# Chapter 5

Name________________________________________

# Chapter 5 Systems of Linear Equations

Dear Family,

Some people have a side business to supplement their income: delivering papers, selling crafts, or running a website, to name a few. The goal is to make a *profit*—to have more income than expenses.

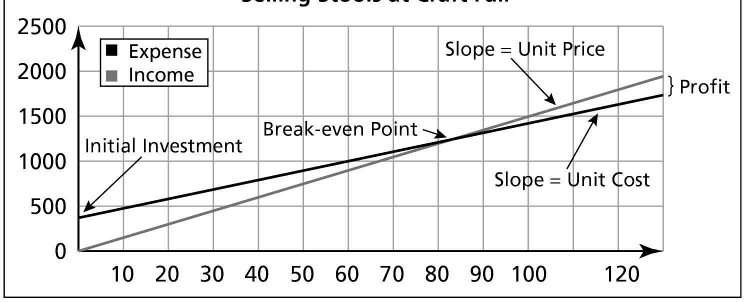
The *break-even point* is where the income equals the expenses. Making a graph is a good way to keep track of income and expenses and will show at a glance when the business will break even. On a graph, the break-even point is where the income line crosses the expense line.

**My Woodworking Business**

| Selling Stools at Craft Fair | |
|---|---|
| Craft Fair Booth: | $160.00 |
| Business Cards: | $85.00 |
| New Tools: | $125.00 |
| **Initial Investment:** | **$370.00** |
| Electricity: | $0.50 |
| Rough Lumber: | $3.00 |
| Fasteners & Glue: | $0.75 |
| Stain & Sandpaper: | $1.25 |
| My Time: | $5.00 |
| **Unit Cost:** | **$10.50** |
| **Unit Price:** | **$14.95** |

| Units | Expense | Income |
|---|---|---|
| 0 | $370.00 | $0.00 |
| 10 | $475.00 | $149.50 |
| 20 | $580.00 | $299.00 |
| 30 | $685.00 | $448.50 |
| 40 | $790.00 | $598.00 |
| 50 | $895.00 | $747.50 |
| 60 | $1,000.00 | $897.00 |
| 70 | $1,105.00 | $1,046.50 |
| 80 | $1,210.00 | $1,196.00 |
| 90 | $1,315.00 | $1,345.50 |
| 100 | $1,420.00 | $1,495.00 |
| 110 | $1,525.00 | $1,644.50 |
| 120 | $1,630.00 | $1,794.00 |
| 130 | $1,735.00 | $1,943.50 |

**Selling Stools at Craft Fair**




Have your student help you make a plan for a small business. A few basic steps will get your business plan started.

- How much money will you need for supplies to get started? This represents your *initial investment.* Plot this point on your graph.
- How much does it cost you to produce each item? This is the *unit cost.* Use this to plot more points on the graph to make an expense line.
- What price will you charge for each item? Starting at the origin of the graph, use this unit price to make an income line.
- Do the two lines cross? This is your break-even point—the number of items you must sell to pay for your expenses.

If the two lines do not cross, you will have to make some changes. Can you increase your unit price? You may not be able to charge more than your competitors. In that case, you will have to find a way to cut expenses.

What effect do changes to your initial investment have on the break-even point? What effect do changes to the unit cost have on the break-even point? Ask your student which one has a greater impact over time.

May your collaboration be a profitable one!

# Systems of Linear Equations (continued)

| Lesson | Learning Target | Success Criteria |
|---|---|---|
| 5.1 Solving Systems of Linear Equations by Graphing | Understand how to solve systems of linear equations by graphing. | • I can graph a linear equation.<br>• I can find the point where two lines intersect.<br>• I can solve a system of linear equations by graphing. |
| 5.2 Solving Systems of Linear Equations by Substitution | Understand how to solve systems of linear equations by substitution. | • I can solve a linear equation in two variables for either variable.<br>• I can solve a system of linear equations by substitution. |
| 5.3 Solving Systems of Linear Equations by Elimination | Understand how to solve systems of linear equations by elimination. | • I can add or subtract equations in a system.<br>• I can use the Multiplication Property of Equality to produce equivalent equations.<br>• I can solve a system of linear equations by elimination. |
| 5.4 Solving Special Systems of Linear Equations | Solve systems with different numbers of solutions. | • I can determine the number of solutions of a system.<br>• I can solve a system of linear equations with any number of solutions. |

Nombre ______________________________________

# Capítulo 5 Sistemas de ecuaciones lineales

Querida familia:

Algunas personas tienen un negocio para complementar sus ingresos: repartir el diario, vender artesanías, administrar un sitio web, por nombrar algunos ejemplos. El objetivo es generar *utilidades*—tener más ingresos que gastos.

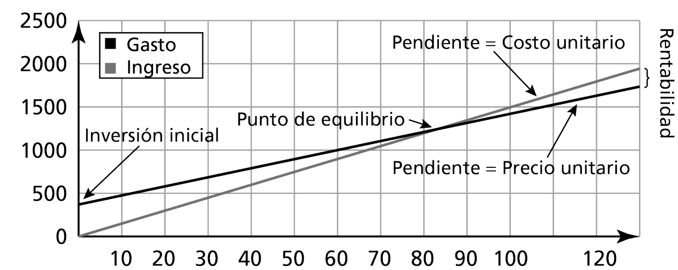
El *punto de equilibrio* se da cuando los ingresos son iguales a los egresos. Hacer un gráfico es una buena manera de monitorear los ingresos y gastos y muestra a simple vista cuando un negocio alcanza este punto. En un gráfico el punto de equilibrio se da cuando la línea de ingresos cruza la línea de gastos.

**Mi negocio de carpintería**

| **Vender bancos en feria artesanal** | |
|---|---|
| Stand en la feria: | $160.00 |
| Tarjetas de presentación: | $85.00 |
| Herramientas nuevas: | $125.00 |
| **Inversión inicial:** | **$370.00** |
| Electricidad: | $0.50 |
| Madera: | $3.00 |
| Grapas y adhesivos: | $0.75 |
| Barniz y lijas: | $1.25 |
| Tiempo: | $5.00 |
| **Costo unitario:** | **$10.50** |
| **Precio unitario:** | **$14.95** |

| Unidades | Gastos | Ingresos |
|---|---|---|
| 0 | $370.00 | $0.00 |
| 10 | $475.00 | $149.50 |
| 20 | $580.00 | $299.00 |
| 30 | $685.00 | $448.50 |
| 40 | $790.00 | $598.00 |
| 50 | $895.00 | $747.50 |
| 60 | $1,000.00 | $897.00 |
| 70 | $1,105.00 | $1,046.50 |
| 80 | $1,210.00 | $1,196.00 |
| 90 | $1,315.00 | $1,345.50 |
| 100 | $1,420.00 | $1,495.00 |
| 110 | $1,525.00 | $1,644.50 |
| 120 | $1,630.00 | $1,794.00 |
| 130 | $1,735.00 | $1,943.50 |

**Vender bancos en feria artesanal**




Haga que su estudiante lo ayude a preparar un plan para un pequeño negocio. Con unos cuantos pasos básicos empezarán su plan de negocios.

- ¿Cuánto dinero necesitarán para comenzar? Esto representa su *inversión inicial*. Ubiquen este punto en su gráfico.
- ¿Cuánto les costará producir cada artículo? Este es el *costo unitario*. Con este dato, coloquen más puntos con el fin de trazar una línea de gastos.
- ¿Qué precio cobrarán por cada artículo? Comenzando en el origen del gráfico, utilicen este precio unitario para dibujar la línea de ingresos.
- ¿Se cruzan estas dos líneas? Este es su punto de equilibrio—el número de artículos que deben vender para cubrir sus gastos.

Si las dos líneas no se cruzan deberán hacer ciertos cambios. ¿Pueden aumentar su precio unitario? Tal vez no puedan cobrar más que la competencia. En ese caso, tendrán que hallar un modo de recortar los gastos.

¿Cómo afectan al punto de equilibro las modificaciones en su inversión inicial? ¿Cómo afectan al punto de equilibro las modificaciones del costo unitario? Pregunte a su estudiante cuál tiene mayor impacto a largo plazo.

¡Que tu colaboración sea útil!

# Sistemas de ecuaciones lineales (continuación)

| Lección | Objetivo de aprendizaje | Criterios de éxito |
|---|---|---|
| 5.1 Resolviendo sistemas de ecuaciones lineales graficando | Entender cómo resolver sistemas de ecuaciones lineales graficando. | • Sé graficar una ecuación lineal.<br>• Sé hallar el punto donde dos líneas se intersectan.<br>• Sé resolver un sistema de ecuaciones lineales graficando. |
| 5.2 Resolver sistemas de ecuaciones lineales por sustitución | Entender cómo resolver sistemas de ecuaciones lineales por sustitución. | • Sé resolver una ecuación lineal en dos variables por cualquier variable.<br>• Sé resolver un sistema de ecuaciones lineales por sustitución. |
| 5.3 Resolver sistemas de ecuaciones lineales por eliminación | Entender cómo resolver sistemas de ecuaciones lineales por eliminación. | • Sé sumar o restar ecuaciones en un sistema.<br>• Sé usar la Propiedad de Igualdad de la Multiplicación para producir ecuaciones equivalentes.<br>• Sé resolver un sistema de ecuaciones lineales por eliminación. |
| 5.4 Resolver sistemas especiales de ecuaciones lineales | Resolver sistemas con diferentes números de soluciones. | • Sé determinar el número de soluciones de un sistema.<br>• Sé resolver un sistema de ecuaciones lineales con cualquier número de soluciones. |

## Lesson 5.1 Cumulative Practice
**For use before Lesson 5.1**

**Write an equation in slope-intercept form of the line that passes through the given points.**

**1.** $(-2, -6), (3, 4)$

**2.** $(-1, 4), (5, -8)$

## Lesson 5.1 Vocabulary Practice
**For use before Lesson 5.1**

**1.** Write what you know about this phrase.

**Preview: system of linear equations**

## Lesson 5.1 Prerequisite Skills Practice
**For use before Lesson 5.1**

**Graph the linear equation.**

**1.** $y = \frac{1}{2}x - 2$

**2.** $y = -\frac{3}{4}x + 3$

Name ____________________________________________ Date________

# Lesson 5.1 Extra Practice

**Solve the system by graphing.**

**1.** $y = x + 4$
$y = -x$

**2.** $y = x - 7$
$y = -4x + 3$

**3.** $y = -x - 1$
$y = -3x + 9$

**4.** $y = 5x - 1$
$y = \frac{3}{2}x + 6$

**5.** $y = -x + 4$
$y = x + 2$

**6.** $y = 3x + 4$
$y = 2x + 1$

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

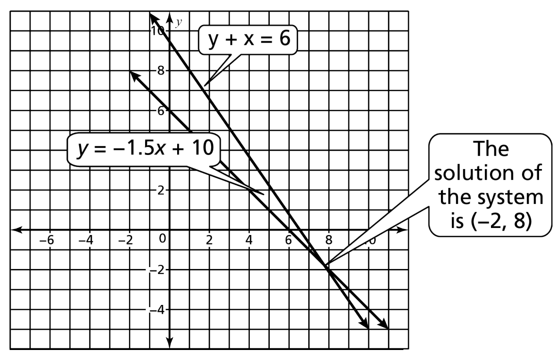
**7.** $0.3x + 0.2y = 1.2$
$0.2x + 0.1y = 0.7$

**8.** $0.2x - 0.3y = 0.5$
$0.3x - 0.2y = 0.5$

**9.** $-0.1x + 0.5y = 0.8$
$0.3x + 0.7y = -0.2$

**10.** Your friend solves the system of linear equations below. Is your friend correct? Explain your reasoning.

$y + x = 6$ Equation 1
$y = -1.5x + 10$ Equation 2



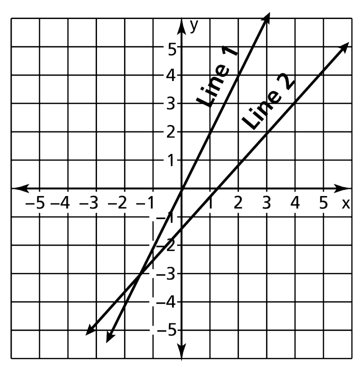

**11.** You and your friend are in an ice skating race. You skate at a rate of 12 feet per second. Your friend skates at a rate of 10 feet per second and has a head start of 20 feet.
**a.** How long will it take you to catch up to your friend?
**b.** The entire race is 180 feet. How far ahead of your friend will you be when you cross the finish line?

**Write a system of linear equations that fits the description. Use a graph to justify your answer.**

**12.** The solution of the system is a point on the line $x - y = 10$.

**13.** The solution of the system is (6, –4).

**14.** A graph of a system of two linear equations is shown. Write the system of linear equations represented by the graph. What is the solution of the system?



# Lesson 5.1 Reteach

A **system of linear equations** is a set of two or more linear equations in the same variables. An example is shown below:

$y = 2x - 1$ Equation 1

$y = -3x + 2$ Equation 2

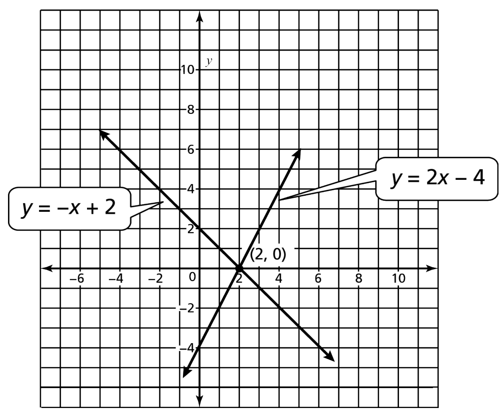
A **solution of a system of linear equations** in two variables is an ordered pair that is a solution of each equation in the system. The solution of a system of linear equations is the point of intersection of the graphs of the equations.

## EXAMPLE Solving a System of Linear Equations by Graphing

**Solve the system by graphing.** $\mathbf{y = -x + 2}$ Equation 1

$\mathbf{y = 2x - 4}$ Equation 2

Graph each equation.




The graphs appear to intersect at (2, 0). Check that the point is a solution of each equation.

**Equation 1**

$y = -x + 2$

$\mathbf{0} \stackrel{?}{=} -\mathbf{2} + 2$

$0 = 0$ ✓

**Equation 2**

$y = 2x - 4$

$\mathbf{0} \stackrel{?}{=} 2(\mathbf{2}) - 4$

$0 = 0$ ✓

▶ The solution is (2, 0).

Name ______________________________ Date __________

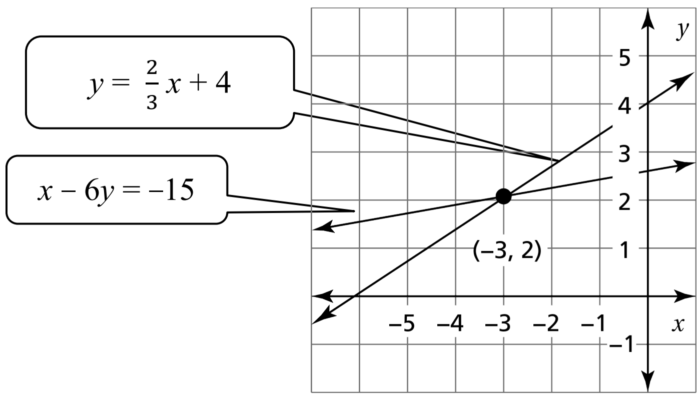
# Lesson 5.1 Reteach (continued)

## EXAMPLE Solving a System of Linear Equations by Graphing

**Solve the system by graphing.** $y = \frac{2}{3}x + 4$ Equation 1

$x - 6y = -15$ Equation 2

Graph each equation.




The graphs appear to intersect at (−3, 2). Check that the point is a solution of each equation.

| **Equation 1** | **Equation 2** |
|---|---|
| $y = \frac{2}{3}x + 4$ | $x - 6y = -15$ |
| $\mathbf{2} \stackrel{?}{=} \frac{2}{3}(\mathbf{-3}) + 4$ | $\mathbf{-3} - 6(\mathbf{2}) \stackrel{?}{=} -15$ |
| $2 = 2$ ✓ | $-15 = -15$ ✓ |

▶ The solution is (−3, 2).

**Solve the system by graphing.**

**1.** $y = -2x + 2$

$y = x - 4$

**2.** $y = x - 8$

$x + 3y = -12$

**3.** $y = 2x - 4$

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

**4.** $5x + 3y = 7$

$3x - 2y = 8$

Name ______________________________ Date __________

# Lesson 5.1 Enrichment and Extension

## Solving Systems Game

### Set Up

With a partner, create game cards with each system of equations below on a separate card. Make or find game pieces for each player.

$y = x$
$y = \frac{1}{2}x$

$y = -x + 7$
$y = 2x - 2$

$y = -2x - 1$
$x + y = 6$

$y = 2x + 3$
$y = \frac{1}{2}x + 4$

$y = -x$
$y = x + 4$

$y = 3x + 7$
$y = x + 4$

$y = \frac{3}{2}x$
$y = \frac{1}{2}x + 4$

$y = \frac{3}{5}x - 5$
$y = \frac{1}{5}x - 1$

$y = -x$
$y = 3x - 4$

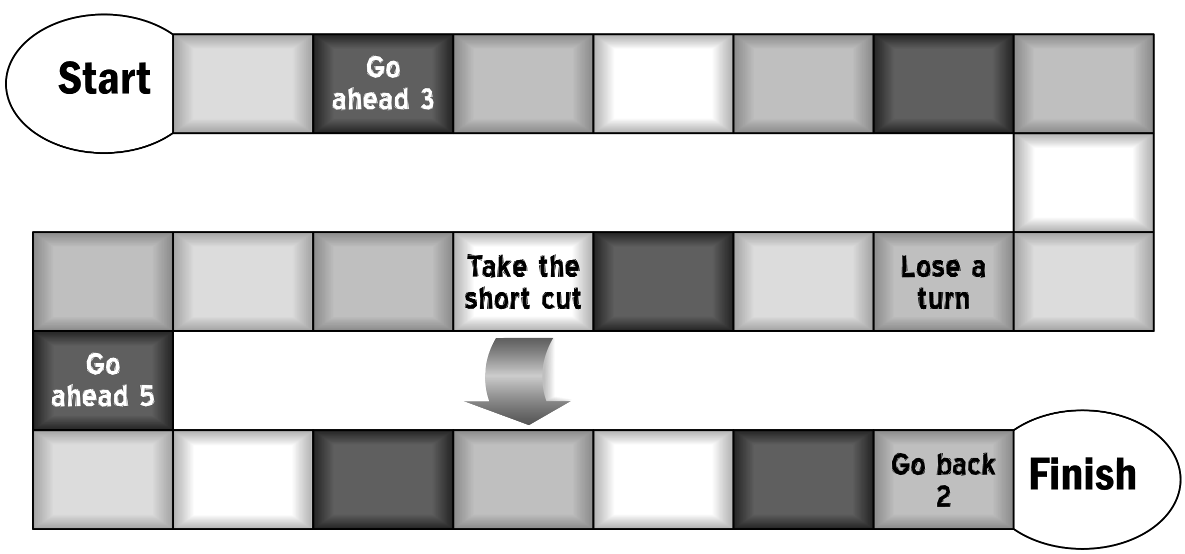
$y = -x + 1$
$-y = 8x$

$y = 2x + 3$
$y = \frac{1}{2}x + 4$

$y = 2x + 1$
$y = -2x + 5$

### How to Play

1. The first player chooses a card, graphs the two equations, and finds the solution of the system.
2. The player calculates the sum of the $x$- and $y$-coordinates of the solution, and moves ahead that number of spaces.
   ***Bonus: If there is no solution, the player can move ahead 5 spaces.***
3. The players take turns. The first player to reach or pass the finish space wins.



Name ______________________________ Date __________

# 5.1 Puzzle Time

## Why Did The Student Eat His Homework?

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| G | H | I | J | | |

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

| |
|---|
| (−4, 4) **STUDENT** |
| (0, 0) **THE** |
| (1, 8) **PIECE** |
| (−2, 1) **DOG** |
| (3, 0) **IT** |
| (5, −3) **HER** |
| (3, 3) **CAKE** |
| (−3, 5) **ICING** |
| (0, 2) **HIM** |

**Solve the system of linear equations by graphing.**

**A.** $y = x$
$y = -x$

**B.** $y = x + 1$
$y = -x - 3$

**C.** $y = 2x$
$y = 4x + 2$

**D.** $y = -4x + 2$
$y = 2x + 2$

**E.** $y = -\frac{1}{4}x + \frac{3}{4}$
$y = \frac{1}{4}x - \frac{3}{4}$

**F.** $y = \frac{1}{2}x - 1$
$y = -x + 2$

**G.** $x + y = 3$
$y = x - 1$

**H.** $4x + y = 12$
$y = 4x + 4$

**I.** $-x + y = -3$
$4x + y = 2$

**J.** At a grocery store, Candy buys 2 cantaloupes at $x$ dollars each and 1 watermelon at $y$ dollars. Her total bill is \$9. Chip goes to the same grocery store and buys 1 cantaloupe at $x$ dollars and 1 watermelon at $y$ dollars. His total bill is \$6. Write and solve a system of linear equations by graphing to find the cost $x$ of a cantaloupe and the cost $y$ of a watermelon.

| |
|---|
| (−1, −2) **TOLD** |
| (1, −2) **OF** |
| (5, 0) **HERSELF** |
| (2, 0) **WAS** |
| (8, 1) **ATE** |
| **(2, 1)** **A** |
| (0, −6) **HOMEWORK** |
| (−2, −1) **TEACHER** |
| (7, 7) **SAID** |

**Lesson 5.2**

# Cumulative Practice

**For use before Lesson 5.2**

1. Write an equation in point-slope form of the line that passes through the point (5, 4) with slope –5.

2. Write in point-slope form an equation of the line that passes through the point (3, 5) with slope 6.

**Lesson 5.2**

# Vocabulary Practice

**For use before Lesson 5.2**

1. Write what you know about this phrase.

**Review: solution of a system of linear equations**

**Lesson 5.2**

# Prerequisite Skills Practice

**For use before Lesson 5.2**

**Write a system of linear equations that has the ordered pair as its solution.**

1. (1, 1)

2. (4, 5)

Name ______________________________________________________ Date __________

# Lesson 5.2 Extra Practice

**Solve the system by substitution. Check your solution.**

**1.** $y = 5x - 2$

$4x + 8y = 6$

**2.** $3x - 7y = 12$

$3x - 12y = 6$

**3.** $\frac{1}{5}x + y = 8$

$10y = 6x$

**4.** $x - y = 9$

$2x + 5y = 4$

**5.** $2x + 3y = 25$

$4x - y = 15$

**6.** $3x - 6y = 2$

$4x + 3y = -1$

**Solve the system. Explain your choice of method.**

**7.** $y = x + 3$

$y = 5x - 5$

**8.** $y = 3x - 1$

$y = x - 7$

**9.** $x = 5y + 2$

$x - 4y = 5$

**10.** The gym has a total of 25 treadmills and stationary bikes. There are 7 more stationary bikes than treadmills.

**a.** Write a system of linear equations that represent this situation.

**b.** How many treadmills are in the gym?

**c.** How many stationary bikes are in the gym?

**11.** A drawer contains 24 spoons and forks. There are three times as many spoons as forks.

**a.** Write a system of linear equations that represent this situation.

**b.** How many spoons are in the drawer?

**c.** How many forks are in the drawer?

**12.** The perimeter of a rectangle is 34 centimeters. The length is two more than twice the width. Write and solve a system of linear equations to find the length and the width of the rectangle.

Name ________________________________________________ Date __________

# Lesson 5.2 Reteach

Another way to solve system of linear equations is to use substitution to obtain an equation in one variable. Then solve the resulting equation and substitute to find the value of the other variable.

## EXAMPLE Solving a System of Linear Equations by Substitution

**Solve the system by substitution.**

$\mathbf{y = 2x - 1}$ Equation 1

$\mathbf{9x + 3y = 12}$ Equation 2

**Step 1:** Notice that Equation 1 is solved for $y$. So, you can substitute $2x - 1$ for $y$ in Equation 2 to obtain an equation in one variable, $x$. Then solve the equation to find the value of $x$.

| | |
|---|---|
| $9x + 3y = 12$ | Equation 2 |
| $9x + 3(\mathbf{2x - 1}) = 12$ | Substitute $2x - 1$ for $y$. |
| $9x + 6x - 3 = 12$ | Distributive Property |
| $15x - 3 = 12$ | Combine like terms. |
| $15x = 15$ | Add 3 to each side. |
| $x = 1$ | Divide each side by 15. |

**Step 2:** Substitute 1 for $x$ in Equation 1 and solve for $y$.

| | |
|---|---|
| $y = 2x - 1$ | Equation 1 |
| $= 2(\mathbf{1}) - 1$ | Substitute 1 for $x$. |
| $= 2 - 1$ | Multiply. |
| $= 1$ | Subtract. |

▶ The solution is (1, **1**).

**Check**

Equation 1

$y = 2x - 1$

$(\mathbf{1}) \stackrel{?}{=} 2(\mathbf{1}) - 1$

$1 = 1$ ✓

Equation 2

$9x + 3y = 12$

$9(\mathbf{1}) + 3(\mathbf{1}) \stackrel{?}{=} 12$

$12 = 12$ ✓

Name ____________________________________________ Date __________

Lesson 5.2

# Reteach (continued)

## EXAMPLE Solving a System of Linear Equations

**Solve the system using any method.** $\mathbf{2x + 3y = 4}$ Equation 1

$\mathbf{3y = x - 11}$ Equation 2

**Step 1:** Both equations have a term for $3y$. So, one solution method is to substitute $x - 11$ for $3y$ in Equation 1 and solve to find the value of $x$.

| | |
|---|---|
| $2x + 3y = 4$ | Equation 1 |
| $2x + \mathbf{x - 11} = 4$ | Substitute $x - 11$ for $3y$. |
| $3x - 11 = 4$ | Combine like terms. |
| $3x = 15$ | Add 11 to each side. |
| $x = 5$ | Divide each side by 3. |

**Step 2:** Substitute 5 for $x$ in Equation 2 and solve for $y$.

| | |
|---|---|
| $3y = x - 11$ | Equation 2 |
| $3y = \mathbf{5} - 11$ | Substitute 5 for $x$. |
| $3y = -6$ | Subtract. |
| $y = -2$ | Divide each side by 3. |

▶ The solution is $(5, -2)$.

**Solve the system by substitution.**

**1.** $2x - y = 6$

$x = y - 1$

**2.** $3x + y = -3$

$x = -y + 3$

**Solve the system. Explain your choice of method.**

**3.** $x = 3y + 14$

$5x - 2y = -8$

**4.** $-2x + 2y = -6$

$2y = -x + 12$

Name ______________________________ Date __________

# Lesson 5.2 Enrichment and Extension

## Solving Systems of Linear Equations

In Exercise 1−12, choose a pair of equations from the list of equations below that has the given solution.

| | | |
|---|---|---|
| $y = x$ | $y = 2x$ | $y = 3x + 4$ |
| $y = x + 2$ | $x = -2$ | $y = 4x + 1$ |
| $y = 6$ | $y = -x + 6$ | $y = 2x - 2$ |
| $y = -x + 12$ | $x = 1$ | $y = -x$ |

**1.** $(0, 0)$

**2.** $(-2, -4)$

**3.** $(6, 6)$

**4.** $(-2, 14)$

**5.** $(2, 4)$

**6.** $(3, 3)$

**7.** $(-2, 0)$

**8.** $(5, 7)$

**9.** $(1, 3)$

**10.** $(4, 8)$

**11.** $(3, 13)$

**12.** $(1, 5)$

**13.** Write a system of equations whose solution is $(-120, 52)$.

Name ______________________________________________________ Date __________

# 5.2 Puzzle Time

## Where Do High Jumpers Store Their Valuables?

Write the letter of each answer in the box containing the exercise number.

**Solve the system of linear equations by substitution.**

**1.** $y = x$
$y = 2x - 1$

**2.** $y = -x$
$y = 3x - 4$

**3.** $y = 5x - 6$
$y = 4x - 2$

**4.** $x + y - 7$
$7x + y = 1$

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

**6.** $9x + y = 0$
$3x + 2y = 12$

**7.** $x + y = 5$
$3x - y = 7$

**8.** $3x + 2y = 12$
$4x + 2y = 16$

**9.** $\frac{1}{2}x + y = 2$
$-x + y = 2$

**10.** $\frac{1}{2}x + \frac{1}{4}y = 2$
$x + y = 1$

**11.** $6x - y = 24$
$6x + y = -12$

**12.** There are a total of 52 students on the soccer team and the field hockey team. The field hockey team has 12 more students than the soccer team. Write a system of linear equations that fits this situation. How many students are on the soccer team *x* and the field hockey team *y*?

**Answers**

**P.** (20, 32)

**V.** (0, 0)

**L.** (7, −6)

**I.** (−1, 8)

**T.** (4, 0)

**U.** (4, 14)

**A.** (1, −18)

**N.** (1, −1)

**E.** (−4, −23)

**O.** (0, 2)

**A.** (3, 2)

**L.** (1, 1)

**Lesson 5.3**

# Cumulative Practice

**For use before Lesson 5.3**

**Graph the linear equation.**

**1.** $4x - 3y = 6$

**2.** $3x - 2y = -4$

**Lesson 5.3**

# Vocabulary Practice

**For use before Lesson 5.3**

**1.** Write what you know about this phrase.

**Review: standard form**

**Lesson 5.3**

# Prerequisite Skills Practice

**For use before Lesson 5.3**

**Solve the equation.**

**1.** $6y = 90$

**2.** $-17x = 102$

**3.** $9x = -144$

**4.** $-11y = -209$

**5.** $4x + 20 = 4$

**6.** $-2y + 4 = -10$

Name ______________________________________________________ Date __________

# Lesson 5.3 Extra Practice

**Solve the system by elimination. Check your solution.**

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

**2.** $x + 3y = 5$
$2x - 3y = 1$

**3.** $4x - y = 7$
$4x - 2y = 2$

**4.** $2x + 3y = -2$
$3x - y = -14$

**5.** $x - 3y = 1$
$4x + 5y = 4$

**6.** $3x - 5y = 9$
$6x - 6y = 6$

**7.** Your friend solves the system. Is your friend correct? Explain your reasoning.

$$\begin{array}{ll} 4x + 4y = 12 & \text{Equation 1} \\ \underline{2x - 4y = 24} & \text{Equation 2} \\ 2x \quad\;\; = -12 & \\ \quad\;\; x = -6 & \end{array}$$

The solution is (–6, –9).

**Solve the system. Explain your choice of method.**

**8.** $y = 2x + 3$
$y = 3x + 2$

**9.** $2x + 5y = -2$
$x - 5y = -16$

**10.** $3x - 2y = 0$
$6x - 5y = -27$

**11.** A 100-point test contains a total of 20 questions. The multiple-choice questions are worth 3 points each, and the short-response questions are worth 8 points each.

**a.** Write a system of linear equations that represents this situation.

**b.** How many multiple-choice questions are on the test?

**c.** How many short-response questions are on the test?

Name ______________________________ Date __________

# Lesson 5.3 Reteach

## EXAMPLE Solving a System of Linear Equations by Elimination

**Solve the system by elimination.** $\mathbf{2x - y = 8}$ Equation 1

$\mathbf{-2x + 3y = 0}$ Equation 2

**Step 1:** Notice that the coefficients of the *x*-terms are opposites. So, you can add the equations to obtain an equation that has one variable, *y*.

| | |
|---|---|
| $2x - y = 8$ | Equation 1 |
| $\underline{-2x + 3y = 0}$ | Equation 2 |
| $2y = 8$ | Add the equations. |

**Step 2:** Solve for *y*.

| | |
|---|---|
| $2y = 8$ | Equation from Step 1. |
| $y = 4$ | Divide each side by 2. |

**Step 3:** Substitute 4 for *y* in one of the original equations and solve for *x*.

| | |
|---|---|
| $2x - \mathbf{y} = 8$ | Equation 1 |
| $2x - \mathbf{4} = 8$ | Substitute 4 for *y*. |
| $2x = 12$ | Add 4 to each side. |
| $x = 6$ | Divide each side by 2. |

▶ The solution is (6, 4).

**Check**

| Equation 1 | Equation 2 |
|---|---|
| $2x - y = 8$ | $-2x + 3y = 0$ |
| $2(\mathbf{6}) - (\mathbf{4}) \stackrel{?}{=} 8$ | $-2(\mathbf{6}) + 3(\mathbf{4}) \stackrel{?}{=} 0$ |
| $8 = 8$ ✓ | $0 = 0$ ✓ |

Name ______________________________________________________ Date __________

**Lesson 5.3**

# Reteach (continued)

## **EXAMPLE** Solving a System of Linear Equations by Elimination

**Solve the system by elimination.** $\mathbf{2x + 3y = -24}$ Equation 1

$\mathbf{-4x + 4y = 8}$ Equation 2

**Step 1:** Notice that no pairs of like terms have the same or opposite coefficients. One way to solve by elimination is to multiply Equation 1 by 2 so that the $x$-terms have opposite coefficients.

$2x + 3y = -24$ → Multiply by 2. → $4x + 6y = -48$ Revised Equation 1

$-4x + 4y = 8$ $\qquad$ $-4x + 4y = 8$ Equation 2

**Step 2:** Add the equations to obtain an equation in one variable, $y$.

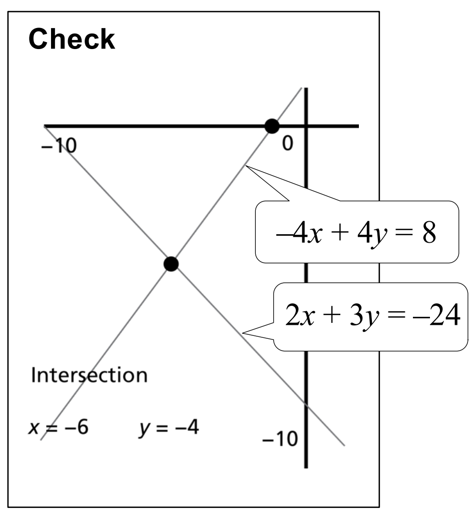
| | |
|---|---|
| $4x + 6y = -48$ | Revised Equation 1 |
| $\underline{-4x + 4y = 8}$ | Equation 2 |
| $10y = -40$ | Add the equations. |

**Step 3:** Solve for $y$.

| | |
|---|---|
| $10y = -40$ | Equation from Step 2 |
| $y = -4$ | Divide each side by 10. |

**Step 4:** Substitute $-4$ for $y$ in one of the original equations and solve for $x$.

| | |
|---|---|
| $-4x + 4y = 8$ | Equation 2 |
| $-4x + 4(\mathbf{-4}) = 8$ | Substitute $-4$ for $y$. |
| $-4x - 16 = 8$ | Multiply. |
| $-4x = 24$ | Add 16 to each side. |
| $x = -6$ | Divide each side by $-4$. |




▶ The solution is $(-6, -4)$.

**Solve the system by elimination. Check your solution.**

**1.** $2x + 3y = 20$

$-2x + y = 4$

**2.** $5x + y = 30$

$3x + 4y = 52$

Name ______________________________________________ Date __________

Lesson 5.3

# Enrichment and Extension

## Which Method is Best?

You have learned about three different methods to solve systems of linear equations: graphing, substitution, and elimination. Complete the following exercises.

1. Explain when it is best to use each method.

2. Discuss the advantages and disadvantages of each method.

3. Which method is your favorite? Explain your answer.

Tell which method—graphing, substitution, or elimination—is the best to solve the system. Then find the solution using that method.

4. $y = 2x + 5$
   $y = -x + 2$

5. $3x + 4y = 36$
   $-2x + 2y = 4$

6. $-6x - y = -6$
   $-2x + 14 = y$

7. $y = x$
   $y = 2x - 3$

8. $2x - 3y = -18$
   $-2x + 5y = 26$

9. $2x - 3y = 15$
   $-4x + 3y = -9$

10. $x + 2y = -15$
    $3x - y = -17$

11. $y = x + 1$
    $2x - 3y = -3$

Name ____________________________________________ Date __________

# 5.3 Puzzle Time

## Does It Take Longer To Run From First Base To Second Base Or From Second Base To Third Base?

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| G | H | I | J | | |

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

| |
|---|
| (2, 9) **BECAUSE** |
| $(\frac{9}{2}, -1)$ **A** |
| (−2, 1) **REFEREE** |
| (4, 2) **SECOND** |
| (5, 5) **CATCHER** |
| (−27, 9) **THIRD** |
| (0, 3) **FIRST** |
| (−9, 8) **BALL** |
| (3, 0) **IS** |

**Solve the system of linear equations by elimination.**

**A.** $x + y = 6$
$x - y = 2$

**B.** $x + 5y = 15$
$-x - 2y = 0$

**C.** $3x + 4y = 5$
$3x - 4y = -11$

**D.** $-x - 2y = 9$
$x + 4y = 9$

**E.** $x - 6y = -11$
$8x + 6y = 20$

**F.** $3x + 2y = 24$
$-x + 2y = 16$

**G.** $4x + 9y = -12$
$4x - 7y = 20$

**H.** $3x + 7y = 9$
$4x - 7y = 12$

**I.** $2x + 5y = 4$
$4x + 7y = 11$

**J.** The local theater is showing a matinee and offering a special deal for the community. A ticket for an adult costs $11 and a ticket for a child costs $6. The theater sells a total of 60 tickets and collects $460. How many adult tickets $x$ and children tickets $y$ are sold?

| |
|---|
| (−1, 2) **TO** |
| (0, 0) **BAT** |
| (6, 0) **HOMERUN** |
| (1, 2) **BASE** |
| (20, 40) **SHORTSTOP** |
| (2, 4) **MITT** |
| $(\frac{3}{2}, -2)$ **THERE** |
| (5, −6) **FOUL** |
| (−10, 5) **BASE** |

Lesson 5.4

# Cumulative Practice

**For use before Lesson 5.4**

**Solve the system.**

**1.** $2x + 3y = 4$

$y = 3x + 5$

**2.** $4x + 4y = 1$

$2x + 3y = -1$

Lesson 5.4

# Vocabulary Practice

**For use before Lesson 5.4**

**1.** Write what you know about this word.

**Review: slope**

Lesson 5.4

# Prerequisite Skills Practice

**For use before Lesson 5.4**

**Solve the system by elimination.**

**1.** $x + y = 10$

$x - y = 7$

**2.** $x + 2y = 8$

$-x + 2y = 20$

Name ______________________________________________ Date _________

# Lesson 5.4 Extra Practice

**Solve the system. Explain your choice of method.**

**1.** $y = 4x - 5$

$y + 2 = 4x$

**2.** $y = 2 - 3x$

$2x - y = 13$

**3.** $y = \frac{2}{3}x - 3$

$2x - 3y = 9$

**Without graphing, determine whether the system of linear equations has *one solution*, *infinitely many solutions* or *no solution*. Explain your reasoning.**

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

$y = 3x + 5$

**5.** $y = 6x + 2$

$y = 6x - 2$

**6.** $y = 5x + 9$

$y = 3x - 2$

**7.** A gift basket has 2 soaps and 5 lotions and costs \$20. A second gift basket has 6 soaps and 15 lotions and costs \$50. Is it possible to determine the price of the soap?

**8.** Both equations in a system of linear equations have $y$-intercepts at (0, 2).

**a.** Is it possible for this system to have only *one solution*? Explain your reasoning.

**b.** Is it possible for this system to have *no solution*? Explain your reasoning.

**c.** Is it possible for this system to have *infinitely many solutions*? Explain your reasoning.

**9.** Your friend finds the number of solutions of the system. Is your friend correct? Explain your reasoning.

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

The lines have the same slope, so there are infinitely many solutions.

**10.** Find the values of $a$ and $b$ so the system shown has infinitely many solutions.

$2x + 9y = 3$

$4x + ay = b$

Name ______________________________ Date __________

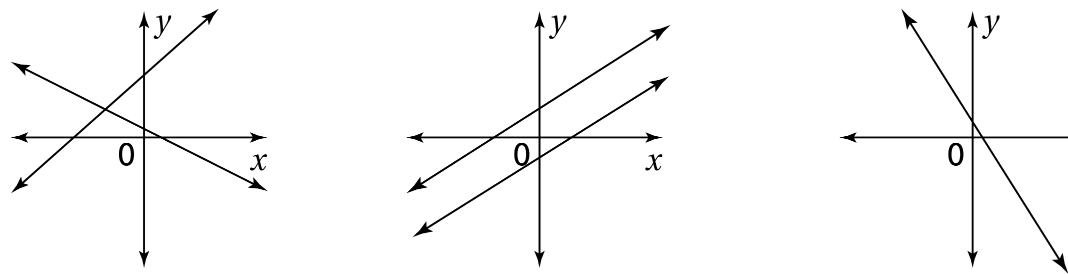
**Lesson 5.4**

# Reteach

## Key Idea

**Solutions of Systems of Linear Equations**

A system of linear equations can have *one solution*, *no solution*, or *infinitely many solutions*.

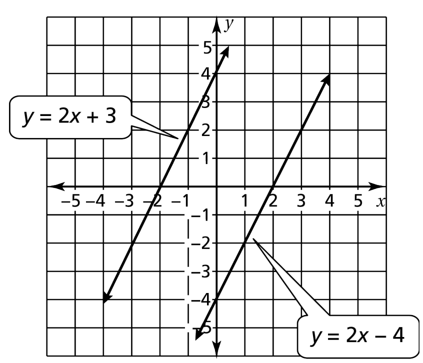


| **One solution** | **No solution** | **Infinitely many solutions** |
|---|---|---|
| The lines intersect. | The lines are parallel. | The lines are the same. |
| • different slopes | • same slope | • same slope |
| | • different $y$-intercepts | • same $y$-intercept |

**EXAMPLE** Solving a System with No Solution

**Solve the system using any method.** $\mathbf{y = 2x + 3}$ Equation 1

**Method 1:** Solve by graphing. $\mathbf{y = 2x - 4}$ Equation 2




The lines have the same slope, 2, and different $y$-intercepts, 3 and –4. So, the lines are parallel. Because parallel lines do not intersect, there is no point that is a solution of both equations.

▶ So, the system has no solution.

**Method 2:** Solve by inspection.

Notice that you can rewrite the system as

$-2x + y = 3$ Revised Equation 1

$-2x + y = -4$ Revised Equation 2

▶ The expression $-2x + y$ cannot be equal to 3 and –4 at the same time. So, the system has no solution.

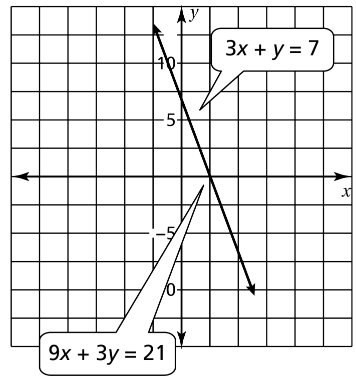
Name ______________________________ Date __________

# Lesson 5.4 Reteach (continued)

## EXAMPLE Solving a System with Infinitely Many Solutions

**Solve the system using any method.** $3x + y = 7$ Equation 1

$9x + 3y = 21$ Equation 2




**Method 1:** Solve by graphing.

The lines have the same slope, –3, and the same *y*-intercept, 7.

So, the two equations in the system represent the same line.

▶ All the points on the line are solutions of the system. So, the system has infinitely many solutions.

**Method 2:** Solve by elimination.

Multiply Equation 1 by 3 and subtract the equations.

$3x + y = 7$ → Multiply by 3. → $9x + 3y = 21$ Revised Equation 1

$9x + 3y = 21$ → $9x + 3y = 21$ Equation 2

$0 = 0$ Subtract.

The equation 0 = 0 is always true. You can also see from Revised Equation 1 that the two equations in the system are equivalent.

▶ All the points on the line are solutions of the system. So, the system has infinitely many solutions.

**Solve the system. Explain your choice of method.**

**1.** $y = 2x - 5$
$y = 2x + 3$

**2.** $2x - 5y = 6$
$-4x + 10y = -12$

**3.** $8y = -6x + 12$
$-3x - 4y = 10$

**4.** $4y = 2x - 7$
$4y = 2x + 3$

**5.** $4x - y = 8$
$y = 4x - 8$

**6.** $7y = 6x + 2$
$-2x - 5y = 8$

**7.** $-\frac{2}{3}x + 3y = 8$
$2x - 9y = -24$

**8.** $y = 4x - \frac{7}{5}$
$5y + 20x = 5$

**9.** $2y = 3x - 6$
$\frac{3}{2}x - y = 3$

Name ______________________________________________ Date __________

## Lesson 5.4 Enrichment and Extension

### Solving Special Systems of Linear Equations

Find the values of *a* and *b* so that the system shown has the given solution.

**1.** $y = ax - 5$

$y = -2x - b$

The solution is (2, −3).

**2.** $y = \frac{1}{2}x + b$

$y = ax - 2$

The system has infinitely many solutions.

**3.** $y = 2x + b$

$y = ax + 3$

The solution is (−1, 4).

**4.** $y = -2x + b$

$y = ax - 1$

The solution is (1, 0).

**5.** $y = 3x + 1$

$y = ax + b$

There is no solution.

**6.** $y = ax + 4$

$y = \frac{1}{2}x + b$

The solution is (6, 6).

**7.** $x + y = b$

$ax + 3y = 13$

The solution is (4, 7).

**8.** $y = 12x - b$

$-ax + y = 4$

The system has infinitely many solutions.

**9.** Write a system of linear equations in *x* and *y* that contains unknown values *a* and *b* and that has infinitely many solutions. Exchange problems with a partner and see if your partner can find the values of *a* and *b*.

Name ______________________________ Date __________

# 5.4 Puzzle Time

## What Should You Do When A Bull Charges You?

Write the letter of each answer in the box containing the exercise number.

**Solve the system of linear equations.**

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

**H.** infinitely many **I.** no solution **J.** $(0, 5)$ **K.** $(5, 0)$

**2.** $4x - 3y = 5$
$-8x + 6y = -10$

**A.** infinitely many **B.** no solution **C.** $(4, -3)$ **D.** $(-3, 4)$

**3.** $-7x - 7y = -14$
$x + y = -2$

**L.** infinitely many **M.** no solution **N.** $(2, 0)$ **O.** $(0, 2)$

**4.** $2x + y = 5$
$x - y = 1$

**W.** infinitely many **X.** no solution **Y.** $(2, 1)$ **Z.** $(1, 2)$

**5.** $3x + 9y = 5$
$-x - 3y = -4$

**H.** infinitely many **I.** no solution **J.** $(3, 9)$ **K.** $(9, 3)$

**6.** $2x - 3y = 8$
$4x - 6y = 16$

**P.** infinitely many **Q.** no solution **R.** $\left(4, \frac{8}{3}\right)$ **S.** $\left(\frac{8}{3}, 4\right)$

| 6 | 2 | 4 | | 5 | 1 | 3 |
|---|---|---|---|---|---|---|
| | | | | | | |