


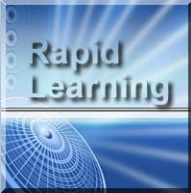
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 **Graphing Linear Equations and Functions**

Rapid Learning Mathematics Series

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Learning Objectives

By completing this tutorial, you will learn how to:

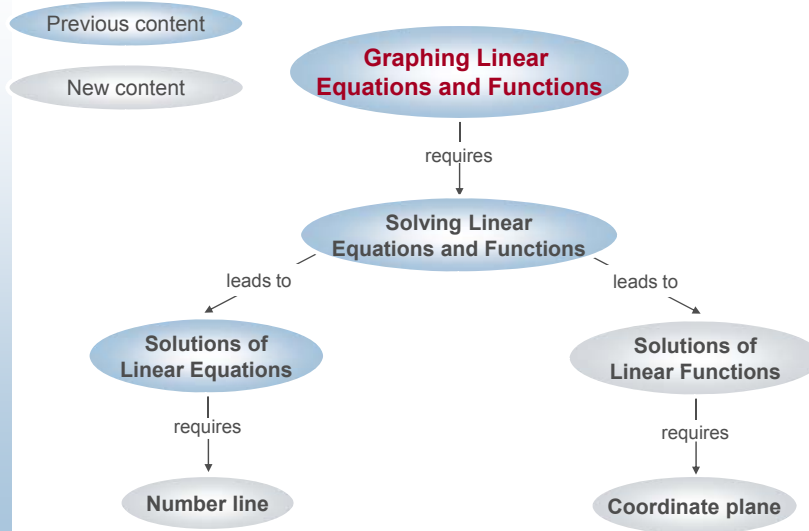


- Draw a number line
- Graph the solution of a linear equation
- Draw a coordinate plane
- Graph a linear function using different techniques

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Concept Map



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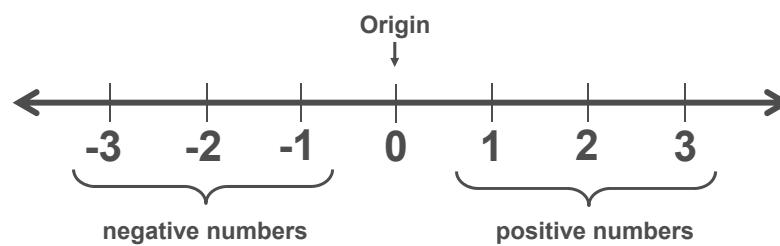


Graphing Linear Equations



The Real Number Line

The real number line contains numbers increasing in value from left to right.



Note: Solutions to some linear equations can be graphed on the real number line.





Definition: Linear Equation

Linear equation – A statement in which two algebraic expressions are equal; at least one expression contains a variable of degree one.

Examples:

1. $3x - 12 = 21$

2. $3y - 5 = 2y + 14$

3. $11z - 19 = 4(z + 6)$

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Properties of Equality

To solve linear equations, apply properties of equality:

- Addition Property
- Subtraction Property
- Multiplication Property
- Division Property
- Distributive Property



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Graph of a Linear Equation

After finding the solution to a linear equation, plot the point corresponding to the solution on the number line, and label the number line with the variable.



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Example 1: Linear Equation

Solve the equation and plot the solution: $7y - 18 = 4y$

Solution:

$$7y - 4y - 18 = 4y - 4y$$

$$3y - 18 = 0$$

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

$$3y = 18$$

$$y = 6$$



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Example 2: Linear Equation

Solve the equation and plot the solution: $3x - 19 = 11 - 7x$

Solution:

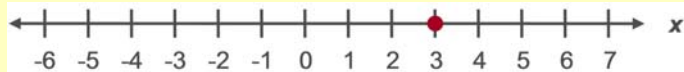
$$3x + 7x - 19 = 11 - 7x + 7x$$

$$10x - 19 = 11$$

$$10x - 19 + 19 = 11 + 19$$

$$10x = 30$$

$$x = 3$$



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Example 3: Linear Equation

Solve the equation and plot the solution: $-7d + 1 = -3d + 17$

Solution:

$$-7d + 3d + 1 = -3d + 3d + 17$$

$$-4d + 1 = 17$$

$$-4d + 1 - 1 = 17 - 1$$


$$-4d = 16$$

$$d = -4$$



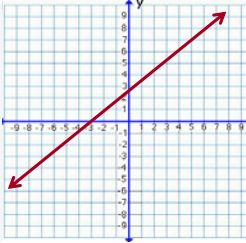


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Graphing Linear Functions




Definition: Linear Function

Linear function – A linear equation with two variables.

Examples:

1. $y = 9x - 11$
2. $x + 4y = 9$
3. $2x - 5y + 3 = 0$



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How-to: Find Points on a Linear Function

The graphs of linear functions have an infinite number of points. To find the coordinates of a point:

1. Replace one of the variables with an arbitrary value.
2. Solve the resulting equation for the other variable.
3. Put the values in point form (x, y) .



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Example: Linear Function

Find the point where $x = 2$ for the function: $y = 3x - 9$

Solution:

$$y = 3x - 9$$

$$y = 3(2) - 9$$

$$y = 6 - 9$$

$$y = -3$$

$$(x, y) = (2, -3)$$

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Definition: Ordered Pair

Ordered pair – The two numbers that give the location of a point in the coordinate plane; written as (x, y) .

Caution! The numbers of an ordered pair cannot be interchanged; (x, y) is not the same as (y, x) .

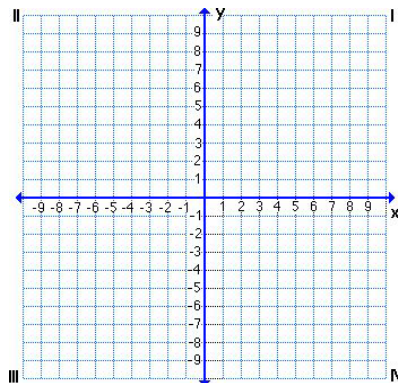


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Definition: Coordinate Plane

Coordinate plane – The plane formed by a horizontal axis and a vertical axis, labeled the x -axis and y -axis, respectively.



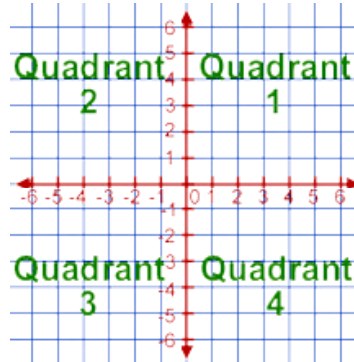
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Definition: Quadrant

Quadrant – One of the four sections the coordinate plane is divided into by the x - and y -axes.

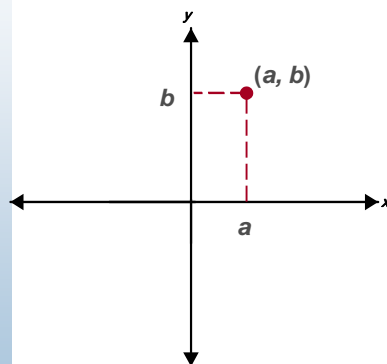


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Locating Ordered Pairs

To locate an ordered pair $(x, y) = (a, b)$:



1. Locate $x = a$ on the x -axis and draw a perpendicular line through the point.

2. Locate $y = b$ on the y -axis and draw a perpendicular line through the point.

3. Plot a point at the intersection of the lines. This point represents (a, b) .

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How-to: Graph Linear Functions

To graph a linear function:

1. Find two points on the line.
2. Plot the two points on the coordinate plane.
3. Connect the points with a line.



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Example: Linear Function Graph (pt. 1)

Graph the line of the function $3x - 2y = 11$.

Solution:

$$x = 1 \rightarrow$$

$$3(1) - 2y = 11$$

$$3 - 2y = 11$$

$$-2y = 8$$

$$y = -4$$

Point 1 = (1, -4)

$$x = 3 \rightarrow$$

$$3(3) - 2y = 11$$

$$9 - 2y = 11$$

$$-2y = 2$$

$$y = -1$$

Point 2 = (3, -1)

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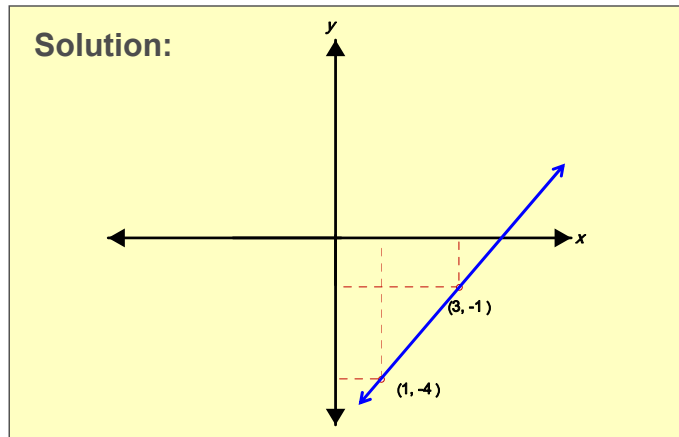




Example: Linear Function Graph (pt. 2)

Graph the line of the function $3x - 2y = 11$.

Solution:



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Definition: Slope of a Line

Slope – The number that indicates the direction and steepness of the line.

Note: the slope of a line is also known as the **rate of change**.



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How-to: Find the Slope of a Line

To find the slope of a line, convert the equation to slope-intercept form:

$$y = mx + b$$



Note: The value of m represents the slope of the line.

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Example 1: Slope of a Line

Find the slope of the line $-6x + 3y = 12$.

Solution:

$$-6x + 3y = 12$$

$$3y = 6x + 12$$

$$y = 2x + 4$$

Therefore, $m = 2$.

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Example 2: Slope of a Line

Find the slope of the line $24x - 6y + 42 = 0$.

Solution:

$$24x - 6y + 42 = 0$$

$$24x - 6y = -42$$

$$-6y = -24x - 42$$

$$y = 4x + 7$$

Therefore, $m = 4$.

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Definitions: x- and y-intercepts

x-intercept – the point where a graph intersects the x-axis.

y-intercept – the point where a graph intersects the y-axis.



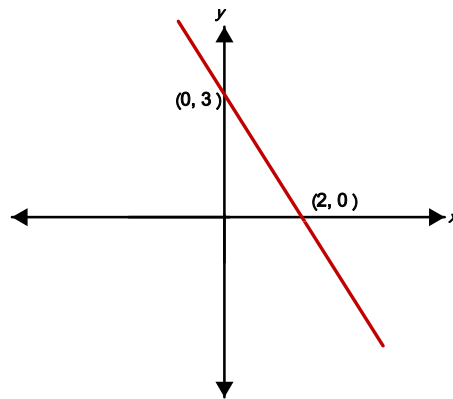
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Example: Intercepts

The graph shows the function $3x + 2y - 6 = 0$. Point $(0, 3)$ is the y -intercept and $(2, 0)$ is the x -intercept.

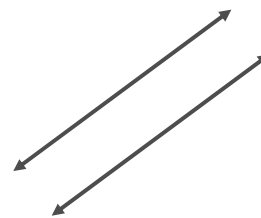


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Definition: Parallel Lines

Parallel lines – Two or more distinct lines that have the same slope.



Example:

$$y = 8x + 17$$

$$y = 8x - 3$$

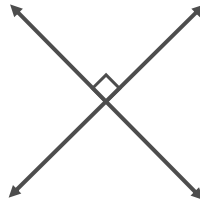
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Definition: Perpendicular Lines

Perpendicular lines – Two lines that have opposite reciprocal slopes; they intersect at a right angle.



Example:

$$y = 4x + 9 \quad y = -\frac{1}{4}x + 6$$

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Example 1: Parallel, Perpendicular, Neither

Determine if these lines are parallel, perpendicular, or neither:

$$3x + y = 19$$

$$6x + 2y = 12$$

Solution:

$$3x + y = 19$$

$$y = -3x + 19$$

$$6x + 2y = 12$$

$$2y = -6x + 12$$

$$y = -3x + 6$$

These lines are parallel.

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Example: Graph Using Intercepts (pt. 1)

Graph the function using intercepts: $4x + 3y = 12$

Solution:

$$\begin{aligned} x = 0 &\rightarrow 4(0) + 3y = 12 \\ &3y = 12 \\ &y = 4 \end{aligned}$$

The y-intercept is **(0, 4)**.

$$\begin{aligned} y = 0 &\rightarrow 4x + 3(0) = 12 \\ &4x = 12 \\ &x = 3 \end{aligned}$$

The x-intercept is **(3, 0)**.

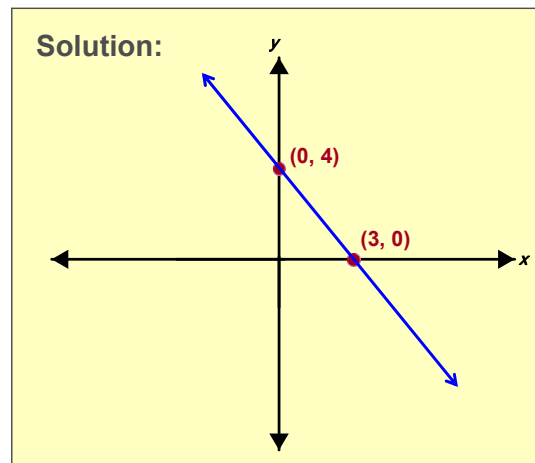
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Example: Graph Using Intercepts (pt. 2)

Graph the function using intercepts: $4x + 3y = 12$

Solution:



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Point-Slope Form

The equation of a line can be written in **point-slope form** if the slope m and a point (x_1, y_1) on the line are given:

$$y - y_1 = m(x - x_1)$$



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Example: Point-Slope & Slope-Intercept

Write the slope-intercept form equation of a line with a slope of 3, passing through point $(4, -7)$.

Solution:

$$m = 3 \quad (x_1, y_1) = (4, -7)$$

$$y - y_1 = m(x - x_1)$$

$$y - (-7) = 3(x - 4)$$

$$y + 7 = 3x - 12$$

$$y = 3x - 19$$

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Standard Form

The **standard form** for the equation of a line is:

$$Ax + By = C$$

where A , B , and C are integers.

Example: $2x + 11y = -14$

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Segments in the Coordinate Plane

A **segment** in the coordinate plane is identified by the coordinates of its endpoints.



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Midpoint of a Segment

Given (x_1, y_1) and (x_2, y_2) are the endpoints of a segment in the coordinate plane, the coordinates of the **midpoint of the segment** are:

$$\text{Midpoint} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

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Example: Midpoint of a Segment

Find the midpoint of the segment with endpoints $(5, 11)$ and $(-9, -3)$.

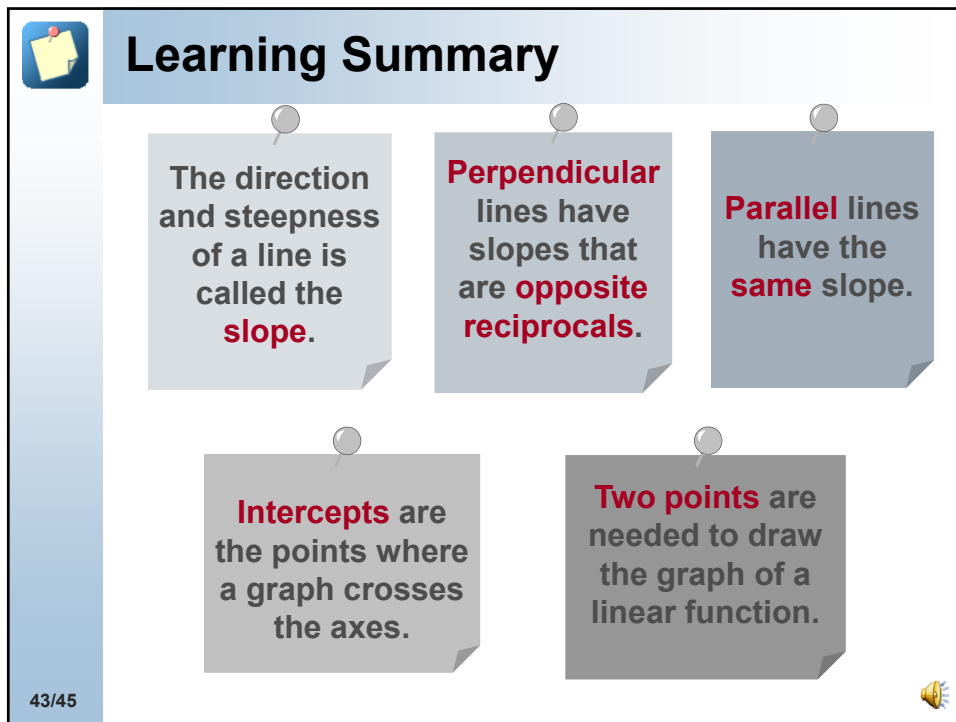
Solution:

$$(x_1, y_1) = (5, 11) \quad (x_2, y_2) = (-9, -3)$$

$$\begin{aligned} \text{Midpoint} &= \left(\frac{5 + (-9)}{2}, \frac{11 + (-3)}{2} \right) \\ &= \left(\frac{-4}{2}, \frac{8}{2} \right) \\ &= \mathbf{(-2, 4)} \end{aligned}$$

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Learning Summary


The direction and steepness of a line is called the **slope**.

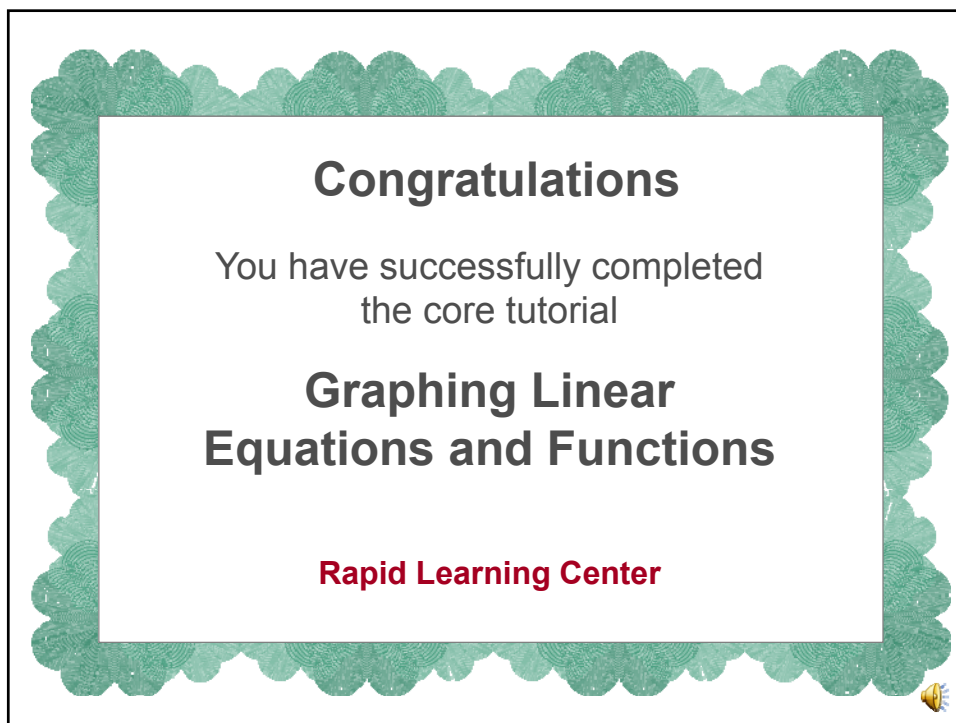
Perpendicular lines have slopes that are **opposite reciprocals**.

Parallel lines have the **same** slope.

Intercepts are the points where a graph crosses the axes.

Two points are needed to draw the graph of a linear function.

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Congratulations

You have successfully completed
the core tutorial

**Graphing Linear
Equations and Functions**


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What's Next ...

Step 1: Concepts – Core Tutorial (Just Completed)
→ Step 2: Practice – Interactive Problem Drill
Step 3: Recap – Super Review Cheat Sheet

Go for it!



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