Slippery Slope

Name ______________________

Class ______________________

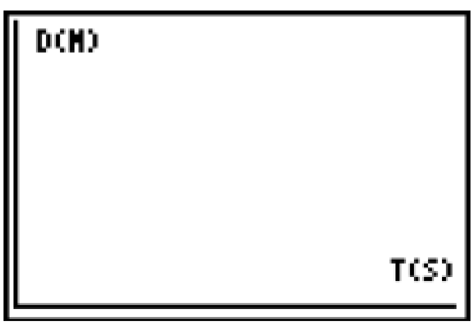
CBR Set Up

1. Connect the CBR to the calculator using the link cable.
2. Turn on the calculator. Run the **RANGER** program:
   a. Press □.
   b. Choose **RANGER**.
   c. Press ⊆.
3. From the **MAIN MENU** select **2: SET DEFAULTS**.
4. With the selector arrow (▶) at **START NOW**, press ⊆.

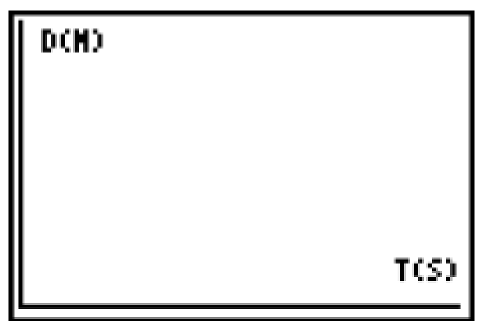
Collecting the Data

1. Place the CBR on a table or desk so that the sensor is aimed at or above the walker's waist.
2. Measure 0.5 meter from the CBR and put a masking tape marker on the floor. Do the same at a distance of 4.5 meters.
3. Stand at the 0.5 mark and prepare to move away from the CBR at a slow and steady rate. When you are ready, press ⊆ and begin.
4. If you are satisfied with your plot, sketch it below in the figure labeled Trial 1 and go to the next section. If not, press ⊆, select **3: REPEAT SAMPLE** from the **PLOT MENU**, and try again.

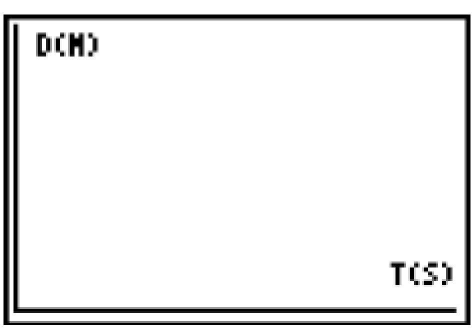
Trial 1



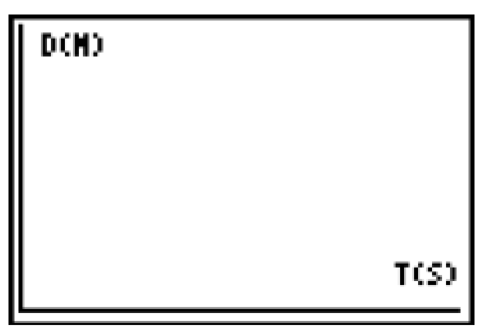
Trial 2



Trial 3



Trial 4



Looking at the Results

Organize the data from the four trials in the table below.

Trial	Starting Distance	Type of Motion	*x*-coordinate (sec)	*y*-coordinate (m)	Slope (m/s)
1	0.5 m	Slow, steady away from CBR	x_1 = x_2 =	y_1 = y_2 =	
2	0.5 m	Moderate, steady away from CBR	x_1 = x_2 =	y_1 = y_2 =	
3	4.5 m	Slow, steady toward CBR	x_1 = x_2 =	y_1 = y_2 =	
4	4.5 m	Moderate, steady toward CBR	x_1 = x_2 =	y_1 = y_2 =	

The slope or steepness of a line is defined as the amount of vertical change divided by the amount of horizontal change between two points on the line.

The equation is:

slope = $\frac{y_2 - y_1}{x_2 - x_1}$ where (x_1, y_1) and (x_2, y_2) represent two points.

1. Use ~ and | to move along the Distance-Time plot. Position the cursor at any point and record the *x*- and *y*-coordinates in the table beside x_1 and y_1 for Trial 1. Round the values to 2 decimal places.

Now position the cursor at a different point (not too close to the previous one) on the plot, and record these *x*- and *y*-values beside x_2 and y_2 in the table for Trial 1.

2. Calculate the slope using the formula above. Record this computed value, expressed as a decimal to the nearest hundredth, in the table for Trial 1.

3. To go to Trial 2, press ⊆ on your calculator and select **3: REPEAT SAMPLE** from the **PLOT MENU**. This time, stand 0.5 meter from the CBR and move away at a moderate but steady rate.

4. Sketch the plot for Trial 2, and then use ~ and | to move to two points on the line. Record the coordinates of these points and then compute and record the slope for Trial 2.

5. Repeat the procedure described in question 3 for the remaining trials. Use the appropriate types of motion listed in the table.

6. For Trials 1 and 2, how do the sizes of the slopes compare? How do their signs (positive or negative) compare?

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7. For Trials 3 and 4, how do the sizes of the slopes compare? How do their signs compare?

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8. How do the slopes from Trials 1 and 2 differ from the slopes for Trials 3 and 4?

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9. What effect does changing speed have on the Distance-Time plot?

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10. What effect does changing *direction* have on the plot?

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11. Complete the statements to summarize the relationships between motion and the characteristics of the slope value.

a. The faster the speed, the _______________ the size of the slope.

b. Moving away from the CBR makes a plot with a _______________ slope, and moving toward the CBR makes a plot with a _______________ slope.

Going Further

1. Calculate the slope of a line given the 2 points (1.5, 2.08) and (6, 4.93).
2. Explain why the units of slope in this activity are meters per second (m/s).
3. Would the value of the slope change if the formula was changed to the following?

   slope = $\frac{y_1 - y_2}{x_1 - x_2}$

   Explain why or why not.
4. Suppose motion data were collected for a person standing still 1 meter in front of the CBR. Predict what the Distance-Time plot would look like. Repeat the data collection for this situation. Was your prediction accurate? If not, describe the plot that was made. Calculate and record the slope.
5. Sketch the plot of a walker starting 0.5 meter from the CBR and moving away quickly for a few seconds, stopping for a few seconds, then moving toward the CBR slowly. What is the sign of the slope for each section?