page 5

1-4 Game: Solve That Equation

Solving Equations

This is a game for three students. Decide which student will be the host and which students will be the players. Your teacher will provide the host with the questions, answers, and scorecard.

Rules

Each player begins with 100 points. The host asks the players questions from the following categories.

- **Properties of Equality:** Players are asked to name the property of equality illustrated in the question.
- **Solve a Multi-Step Equation:** Players are given an equation requiring multiple steps to solve for x.
- ***Sometimes, Always,* or *Never:*** Players are given an equation and must determine whether the equation is *sometimes, always,* or *never* true.
- **Literal Equations:** Players are asked to solve a literal equation for a given variable.

Before a player receives a question, the host tells the player the category and the player must choose a "risk value" from 1 to 10. If the answer is correct, then the player earns the number of points risked. If the answer is incorrect, then the player loses the number of points risked.

Students take turns answering questions. Each question is asked only once. The host asks each player two questions from each category. The host keeps score on a scorecard.

The player with the most points after all questions have been answered wins!

See Teacher Instructions Page.

page 6

1-5 Puzzle: What's the Inequality?

Solving Inequalities

To solve this puzzle, each box must be filled in with a math symbol (x, $+$, $-$, $<$, $>$) or a digit from 0 to 9 to complete an inequality. The clues below give the solution to the inequality you complete. 1-Across has been done for you. The boldfaced "**4**" and "$>$" complete the inequality $4x > 4, x > 1$ (See clue below).

1 4	x	$>$	2 4		3 2	x	$<$	1	4 4
			x		x				x
	5 3	x	$+$	1	$<$	1	6 2		$>$
	9		3		8		$>$		2
	$<$		$<$				x		
7 1	1	x	$-$	2	8 x	$\geq$	$-$	1	
	3		3		$+$		1		
9 9	x	$>$	x	$+$	2		0		
					$\leq$				
		10 5	x	$-$	5	$>$	7	$+$	x

ACROSS

1. $x > 1$
3. $x < 7$ $2x < 14$
5. $x < \frac{11}{3}$ $3x + 1 < 12$
7. $x \geq -\frac{1}{9}$ $11x - 2x \geq -1$
9. $x > \frac{1}{4}$ $9x > x + 2$
10. $x > 3$ $5x - 5 > 7 + x$

DOWN

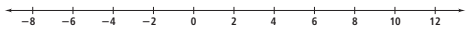
2. $x < -\frac{3}{7}$ $4x + 3 < -3x$
3. $x < 4$ $2x < 8$
4. $x > \frac{1}{2}$ $4x > 2$
5. $x > 3$ $39 < 13x$
6. $x < 12$ $2 > x - 10$
8. $x \leq 3$ $x + 2 \leq 5$

page 7

1-6 Activity: Rolling Out Inequalities

Absolute Value Equations and Inequalities

1. Roll a number cube. Plot the value of the roll on a number line.



2. Roll the number cube again. Using the same number line, plot two different points whose distances from the point in Step 1 are equal to the value of the roll.

3. Describe the points you plotted in Step 2 verbally.
"I plotted two points on the number line that are [circle one] (*exactly, greater than, less than*) a distance of ☐ units from ☐."

4. Describe the two points you plotted in Step 2 mathematically.
$|x - (\text{1st roll})| = (\text{2nd roll})$
$x - (\text{1st roll}) = (\text{2nd roll})$ or $x - (\text{1st roll}) = -(\text{2nd roll})$
$x - \square = \square$ or $x - \square = \square$
$x = \square$ or $x = \square$

5. Roll the number cube a third time. If it is an even number, draw a line segment connecting the points you plotted in Step 2. If it is an odd number, draw two rays on the number line that do not intersect, with endpoints at the points you plotted in Step 2.

6. Describe the points you graphed in Step 5 verbally.
"I plotted all points on the number line that are [circle one] (*exactly, greater than or equal to, less than or equal to*) a distance of ☐ units from ☐."

7. Describe the points you graphed in Step 5 mathematically. Refer to the setup in Step 4 for help.
Check students' work.

page 8

2-1 Activity: Real-Life Relations and Functions

Relations and Functions

This activity should be done in groups of 3 to 5 students, with each group completing the entire sheet.

Relations That Are Not Functions

Here is an ad for a roofing company from a telephone book. Discuss why this is not a function if:

- domain: roofing companies;
- range: telephone numbers.

Check students' work.

Acme Roofing Co.
(555) 314-1592
(555) 271-8281

Use the spaces below to explain why the following are not functions:

- **Domain:** teachers; **range:** students assigned to each teacher
  Answers may vary. Sample: Any teacher will have more than one student in class.
- **Domain:** all students; **range:** each student's biological parents
  Answers may vary. Sample: Any student has more than one biological parent.

Find two more relations that are not functions, including one that you encountered today. Think about sports, music, science, art, employment, and so on. Discuss how you can express these relations using ordered pairs, a mapping diagram, a table of values, and a graph.

1. Check students' work.
2. Check students' work.

Relations That Are Functions

Here is the cost for mailing a first-class letter at the post office. Discuss why this is a function if:

- domain: letter weight;
- range: mailing cost.

Check students' work.

First–Class Mail Letter Prices

Weight Up To	Price	Weight Up To	Price
1 oz	$0.42	3 oz	$0.76
2 oz	$0.59	3.5 oz	$0.93

Use the spaces below to explain why the following are functions:

- **Domain:** students; **range:** algebra teacher assigned to each student
  Answers may vary. Sample: Each student will have exactly one algebra teacher.
- **Domain:** all students; **range:** each student's biological mother
  Answers may vary. Sample: Each student will have exactly one biological mother.

Find two more relations that are functions, including one that you encountered today. Think about sports, music, science, art, employment, and so on. Discuss how you could express these functions using ordered pairs, a mapping diagram, a table of values, and a graph.

3. Check students' work.
4. Check students' work.

page 9

2-2 Puzzle: Constant of Variation

Direct Variation

Begin by answering the questions below. Write your simplified answers next to the exercise.

For Exercises 1–16, *y* varies directly with *x*. Find the constant of variation.

1. $y = -8x$ **−8**
2. $y = 2x$ **2**
3. $y + 3x = 0$ **−3**
4. $y - 13x = 0$ **13**
5. $9x - y = 0$ **9**
6. $x - y = 0$ **1**
7. $\frac{1}{7}y = x$ **7**
8. $\frac{1}{3}y = x$ **3**
9. $\frac{1}{2}y + x = 0$ **−2**
10. $\frac{1}{2}y - x = 0$ **2**
11. $y + x = 2x$ **1**
12. $y - x = -2x$ **−1**
13. $2y - 7x = y + 6x$ **13**
14. $3y + x = 2y - 3x$ **−4**
15. $2y - 5x = 7x$ **6**
16. $4y + 19x = y - 5x$ **−8**

For Exercises 17–23, *y* varies directly with *x*.

17. If $y = 12$ when $x = 6$, find x when $y = -2$. **−1**
18. If $y = 6$ when $x = -2$, find x when $y = -39$. **13**
19. If $y = 4$ when $x = 8$, find x when $y = \frac{3}{2}$. **3**
20. If $y = -7$ when $x = 4$, find x when $y = \frac{7}{2}$. **−2**
21. If $y = \frac{3}{5}$ when $x = \frac{1}{2}$, find x when $y = -\frac{18}{5}$. **−3**
22. If $y = 1.2$ when $x = 4$, find x when $y = 3.9$. **13**
23. If $y = 3.9$ when $x = 3$, find x when $y = -2.6$. **−2**

The answers correspond to letters as shown in the table below.

−1	1	−2	2	−3	3	−4	4	−5	5	−6	6	−7
O	E	T	H	A	S	L	V	U	J	D	Y	X
7	**−8**	**8**	**−9**	**9**	**−10**	**10**	**−11**	**11**	**−12**	**12**	**−13**	**13**
I	C	Q	P	G	R	M	B	K	W	Z	F	N

Decode each answer and place its corresponding letter in the appropriate space below. If your answers are correct, then you will uncover an important quote.

C	H	A	N	G	E		I	S		T	H	E
1	2	3	4	5	6		7	8		9	10	11
O	N	L	Y		C	O	N	S	T	A	N	T
12	13	14	15		16	17	18	19	20	21	22	23

Heraclitus
~ 535−475 BCE

page 10

TEACHER INSTRUCTIONS

2-3 Game: Risk and Reward

Linear Functions and Slope-Intercept Form

Provide the host with the following questions and answers.

	Vocabulary (Define)	Find the Slope of the Line	Find the *y*-Intercept of the Line	Express in Slope-Intercept Form	Review
10 pts	*y*-intercept of a line **See below.**	$y = 2x + 1$ **Answer: 2**	$y = 4x - 5$ **Answer: (0, −5)**	$m = -5$ and the *y*-intercept is 1 **Answer: $y = -5x + 1$**	Solve $3x + 2 = 5x - 6$. **Answer: $x = 4$**
20 pts	*x*-intercept of a line **See below.**	$y + 3x = 5$ **Answer: −3**	through (1, 3) and (0, 4) **Answer: (0, 4)**	$m = 0$ and the *y*-intercept is −4 **Answer: $y = -4$**	Solve $\lvert x - 1\rvert < 3$. **Answer: $-2 < x < 4$**
30 pts	linear function **See below.**	$2y - 5x = 1$ **Answer: $\frac{5}{2}$**	$3x - 2y = -6$ **Answer: (0, 3)**	$9x + 6y = -18$ **Answer: $y = -\frac{3}{2}x - 3$**	Solve $\lvert x + 2\rvert \geq 2$. **Answer: $x \leq -4$ or $x \geq 0$**
40 pts	slope **See below.**	$\frac{2}{3}x = \frac{3}{4}y - 3$ **Answer: $\frac{8}{9}$**	$x = 3y + \frac{2}{7}$ **Answer: $\left(0, -\frac{2}{21}\right)$**	$0.2x - 0.6y = 1.2$ **Answer: $y = \frac{1}{3}x - 2$**	Solve $r = \frac{s}{2\pi h}$ for h. **Answer: $h = \frac{s}{2\pi r}$**
50 pts	slope-intercept form **See below.**	through $\left(\frac{2}{5}, -\frac{2}{3}\right)$ and $\left(-\frac{1}{2}, -\frac{3}{4}\right)$ **Answer: $\frac{5}{54}$**	$-\frac{2}{3}x - \frac{3}{4}y - 3 = \frac{1}{4}$ **Answer: $\left(0, -\frac{13}{3}\right)$**	$\frac{1}{2}x = \frac{5}{6}y + \frac{3}{4}$ **Answer: $y = \frac{3}{5}x - \frac{9}{10}$**	Evaluate $f(x) = -9x + 2$ for $x = -\frac{2}{3}$. **Answer: 8**

Row 1. the point at which the line crosses the *y*-axis
Row 2. the point at which the line crosses the *x*-axis
Row 3. a function whose graph is a line
Row 4. the ratio of the vertical change to the horizontal change between points
Row 5. $y = mx + b$, where m = slope and $(0, b)$ = *y*-intercept

page 11

2-3 Game: Risk and Reward

Linear Functions and Slope-Intercept Form

This is a game for three students. Select a host and two players.

Host: Your teacher will provide you with a separate sheet of questions and answers. Use this sheet to keep track of the score. Play along if you like.

Players: Below is the game board showing the categories and point values. Use it to keep track of which questions are still available and your score.

Rules: Decide which player goes first. When it is your turn:

- Select a category. The host will select the question with the lowest available point value.
- If you answer correctly within the time assigned by your teacher, you earn the points for that question. Your turn continues, and you select another category.
- If you answer incorrectly, you lose that number of points and your opponent takes over. In addition, your opponent has 10 seconds to provide the correct answer and earn the points for any questions you miss. Your group or your teacher can decide to change the response time if needed.
- Play continues in this manner until all the questions have been used. The player with the highest point total wins. **See Teacher Instructions page.**

	Vocabulary (Define)	Find the Slope of the Line	Find the *y*-Intercept of the Line	Express in Slope-Intercept Form	Review
10 pts	*y*-intercept of a line	$y = 2x + 1$	$y = 4x - 5$	$m = -5$ and the *y*-intercept is 1	Solve $3x + 2 = 5x - 6$.
20 pts	*x*-intercept of a line	$y + 3x = 5$	through (1, 3) and (0, 4)	$m = 0$ and the *y*-intercept is −4	Solve $\lvert x - 1\rvert < 3$.
30 pts	linear function	$2y - 5x = 1$	$3x - 2y = -6$	$9x + 6y = -18$	Solve $\lvert x + 2\rvert \geq 2$.
40 pts	slope	$\frac{2}{3}x = \frac{3}{4}y - 3$	$x = 3y + \frac{2}{7}$	$0.2x - 0.6y = 1.2$	Solve $r = \frac{s}{2\pi h}$ for h.
50 pts	slope-intercept form	through $\left(\frac{2}{5}, -\frac{2}{3}\right)$ and $\left(-\frac{1}{2}, -\frac{3}{4}\right)$	$-\frac{2}{3}x - \frac{3}{4}y - 3 = \frac{1}{4}$	$\frac{1}{2}x = \frac{5}{6}y + \frac{3}{4}$	Evaluate $f(x) = -9x + 2$ for $x = -\frac{2}{3}$.

page 12

2-4 Game: Gridlock

More About Linear Equations

You will need two number cubes for this game.

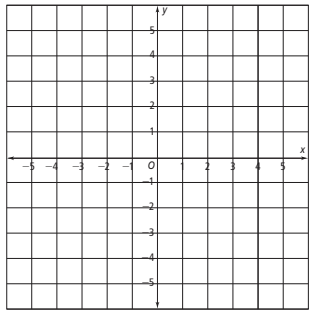
This is a game for two students. Players attempt to get four collinear marks on the grid below. The line may be horizontal, vertical, or diagonal. The player must then use skills learned from the lesson to give the equation of the line.

Rules: The player rolling the higher number on a number cube goes first. When it is your turn:

- Roll both number cubes. Use these numbers in either order to form an ordered pair.
- The numbers can be used as either positive or negative values.
- The number 6 is "wild." It can be used as any other number.
- Place your unique mark (for example, X, O) on the point determined by your ordered pair.
- If all possible points are already occupied, you lose your turn.
- Take turns until someone gets four collinear marks. When this happens:
  - Call out "Gridlock!"
  - You now have two minutes to write the equation of the line passing through the four points, *in standard form*.
  - Upon verification by your opponent or teacher, you win! If your equation is incorrect, play continues and you must use a different line to win.

Example: You roll a 1 and a 4. If available, you can place a marker on one of the following: (1, 4); (4, 1); (−1, 4); (4, −1); (1, −4); (−4, 1); (−1, −4); (−4, −1)

Check students' work.



page 13

2-5 Activity: Making a Scatter Plot

Using Linear Models

This activity works best for groups of seven to nine students. You will make scatter plots showing the relationship between variable quantities. You will need a ruler, a graphing calculator, and a sheet of graph paper.

1. With the ruler, carefully measure the length of the right index finger and the right foot (with shoe removed) of each group member. Use the table to record your data. Your teacher will determine whether to use inches or centimeters.

	1	2	3	4	5	6	7	8	9
Finger Length	Check students' work.								
Foot Length									

2. Use the graph paper to make a scatter plot of the collected data. Record the finger length values on the horizontal axis and foot length values on the vertical axis.

   Check students' work.

3. From your scatter plot, is there a correlation between foot length and index finger length? If so, is it positive or negative?

   yes; positive

4. Use a graphing calculator to find the line of best fit. Write the equation below and then carefully plot the line on your scatter plot.

   Check students' work.

5. Ask your teacher for his or her index finger length. According to your model, what do you expect his or her foot length to be? Show your calculation below.

   Teacher's Finger Length =

   Check students' work.

6. Plot a point representing the prediction from Step 5 on the scatter plot. Does it lie on the line of best fit?

   Check students' work.

7. Ask your teacher for his or her actual foot length. Plot your teacher's actual measurement on your scatter plot. Numerically, how accurate is your prediction?

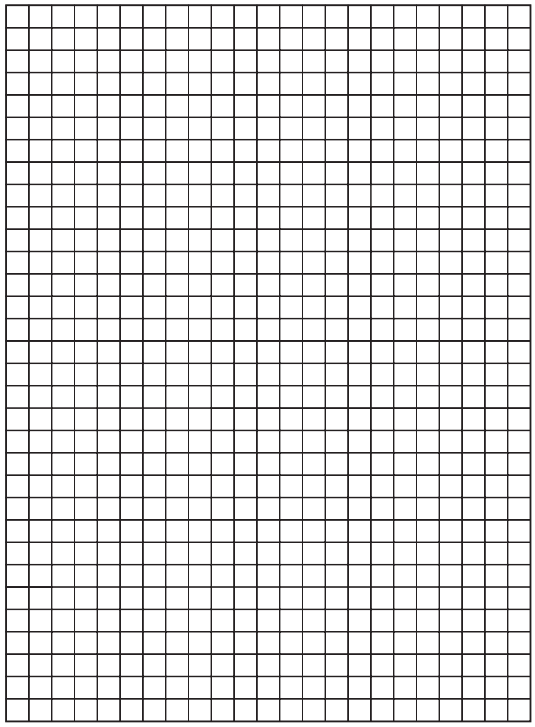
   Teacher's Foot Length =

   Check students' work.

page 14

2-5 Activity: Making a Scatter Plot

Using Linear Models



page 15

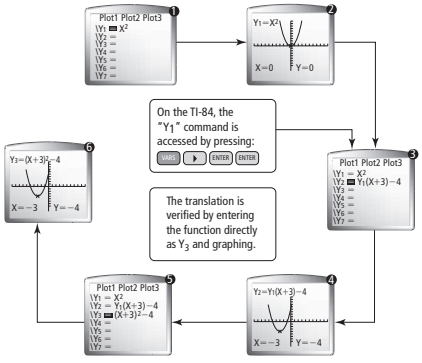
2-6 Activity: Graphing Transformations

Families of Functions

This activity is best done alone or with a partner. Use your graphing calculator to transform functions.

Background

Transformations can be applied to any function. In the series of screenshots below, the function $f(x) = x^2$ is entered into a calculator as Y_1 (❶) and graphed (❷). Then the function Y_2 is made by translating Y_1 to the left 3 units and down 4 units (❸) and graphed (❹). Finally the transformation is verified by entering the function directly as Y_3 (❺) and graphed (❻).



Enter the function $f(x) = x^2$ into your calculator as Y_1. Perform the sequence of steps above for the following transformations. In the space provided, write Y_2 and Y_3 exactly as you entered them in the calculator.

1. 2 units right and 5 units down — $Y_2 = Y_1(x - 2) - 5$; $Y_3 = (x - 2)^2 - 5$
2. 1 unit right and y-axis reflection — $Y_2 = -Y_1(x - 1)$; $Y_3 = -(x - 1)^2$
3. 3 units up and vertical compression by a factor of $\frac{1}{2}$ — $Y_2 = \frac{1}{2}(Y_1(x) + 3)$; $Y_3 = \frac{1}{2}(x^2 + 3)$
4. 4 units left, x-axis reflection, and vertical stretching by a factor of 2 — $Y_2 = -2Y_1(x + 4)$; $Y_3 = -2(x + 4)^2$

page 16

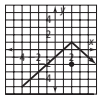
2-7 Game: Bounce and Hit

Absolute Value Functions and Graphs

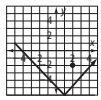
This is a game for two players. Each player secretly places a point, or *flag*, on the grid at the bottom of the page. Then players take turns trying to hit the opponent's flag with the graphs of absolute value functions. Your teacher will decide if a graphing calculator can be used.

Rules: The flag must have integer coordinates and be on the interior of the grid; neither coordinate of the flag can be -5 or 5. *Do not* allow your opponent to see your flag! With a coin flip, decide which player begins. When it is your turn:

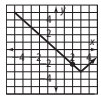
- Try to find an absolute value function whose graph goes through your opponent's flag. The graph of the function must have its vertex on the grid. Announce it to your opponent.
- You want the vertex of the function to have an x-coordinate smaller than the flag's; that is, the vertex must be to the *left* of the flag. Think of the graph as the path of a ball bouncing from left to right—the hit must occur *after* the bounce.
- Your opponent checks your function and announces one of the four possibilities:



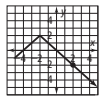
Misses Above (vertex *above* point; *no* hit)



Misses Below (vertex *below* point; *no* hit)

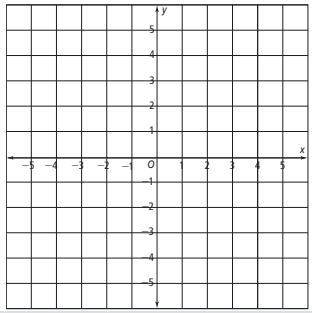


Hits On The Fly (vertex to *right* of point; *no* hit)



Hits On The Bounce (vertex to *left* of point; hit!)

- Take turns until someone hits the opponent's flag "on the bounce." Check students' work.



page 17

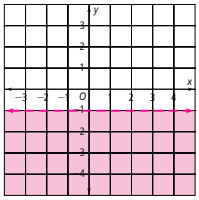
2-8 Puzzle: Identify the Inequality

Two-Variable Inequalities

Four different inequalities are described below. Write each inequality in the space provided and graph it on the grid.

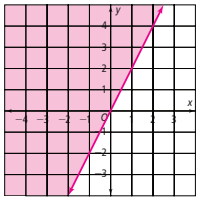
1. **a.** I am not in the second quadrant.
   b. One point on my border is $(-2, -1)$. It is not one of my solutions.
   c. My border is a horizontal line.

   $y < -1$



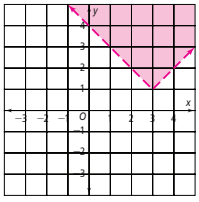
2. **a.** I am not in the fourth quadrant.
   b. $(0, 0)$ is one of my solutions and on my border.
   c. My border is the graph of a line.
   d. One point on my border is $(2, 4)$, which is also one of my solutions.

   $y \geq 2x$



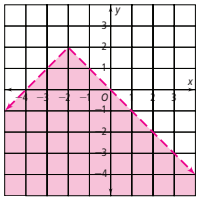
3. **a.** I am not in the third quadrant.
   b. My lowest point is $(3, 1)$.
   c. My border is the graph of an absolute value function.
   d. One point on my border is $(0, 4)$. It is not one of my solutions.

   $y > |x - 3| + 1$



4. **a.** I am not in the first quadrant.
   b. My highest point is $(-2, 2)$.
   c. My border is the graph of an absolute value function.
   d. $(0, 0)$ is on my border but is not one of my solutions.

   $y < -|x + 2| + 2$

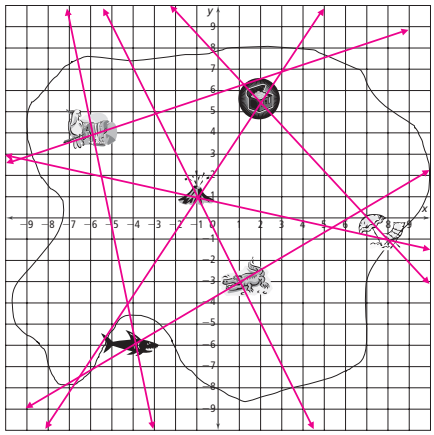


page 18

3-1 Puzzle: X Marks the Spot

Solving Systems Using Tables and Graphs

René "Axes" Descartes was a mathematical pirate. He subtracted poor crewmates, added new ones, multiplied his treasure, and divided the goods. Upon arriving at Treasure Island, he would give each of his crewmates a system of equations whose solution, he claimed, was the location of the treasure. Below is a map of the island and the systems he gave to each of his crewmates. Graph each of his crewmates' systems, and list the solution along with the location the crewmates were actually sent.



Galois, the dueler: $\begin{cases} y = -5x - 26 \\ 5y = 3x - 18 \end{cases}$
(−4, −6); shark

Fermat, the marginal: $\begin{cases} 2x + y = -1 \\ 3x - 2y = -5 \end{cases}$
(−1, 1); volcano

Pascal, the lamb: $\begin{cases} 2x + 9y = 7 \\ 13x + 12y = 92 \end{cases}$
(8, −1); beach

Poisson, the distributer: $\begin{cases} y = \frac{13}{12}x + \frac{23}{3} \\ y = \frac{3}{2}x + \frac{5}{2} \end{cases}$
(2, 5.5); treasure chest

Lagrange, the multiplier: $\begin{cases} 2x = -y - 1 \\ 5y - 3x = -18 \end{cases}$
(1, −3); alligator

Poincaré, the conjecturer: $\begin{cases} 2y = -10x - 52 \\ 3y - x = 18 \end{cases}$
(−6, 4); waterfall

page 19

TEACHER INSTRUCTIONS

3-2 Game: Risk and Reward

Solving Systems Algebraically

Provide the host with the following questions and answers for the given categories and point values.

Vocabulary

Points	Question: What is . . .	Answer
10	a system of equations?	when two or more equations are considered simultaneously
20	a solution of a system?	an ordered pair that is a solution of all equations in a system
30	an equivalent system?	systems that have the same solutions
40	a substitution method?	solving one equation for a variable, substituting it in the other equation, and solving for the remaining variable
50	an elimination method?	multiplying equations so like terms have opposite coefficients, adding the equations, and solving the result

Substitution

Points	System	Answer
10	$\begin{cases} y = 3x - 1 \\ 2x + y = 9 \end{cases}$	(2, 5)
20	$\begin{cases} 3y - 2x = 4 \\ x = 3 - y \end{cases}$	(1, 2)
30	$\begin{cases} 2x - y = -8 \\ 3x + 2y = -5 \end{cases}$	(−3, 2)
40	$\begin{cases} 3x - 6y = 30 \\ 2y = x + 6 \end{cases}$	No solution
50	$\begin{cases} 2a + 4b = -5 \\ 3a - 5b = 9 \end{cases}$	(0.5, −1.5)

Elimination

Points	System	Answer
10	$\begin{cases} x + 3y = -9 \\ -x + y = -7 \end{cases}$	(3, −4)
20	$\begin{cases} 2x + 6y = -12 \\ 3x - 2y = 4 \end{cases}$	(0, −2)
30	$\begin{cases} 2x + y = 2 \\ 3y = -6x + 6 \end{cases}$	Infinite solutions
40	$\begin{cases} 5x + 2y = 2 \\ 3x + 5y = 24 \end{cases}$	(−2, 6)
50	$\begin{cases} 0.7x + 2y = 1.61 \\ 2x - 0.3y = 0.39 \end{cases}$	(0.3, 0.7)

Application

Points	Question	Answer
10	The sum of two numbers is 12, and their difference is 6. What are the two numbers?	3, 9
20	Twice a boy's age is 9 more than his brother's. The average of their ages is 12. How old are they?	11, 13
30	A girl has $6 in 36 coins (all quarters and nickels). How many of each does she have?	21 quarters, 15 nickels
40	A girl's cell phone costs $10 per month plus 10¢ per minute. Her friend's costs $3 per month plus 15¢ per minute. For what amount of talking time will the cost of these plans be the same?	140 min
50	How many liters of a 60% salt mixture must be added to 2 liters of a 30% salt mixture to yield a 48% mixture?	3 l

page 20

3-2 Game: Risk and Reward

Solving Systems Algebraically

This is a game for three students. One student is the host and the other two are players.

Your teacher will provide the host with a sheet of questions and answers. Use the scorecard below to record the score and keep track of the questions in each category that have been asked.

Rules

- Decide which player goes first. Players alternate turns.
- During a turn, a player selects a category from the list below. The host will ask the available question with the lowest point value. There are five questions in each of the four categories worth 10, 20, 30, 40, or 50 points, for a total of 20 questions.
- If the player answers correctly within a reasonable amount of time, the player earns the point value of that question.
- If the player answers incorrectly, the player loses the point value and the other player has the option of answering the question to earn or lose the point value.
- Play continues until all the questions have been used. The player with the highest point total wins.

Categories

- **Vocabulary** Provide a definition for a given vocabulary.
- **Substitution** Solve a system of equations using the substitution method.
- **Elimination** Solve a system of equations using the elimination method.
- **Application** Solve an application problem using a system of equations.

See Teacher Instructions page.

Points	Category	Player 1	Player 2
	Total		