Activity 4: Cycling

Objectives: The student will be able to:

- Construct function rules and graphs using unit rates and starting points.
- Solve related linear equations.

Materials: Graphing calculator, 1" grid paper, markers, peel-and-stick dots

Procedure:

1. Start by having two students walk next to each other in a straight line to simulate Daryl's and Rebecca's cycling in Activity 1.1.

2. Lead students to mark the number line in Activity 1.1, Exercise 1. Possible questions include:
   - Where do Rebecca and Daryl start the course? (At distance 0)
   - If Rebecca averages about 10 mph, about how far will she go in one hour? (10 miles)
   - After one hour, how far will Rebecca be from the beginning of the course? (10 miles)
   - If Daryl averages about 8 mph, about how far will he go in one hour? (8 miles)
   - After one hour, how far will Daryl be from the beginning of the course? (8 miles)

3. As a whole group, complete the "Mile Marker" column in the table in Activity 1.1, Exercise 2 and answer parts *a* and *b*. Then ask students questions to fill in the process column and write sentences and equations. These questions should be answered from the number line and table.

4. As a whole group, label the axes on the graphs of Activity 1.1, Exercise 3. Have students plot each point from the table, and label the point with an ordered pair. After they have plotted the points, answer the questions as a whole group.

5. Complete Activity 1.1, Exercise 4. Ask students what information they need to write the function rule (starting point and rate). Discuss what the starting point for each line is. Discuss how to find the rate from the equation. Draw triangles or steps on the line to demonstrate the change in distance over one second. For example, after one hour, cyclist 1 has gone fifteen miles. Have students graph the equations on their calculators and compare with those in the exercise. You want students to notice that the larger the coefficient of *H*, the steeper the line.

6. Begin Activity 1.2 like Activity 1.1 with two students simulating the walk. Question all students about where the bicycle riders should be after each hour.

7. Have students explore Activity 1.2 in small groups. The remaining parts may be assigned for homework. In any case, have one group present Exercise 2. Have another make the graph in Exercise 3 on large grid paper with peel-and-stick dots. They can draw the line with markers or connect the dots with string or yarn. Have them label the lines with their function rule and indicate the answers to the questions on the grid. If time allows, have all groups present Exercise 3 in this manner. For Exercise 4, assign groups that have not presented a line for which to present the function rule and check on the calculator.

8. Begin Activity 1.3 in a similar manner as the other activities. This time ask for two students to walk the graph, two to mark their positions on the number line, and another to stand at the end of the course. Try to include students that have not participated in sometime. Assign each person marking the number line a person of which to keep track. Show the other student where to stand to indicate the end of the course. Discuss with the walkers how they should walk the course. Then go through the simulation of the walks. Discuss.

9. Have students complete Activity 1.3 with their groups. Then have students number off by the number of groups. For example, if there are six groups, students would number off by six. Then have students regroup by number, move to form a group, and discuss Activity 1.3. Encourage discussion. If there are different answers within the new groups, have them check using the calculator and debate whose answer is most correct.

10. On Activity 1.4, Exercise 1, show students how to choose x-values for the table. Point out that the x-values need to be on the graph. Then show them how to find the corresponding y-value for one x-value. Next pair groups. Have one group complete the first table and graph those points. Have the other group complete the second table and graph those points. If possible, have students use large grid paper, markers, and peel-and-stick dots to build the graphs. Then the groups can answer the questions together on the graph. They should also label the axes according to the situation they make up. Ask a group to volunteer to present its work.

11. Students can complete Activity 1.4, Exercise 2 in small groups. Ask students to share creative ideas for the situation. If time allows, ask

each group to share its answer to one part of the exercise. Involve as many groups as possible.

Extensions: Use graphing calculators to find the points of intersection in Activity 1.3.

Graph the equations parametrically using a graphing calculator. For example, recall the situation in Activity 1.1 where Rebecca and Daryl are training on a 40-mile course, Rebecca averages about 10 mph, and Daryl averages about 8 mph. Graphing parametrically creates a "picture" of their bike ride. To use parametric mode to graph a “picture” of their bike rides on the course use the following equations:

1st Cyclist: X=1, Y=10T

2nd Cyclist: X=2, Y=8T

Activity 1.1:

2a. 4 hours
 b. 5 hours
 c. $R = 10H$
 d. $D = 8H$

3a. At 3 hours, Rebecca has gone 30 miles.
 b. Rebecca's line
 c. 4 hours
 d. At 2.5 hours, Daryl has gone 20 miles.
 e. Daryl
 f. 5 hours

4. Cyclist 1: $D = 15H$, Cyclist 2: $D = 10H$

Activity 1.2:

2a. 4 hours
 b. 4 hours and 15 minutes or 4.25 hours
 c. $R = 10H$
 d. $D = 6 + 8H$

3a. Daryl's
 b. 4 hours and 15 minutes or 4.25 hours
 c. They are in the same place at 3 hours because the lines intersect there. They are both at mile marker 30.
 d. $10H = 6 + 8H$; This equation describes the H-coordinate of the point where the two lines intersect.

4. Cyclist 1: $D = 10H$; Cyclist 2: $D = 10 + 10H$; Cyclist 3: $D = 20 + 10H$

Activity 1.3

1a. between 3 and 4 hours
 b. between 4 and 5 hours
 c. $R = 11H$
 d. $D = 40 - 9H$

2a. They are in the same place at 2 hours because the lines intersect there. They are both at mile marker 22.
b. $11H = 40 - 9H$; This equation describes the H-coordinate of the point where the two lines intersect.

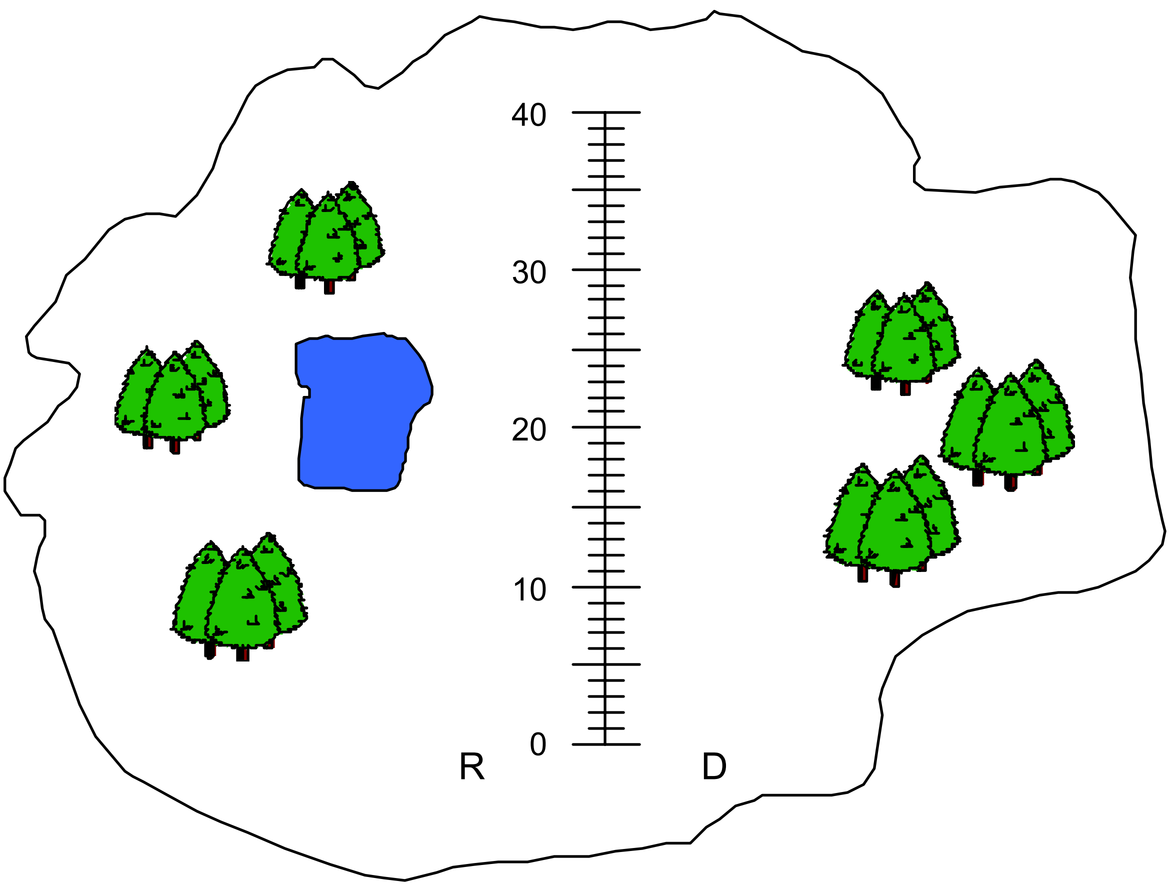
Activity 1.4

1b. (2, 35)
 d. $45 - 5H = 5 + 15H$

2a. Line 1: $y = 15 + 10x$; Line 2: $y = 30 - 5x$
 b. (1, 25)
 d. $15 + 10H = 30 - 5H$

Rebecca and Daryl begin cross-country cycling as a hobby and train on a 40-mile course. At first, Rebecca averages about 10 mph, and Daryl averages about 8 mph.

1. Mark the number line to show Rebecca's and Daryl's distances from the beginning of the course after each hour.



2. Complete the tables to show Rebecca's and Daryl's distances from the beginning of the course after each hour.

REBECCA		
INPUT	PROCESS	OUTPUT
Hours		Mile Marker
0		
1		
2		
3		
4		
5		
H		R

DARYL		
INPUT	PROCESS	OUTPUT
Hours		Mile Marker
0		
1		
2		
3		
4		
5		
H		D

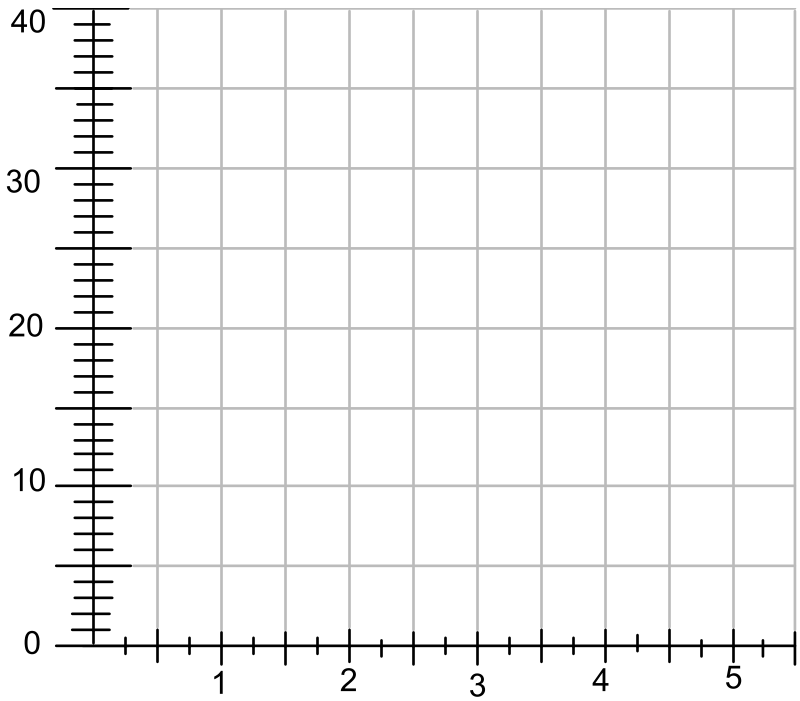
a. How long does it take Rebecca to finish the 40-mile course?

b. How long does it take Daryl to finish the 40-mile course?

c. Use the process column in the table to write a sentence and a function rule describing the relationship between Rebecca's distance from the beginning of the course and elapsed time.

d. Use the process column in the table to write a sentence and a function rule describing the relationship between Daryl's distance from the beginning of the course and elapsed time.

3. Label the axes, plot the points from both tables in Exercise 2, and label each point with an ordered pair.



a. What does the ordered pair (3, 30) mean in this problem?

b. On which line would you find the solution to the equation $40 = 10H$?

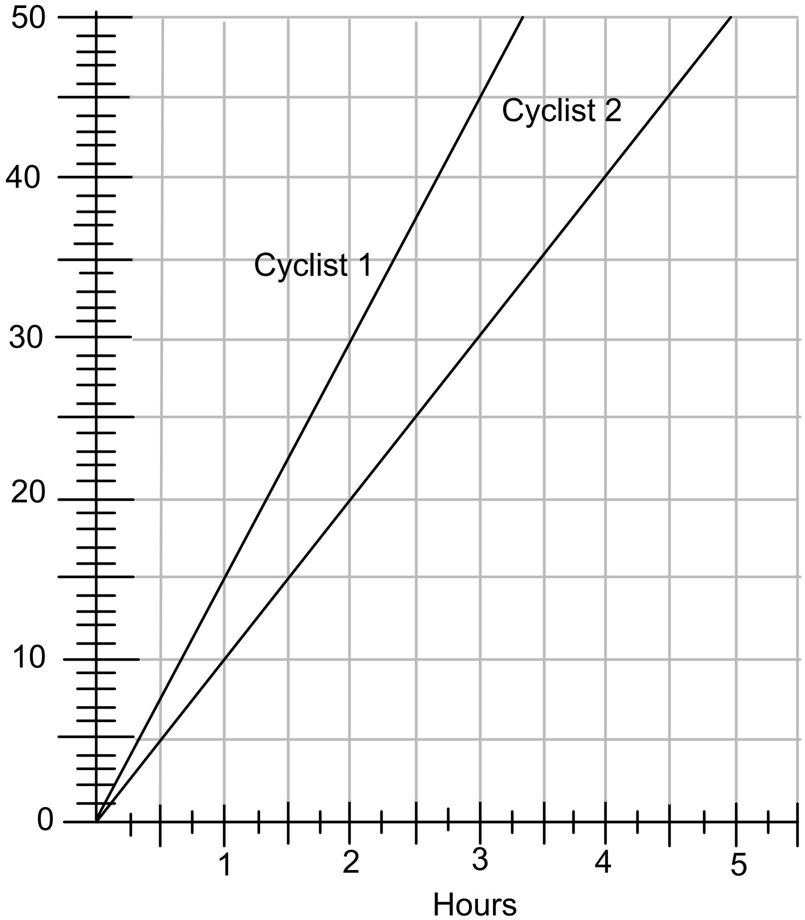
c. What is the solution to $40 = 10H$?

d. What does the ordered pair (2.5, 20) mean in this problem?

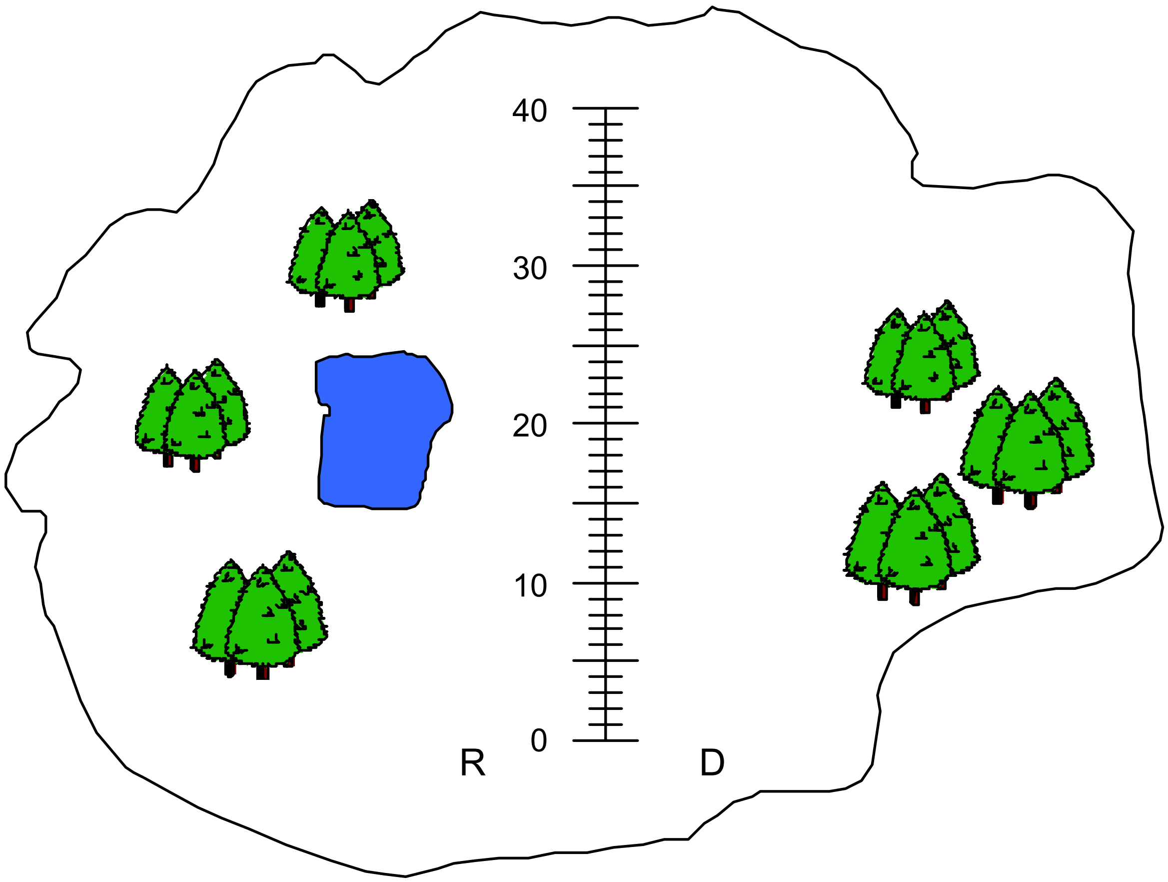
e. On which line would you find the solution to the equation $40 = 8H$?

f. What is the solution to $40 = 8H$?

4. The graph below shows the location of two cyclists on a fifty-mile training course. Write a function rule describing the relationship between distance from the beginning of the course and elapsed time for each cyclist. Then use your graphing calculator to check your rules by graphing them together.



1. Suppose Rebecca, who averages 10 mph, decides to give Daryl, who averages 8 mph, a head start of six miles on the bike course. Mark the number line to show where they are at each hour.



2. Complete the tables to show where they are at each hour.

REBECCA		
INPUT	PROCESS	OUTPUT
Hours		Mile Marker
0		
1		
2		
3		
4		
5		
H		R

DARYL		
INPUT	PROCESS	OUTPUT
Hours		Mile Marker
0		
1		
2		
3		
4		
5		
H		D

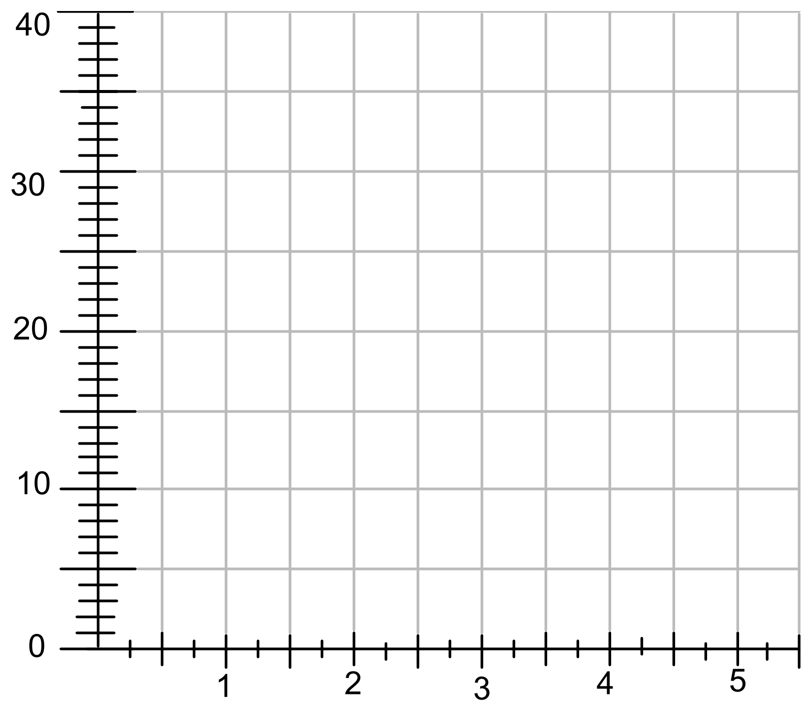
a. How long does it take Rebecca to complete the 40-mile course?

b. How long does it take Daryl to complete the 40-mile course?

c. Use the process column in the "Rebecca" table to write a sentence and a function rule for Rebecca's distance from the beginning of the course over time.

d. Use the process column in the "Daryl" table to write a sentence and a function rule for Daryl's distance from the beginning of the course over time.

3. Label the axes, plot the points from both tables in Exercise 2, and label each point with an ordered pair.



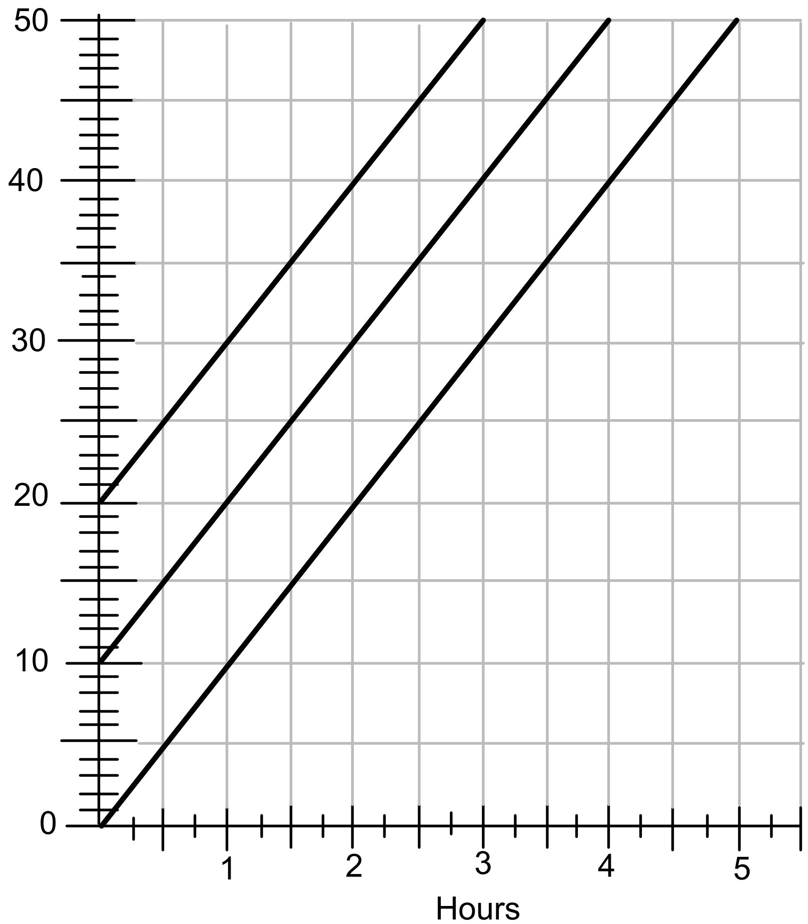
a. On which line would you find the solution to the equation $40 = 6 + 8H$?

b. What is the solution to $40 = 6 + 8H$?

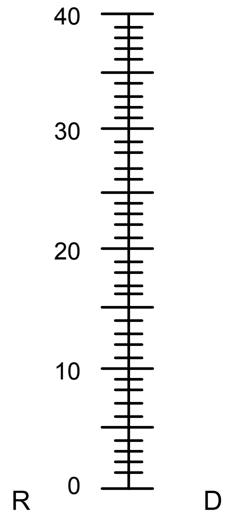
c. When are Rebecca and Daryl at the same place on the course? How can you tell from the graph?

d. Write an equation to determine how long it takes for Rebecca and Daryl to be at the same place on the course. What does this equation represent in the graph?

4. The graph below shows three cyclists on a 50-mile course. Write a function rule for each cyclist. Use your graphing calculator to confirm your rules by graphing all three in the same calculator window.



1. Suppose Rebecca starts cycling at the beginning of the course, and Daryl starts at the end of the course and moves toward the beginning. Rebecca is now averaging 11 mph, and Daryl is averaging 9 mph. Mark the number line and complete the table to show where each is on the course after each hour.



REBECCA		
INPUT	PROCESS	OUTPUT
Hours		Mile Marker
0		
1		
2		
3		
4		
5		
H		R

DARYL		
INPUT	PROCESS	OUTPUT
Hours		Mile Marker
0		
1		
2		
3		
4		
5		
H		D

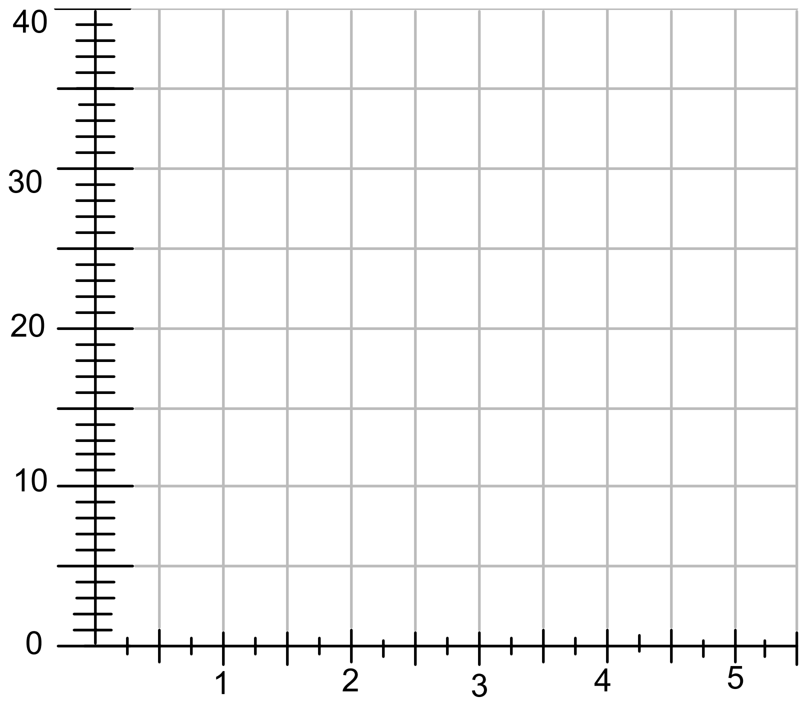
a. How long does it take Rebecca to complete the course?

b. How long does it take Daryl to complete the course?

c. Write a sentence and a function rule describing Rebecca's distance from the beginning of the course in relation to elapsed time.

d. Use the pattern in the table to write a sentence and a function rule describing Daryl's distance from the beginning of the course in relation to elapsed time.

2. Label the axes, plot the points from both tables in Exercise 2, and label each point with an ordered pair.



a. When are Rebecca and Daryl at the same place on the course? How can you tell from the graph?

b. Write an equation to determine how long it takes for Rebecca and Daryl to be at the same place on the course. What does this equation represent in the graph?

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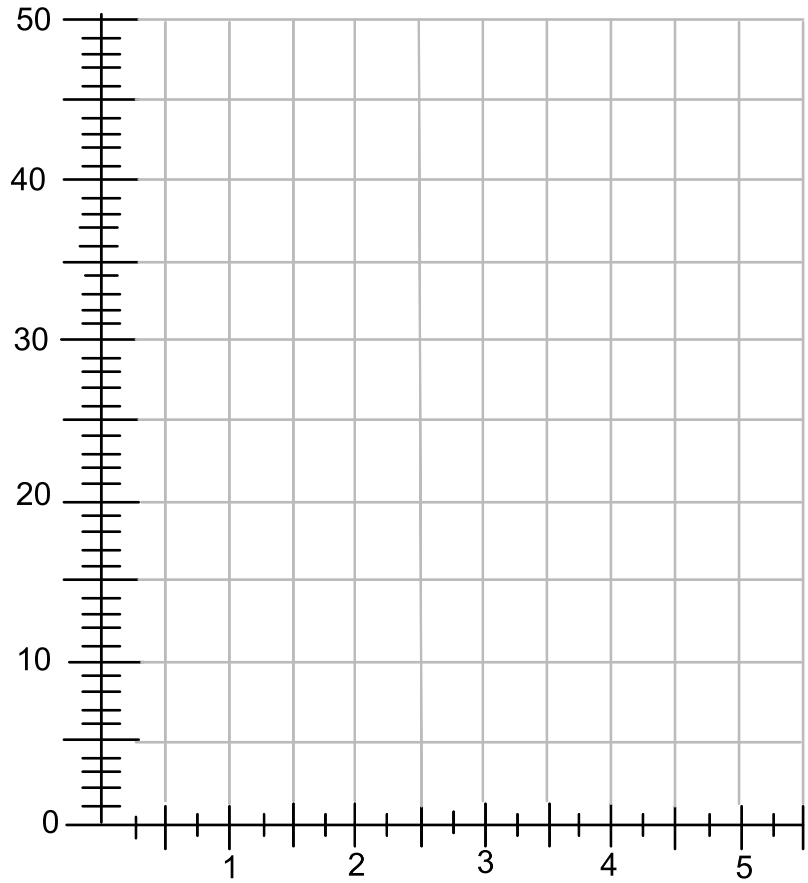
1. Consider the two function rules: $y = 45 - 5x$ and $y = 5 + 15x$. Fill in the tables with appropriate values and build the graph.

x	$y = 45 - 5x$

x	$y = 5 + 15x$



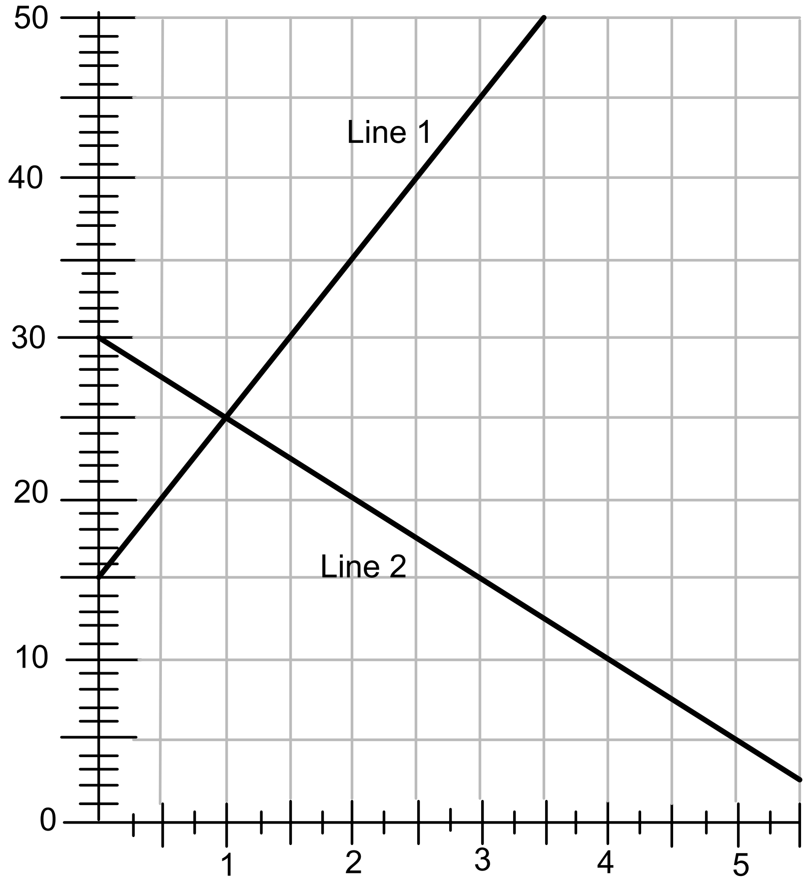
   a. Make up a situation these functions could represent.

   b. What is the point of intersection?

   c. What does the point of intersection mean in your context?

   d. What equation can you write to describe the point of intersection?

2. Consider the two lines on the grid below. Make up a situation the graph could represent and label the axis.



a. Write a function rule describing the relationship between your variables.

Line 1: ________________ Line 2: _________________

b. What is the point of intersection?

c. What does the point of intersection mean in your context?

d. What equation can you write to describe the point of intersection?