Unit 16
Solving Systems of Linear Equations (Substitution)

Math Essentials

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Practice 16.1

Keisha will rent a car for the weekend. She can choose one of two plans. The first plan has an initial fee of $50 and costs an additional $0.70 per mile driven. The second plan has no initial fee but costs $0.80 per mile driven. How many miles would Keisha need to drive for the two plans to cost the same?

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Practice 16.2

Mary's penny bank is 1/4 full. After she adds 400 pennies, it is 2/3 full. How many pennies can Mary's bank hold?

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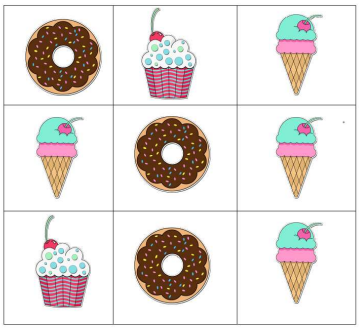
Try this puzzle



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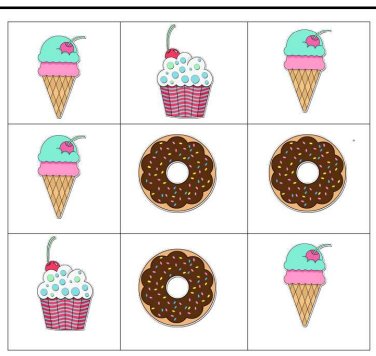
Try this puzzle



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Practice 16.3

For each ordered pair, determine whether it is a solution to the system of equations.

$5x + 4y = -1$

$3x - 2y = -5$

x, y	Is it a solution?	
	Yes	No
$-2, -2$	○	○
$3, -4$	○	○
$-7, -8$	○	○
$5, 0$	○	○

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Practice 16.4

1. Is (0,7) a solution of the given system?

$$x + y = 7$$
$$4x + 2y = 14$$

2. Is (-1,2) a solution of the given system?

$$2x - y = -4$$
$$x + 3y = 0$$

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Now consider...

On Saturday, Tim goes to the local donut shop and picks up 5 donuts and 4 kolaches for a total of $15.00. His sister Teresa comes along and buys 2 donuts and 1 kolache for just $4.50. What is this week's price for a donut and kolache?

$$5D + 4K = 15$$
$$2D + K = 4.5$$

(D=price of a donut, K=price of a kolache)

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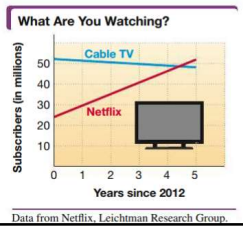
System of Equations: a set of equations

Solution set of a linear system: all ordered pairs that satisfy ALL equations at the SAME time



$-5.61x + y = 23.9$
$0.77x + y = 52.1$
Linear system of equations

(Here, $x = 0$ represents 2012, $x = 1$ represents 2013, and so on. y represents millions of subscribers.)

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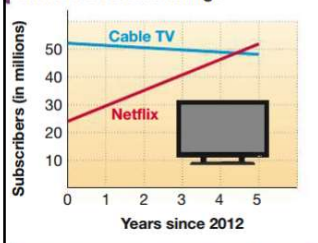
What Are You Watching?



Data from Netflix, Leichtman Research Group.

FIGURE 1

$-5.61x + y = 23.9$
$0.77x + y = 52.1$

Linear system of equations

(Here, $x = 0$ represents 2012, $x = 1$ represents 2013, and so on. y represents millions of subscribers.)

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Solve linear systems by graphing.

1. Graph all equations.
2. Identify the intersection point.

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Practice 16.5

1. Graph the lines and find the solution to the system.

$$y = 2x - 1$$
$$4x + 2y = -2$$

2. Graph the lines and find the solution to the system.

$$x = 3$$
$$y = 2x + 1$$

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Practice 16.6

Graph the system below and write its solution.

$$\begin{cases} y = -\frac{1}{2}x - 2 \\ -x - 2y = 6 \end{cases}$$

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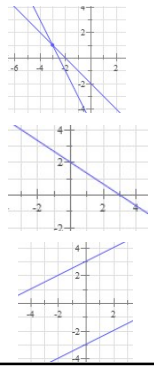
Solutions to Systems



There are 3 types of systems.

1. **Consistent Independent:** There is only one point that is a solution to the system (one intersection).
2. **Consistent dependent:** There are infinitely many points that are solutions to the system (SAME line).
3. **Inconsistent:** If there is no point that is a solution to the system (parallel lines).

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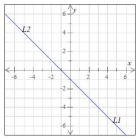
Practice 16.7

For each system below, classify the system as "consistent dependent," "consistent independent," or "inconsistent." Then, choose the best description of its solution.

System A

Line 1: $y = -x - 1$

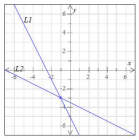
Line 2: $x + y = -1$



System B

Line 1: $y = -2x - 5$

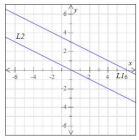
Line 2: $y = -\frac{1}{2}x - \frac{7}{2}$



System C

Line 1: $y = -\frac{1}{2}x + 3$

Line 2: $y = -\frac{1}{2}x$



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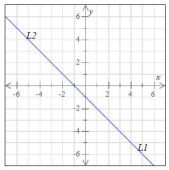
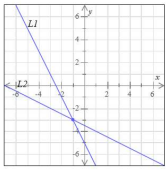
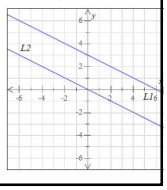
Practice 16.7

System A	System B	System C
Line 1: $y = -x - 1$	Line 1: $y = -2x - 5$	Line 1: $y = -\frac{1}{2}x + 3$
Line 2: $x + y = -1$	Line 2: $y = -\frac{1}{2}x - \frac{7}{2}$	Line 2: $y = -\frac{1}{2}x$
		

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Could we solve this system without graphing?

$$x = 3$$
$$y = 2x + 1$$

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Now consider...

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$$5D + 4K = 15$$
$$2D + K = 4.5$$

(D=price of a donut, K=price of a kolache)

How could we solve this system of equations?

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Solve a system by substitution.

1. **Solve one of the equations for either variable.** Choose a variable term with coefficient 1 or -1 to make it easier!
2. **Plug it into that variable in the other equation.** The result should be an equation with just one variable.
3. **Solve the equation** from Step 2.
4. **Find the other value.** Substitute the result from Step 3 into the equation from Step 1 and solve for the value of the other variable.
5. **Check the values** in BOTH of the original equations.

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Practice 16.8

Solve the following systems by substitution.

1. $-x - 4y = -14$
   $y = 2x - 1$

2. $4x - 5y = 7$
   $3x - 8 = y$

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Practice 16.9

Solve the following system by substitution.

$$-5x - 9y = -11$$
$$7y + x = 0$$

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Practice 16.10

A textbook store sold a combined total of 460 math and sociology textbooks in a week. The number of math textbooks sold was three times the number of sociology textbooks sold. How many textbooks of each type were sold?

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Motion Formulas

$$d = rt \rightarrow \text{Distance} = \text{Rate} \cdot \text{Time}$$

$$r = \frac{d}{t} \rightarrow \text{Rate} = \frac{\text{Distance}}{\text{Time}}$$

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Practice 16.11

Two buses leave towns 1440 kilometers apart at the same time and travel toward each other. One bus travels 18 km/hr faster than the other. If they meet in 6 hours, what is the rate of each bus?

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	Distance	Speed	Time
Slow Bus	d	x	6
Fast Bus	$1440 - d$	$x + 18$	6

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