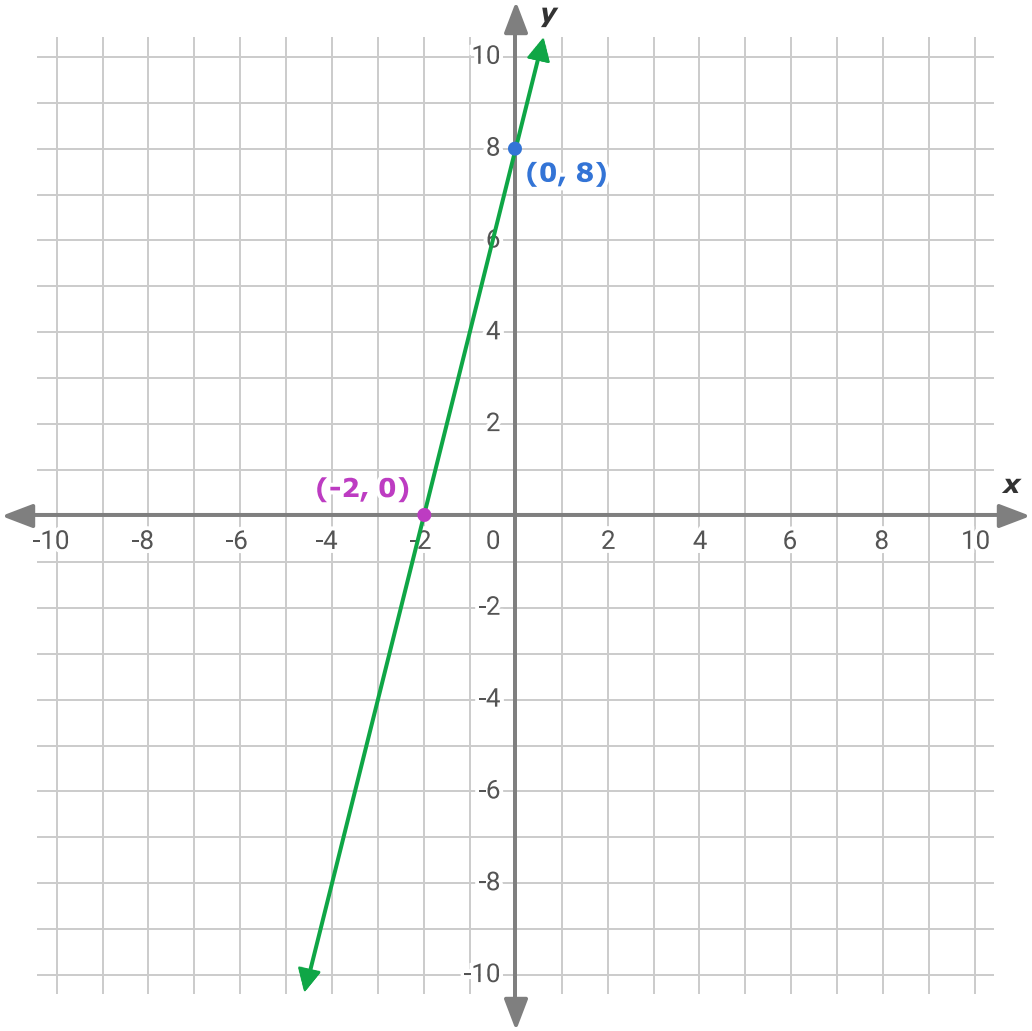
$$0 - y = -8$$

$$-y = -8$$

$$y = 8$$

So, the y-intercept is 8.

Now, plot the x-intercept at **(−2, 0)** and the y-intercept at **(0, 8)** on a graph. Connect the points with a straight line.



This is the graph of $4x - y = -8$.

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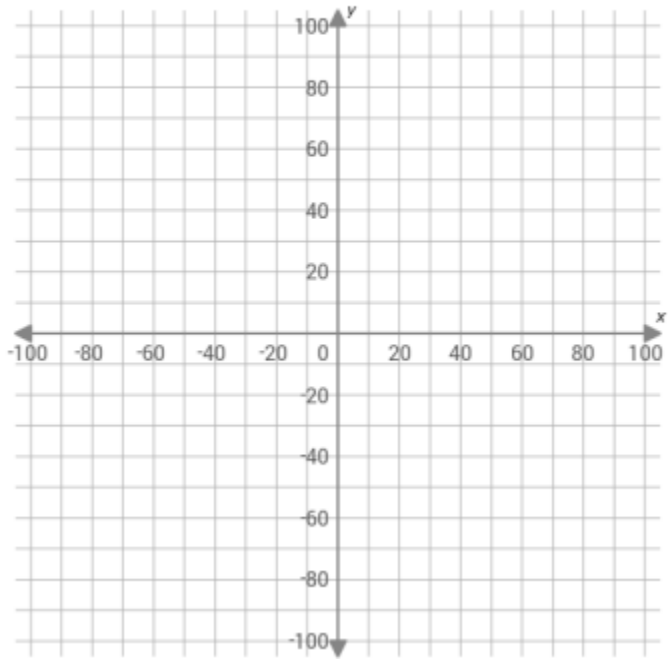
Graph this line using intercepts:

$2x - y = -100$

Click to select points on the graph.



Standard form: graph an equation U6U

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