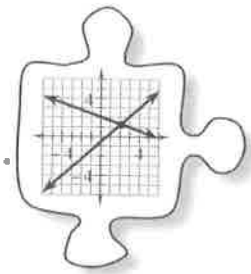
4.2.3 Can I solve without substituting?

Solving Systems Using Elimination



In this chapter, you have learned the Substitution Method for solving systems of equations. You also studied the Equal Values Method that set two equations equal to each other. But are these methods the best to use for all types of systems? Today you will develop a new solution method that can save time for systems of linear equations in standard form, $ax + by = c$.

4-55. Jeanette is trying to find the intersection point of these two lines:

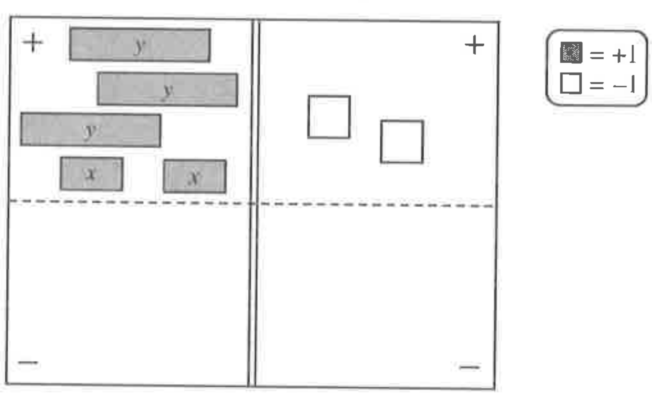
$$3y + 2x = -2$$
$$-3y + 5x = 16$$

She has decided to use substitution to find the point of intersection. Her plan is to solve the first equation for y, and then to substitute the result into the second equation. Use Jeanette's idea to solve the system. **[(2, –2)]**

4-56. AVOIDING THE MESS: THE ELIMINATION METHOD

Your class will now discuss a new method, called the **Elimination Method**, to find the solution to Jeanette's problem without the complications and fractions of the previous problem. Your class discussion is outlined below.

a. Build Jenna's first equation on an Equation Mat as shown below.

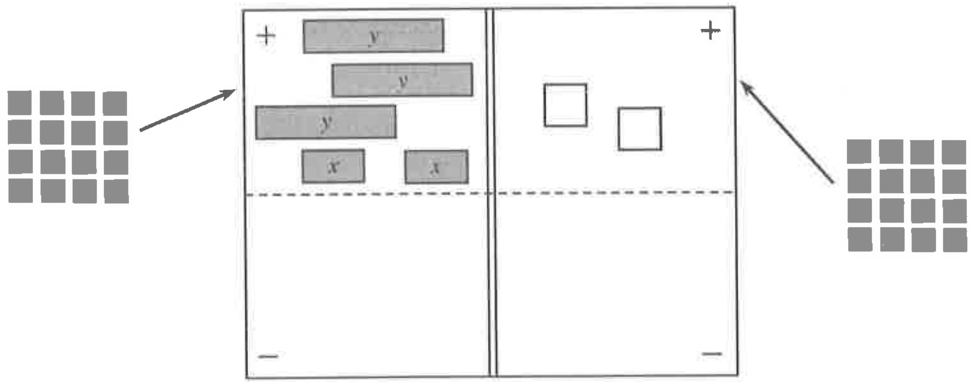


$$3y + 2x = -2$$

Problem continues on next page. →

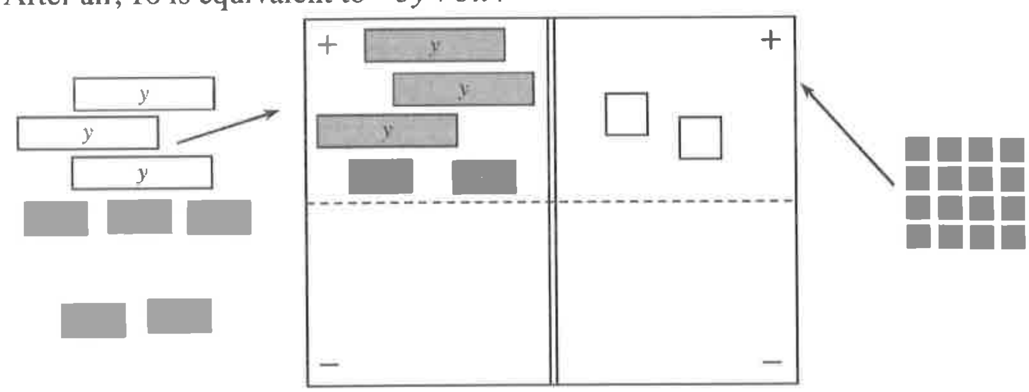
4-56. *Problem continued from previous page.*

b. "Add the same tiles to both sides" is a "legal" tile move. Jeanette can add anything she wants to both sides of the equation. If she wanted to, she could choose to add 16 to both sides. You will see in a moment why that makes sense.



$$3y + 2x = -2$$
$$+16 \qquad +16$$

c. But 16 is equal to $-3y + 5x$, according to the original equations in problem 4-55. On the left side, instead of adding 16, Jeanette decides to add $-3y + 5x$. After all, 16 is equivalent to $-3y + 5x$.



$$3y + 2x = -2$$
$$-3y + 5x \qquad +16$$

d. Write a new equation for the result of Jeanette's addition to both sides of the equation. Notice that you now have only one equation with one variable. What happened to the y-terms? Simplify and then solve this new equation for the remaining variable. **[The y-terms were eliminated when simplified; $7x = 14$, $x = 2$]**

e. Use your solution for x to find y. Check to be sure your solution makes both original equations true. **[$y = -2$; $3(-2) + 2(2) = -2$ and $-3(-2) + 5(2) = 16$]**

f. Now use algebra tiles and the Elimination Method to solve the system of equations at right for x and y. Check your solution. **[$x = 1, y = 4$]**

$$2x - y = -2$$
$$-2x + 3y = 10$$

4-57. Pat was in a fishing competition at Lake Pisces. He caught some bass and some trout. Each bass weighed 3 pounds, and each trout weighed 1 pound. Pat caught a total of 30 pounds of fish. He got 5 points in the competition for each bass, but since trout are endangered in Lake Pisces, he lost 1 point for each trout. Pat scored a total of 42 points.

a. Write a system of equations representing the information in this problem. **[If b represents the number of bass and t represents the number of trout, then $3b+t=30$, $5b-t=42$]**

b. Is this system a good candidate for the Elimination Method? Why or why not? **[Yes; one variable (the variable representing trout) will be eliminated when the equations are combined.]**

c. Solve this system to find out how many bass and trout Pat caught. Be sure to record your work and check your answer by substituting your solution into the original equations. **[Pat caught 9 bass and 3 trout.]**

4-58. ANNIE NEEDS YOUR HELP

Annie was going to use the Elimination Method. She was ready to add the same value to both sides of the equation to eliminate the x-terms when she noticed a problem: Both x-terms are positive!

$$2x+7y=13$$
$$2x+3y=5$$

With your team, figure out something you could do that would allow you to add the value of the second equation to the first equation and eliminate the x-terms. Once you have figured out a method, solve the system and check your solution. Be ready to share your method with the class. **[$x=-\frac{1}{2}$, $y=2$]**

4-59. Find the point of intersection of each pair of lines below. Show your steps algebraically. Check each solution when you are finished.

a. $2y-x=5$
$-3y+x=-9$
[(3, 4)]

b. $2x-4y=14$
$4y-x=-3$
[(11, 2)]

c. $3x+4y=1$
$2x+4y=2$
[(–1, 1)]

Review & Preview

4-60. Find the point of intersection of each pair of lines, if one exists. If you use an Equation Mat, be sure to record your process on paper. Check each solution, if possible.

a. $x = -2y - 3$
$4y - x = 9$
[(–5, 1)]

b. $x + 5y = 8$
$-x + 2y = -1$
[(3, 1)]

c. $4x - 2y = 5$
$y = 2x + 10$
[no solution]

4-61. Jai was solving the system of equations below when something strange happened.

$$y = -2x + 5$$
$$2y + 4x = 10$$

a. Solve the system. Explain to Jai what the solution should be.
[There are infinite solutions.]

b. Graph the two lines on the same set of axes. What happened?
[The two lines coincide.]

c. Explain how the graph helps to explain your answer in part (a).
[Since the two lines coincide, they will have an infinite number of points of intersection. Thus, the system has infinite solutions.]

4-62. On Tuesday the cafeteria sold pizza slices and burritos. The number of pizza slices sold was 20 less than twice the number of burritos sold. Pizza sold for $2.50 a slice and burritos for $3.00 each. The cafeteria collected a total of $358 for selling these two items.

a. Write two equations with two variables to represent the information in this problem. Be sure to define your variables. **[Let p represent the number of pizza slices and b represent the number of burritos sold. Then $2.50p + 3b = 358$ and $p = 2b - 20$.]**

b. Solve the system from part (a). Then determine how many pizza slices were sold. **[82 pizza slices were sold.]**

4-63. A local deli sells 4-inch sub sandwiches for $2.95. It has decided to sell a "family sub" that is 50 inches long. How much should it charge? Show all work. **[$36.88]**

4-64. Use generic rectangles to multiply each of the following expressions.

a. $(x+2)(x-5)$
[$x^2-3x-10$]

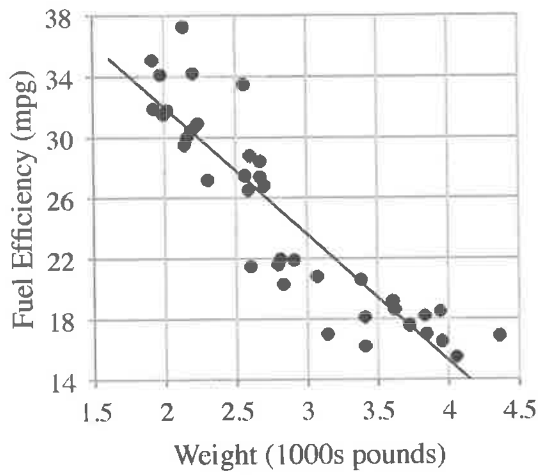
b. $(y+2x)(y+3x)$
[$y^2+5xy+6x^2$]

c. $(3y-8)(-x+y)$
[$-3xy+3y^2+8x-8y$]

d. $(x-3y)(x+3y)$
[x^2-9y^2]

4-65. A consumer magazine collected the following data for the fuel efficiency of cars (miles per gallon) compared to weight (thousands of pounds).

$e=49-8.4w$
w is the weight (1000s of pounds) and e is the fuel efficiency (mpg).



a. Describe the association between fuel efficiency and weight. **[Moderately strong negative linear association with no apparent outliers.]**

b. Cheetah Motors has come out with a super lightweight sports utility vehicle (SUV) that weighs only 2800 pounds. What does the model predict the fuel efficiency will be? **[About 25 mpg]**

4-66. Which system of equations below would be easiest to solve using the Elimination Method? Once you have explained your decision, use the Elimination Method to solve this system of equations. (You do not need to solve the other system!) Record your steps and check your solution. **[a: $-3x = -15$; $x = 5$, $y = -3$]**

a. $5x - 4y = 37$
$-8x + 4y = -52$

b. $4 - 2x = y$
$3y + x = 11$

4-67. Rachel is trying to solve this system:

$$2x + y = 10$$
$$3x - 2y = 1$$

a. Combine these equations. What happened?
[No variable was eliminated.]

b. Is $2x + y = 10$ the same line as $4x + 2y = 20$? That is, do they have the same solutions? Are their graphs the same? Justify your conclusion! Be ready to share your reasoning with the class. **[Debrief this step with the class. Point out that when students solve equations, they routinely multiply or divide both sides of an equation by a constant to find a new equation.]**

c. Since you can rewrite $2x + y = 10$ as $4x + 2y = 20$, perhaps this equivalent form of the original equation can help solve this system. Combine $4x + 2y = 20$ and $3x - 2y = 1$. Is a variable eliminated? If so, solve the system for x and y. If not, brainstorm another way to eliminate a variable. Be sure to check your solution. **[(3, 4)]**

d. Why was the top equation changed? Would a variable have been eliminated if the bottom equation were multiplied by 2 on both sides? Test this idea.
[No; multiplying the top equation by 2 created a zero with the *y*-terms.]

4-68. For each system below, determine:

- Is this system a good candidate for the Elimination Method? Why or why not?
- What is the best way to get one equation with one variable? Carry out your plan and solve the system for both variables.
- Is your solution correct? Verify by substituting your solution into both original equations.

a. $5m + 2n = -10$
$3m + 2n = -2$
[$m = -4$, $n = 5$]

b. $6a - b = 3$
$b + 4a = 17$
[$a = 2$, $b = 9$]

c. $7x + 4y = 17$
$3x - 2y = -15$
[$x = -1$, $y = 6$]

4-69. Tracy's team was given the following system by their teacher.

$$10x+4y=-8$$
$$5x+2y=10$$

a. Combine these equations and solve. What happened? **[Both variables were eliminated. No solution.]**

b. Are these two equations the same line? How can you tell? **[No. Put them both in $y=mx+b$ form; they have different equations.]**

c. How can you explain the solution you got in part (a)? **[The lines are parallel. There are no points that are solutions to both lines.]**

4-70. A NEW CHALLENGE

Carefully examine this system:

$$4x+3y=10$$
$$9x-4y=1$$

With your team, propose a way to combine these equations so that you eventually have one equation with one variable. Be prepared to share your proposal with the class. **[Answers vary, but one possible strategy is to multiply the top equation by 4 and the bottom equation by 3. Once strategies are presented, solve the system with the class. Solution: (1, 2).]**

MATH NOTES

METHODS AND MEANINGS

Forms of a Linear Function

There are three main forms of a linear function: slope-intercept form, standard form, and point-slope form. Study the examples below.

Slope-Intercept form: $y=mx+b$. The slope is m, and the y-intercept is $(0, b)$.

Standard form: $ax+by=c$

Point-Slope form: $y-k=m(x-h)$. The slope is m, and (h, k) is a point on the line. For example, if the slope is –7 and the point (10, 20) is on the line, the equation of the line can be written $y-(-10)=-7(x-20)$ or $y+10=-7(x-20)$.

Review & Preview

4-71. Solve these systems of equations using any method. Check each solution, if possible.

a. $2x+3y=9$ **[(3, 1)]**
$-3x+3y=-6$

b. $x=8-2y$ **[(0, 4)]**
$y-x=4$

c. $y=-\frac{1}{2}x+7$ **[(10, 2)]**
$y=x-8$

d. $9x+10y=14$ **[(–4, 5)]**
$7x+5y=-3$

4-72. For each line below, make a table and a graph. What do you notice? **[These lines coincide. There are infinite points of intersection.]**

a. $y=\frac{2}{3}x-1$

b. $2x-3y=3$

4-73. Find all possible values for x in each equation.

a. $-2|x|=-8$
[$x=4$ or $x=-4$]

b. $|x-3.2|=4.7$
[$x=7.9$ or $x=-1.5$]

c. $|9+6x|=4$
[$x=-\frac{5}{6}$ or $x=-2\frac{1}{6}$]

c. $|-7x-7|=1$
[$x=-1\frac{1}{7}$ or $x=-\frac{6}{7}$]

4-74. Aimee thinks the solution to the system below is (–4, –6). Eric thinks the solution is (8, 2). Who is correct? Explain your reasoning. **[They are both correct. The lines coincide.]**

$$2x-3y=10$$
$$6y=4x-20$$

4-75. Figure 3 of a tile pattern has 11 tiles, while Figure 4 has 13 tiles. If the tile pattern grows at a constant rate, how many tiles will Figure 50 have? **[$y=2x+5$, 105 tiles]**

4-76. Solve each equation for the indicated variable.

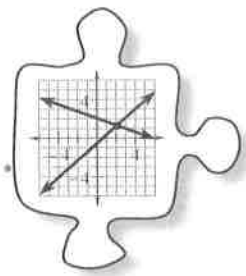
a. $y=mx+b$ (for b)
[$b=y-mx$]

b. $y=mx+b$ (for x)
[$x=\frac{y-b}{m}$]

c. $I=prt$ (for t)
[$t=\frac{I}{pr}$]

d. $A=p+prt$ (for t)
[$t=\frac{A-p}{pr}$]

4.2.5 What is the best method?



Choosing a Strategy for Solving Systems

When you have a system of equations to solve, how do you know which method to use? Focus today on how to choose a strategy that is the most convenient, efficient, and accurate for a system of equations.

4-77. Erica works in a soda-bottling factory. As bottles pass her on a conveyer belt, she puts caps on them. Unfortunately, Erica sometimes breaks a bottle before she can cap it. She gets paid 4 cents for each bottle she successfully caps, but her boss deducts 2 cents from her pay for each bottle she breaks.

Erica is having a bad morning. Fifteen bottles have come her way, but she has been breaking some and has only earned 6 cents so far today. How many bottles has Erica capped and how many has she broken?

a. Write a system of equations representing this situation. **[Let c = the number of capped bottles and b = the number of broken bottles, then $c + b = 15$ and $4c - 2b = 6$.]**

b. Solve the system of equations using *two* different methods: substitution and elimination. Demonstrate that each method gives the same answer. **[Erica has capped 6 bottles and broken 9.]**

4-78. For each system below, decide which algebraic solving strategy to use. That is, which method would be the most efficient and convenient: the Substitution Method, the Elimination Method, or setting the equations equal to each other (equal values)? Do not solve the systems yet! Be prepared to justify your reasons for choosing one strategy over the others.

a. $x = 4 - 2y$ **[substitution]**
$3x - 2y = 4$

b. $3x + y = 1$ **[elimination]**
$4x + y = 2$

c. $x = -5y + 2$ **[equal values]**
$x = 3y - 2$

d. $2x - 4y = 10$ **[substitution]**
$x = 2y + 5$

e. $y = \frac{1}{2}x + 4$ **[equal values]**
$y = -2x + 9$

f. $-6x + 2y = 76$ **[elimination]**
$3x - y = -38$

g. $5x + 3y = -6$ **[elimination]**
$2x - 9y = 18$

h. $x - 3 = y$ **[substitution]**
$2(x - 3) - y = 7$

4-79. Your teacher will assign you several systems from problem 4-78 to solve. With your team, use the best strategy to solve each system assigned by your teacher. Be sure to check your solution. [**a: (2, 1), b: (1, –2), c: (–0.5, 0.5), d: infinite solutions, e: (2, 5), f: no solution, g: (0, –2), h: (10, 7)**]

4-80. In your Learning Log, write down everything you know about solving systems of equations. Include examples and explain your reasoning. Title this entry "Solving Systems of Equations" and label it with today's date.

MATH NOTES

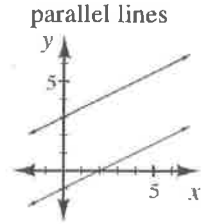
METHODS AND MEANINGS

Intersection, Parallel, and Coincide

When two lines lie on the same flat surface (called a plane), they may **intersect** (cross each other) once, an infinite number of times, or never.

For example, if the two lines are **parallel**, then they never intersect. The system of these two lines does not have a solution. Examine the graph of two parallel lines at right. Notice that the distance between the two lines is constant and that they have the same slope but different y-intercepts.

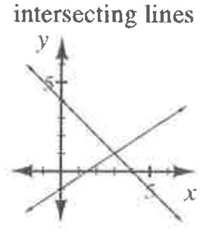
parallel lines



However, what if the two lines lie exactly on top of each other? When this happens, we say that the two lines **coincide**. When you look at two lines that coincide, they appear to be one line. Since these two lines intersect each other at all points along the line, coinciding lines have an infinite number of intersections. The system has an infinite number of solutions. Both lines have the same slope and y-intercept.

While some systems contain lines that are parallel and others coincide, the most common case for a system of equations is when the two lines intersect once, as shown at right. The system has one solution, namely, the point where the lines intersect, (x, y).

intersecting lines



Review & Preview

4-81. Solve the following systems of equations using any method. Check each solution, if possible.

a. $-2x+3y=1$ **[$(0,\ \frac{1}{3})$]**
$2x+6y=2$

b. $y=\frac{1}{3}x+4$ **[$(-6, 2)$]**
$x=-3y$

c. $3x-y=7$ **[no solution]**
$y=3x-2$

d. $x+2y=1$ **[$(11, -5)$]**
$3x+5y=8$

4-82. The Math Club is baking pies for a bake sale. The fruit-pie recipe calls for twice as many peaches as nectarines. If it takes a total of 168 pieces of fruit for all of the pies, how many nectarines are needed? **[$2n = p$ and $n + p = 168$; 56 nectarines are needed.]**

4-83. Candice is solving this system:

$$2x-1=3y$$
$$5(2x-1)+y=32$$

a. She notices that each equation contains the expression $2x-1$. Can she substitute $3y$ for $2x-1$? Why or why not? **[Yes, because these expressions are equal.]**

b. Substitute $3y$ for $2x-1$ in the second equation to create one equation with one variable. Then solve for x and y. **[$5(3y) + y = 32$, $y = 2$, $x = 3.5$]**

4-84. Find $g(-5)$ for each function below.

a. $g(x)=x^3-2$ **[-127]**

b. $g(x)=7+\sqrt{4-x}$ **[10]**

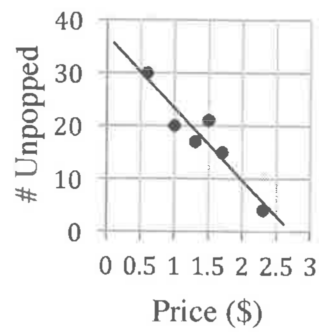
c. $g(x)=\sqrt[3]{x+(-59)}$ **[-4]**

d. $g(x)=-4|x-1|$ **[-24]**

4-85. Tim is buying snacks for the Mathletes who love microwave popcorn. When Tim looks at the popcorn selection he notices many brands and different prices. He wonders if the cost is related to the quality of the popcorn. To answer his question he purchases a random sample of popcorn bags and records their price. When it is time for the Mathletes meeting he pops each bag in the same microwave, opens each bag and counts the number of unpopped kernels.

Price ($)	2.30	0.60	1.30	1.50	1.70	1.00
# Unpopped	4	30	17	21	15	20

a. Make a scatterplot on graph paper and draw the line of best fit. Determine the equation of the line of best fit. **[See graph at right.** ***u*** **= 37 – 13.7*p* where *p* is the price in dollars and *u* is the number of unpopped kernels.]**



b. Estimate the number of unpopped kernels (after cooking) in a bag that costs $1.19. **[≈ 21 kernels]**

4-86. This problem is part 2 of the checkpoint for solving linear equations (with fractional coefficients). It will be referred to as Checkpoint 4.

Solve each equation.

a. $\frac{1}{6}m - 3 = -5$

[$m = -12$]

b. $\frac{2}{3}x - 3 = \frac{1}{2}x - 7$

[$x = -24$]

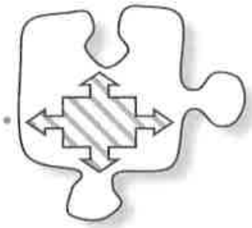
c. $x + \frac{x}{2} - 4 = \frac{x}{4}$

[$x = \frac{16}{5}$]

Check your answers by referring to the Checkpoint 4 materials located at the back of your book.

If you needed help solving these problems correctly, then you need more practice. Review the Checkpoint 4 materials and try the practice problems. Also, consider getting help outside of class time. From this point on, you will be expected to do problems like these quickly and easily.

4.3.1 What can I do now?



Pulling It All Together

This lesson contains several problems that will require you to use the algebra content you have learned so far in new ways.

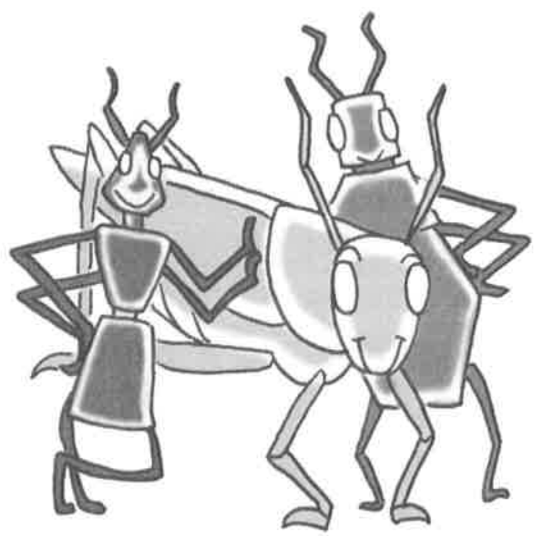
Your teacher will describe today's activity. As you solve the problems below, remember to make connections between all of the different topics you have studied in Chapters 1 through 4. If you get stuck, think of what the problem reminds you of. Decide if there is a different way to approach the problem. Most importantly, discuss your ideas with your teammates.

4-87. Brianna has been collecting insects and measuring the lengths of their legs and antennae. Below is the data she has collected so far.

	Ant	**Beetle**	**Grasshopper**
Length of Antenna (x)	2 mm	6 mm	20 mm
Length of Leg (y)	4 mm	10 mm	31 mm

a. Graph the data Brianna has collected. Put the antenna length on the x-axis and leg length on the y-axis.

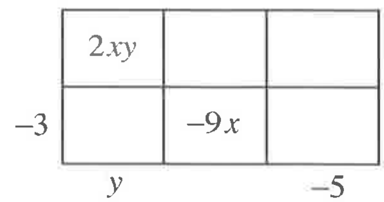
b. Brianna thinks that she has found an algebraic rule relating antenna length and leg length: $4y-6x=4$. If x represents the length of the antenna and y represents the leg length, could Brianna's rule be correct? If not, find your own algebraic rule relating antenna length and leg length. **[This rule is correct.]**



c. If a ladybug has an antenna 1 mm long, how long does Brianna's rule say its legs will be? Use both the rule and the graph to justify your answer. **[When $x = 1$ mm, $y = 2.5$ mm.]**

4-88. Barry is helping his friend understand how to solve systems of equations. He wants to give her a practice problem that has two lines that intersect at the point (–3, 7). Help him by writing a system of equations that will have (–3, 7) as a solution and demonstrate how to solve it. **[Answers vary.]**

4-89. Examine the generic rectangle at right. Determine the missing attributes and then write the area as a product and as a sum. **[$(2x-3)(y+3x-5) = 2xy + 6x^2 - 19x - 3y + 15$]**



4-90. One evening, Gemma saw three different phone company ads. TeleTalk boasted a flat rate of 8¢ per minute. AmeriCall charges 30¢ per call plus 5¢ per minute. CellTime charges 60¢ per call plus only 3¢ per minute.

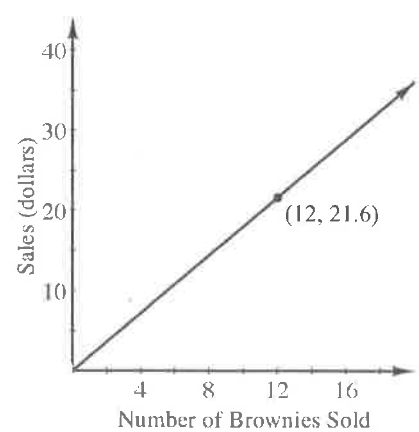
a. Gemma is planning a phone call that will take about 5 minutes. Which phone plan should she use and how much will it cost? **[TeleTalk; 40¢]**

b. Represent each phone plan with a table and a rule. Then graph each plan on the same set of axes, where x represents time in minutes and y represents the cost of the call in cents. If possible, use different colors to represent the different phone plans. **[TeleTalk: $y = 8x$, AmeriCall: $y = 30 + 5x$, CellTime: $y = 60 + 3x$]**

c. How long would a call need to be to cost the same with TeleTalk and AmeriCall? What about AmeriCall and CellTime? **[10 min.; 15 min.]**

d. Analyze the different phone plans. How long should a call be so that AmeriCall is cheapest? **[Between 10 and 15 minutes.]**

4-91. Mary Sue is very famous for her delicious brownies, which she sells at football games at her Texas high school. The graph at right shows the relationship between the number of brownies she sells and the amount of money she earns.



a. How much should she charge for 10 brownies? Be sure to demonstrate your reasoning. **[$18]**

b. During the last football game, Mary Sue made $34.20. How many brownies did she sell? Show your work. **[She sold 19 brownies.]**

4-92. How many solutions does each equation below have? How can you tell?

a. $4x-1+5=4x+3$
[none]

b. $6t-3=3t+6$
[one ($t=3$)]

c. $6(2m-3)-3m=2m-18+m$
[one ($m=0$)]

d. $10+3y-2=4y-y+8$
[infinite]

4-93. Anthony has the rules for three lines: A, B, and C. When he solves a system with lines A and B, he gets no solution. When he solves a system with lines B and C, he gets infinite solutions. What solution will he get when he solves a system with lines A and C? Justify your conclusion. **[He should get no solution. Lines A and B are parallel, while B and C coincide. That means that A and C are also parallel.]**

4-94. Normally, the longer you work for a company, the higher your salary per hour. Hector surveyed the people at his company and placed his data in the table below.

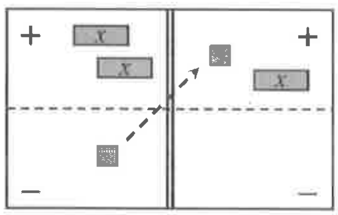
Number of Years at Company	1	3	6	7
Salary per Hour	\$7.00	\$8.50	\$10.75	\$11.50

a. How much can Hector expect to make after working at the company for 5 years? **[$p=0.75y+6.25$ where p is pay (\$/hour) and y is time worked for the company (years). \$10 per hour.]**

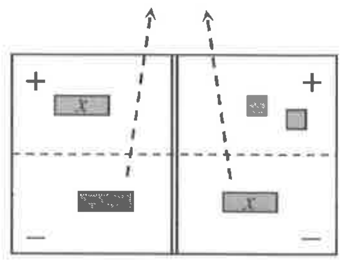
b. Hector's company is hiring a new employee who will work 20 hours a week. How much do you expect the new employee to earn for the first week? **[\$6.25 · 20 hours = \$125]**

4-95. Dexter loves to find shortcuts. He has proposed a few new moves to help simplify and solve equations. Examine his work below. For each Equation Mat, decide if his move is "legal." That is, decide if the move creates an equivalent equation. Justify your conclusions using the "legal" moves you already know. **[(a), (b), and (c) all create equivalent equations. Part (d) is not legal, because unless $x = 1$, $-x + 1 \neq 0$.]**

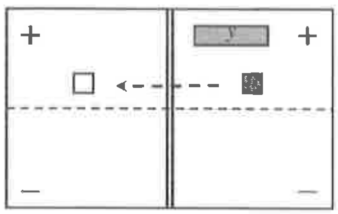
a.



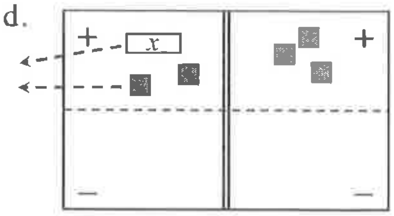
b.



c.



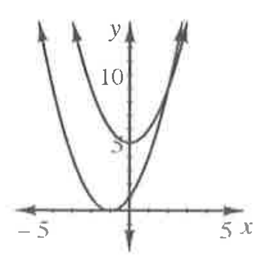
d.



4-96. Solve the problem below using *two different methods*.

The Math Club sold roses and tulips this year for Valentine's Day. The number of roses sold was 8 more than 4 times the number of tulips sold. Tulips were sold for \$2 each and roses for \$5 each. The club made \$414.00. How many roses were sold? **[Let r = the number of roses sold and t = the number of tulips sold, $r = 4t + 8$, $5r + 2t = 414$; 76 roses were sold.]**

4-97. Use substitution to find where the two parabolas below intersect. Then confirm your solution by graphing both on the same set of axes. **[See graph at right. $x^2 + 5 = x^2 + 2x + 1$, $x = 2$, $y = 9$]**



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

Review & Preview

4-98. Find the point of intersection for each set of equations below using any method. Check your solutions, if possible.

a. $6x - 2y = 10$
$3x - 5 = y$
[all numbers]

b. $6x - 2y = 5$
$3x + 2y = -2$
[$(\frac{1}{3}, -\frac{3}{2})$]

c. $5 - y = 3x$
$y = 2x$
[(1, 2)]

d. $y = \frac{1}{4}x + 5$
$y = 2x - 9$
[(8, 7)]

4-99. Consider the equation $-6x = 4 - 2y$.

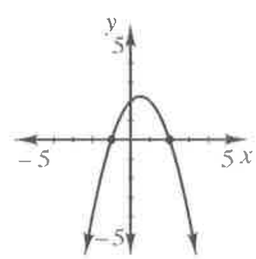
a. If you graphed this equation, what shape would the graph have? How can you tell? **[It is a line.]**

b. Without changing the form of the equation, find the coordinates of three points that must be on the graph of this equation. Then graph the equation on graph paper. **[Answers will vary. Possible solutions: (0, 2), (1, 5), (2, 8), ...]**

c. Solve the equation for y. Does your answer agree with your graph? If so, how do they agree? If not, check your work to find the error. **[$y = 3x + 2$; Yes, because the points are the same.]**

4-100. A tile pattern has 10 tiles in Figure 2 and increases by 2 tiles for each figure. Find a rule for this pattern and then determine how many tiles are in Figure 100.
[$y = 2x + 6$; 206 tiles]

4-101. Make a table and graph the rule $y = -x^2 + x + 2$ on graph paper. Label the x-intercepts. **[See graph at right. (–1, 0) and (2, 0)]**



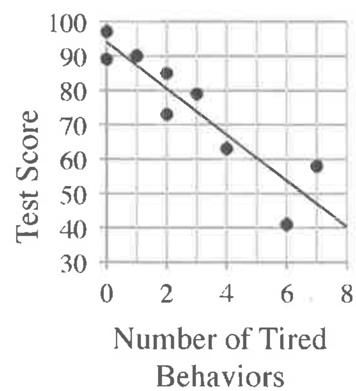
4-102. Mr. Greer solved the equation below. However, when he checked his solution, it did not make the original equation true. Find his error and then find the correct solution.
[Mr. Greer distributed incorrectly. The correct solution is $x = 2$.]

$$4x = 8(2x - 3)$$
$$4x = 16x - 3$$
$$-12x = -3$$
$$x = \frac{-3}{-12}$$
$$x = \frac{1}{4}$$

4-103. Mr. Saksunn is concerned with his students' scores on the last math test and also concerned about the number of students looking tired in class. He decides to see if there is a relationship between the number of tired or sleepy behaviors (yawns, nodding-off, head on desk) a student exhibits and their test score. He has his assistant observe 10 students and count the number of tired behaviors during one week of class.

Tired Behaviors	2	4	0	2	1	7	0	1	3	6
Test Score	73	63	89	85	90	58	97	90	79	41

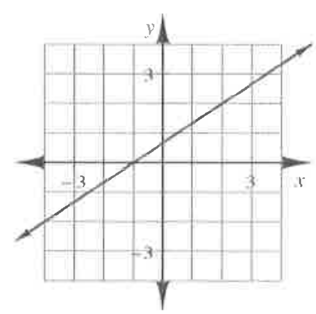
a. Make a scatterplot on graph paper and draw the line of best fit. Determine the equation of the line of best fit. **[See graph at right. $y = 94 - 6.7x$ where y is the test score and x is the number of tired behaviors observed.]**



b. Using your equation from part (a), estimate the test score of a student who exhibits 5 tired behaviors during Professor Saksunn's math class in a week.
[≈ 61]

4-104. Thirty coins, all dimes and nickels, are worth \$2.60. How many nickels are there?
[$n + d = 30$ and $0.05n + 0.10d = 2.60$, so $n = 8$. There are 8 nickels.]

4-105. **Multiple Choice:** Martha's equation has the graph shown at right. Which of these are solutions to Martha's equation? (Remember that more than one answer may be correct.) **[(a), (b), and (d)]**



a. $(-4, -2)$

b. $(-1, 0)$

c. $x = 0$ and $y = 1$

d. $x = 2$ and $y = 2$

4-106. Copy and complete the table below. Then write the corresponding rule. **[$y = -5x + 3$]**

IN (x)	2	10	6	7	-3	0	-10	100	x
OUT (y)	-7	**-47**	**-27**	**-32**	18	3	**53**	**-497**	**$-5x+3$**

4-107. Simplify each expression. In parts (c) and (d) write your answers using scientific notation.

a. $2^3 \cdot 5^{-2}$ **[$\frac{8}{25}$]**

b. $(xy^2)^3 \cdot (x^{-2})$ **[xy^6]**

c. $3\times10^3 \cdot 4\times10^5$ **[1.2×10^9]**

d. $\frac{4\times10^2}{5\times10^{-2}}$ **[8×10^3]**

4-108. Using the variable x, write an equation that has no solution. Explain how you know it has no solution. [**Answers vary, but the answer should have the same number of x-terms on both sides of the equation and the constants on each side should not be equal.**]

4-109. If $f(x) = 3 - |x|$ and $g(x) = \sqrt[3]{x} + 5$, then find:

a. $f(-5)$ **[-2]**

b. $g(64)$ **[9]**

c. $f(0)$ **[3]**

d. $f(2)$ **[1]**

e. $g(-8)$ **[3]**

f. $g(0)$ **[5]**

4-110. **Multiple Choice:** Which equation below could represent a tile pattern that grows by 3 and has 9 tiles in Figure 2? **[C]**

a. $3x + y = 3$

b. $-3x + y = 9$

c. $-3x + y = 3$

d. $2x + 3y = 9$

4-111. Solve the systems of equations below using the method of your choice. Check your solutions, if possible.

a. $y = 7 - 2x$
$2x + y = 10$
[no solution]

b. $3y - 1 = x$
$4x - 2y = 16$
[$x = 5$, $y = 2$]

4-112. Decide if the statement below is true or false. Justify your response.
[These expressions are equivalent because of the Commutative Properties of Addition and Multiplication.]

"The expression $(x+3)(x-1)$ is equivalent to $(x-1)(3+x)$."

4-113. Find each of the following products by drawing and labeling a generic rectangle or by using the Distributive Property.

a. $(x+5)(x+4)$
[$x^2+9x+20$]

b. $2y(y+3)$
[$2y^2+6y$]

4-114. Solve each equation below for the indicated variable, if possible. Show all steps.

a. Solve for x: $2x+22=12$
[$x=-5$]

b. Solve for y: $2x-y=3$
[$y=2x-3$]

c. Solve for x: $2x+15=2x-15$
[no solution]

d. Solve for y: $6x+2y=10$
[$y=-3x+5$]

4-115. **Consecutive integers** are integers that are in order without skipping, such as 3, 4, and 5. Find three consecutive numbers with a sum of 54. **[17, 18, and 19]**

Answers and Support for Closure Activity #4
What Have I Learned?

Note: MN = Math Note, LL = Learning Log

Problem	Solution	Need Help?	More Practice
CL 4-116.	a. Setting the two equations equal to each other results in an answer that is not possible, so no solution. b. There can be no intersection because the lines are parallel.	Section 4.2 MN: 4.2.3 and 4.2.5 LL: 4.2.2 and 4.2.5	Problems 4-60(c), 4-69, and 4-81
CL 4-117.	a. Setting the two equations equal to each other results in an answer that is all real numbers. b. The two lines coincide is why the answer is all numbers.	Section 4.2 MN: 4.2.3 and 4.2.5 LL: 4.2.2 and 4.2.5	Problems 4-47, 4-61, 4-74, 4-81, 4-98, and 4-111
CL 4-118.	a. $x=2$, $y=13$ b. $x=5$, $y=-2$ c. $x=-4$, $y=\frac{1}{3}$	Section 4.2 MN: 4.1.2, 4.2.2 and 4.2.3 LL: 4.2.2 and 4.2.5	Problems 4-60, 4-71, 4-81, 4-98, and 4-111
CL 4-119.	They were on the 10th rung.	Chapter 4 MN: 4.2.3 LL: 4.2.5	Problems 4-25, 4-26, 4-38, 4-51, 4-82, and 4-104
CL 4-120.	a. $x=11.5$ b. no solution c. $x=16$ d. $x=17.5$ e. $x=-24$ f. $x=3$	Lesson 3.2.1, Checkpoints 2 and 4	Problems CL 2-107, CL 3-116, 4-9, 4-37, 4-54, and 4-86
CL 4-121.	a. $y=-3x-4$ b. $y=2x-\frac{7}{2}$ c. (a) y-intercept: (0, –4), slope: –3 (b) y-intercept: (0, –3.5), slope: 2	Lessons 2.1.4 and 3.2.2	Problems CL 3-117, 4-99, and 4-114

Problem	Solution	Need Help?	More Practice
CL 4-122.	b. $y=-2x+5$ and $y=x+1$ c. $\left(1\frac{1}{3},2\frac{1}{3}\right)$	Section 4.2 MN: 4.2.1, 4.2.2, and 4.2.3 LL: 4.2.5	Problem 4-40, 4-60, 4-71, 4-81, 4-98, and 4-111
CL 4-123.	a. $9x+15y=180$, $x+y=18$ b. 15 t-shirts, 3 sweatshirts	Chapter 4 MN: 4.2.3 LL: 4.2.5	Problems 4-25, 4-26, 4-38, 4-51, 4-82, and 4-104
CL 4-124.	a. $\frac{1}{9}$ b. $\frac{a^3}{b}$ c. y^4 d. 5×10^{-3}	Section 3.1	Problems CL 3-121, 4-11, 4-41, and 4-107
CL 4-125.	a. $2x^2+9x-35$ b. $5xy-35x$ c. $3x^3-13x^2+47x-77$	Lessons 3.1.3 and 3.2.3	Problems CL 3-114, 4-19, 4-64, and 4-102