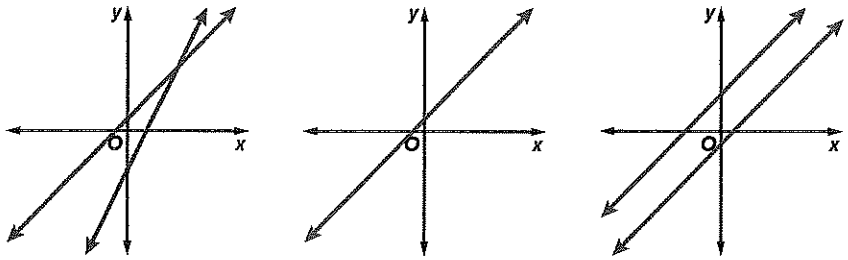
# Solving Systems of Equations Graphically

## Explore Solutions of Systems of Equations

**Online Activity** Use graphing technology to complete the Explore.

**INQUIRY** How is the solution of a system of equations represented on a graph?

## Learn Solving Systems of Equations in Two Variables by Graphing




| Types of Graphs | | |
|---|---|---|
| The lines intersect at one point. The equations have different slopes. | The lines are identical. The equations have the same slope and *y*-intercept. | The lines are parallel. The equations have the same slope and different *y*-intercepts. |
| **Solutions** | | |
| one solution | infinitely many solutions | no solutions |
| **Classifications** | | |
| The system is **consistent** because there is at least one solution. It is **independent** because it has exactly one solution. | The system is **consistent** and **dependent** because there are infinitely many solutions. | The system is **inconsistent** because there is no solution. |

**Today's Standards**
A.CED.3, A.REI.11
MP1, MP5

**Today's Vocabulary**
system of equations
consistent
inconsistent
independent
dependent

**Talk About It!**
Explain why the intersection of the two graphs is the solution of the system of equations.

Your Notes

Study Tip

**Number of Solutions**
By first determining the number of solutions a system has, you can make decisions about whether further steps need to be taken to solve the system. If a system has one solution, you can graph to find it. If a system has infinitely many solutions or no solution, no further steps are necessary. However, you can graph the system to confirm.

## Example 1 Classify Systems of Equations

**Determine the number of solutions each system has. Then state whether the system of equations is *consistent* or *inconsistent* and whether it is *independent* or *dependent*.**

Solve each equation for $y$.

$2y = 6x - 14 \rightarrow y = 3x - 7$

$3x - y = 7 \rightarrow y = \_\_\_x - \_\_\_$

The equations have the same slope and $y$-intercept. Thus, both equations represent the same line and the system has _____ _____. The system is _____ and _____.

### Check

Determine the number of solutions and classify the system of equations.

$3x - 2y = -7$

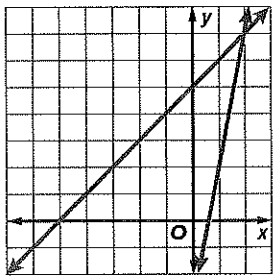
$4y = 9 - 6x$

## Example 2 Solve a System of Equations by Graphing

**Solve the system of equations.**

**$5x - y = 3$**

**$-x + y = 5$**




Solve each equation for $y$. The equations have different slopes, so there is one solution. Graph the system.

$5x - y = 7 \rightarrow$ _____

$-x + y = 5 \rightarrow$ _____

The lines appear to intersect at one point, (___, ___).

**CHECK** Substitute the coordinates into each original equation.

| | | |
|---|---|---|
| $5x - y = 3$ | Original equation | $-x + y = 5$ |
| $5(2) - 7 = 3$ | $x = 2$ and $y = 7$ | $-(2) + 7 = 5$ |
| $3 = 3$ | True | $5 = 5$ |

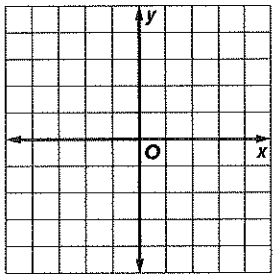
The solution is (2, 7).

### Check

Solve the system of equations by graphing.

$2y + 14x = -6$

$8x = 4y = -24$




The solution is (_____).

## Example 3 Solve a System of Equations

**Solve the system of equations.**

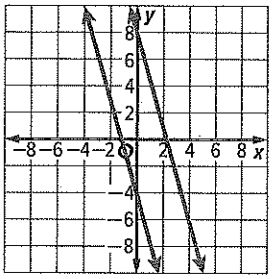
$7x + 2y = 16$

$-21x - 6y = 24$

Solve each equation for $y$ to determine the number of solutions the system has.

$7x + 2y = 16 \rightarrow y =$ _____$x +$ _____

$-21x - 6y = 24 \rightarrow y =$ _____$x +$ _____




The equations have the _____ slope and _____ $y$-intercepts. So, these equations represent _____ _____, and there is ___ _____.

You can graph each equation on the same grid to confirm that they do not intersect.

Study Tip

**Parallel Lines** Graphs of lines with the same slope and different intercepts are, by definition, parallel.

Think About It!

What would the graph of a system with infinitely many solutions look like? Explain your reasoning.

## Example 4 Write and Solve a System of Equations by Graphing

CARS **Suppose an electric car costs $29,000 to purchase and $0.036 per mile to drive, and a gasoline-powered car costs $19,000 to purchase and $0.08 per mile to drive. Estimate after how many miles of driving the total cost of each car will be the same.**

**Part A Write equations for the total cost of owning each type of car.**

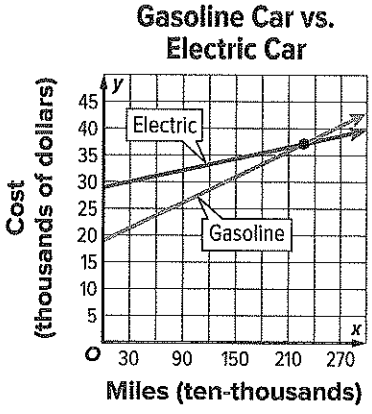
Let $y =$ the total cost of owning the car and $x =$ the number of miles driven.

So, the equation is $y =$ _____$x +$ _____ for the electric car and $y =$ _____$x +$ _____ for the gasoline car.

Think About It!

Explain what the two equations represent in the context of the situation.

**Part B Examine the graph to estimate the number of miles you would have to drive before the cost of owning each type of car would be same.**




The graphs appear to intersect at approximately (_____, _____). This means that after driving about _____ miles, the cost of owning each car will be the same.

Watch Out!

**Solving by Graphing** Solving a system of equations by graphing does not usually give an exact solution. Remember to substitute the solution into both of the original equations to verify the solution or use algebraic method to find the exact solution.

## Example 5 Solve a System by Using Technology

**Use a graphing calculator to solve the system of equations.**

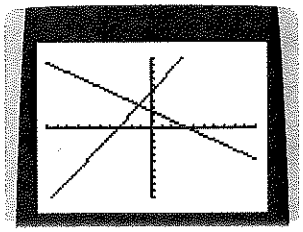
**Step 1 Solve for *y***

$3.5y - 5.6x = 18.2 \rightarrow y =$ ____ $x +$ ____

$-0.7x - y = -2.4 \rightarrow y =$ ____ $x +$ ____

**Step 2 Graph the System.**

Enter the equations in the **Y =** list and graph in the standard viewing window.



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**Step 3 Find the Intersection.**

Use the **intersect** feature from the **CALC** menu to find the coordinates of the point of intersection. When prompted, select each line. Press **enter** to see the intersection.

The solution is approximately (_____).

Study Tip

**Window Dimensions** If the point of intersection is not visible in the standard viewing window, zoom out or adjust the window settings manually until it is visible. If the lines appear to be parallel, zoom out to verify that they do not intersect.

### Check

Use a graphing calculator to solve the system of equations. Round to the nearest hundredth, if necessary.

$-4.55x = 1.25y + 7.15$

$y - 1.08x = -2$

(____, ____)

## Example 6 Solve a Linear Equation by Using a System

**Use a graphing calculator to solve $4.5x - 3.9 = 6.5 - 2x$ by using a system of equations.**

**Step 1 Write a system.**

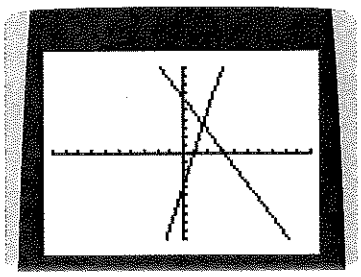
Set each side of $4.5x - 3.9 = 6.5 - 2x$ equal to $y$ to create a system of equations.

$y =$ _____

$y =$ _____

**Step 2 Graph the System.**

Enter the equations in the **Y =** list and graph in the standard viewing window.



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**Step 3 Find the Intersection.**

The solution is the $x$-coordinate of the intersection, which is ___.

Go Online You can complete an Extra Example online.