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7.2 General Form

6. Relate linear relations expressed in:

- slope-intercept form ($y = mx + b$)
- general form ($Ax + By + C = 0$)
- slope-point form ($y - y_1 = m(x - x_1)$) to their graphs.

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general form

- the equation of a line in the form $Ax + By + C = 0$, where A , B , and C are **Integers**, and A and B are not both zero. By convention, A is a whole number. This means that A will always be positive.

x-intercept

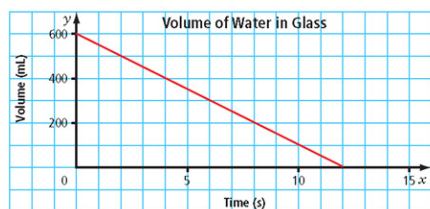
- the x -coordinate of the point where a line or curve crosses the x -axis
- the value of x when $y = 0$

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Investigate Intercepts and General Form

Find your partners by finding two other students who belong to your Line Set: slope, y -intercept and graph. Sit together and answer the following questions.

Leora quenches her thirst after a soccer game by drinking a large glass of water at a constant rate. The following straight-line graph shows how the volume of water in the glass changes with time.



1. Identify the domain and range in this situation.
2. Identify the slope of the line segment. What does the sign of the slope mean? What does the slope represent?
3. What is the y -intercept of the line segment? What does the y -intercept represent?
4. a) What is the equation of the line in slope-intercept form?
b) Rearrange the terms in the equation so that the right side is zero. This is the **general form** of an equation.
5. a) Identify the **x-intercept** of the line. What does the x -intercept represent?
b) Write the coordinates of the x -intercept and the y -intercept.

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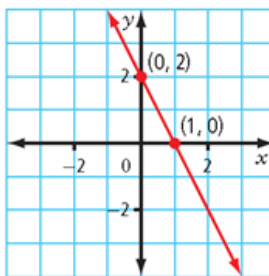
The general form of a linear equation is $Ax + By + C = 0$, where A , B , and C are real numbers, and A and B are not both zero.

The slope-intercept form of a linear equation is $y = mx + b$, where m represents the slope and b represents the y -intercept.

You can convert a linear equation from one form to another by applying the rules of algebra.

The x -intercept of a line is the x -coordinate of the point where the line crosses the x -axis. The y -intercept is the y -coordinate of the point where the line crosses the y -axis. To sketch a linear equation, you can draw a line joining the intercepts, $(x, 0)$ and $(0, y)$.

The line in the graph below has an x -intercept of 1 and a y -intercept of 2



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Example 1 Convert an Equation to General Form

Rewrite the equation $y = -\frac{2}{3}x + 6$ in general form, $Ax + By + C = 0$

Solution

$$y = -\frac{2}{3}x + 6$$

$$3(y) = 3\left(-\frac{2}{3}x + 6\right) \quad \text{Why are both sides multiplied by 3?}$$

$$3y = 3\left(-\frac{2}{3}x\right) + 3(6)$$

$$3y = -2x + 18$$

$$2x + 3y - 18 = 0$$

The equation written in general form is $2x + 3y - 18 = 0$.

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Your Turn
 Rewrite the equation $y = \frac{3}{4}x - 2$ in general form.

$Ax + By + C = 0$

$\frac{4}{1} \times \frac{3}{4} = \frac{12}{4} = 3$

$y \uparrow \frac{3}{4}x - 2$
 $-y \quad | \quad -y$

$4 \left[0 = \frac{3}{4}x - y - 2 \right]$
 $4(0) = 4\left(\frac{3}{4}\right)x - (4)y - 2(4)$
 $0 = 3x - 4y - 8$

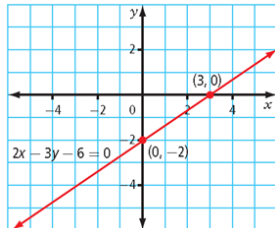
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Example 2 Sketch a Graph Using Intercepts
 For the linear equation $2x - 3y - 6 = 0$,
 a) state the x -intercept of a graph of the equation
 b) state the y -intercept
 c) use the intercepts to graph the line

Solution
 a) To determine the x -intercept, substitute $y = 0$. Then, solve for x
 $2x - 3y - 6 = 0$
 $2x - 3(0) - 6 = 0$ Why do you substitute $x = 0$ to find the y -intercept?
 $2x - 6 = 0$
 $2x = 6$ +6
 $x = 3$ 2
 The x -intercept is 3. So, the line crosses the x -axis at the point $(3, 0)$.

b) To determine the y -intercept, substitute $x = 0$. Solve for y .
 $2x - 3y - 6 = 0$
 $2(0) - 3y - 6 = 0$ -3y - 6 = 0 Why do you substitute $y = 0$ to find the x -intercept?
 $-3y - 6 = 0$ +3y
 $-6 = 0 + 3y$ -6 = 3y
 $-2 = y$ 3 3
 The y -intercept is -2. The line crosses the y -axis at the point $(0, -2)$.

c) Locate the points $(3, 0)$ and $(0, -2)$ on the grid. Then, draw a line passing through these points.



How else could you graph an equation given in general form?

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Your Turn
 Consider the linear equation $4x + 5y - 20 = 0$.

a) What is the x -intercept of a graph of the equation?
 b) What is the y -intercept?
 c) Use the intercepts to graph the line.

a) x -int $\rightarrow y=0$
 $4x + 5(0) - 20 = 0$
 $4x - 20 = 0$
 $+20 \quad +20$
 $4x = 20$
 $\frac{4x}{4} = \frac{20}{4}$
 $x = 5 \quad (5, 0)$

b) y -int $x=0$
 $4(0) + 5y - 20 = 0$
 $5y - 20 = 0$
 $+20 \quad +20$
 $5y = 20$
 $\frac{5y}{5} = \frac{20}{5}$
 $y = 4 \quad (0, 4)$

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Example 3 Identify Intercepts of Horizontal or Vertical Lines

Sketch each linear relation and identify the intercepts.
 Then, state the domain and range.

- a) $y - 3 = 0$
- b) $x + 4.5 = 0$
- c) $y = 0$

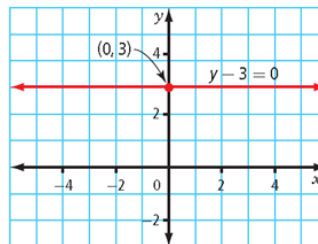
Solution

$y - 3 = 0$
 $+3 \quad +3$
 $y = 0x + 3$

$y = 3$

a) The equation $y - 3 = 0$ can be written in slope-intercept form as $y = 0x + 3$.

The graph is a horizontal line with slope zero.
 The line crosses the y -axis at the point $(0, 3)$.



The y -intercept is 3. There is no x -intercept.
 The domain of the line $y - 3 = 0$ is $\{x \in \mathbb{R}\}$.
 The range of the line is $\{3\}$.

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b) The equation $x + 4.5 = 0$ expressed in general form is $x + 0y + 4.5 = 0$. The coefficient of y is zero.

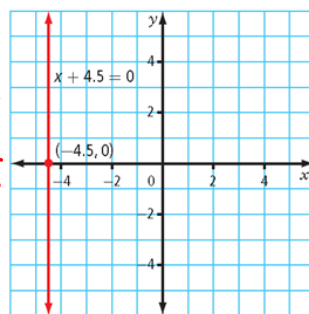
$$x + 4.5 = 0$$

$$-4.5 \quad 4.5$$

The value of x is always -4.5 .

$$x = -4.5$$

The graph is a vertical line and crosses the x -axis at $(-4.5, 0)$.



The x -intercept is -4.5 . There is no y -intercept.

The domain of the line $x + 4.5 = 0$ is $\{-4.5\}$.

The range of the line is $\{y \in \mathbb{R}\}$.

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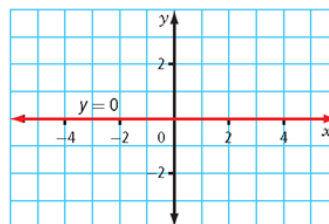
c) The equation $y = 0$ is a horizontal line, which represents the entire x -axis.

The graph always intersects the x -axis. Therefore, there are an infinite number of x -intercepts.

The y -intercept is 0 .

The domain of the line $y = 0$ is $\{x \in \mathbb{R}\}$.

The range of the line is $\{0\}$.



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Your Turn

Sketch each linear relation and identify the intercepts.
What are the domain and range for each relation?

a) $x - 3 = 0$

b) $x = 0$

c) $y + 2 = 0$

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Homework:
Page 365 #1, 2 and 3(odd letters), 4-7, 11, 12, 14, ch 15, 16.

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