What is Your View Through the Tube?

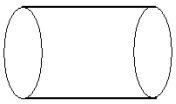
Materials for Each Group: $1\frac{1}{2}$" PVC pipe cut into 3", 5", and 7" pieces, a tape measure, a yard stick, tape, recording sheet, and a TI-Nspire calculator.

Each Group:

- A viewer (this student will look through the PVC pipe)
- A spotter (this student will mark the view on the wall)
- A measurer (this student will measure the distance from the wall to the end of the PVC pipe). To save time, these distances could be pre-determined and marked off before class.
- A recorder (this student will record the information into the chart)

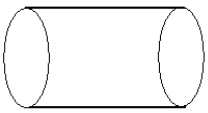
Procedure: A tape measure is taped vertically on a wall. The viewer will stand a designated distance from the tape measure. With the 3" PVC pipe in hand, the viewer will tell what length he/she sees on the wall. The data should be recorded in the chart below. Have students measure all values to the nearest sixteenth of an inch.

Data Tables:



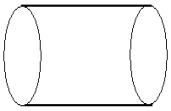
ShortTube Length of Tube _____ Inside diameter of Tube _____

Distance from the Wall	24"	36"	48"	60"	72"
Linear Vertical Height					



MediumTube Length of Tube _____ Inside diameter of Tube _____

Distance from the Wall	24"	36"	48"	60"	72"
Linear Vertical Height					



Long Tube Length of Tube _____ Inside diameter of Tube _____

Distance from the Wall	24"	36"	48"	60"	72"
Linear Vertical Height					

1. Answer the following questions.

   a. What is the independent variable? _____

   b. What is the dependent variable? _____

   c. Should the same person be the viewer throughout the experiment? Why or why not?

_____

   d. On which axis will the distance from the wall be plotted? _____

   e. On which axis will the linear vertical height be plotted? _____

   f. What happens to the rate of change as the tube gets longer? _____

   g. What would the visible linear vertical height if the distance from the wall is zero?

2. Graph the data for each tube in the calculator.

A. In order to enter data and then graph it, you will need to open a New Document.

i. Press the ⌂ key and 5 to select New Document. (Figure 1)

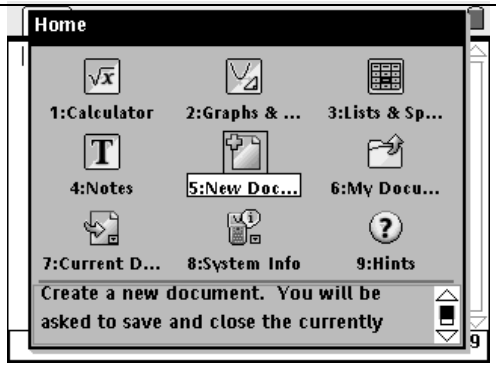


Figure 1

ii. Press (3) to choose 3:Add Lists & Spreadsheets

(Figures 2 and 3)

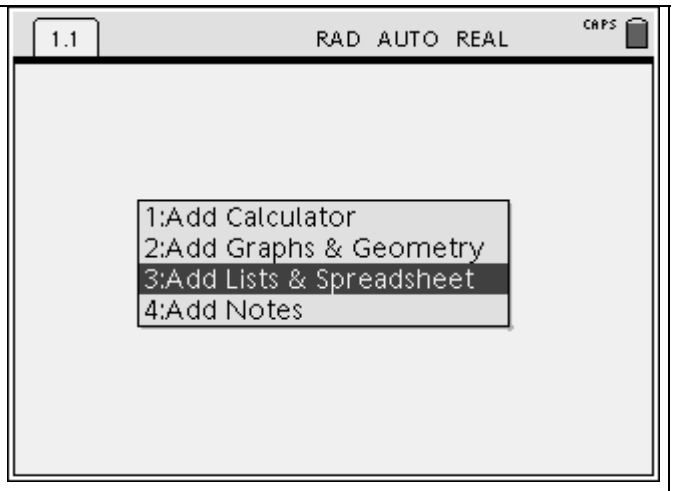


Figure 2

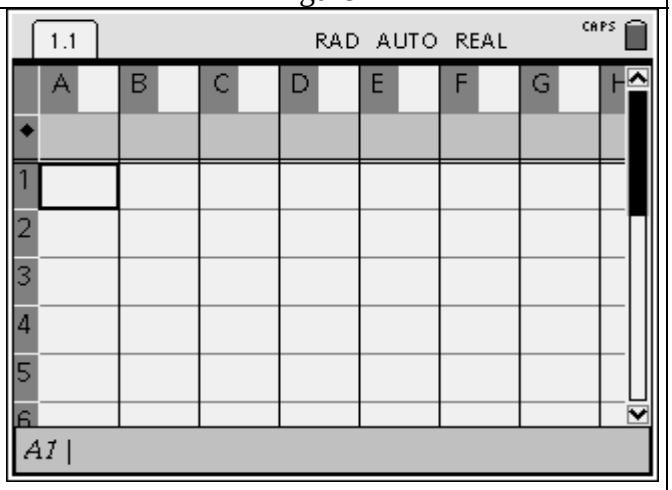


Figure 3

iii. Enter the Distances from the Wall into column A. Enter the Linear Vertical Height for 3" pipe in column B. Enter Linear Vertical Height for 5" pipe in column C. Enter Linear Vertical Height for 7" pipe in column D (Figure 4)

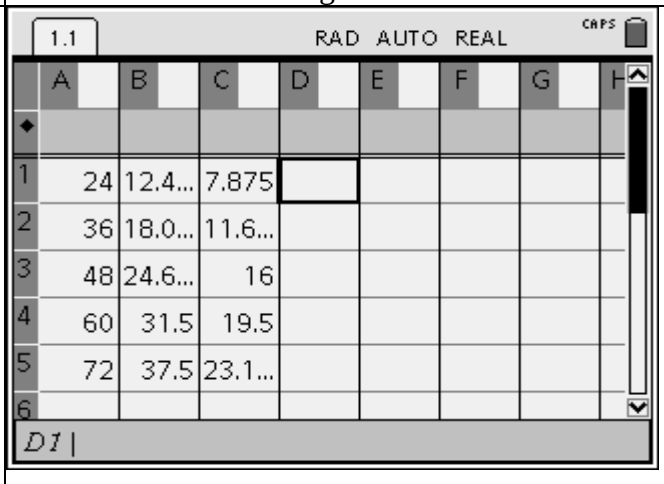


Figure 4

iv. Label the columns.

- Using the NavPad, move up and left to the white space next to the "A" column heading. Type in "FLDIST" (Figure 5)
- Press the enter key.

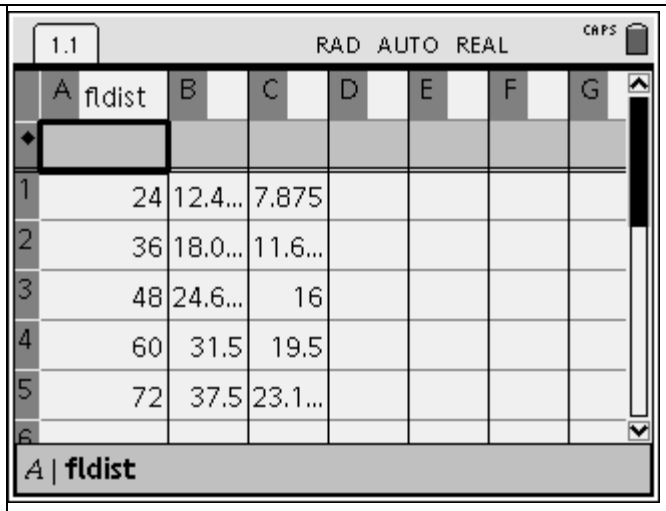


Figure 5

v. Do a similar operation for columns "B", "C", and "D" labeling them "TB3IN", TB5IN", TB7IN" respectfully. (Figure 6)

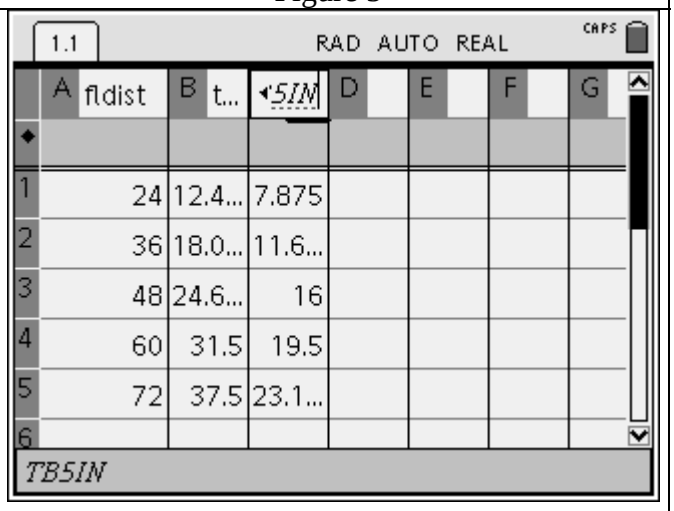


Figure 6

B. In order to graph the data, you will need to add a new page to this problem.

i. Press the home key and press 2 to add a Graphs & Geometry page (Figure 7)

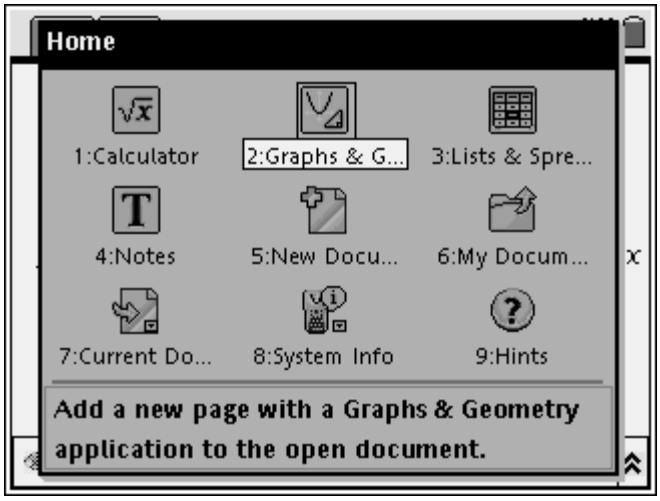


Figure 7

ii. The default graph screen is shown in Figure 8.

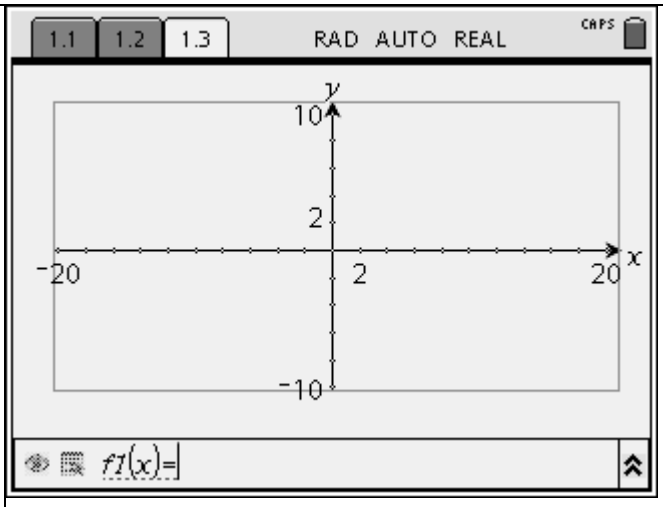


Figure 8

iii. Press (menu) (3) (3) to choose Menu 3: Graph Type, 3: Scatter Plot (Figure 9).

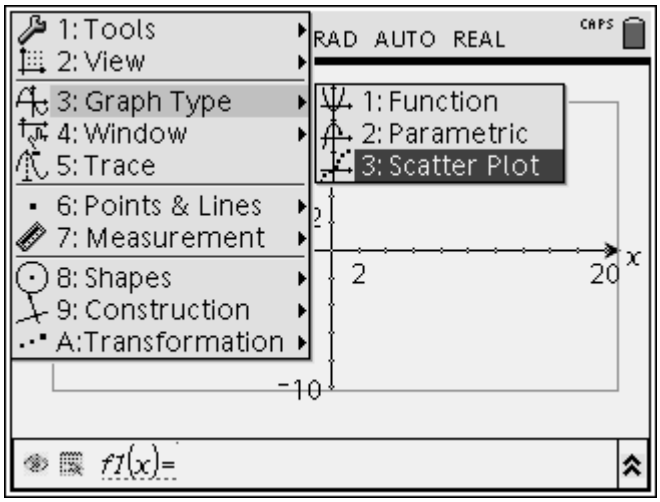


Figure 9

iv. Press (ctrl) to open the x-values list, arrow down to "fldist" and press (ctrl) to choose fldist (Figure 10).

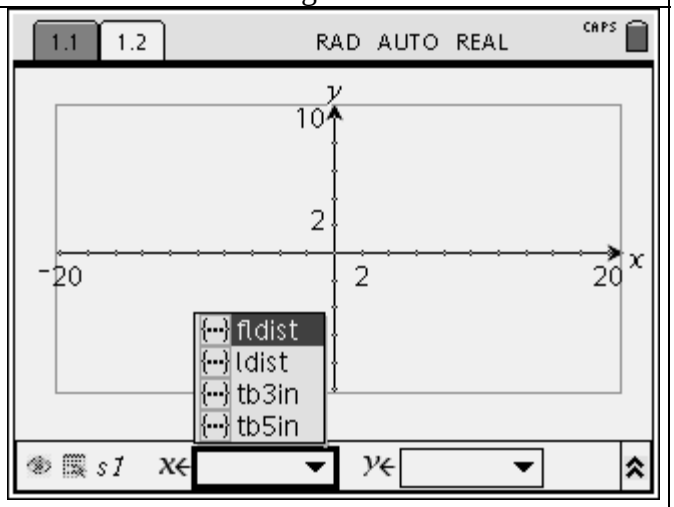


Figure 10

v. Move to the right (by pressing (tab)) to highlight the y-values list. Press (·). Arrow down to "tb3in" and press (·) to choose "tb3in" (Figure 11).

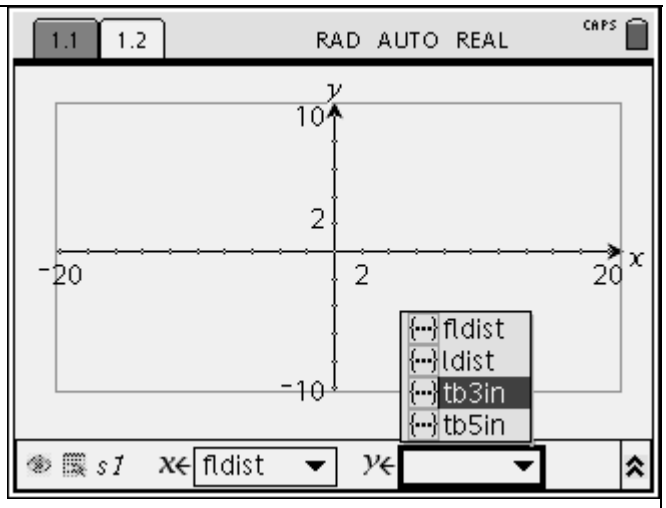


Figure 11

vi. Press (tab) four times or until you see the ↖ in the graph area (Figure 12).

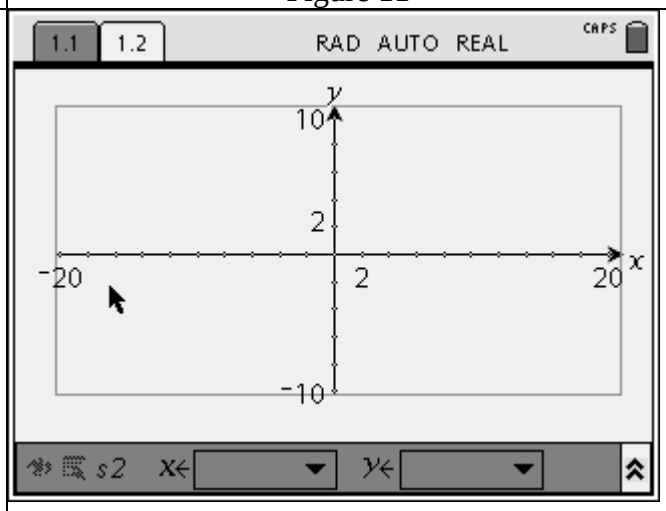


Figure 12

vii. The window needs to be changed before we graph our points.

Move ↖ near the value of -20. Press (ctrl) (·) four time or until you see a text box around the value -20. (Figure 13)

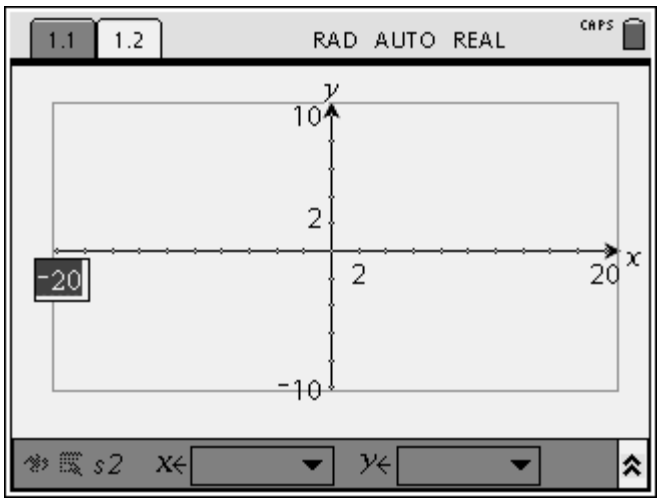


Figure 13

viii. Backspace using the clear key. Change the value to -1. (Figure 14)

Press enter clear clear

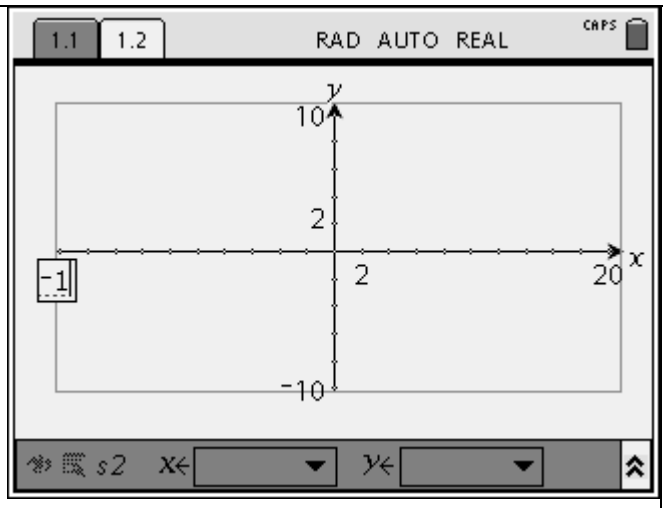


Figure 14

ix. Likewise, change the maximum and minimum x and y values on the graph. The points for the 3-inch tube should appear. (Figure 15)

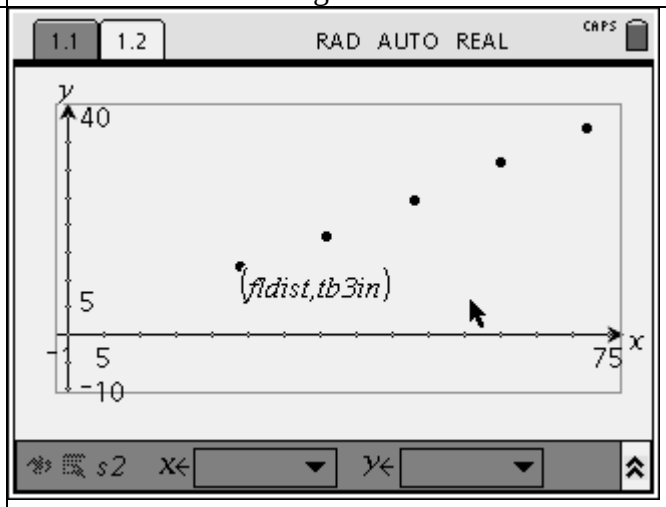


Figure 15

C. Now graph the other relations for the 5-inch and 7-inch tubes.

i. Press menu 3 3 to choose Menu 3: Graph Type, 3: Scatter Plot (Figure 16)

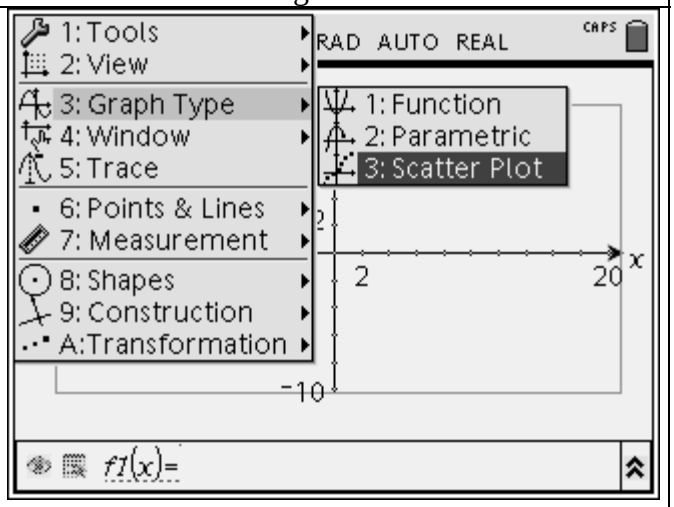


Figure 16

ii. Press ⏺ to open the x-values list, arrow down to "fldist" and press ⏺ to choose fldist (Figure 17).

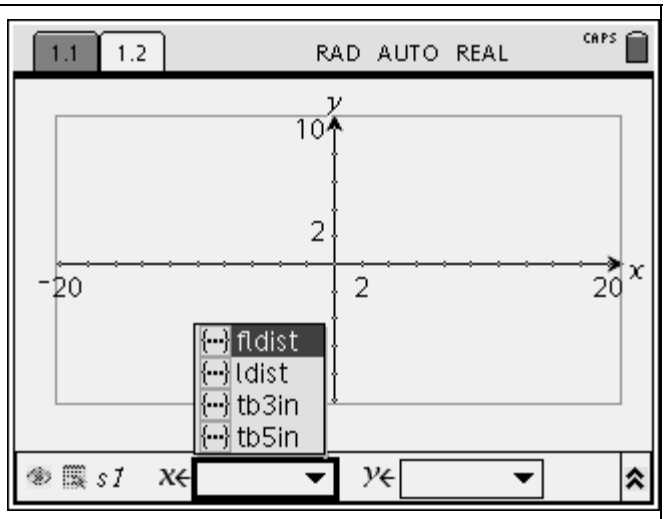


Figure 17

iii. Move to the right (by pressing (tab)) to highlight the y-values list. Press ⏺. Arrow down to "tb5in" and press ⏺ to choose "tb5in" (Figure 18).

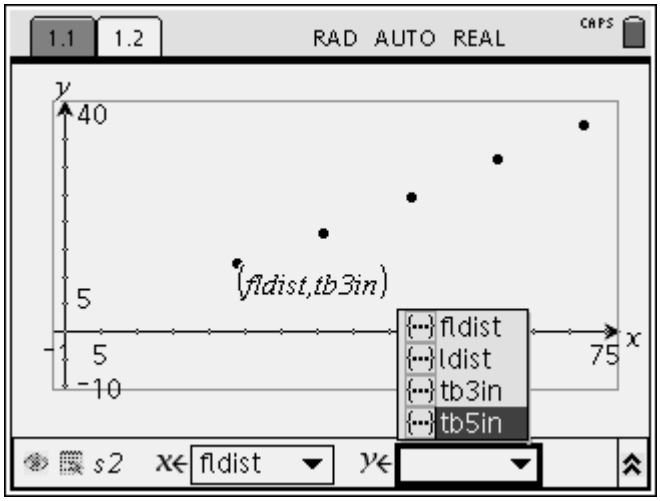


Figure 18

iv. Press (enter).
The points for the 5-inch tube should appear. (Figure 19)

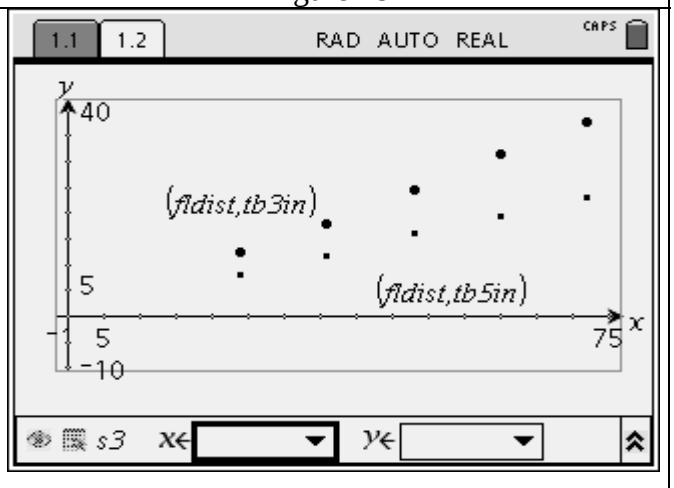


Figure 19

C. Follow the same steps to graph the points for the 7-inch pipe.

3. Now let's determine the regression equation for the set of data. Find the regression equation for the 3-inch tube first.

i. Press ctrl ◧ (to the left of the NavPad) to return to the spreadsheet. (Figure 20)

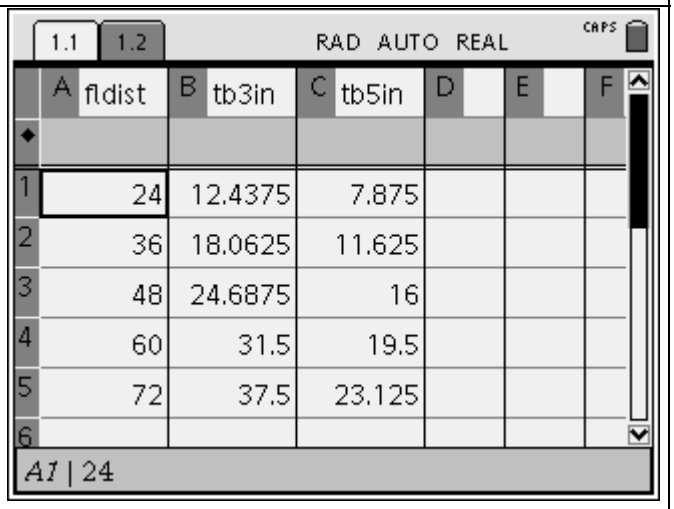


Figure 20

ii. Press menu 4 1 to choose Menu 4: Statistics, 1:Stat Calculations. (Figure 21)

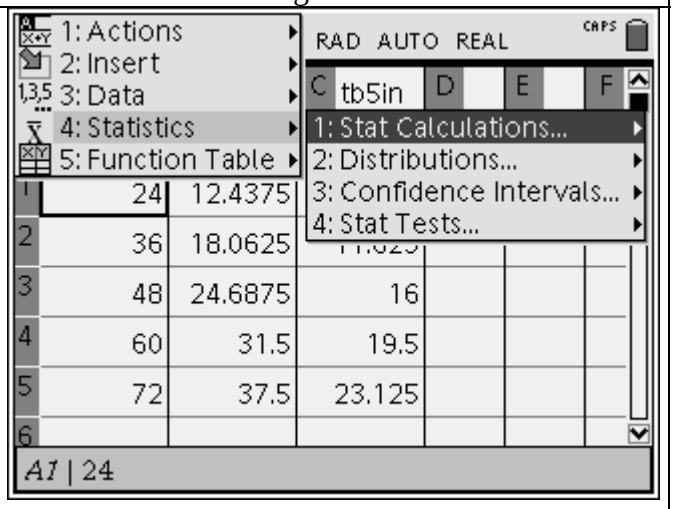


Figure 21

iv. Press 3 to choose 3: Linear Regression (mx+b). (Figure 22)

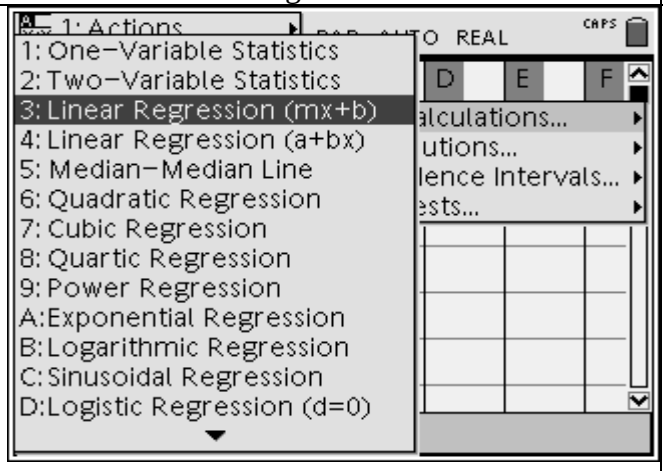


Figure 22

v. The Linear Regression (mx+b) set up box will appear on the screen (Figure 23)

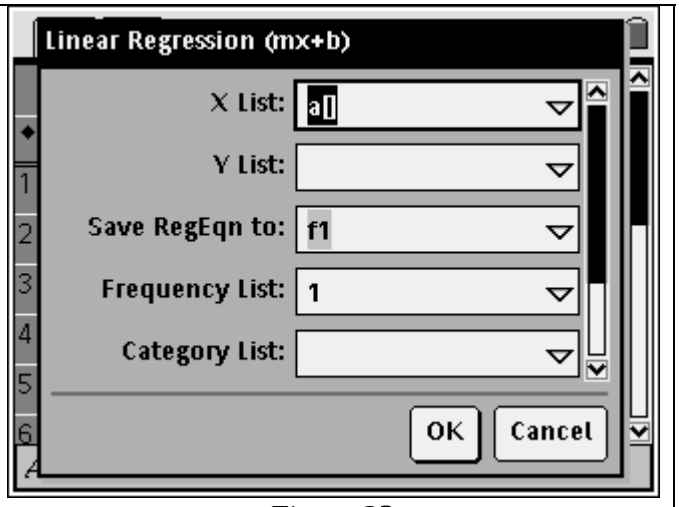


Figure 23

vi. Press the down arrow (▼) on the NavPad cursor control to choose "fldist" and press ⏺. (Figure 24)

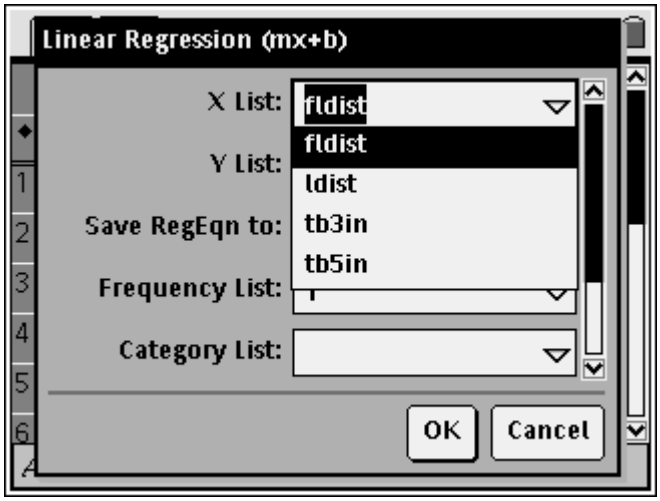


Figure 24

vii. Press the tab key to change to the Y-List. Press the down arrow key and choose "tb3in". (Figure 25)

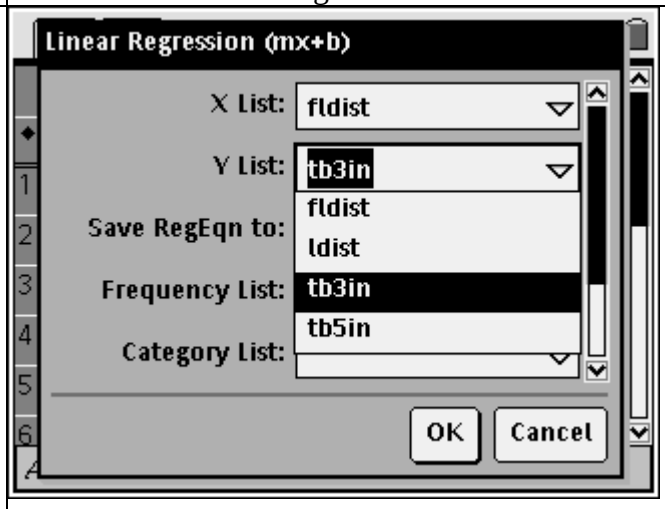


Figure 25

viii. Press the (tab) key until "1st Result Column" is highlighted. Type in "E". (The stats will be stored in column E.)(Figure 26)

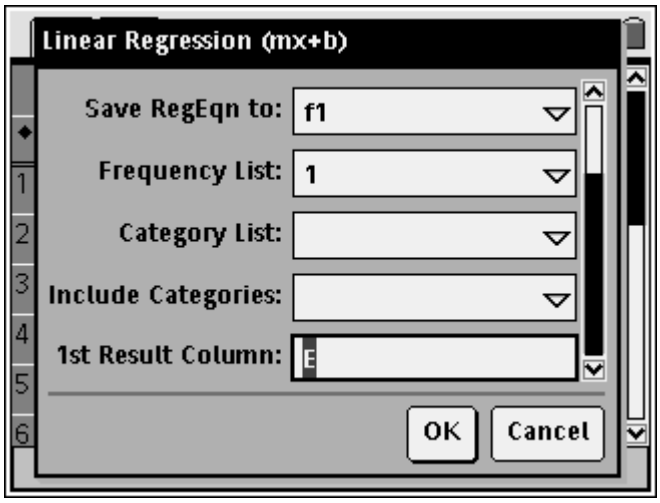


Figure 26

ix. Press the (tab) key until OK is highlighted. (Figure 27)

Note: the RegEqu will be saved in f1.

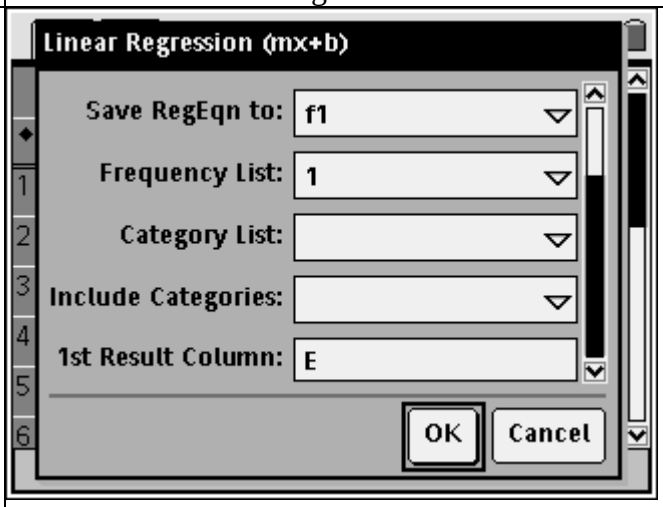


Figure 27

x. Press the (enter) button. The stats are now in column E. (Figure 28)

Notice what the entry line at the bottom of the screen shows.

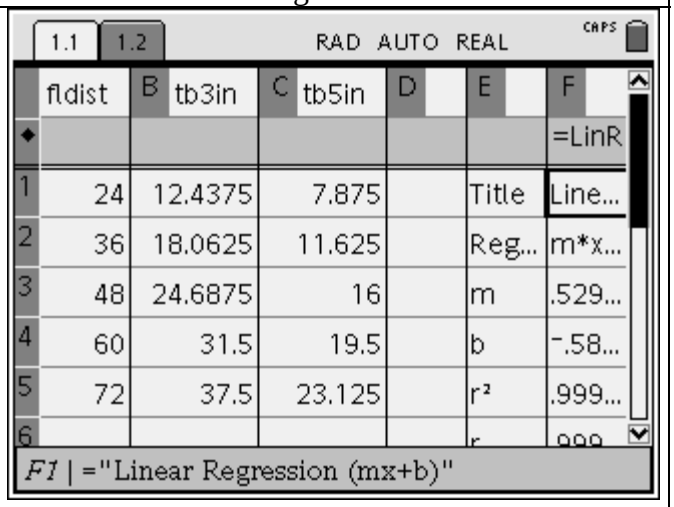


Figure 28

B. A similar process can be repeated to find the regression line for the 5-inch and 7-inch tubes. Be sure to save the other regression equations in something other than f1. Also, save the regression information in columns G or greater

C. i. Press the ctrl ▷ to return to the Graphs & Geometry page (Figure 29)

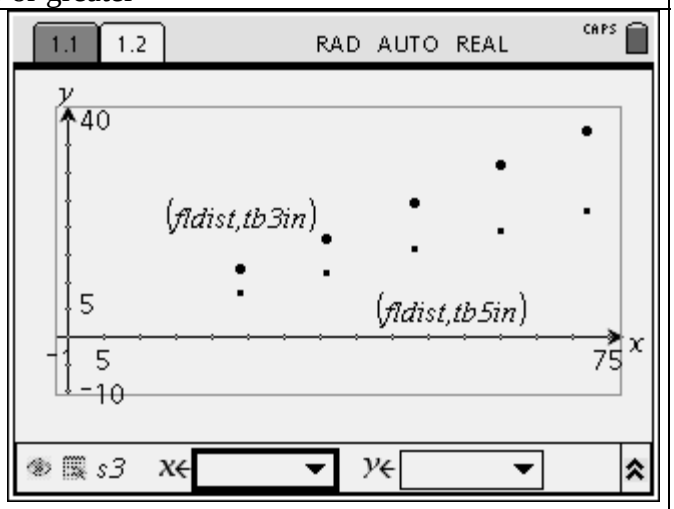


Figure 29

ii. Press menu 3 1 to choose Menu 3: Graph Type, 1: Function. (Figure 30 & 31)

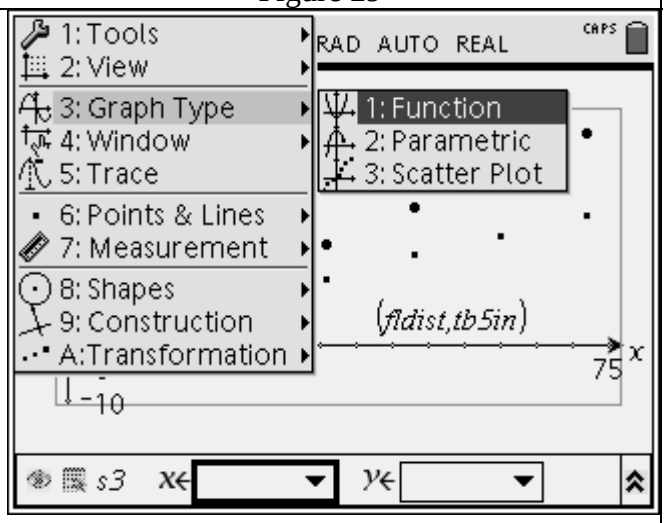


Figure 30

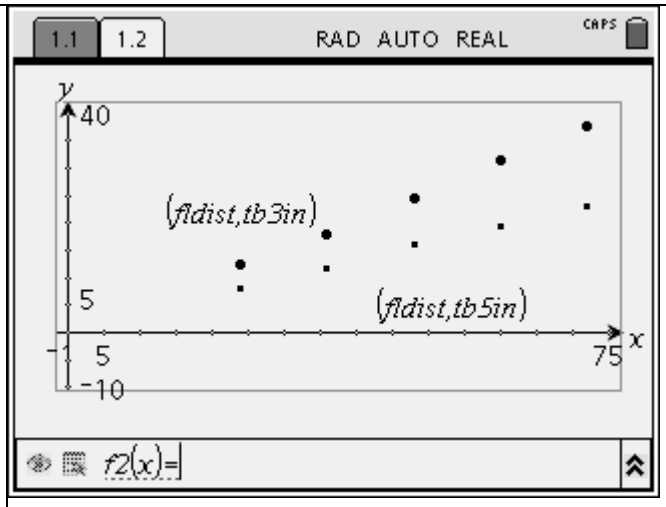


Figure 31

iii. Press the ▲ key so the f1(x) appears in the Entry Line. Then press the enter key. (Figures 32 & 33)

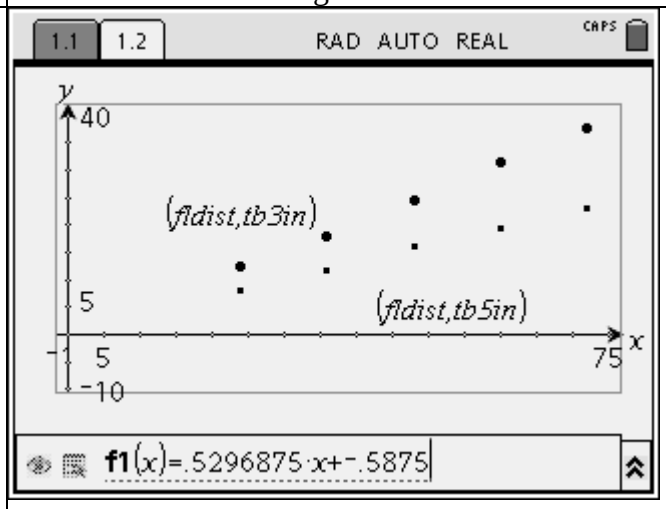


Figure 32

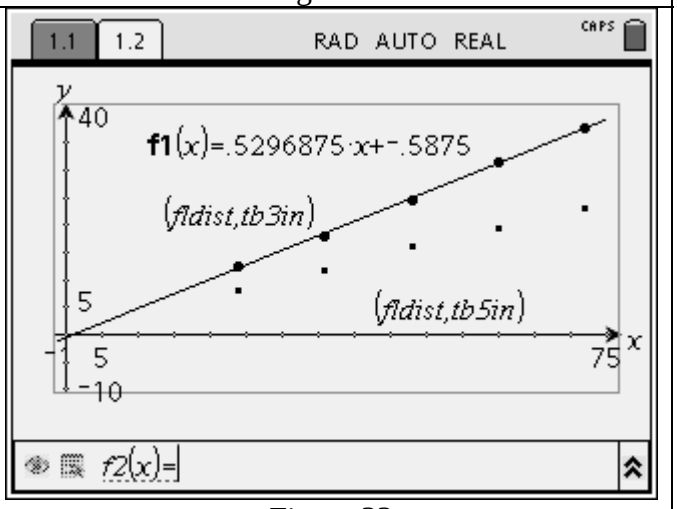


Figure 33

4. Explore various distances and linear vertical distances with the Regression Equation and Data.
   A. Trace the Regression Line.
      i. Press (menu) (5) to choose Menu 5: Trace. (Figure 34)

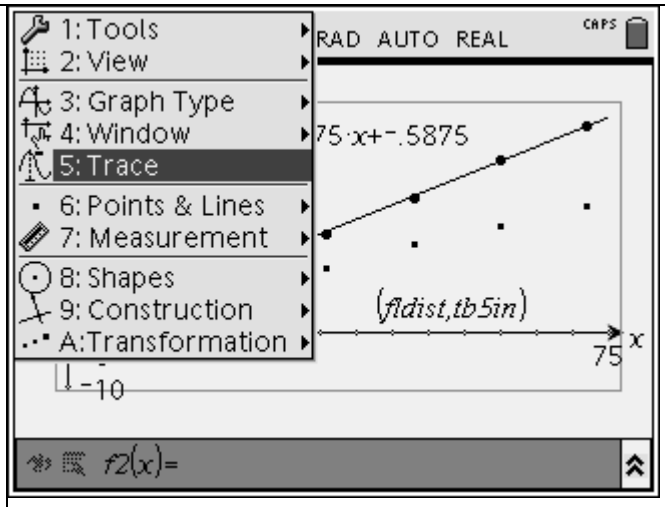


Figure 34

ii. Press the ▲ key on the NavPad to change from the plot to the equation. (Figure 35)

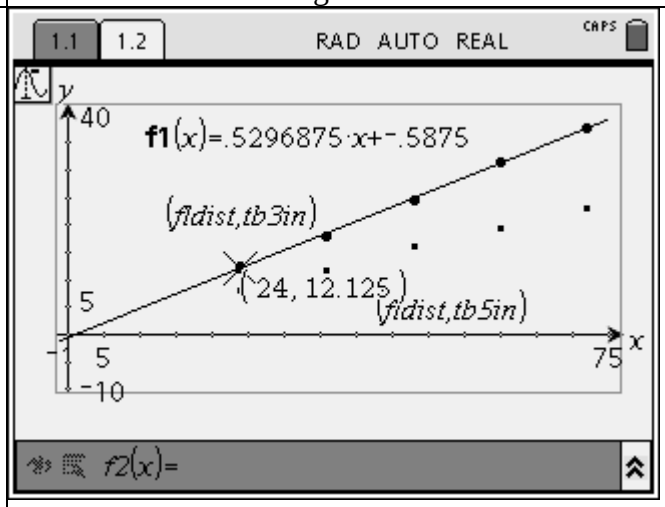


Figure 35

iii. Press the ◀ ▶ keys on the NavPad to move left and right on the graph of the regression equation until you reach a desired distance from the wall. For example: Try to find a distance of 42 “. (Figure 36) .
Notice, the linear viewing distance is 21.4252” for a distance of 41.558 inches from the wall.

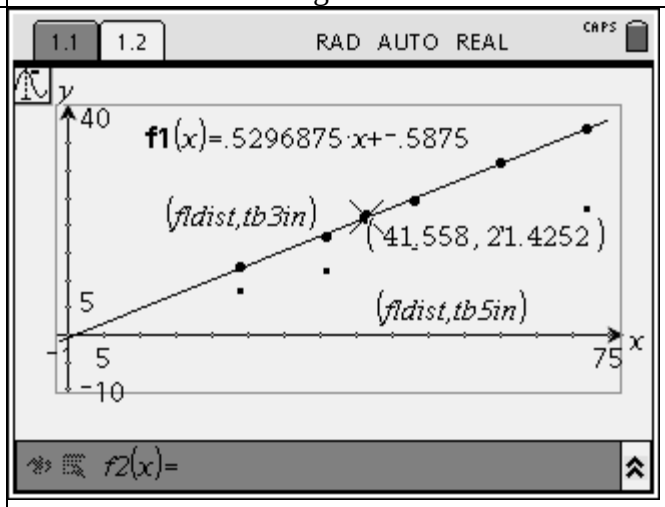


Figure 36

iv. While in the Trace Mode, type an x-value and the value will appear on the screen. (Figure 37).

For example: type 47" for an x value.

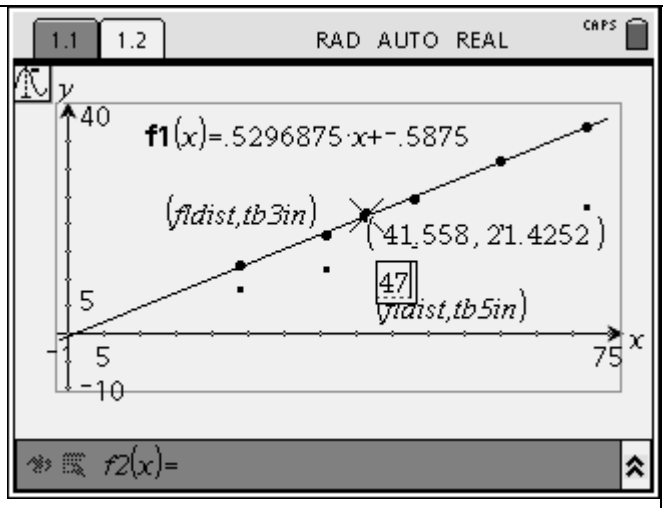


Figure 37

After typing the number, press enter to find the number of linear vertical inches a person 47" away is expected to see.

The answer is: 24.3078".

(Figure 38)

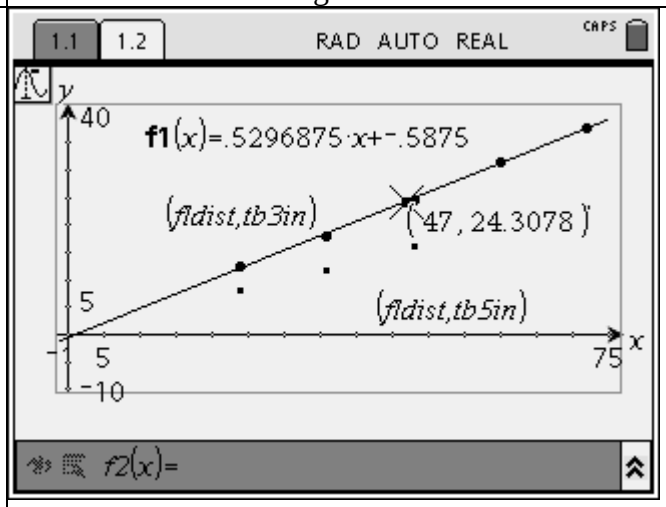


Figure 38

B. Analyze the Data Using a Point on the Regression Line.

Place a point on the line then manipulate the x-value to determine y or manipulate the y-value to determine the x.

i. Press the esc key to exit the trace mode.

ii. Press (menu) (6) (2) to choose Menu 6: Points & Lines, 2: Point On. (Figure 39)

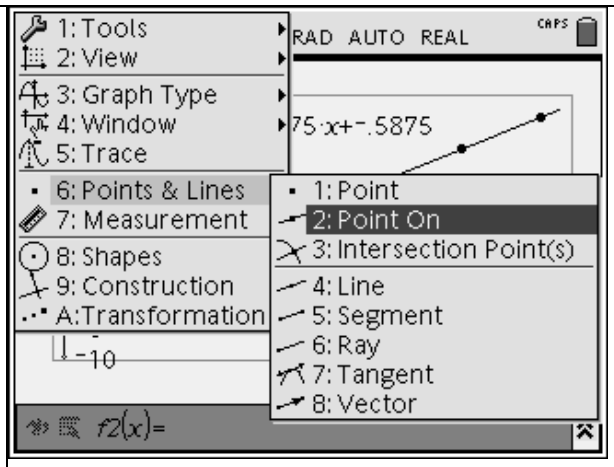


Figure 39

iii. Move the cursor pencil onto the regression line until an ordered pair appears. Press the (enter) key to drop the point on the line. (Figure 40)

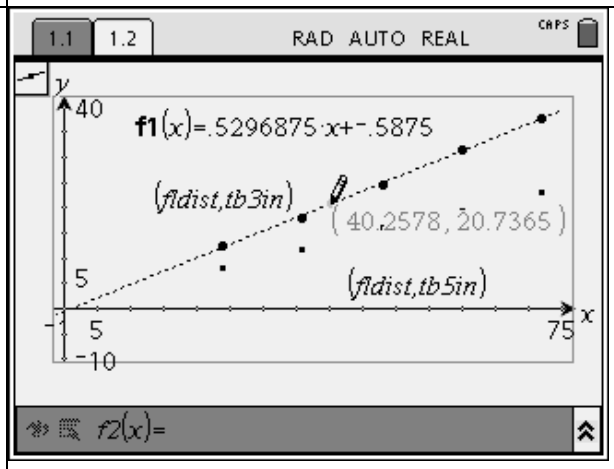


Figure 40

iv. Press the (esc) key to exit the Point On mode.

v. Place the cursor over the x-coordinate. Press the (enter) key twice. (Figure 41)

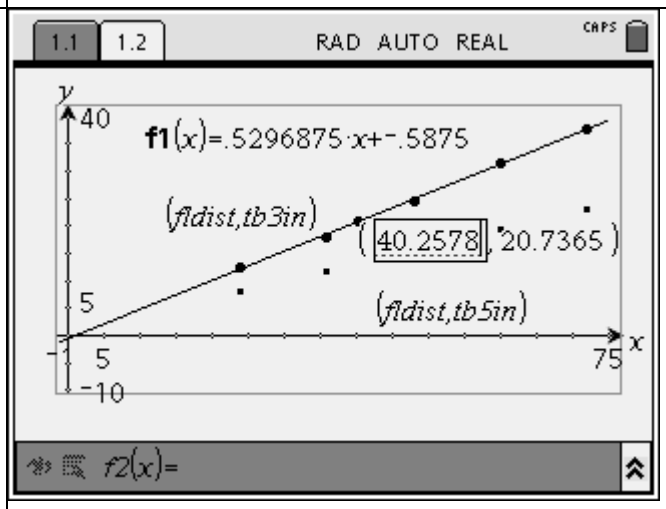


Figure 41

vi. Enter a new value for distance from the wall. Press the ⏎ key to see the value for linear vertical inches. (Figure 42)

For example: Enter 20” as the x-value. The y-value shows up as 10.0062”.

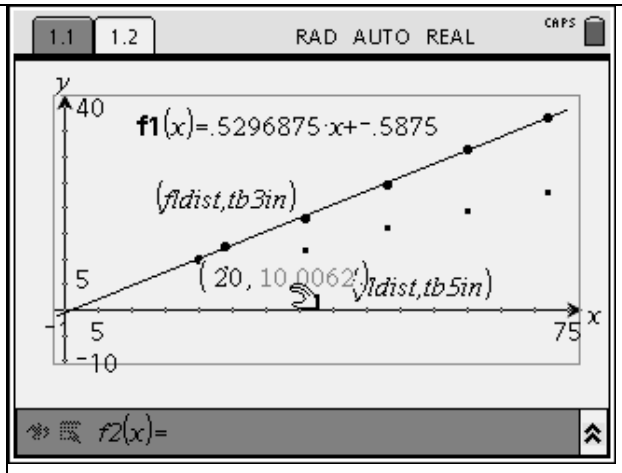


Figure 42

vii. Change the number for the y-value to determine how far someone is from the wall for a given linear vertical inches.

Place the cursor over the y-coordinate. Press the ⏎ key twice. (Figure 43)

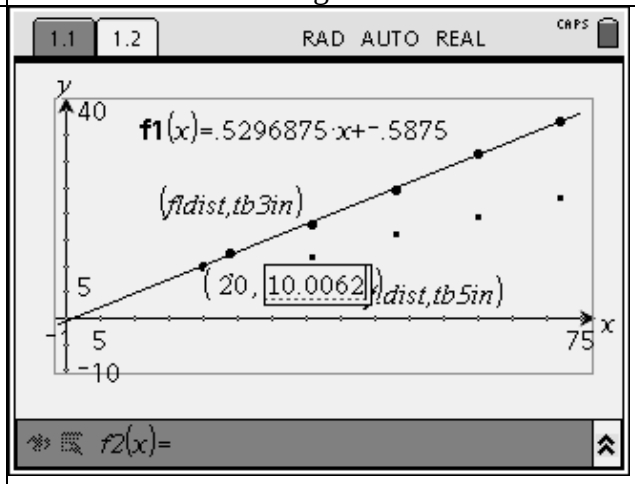


Figure 43

For example: Enter 22 “ as the y-value. The x-value shows up as 46.6431”.

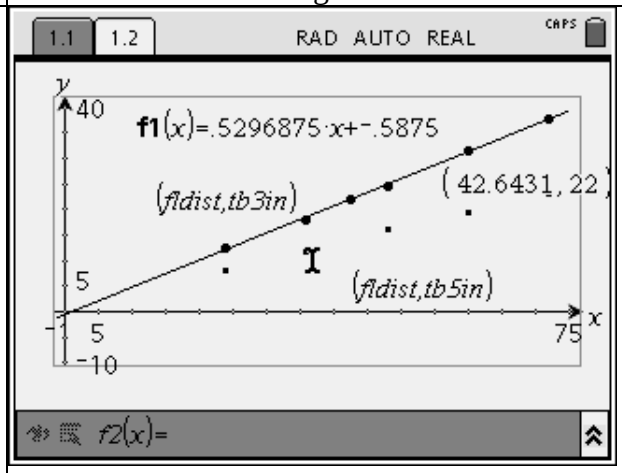


Figure 44

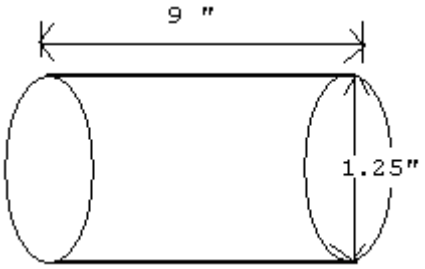
This process of places points on the graph can be repeated as often as you like.

1. Answer the following questions.
    a. Use your graph for the 3” tube to predict how much of the tape measure you could see if you stood 18 inches from the wall. _____
    b. Use your 3” data again. Tell how many inches you could see if you stood 7 feet away. _____
    c. If you could see 28” on the wall using a 3” tube, how far away are you from the wall? _____

2. Answer the following questions.
    a. Use your graph for the 5” tube to predict how much of the tape measure you could see if you stood 18 inches from the wall. _____
    b. Use your 5” data again. Tell how many inches you could see if you stood 7 feet away. _____
    c. If you could see 28” on the wall using a 5” tube, how far away are you from the wall? _____

3. Answer the following questions.
    a. Use your graph for the 7” tube to predict how much of the tape measure you could see if you stood 18 inches from the wall. _____
    b. Use your 7” data again. Tell how many inches you could see if you stood 7 feet away. _____
    c. If you could see 28” on the wall using a 7” tube, how far away are you from the wall? _____

4. If Jacob has the given tube shown below. What do you think his graph will look like?



_____

5. Tom uses a 4 inch tube to view a tree 30 feet away (note the units). The tube has an inside diameter of 1.25”. How tall is the tree (in inches)? _____

6. Below are the graphs of the curves for both Tammy and Steve. How might the dimensions of Tammy's tube differ from Steve's?