Name _____

Date _____

EXPLORATIONS

ACTIVITY 6

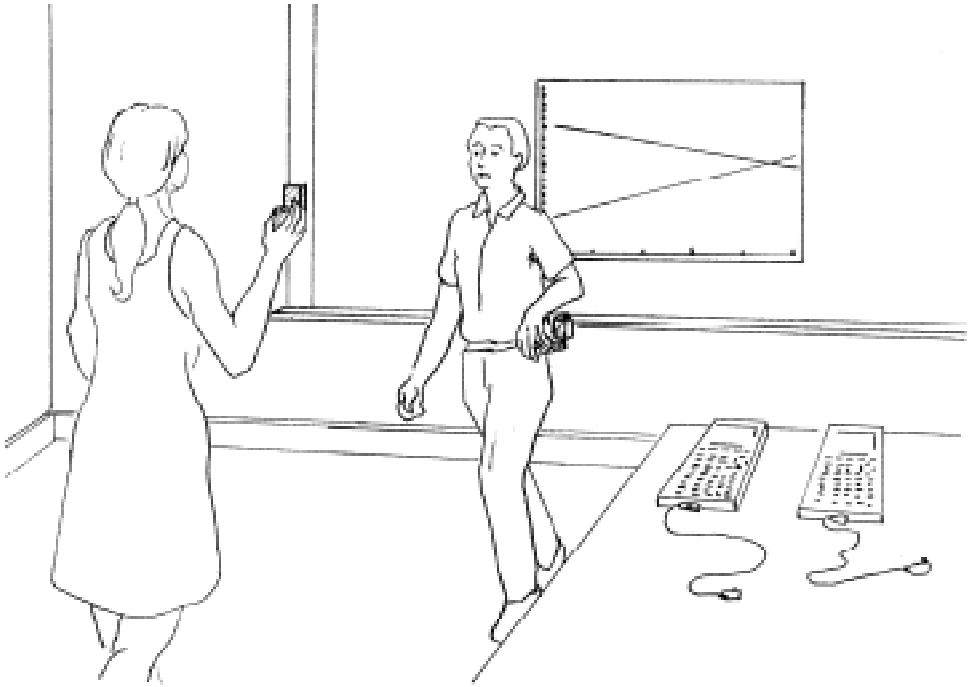
Intersection

Suppose two people walking meet on the street and pass each other. These motions can be modeled graphically. The motion graphs are linear if each person is walking at a constant rate.

In this activity, you will investigate modeling the motion of these two people to find where they will meet and at what rate each was walking.

You'll Need

- 2 CBR units
- 2 TI-83 or TI-82 Graphing Calculators
- Yard stick
- Masking tape



Instructions

1. Use masking tape to set a scale on the floor. Place a piece of tape on the floor 2 feet from the wall.
2. Run the **RANGER** program on both calculators.
3. Enter the setup instructions on both calculators.
   a. From the **MAIN MENU** select **1:SETUP/SAMPLE** to access the setup menu.
   b. Press [ENTER] until the **REALTIME** option reads **no**.
   c. Press [▼] (the down arrow) to select the next line **TIME (S)** and press [ENTER] [5] [ENTER] to change the time to **5** seconds.
   d. Press [▼] to select the next line. Correct or verify the settings and press [ENTER]. Repeat until the options for each line read as shown at right.
   e. Press [▼] to move the cursor to the **START NOW** command. Press [ENTER] and follow the directions on the screen. Detach the CBRs when prompted to do so.

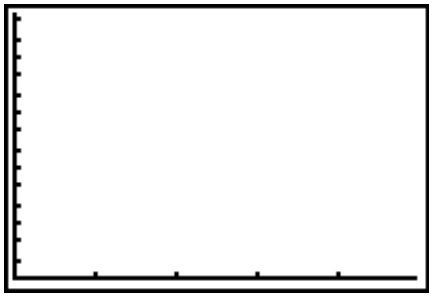
```
MAIN MENU        START NOW

 REALTIME:  NO
   TIME(S):  5
  DISPLAY:  DIST
 BEGIN ON:  [TRIGGER]
SMOOTHING:  LIGHT
    UNITS: ▶FEET
```

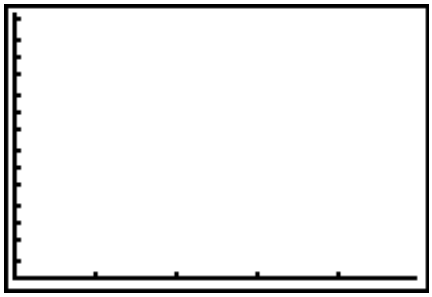
4. Walker A should stand close to a wall (facing away from the wall) and point the CBR towards the wall. Walker B should stand approximately 18 feet from the same wall and point the CBR towards the wall. Walker A should begin to walk away from the wall with a constant rate as Walker B begins to walk toward the wall at a constant rate. When Walker A is at least 2 feet from the wall, both walkers should press (TRIGGER) on the CBRs and continue to walk until the data collecting is done. Reconnect the CBRs and follow the directions on the screen.

Data Collection

1. The graph for Walker A should be a line with positive slope. The graph for Walker B should be a line with a negative slope. If you are not satisfied with the results of your experiment, select **5:REPEAT SAMPLE** and try again.
2. When you are satisfied with your data, sketch a Distance-Time plot for each walker.



Walker A



Walker B

3. Press [ENTER] and select **7:QUIT**. Press [GRAPH] to display the Distance-Time graph. Do *not* share the data. You will need *both* sets of data to answer the following questions.

Questions - Part One

1. Press TRACE and record the coordinates of the starting distance for each walker as Point 1. Using ▶ trace to one other point on each of the distance graphs for each walker between 4 and 5 seconds. Record this point as Point 2.

	Point 1		Point 2	
	Time	**Distance**	**Time**	**Distance**
Walker A				
Walker B				

2. The velocity of each walker is the change in distance, Δy, divided by the change in time, Δt. Find the velocity for each walker.

	$\Delta y = y_2 - y_1$	$\Delta t = t_2 - t_1$	$\text{velocity} = \frac{\Delta y}{\Delta t} = \frac{y_2 - y_1}{t_2 - t_1}$
Walker A			
Walker B			

3. What are the units associated with the velocity? _____

4. Slope is defined to be the rate of change. What would determine the rate of change of the distance for each walker?

_____

5. Find the slope and the y-intercept of each line. Write the equation of the line that best fits the Distance-Time graph for each walker.

	m	***b***	**Equation of Line**
Walker A			
Walker B			

6. What is the physical significance of the y-intercept for each walker?

_____

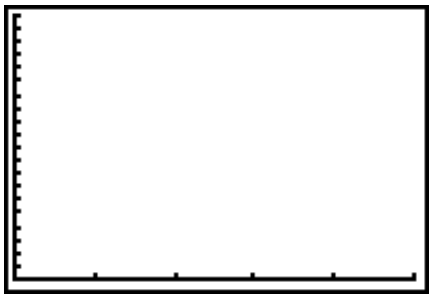
_____

7. The slope of the line for Walker A is positive, while the slope of the line for Walker B is negative. Explain the significance of the sign of each walker's slope.

_____

_____

8. Press [WINDOW]. Change the **Ymin** to 0 and the **Ymax** to 20. Press [Y=]. Enter the equation of the line for Walker A in **Y1**. Enter the equation of the line for Walker B in **Y2**. Press [GRAPH]. Record a sketch of the graphs of the two walkers.



9. To find the point of intersection, press [2nd] **[CALC]**. Select **5:Intersect**. Press [ENTER] [ENTER] [ENTER]. Record this point.

Point of Intersection: _____

10. What is the significance of the y-coordinate of the point of intersection of these two graphs?

_____

_____

11. What is the significance of the x-coordinate of the point of intersection of these two graphs?

_____

_____

Questions — Part Two

1. How do the graphs from Part One compare to the actual paths taken by the walkers? Explain why the graphs on the calculator don't model the actual paths taken by the two walkers.

   _____

   _____

2. Suppose the bottom of the calculator screen represents the wall. Assume that Walker A was in Lane One and Walker B was in Lane Two. Sketch a graph of the paths taken by the walkers. Be sure to note the starting point for each walker.

3. The distance to the wall would be the starting distance from the wall plus the rate times the time for each walker. Write the expression for the distance for each walker from the wall at any time, t.

	Lane	**Distance to the Wall**
Walker A	1	
Walker B	2	

4. Since each walker walked for 5 seconds, calculate the final position of each walker by substituting 5 for t in each of the expressions above. Show your work.

   Final position of Walker A: _____

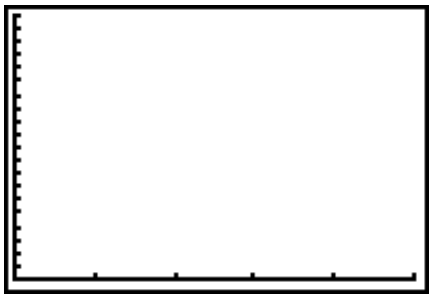
   Final position of Walker B: _____

5. To see a model of the actual paths of the walkers, the calculator should be in Parametric mode instead of Function mode. Press [MODE]. Use [▼] and [▶] to highlight **Par**. Press [ENTER].

   Change from sequential to simultaneous mode by using [▼] and [▶] to highlight **Simul**. Press [ENTER].

   Also, the scatter plots need to be turned off. Press [2nd] **[STAT PLOT]**, select **4:PlotsOff** and press [ENTER]. Press [WINDOW] and enter 0 for **Tmin**, 5 for **Tmax** and 0.1 for **Tstep**.

6. Press [Y=]. Enter 1 for **XIT** and the distance from the wall for Walker A in **YIT**. Enter 2 for **X2T** and the distance from the wall for Walker B in **Y2T**. Press [GRAPH]. Sketch a graph of the paths taken by the walkers. Be sure to note the starting point for each walker.



7. How does the graph on the calculator compare to your sketch from question 2?

_____

8. Press [TRACE]. Record the distance Walker A is from the wall when the time is 0 seconds. Press [▲] and record the distance Walker B is from the wall when the time is 0 seconds. Press [▶] to change the time to the values given then use [▲] to move from Lane 1 to Lane 2 and record the distance each walker is from the wall for each time.

Time	Distance	
	Walker A	Walker B
0		
1		
2		
3		
4		
5		

9. To confirm the velocity of each walker, subtract the starting distance (time = 0 s) from the final distance (time = 5 s). Divide this difference by the total time (5 seconds). Show your work.

Velocity of Walker A: _____

Velocity of Walker B: _____

10. How do these velocities compare to the rate of change found in **Part One, Question 4** (page 29)?

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