LESSON 4

Expressions and Equations

Problem Solving with Rates of Change

As students increase their understanding of slope, *y*-intercept, and rate of change, it is important for them to test their knowledge with practical problems—those that they may encounter in the real world. This activity incorporates all of these concepts with a realistic problem about movie rentals.

Objective

Graph lines using rates of change and determine the meaning of the point of intersection.

Common Core State Standards

- **8.EE.8a** Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *What is special about the y-intercept for Store B?*
- **Ask:** *On what day would Sara and Matt pay the same amount at either store? How can you tell from looking at the graphs?*
- **Ask:** *Suppose Sara and Matt wanted to rent the movie and to spend the least amount of money possible. What should they do? Explain.*

Solve It

Reread the problem with students. Have students create a table of values that will represent the situation as stated in the story problem. Ask students to graph the values to determine the slopes and *y*-intercepts. Once their lines are formed, have them compare to see which store is the better value at $y = 10$.

More Ideas

For another way to teach about rates of change—

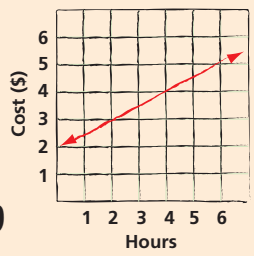
- Have students compare rental costs for various goods at local stores. Have them create a table of values and graph them on their XY Coordinate Pegboards. **Ask:** *Which stores offer better deals? Do some stores have better deals under certain conditions (as in the story problem on page 31)?*

Formative Assessment

Have students try the following problem.

Jim and Marty want to rent mountain bikes. The graphs show the pricing policy of four different outfitters. Which of the following graphs represents the best deal if they plan to use the bikes for 5 hours?

A.



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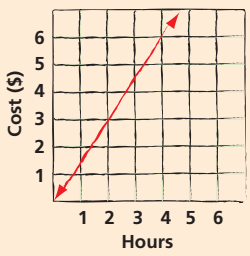

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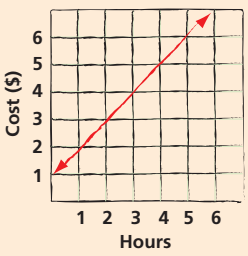

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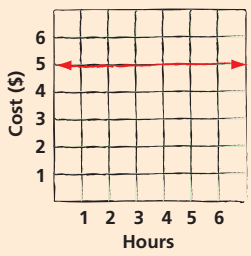
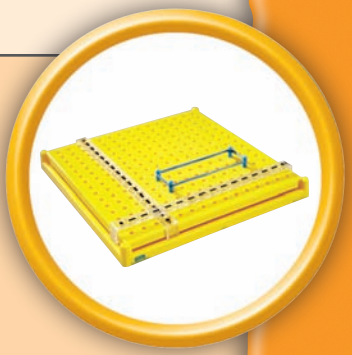




Try It! 40 minutes | Pairs

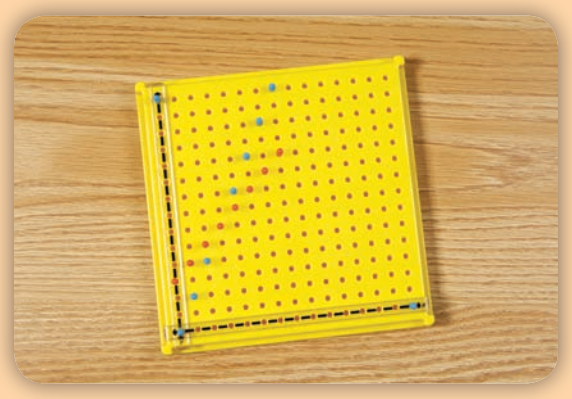
Here is a problem about rates of change.

Sara and Matt are checking out movie rental stores for the best deal. Store A charges an initial fee of $3 and then $1 for each day the movie is rented. Store B charges no initial fee but charges $2 per day for rental. Sara and Matt want to keep the movie as long as possible, but they have only $10 to spend. Which store should they rent from?

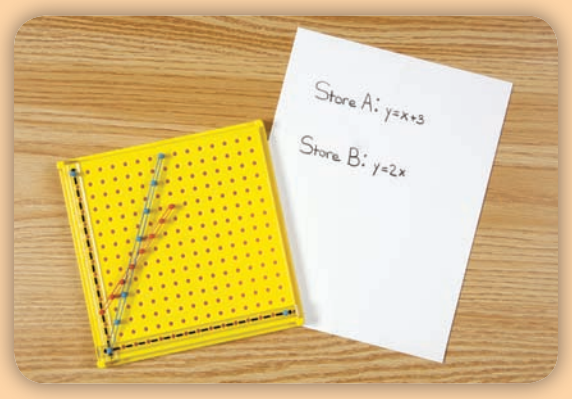
Introduce the problem. Then have students do the activity to solve the problem. Distribute the materials.

Materials

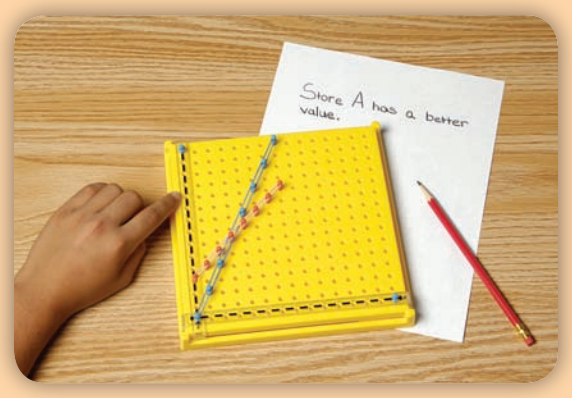
- XY Coordinate Pegboard
- paper (2 sheets per pair)
- pencils (1 per pair)



1. Have students create a table of values for the two stores, listing seven values for each store, starting with $x = 1$ (for Day 1). Ask students to plot the values, using red pegs for Store A and the blue pegs for Store B.



2. Have students use rubber bands to form the two lines. **Ask:** *What is the slope of each line? What is the y-intercept?* Have students write the equation for each line in the form of $y = mx + b$ on a sheet of paper. Elicit from them that x is the number of days Sara and Matt can rent the movie and y is the total cost of the rental.



3. Have students examine the lines to determine which store offers a better deal if Sara and Matt want to keep the movie for as long as possible, but have only $10 to spend.

⚠ Look Out!

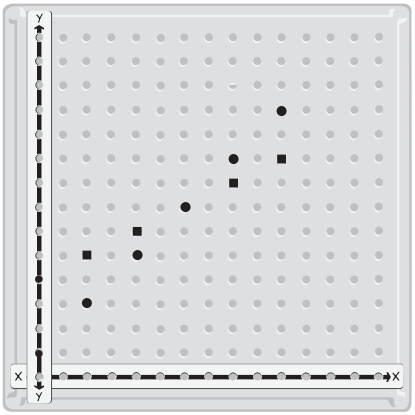
Some students may assume that the smaller the value of x, the better the deal they'll get. They need to understand that x represents number of days, so, in the context of the story problem (Sara and Matt want to keep the movie as long as possible), more days is a better deal.

Watch for students who think that both lines should go through the origin of the graph. Remind them that one of the stores charges an initial fee of $3, which means that the y-intercept is 3.

Answer Key

Use an XY Coordinate Pegboard to plot the ordered pairs shown. Draw each line and write its equation in the form $y = mx + b$. At what point do the lines intersect? (Check students' work.)

1.



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

$y =$ $x + 1$

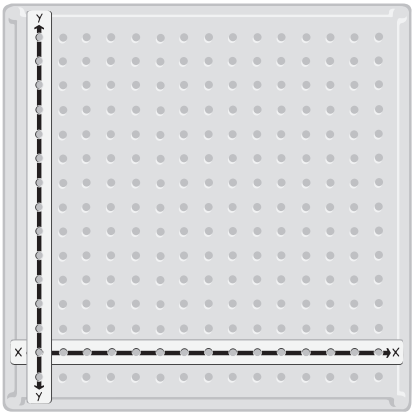
point of intersection: (6, 7)

Using an XY Coordinate Pegboard, model the lines for the given equations. Name the slope and y-intercept for each line. Name the point of intersection of the lines.

(Check students' models.)

2. $y = 3x$

$y = x + 6$



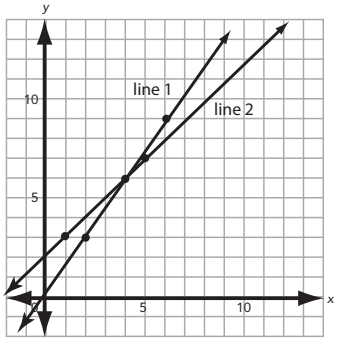
$m =$ 3, $b =$ 0

$m =$ 1, $b =$ 6

point of intersection: (3, 9)

Name the slope and y-intercept of each line graphed. Name the point of intersection.

3.

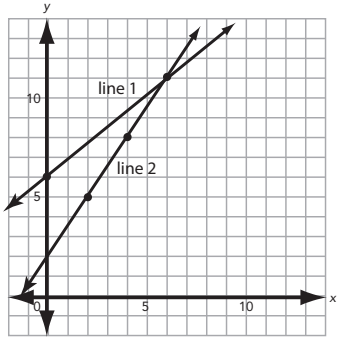


point of intersection: (4, 6)

line 1: $m =$ $\frac{3}{2}$, $b =$ 0

line 2: $m =$ 1, $b =$ 2

4.



point of intersection: (6, 11)

line 1: $m =$ $\frac{5}{6}$, $b =$ 6

line 2: $m =$ $\frac{3}{2}$, $b =$ 2

Answer Key

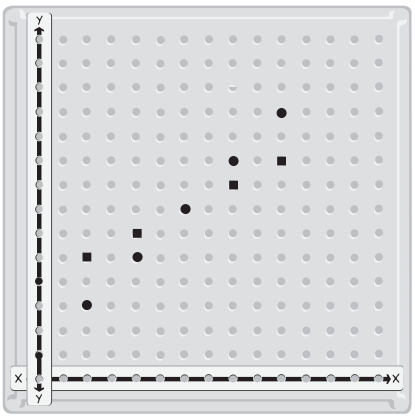
Challenge! What do you know about the ordered pair for the point of intersection of two lines in terms of their equations? What might it mean if the lines are parallel? Explain.

Challenge: (Sample) The ordered pair can be substituted into each equation and it will make a true statement. When lines are parallel, there is no ordered pair that will make both statements (equations) true.

Name _____

Use an XY Coordinate Pegboard to plot the ordered pairs shown. Draw each line and write its equation in the form $y = mx + b$. At what point do the lines intersect?

1.



$y =$ _____

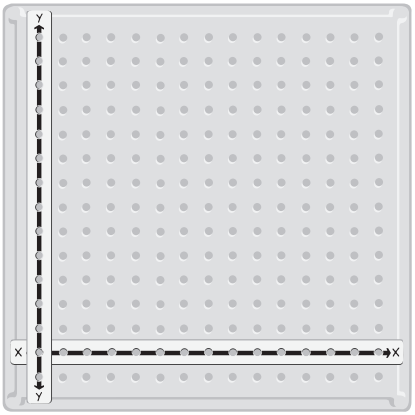
$y =$ _____

point of intersection: _____

Using an XY Coordinate Pegboard, model the lines for the given equations. Name the slope and *y*-intercept for each line. Name the point of intersection of the lines.

2. $y = 3x$

$y = x + 6$



$m =$ _____, $b =$ _____

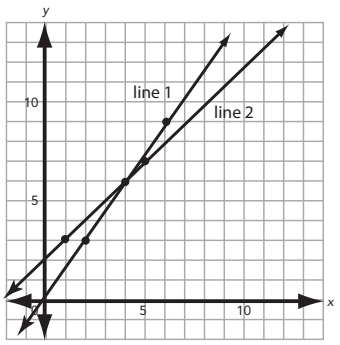
$m =$ _____, $b =$ _____

point of intersection:

_____

Name the slope and *y*-intercept of each line graphed. Name the point of intersection.

3.



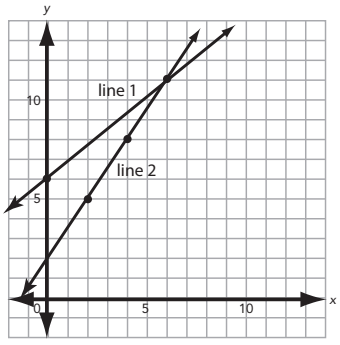
point of intersection:

_____

line 1: $m =$ _____, $b =$ _____

line 2: $m =$ _____, $b =$ _____

4.



point of intersection:

_____

line 1: $m =$ _____, $b =$ _____

line 2: $m =$ _____, $b =$ _____

Name _____

Challenge! What do you know about the ordered pair for the point of intersection of two lines in terms of their equations? What might it mean if the lines are parallel? Explain.