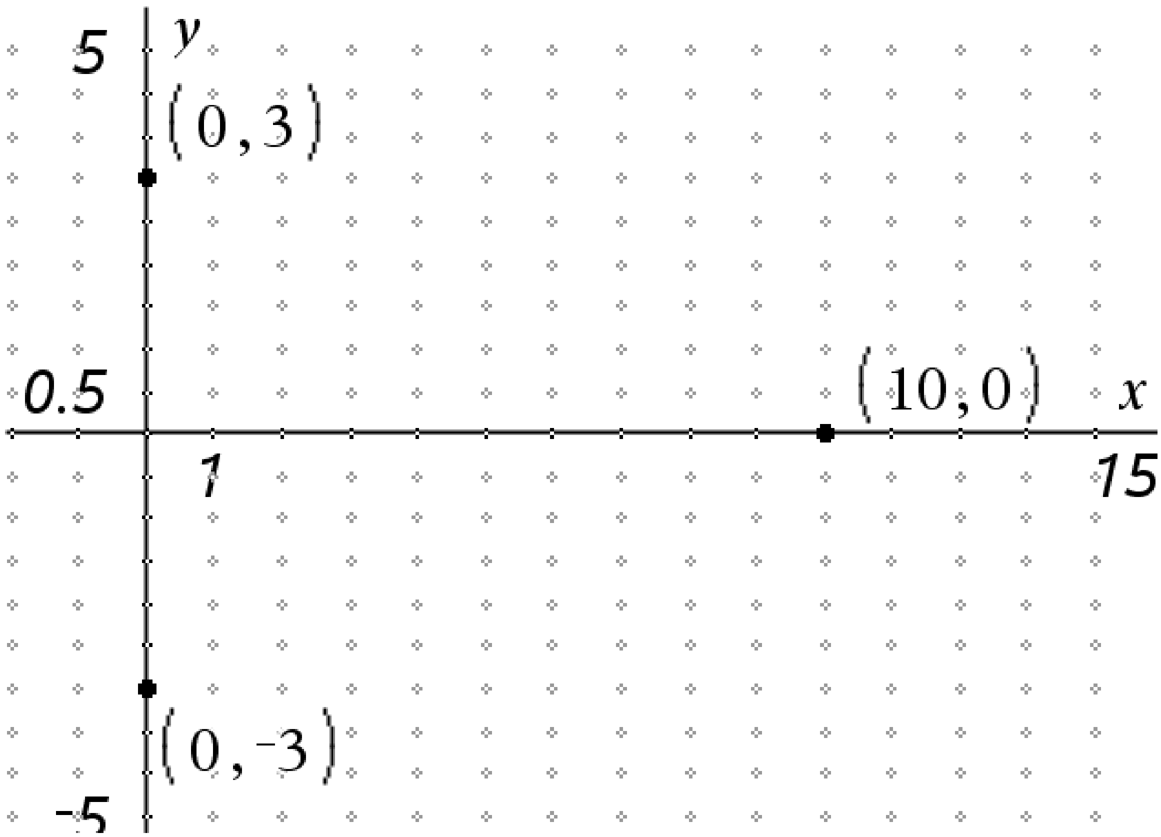
Geometry
SOAP I: The Shortest Distance

In this investigation we are going to determine the best place to build a warehouse so that it can service three stores with the least amount of travel.

1. Given Store A at (0,3), Store B at (0,-3) and Store C at (10,0) as shown below we wish to build a warehouse that will service all three locations so that the total distance to the three stores is kept to a minimum. Find point P for the warehouse such that P is on the x-axis between (0,0) and (10,0) inclusive such that PA + PB + PC is as small as possible.



2. Where do you think the best location for P is? Give the coordinates and explain why.

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3. Now let's test some possibilities. Fill in the table below for the given warehouse locations.

P	**PA**	**PB**	**PC**	**PA + PB + PC**
(0,0)				
(0,1)				
(0,2)				
(0,3)				
(0,4)				
(0,5)				
(0,6)				
(0,7)				
(0,8)				
(0,9)				
(0,10)				

4. Given the data from the table above, answer question 2 again and give **PA + PB + PC** for these new coordinates. Explain your new choice or why you kept the original position for the warehouse.

5. How did you calculate the distances?

6. Give a general statement of the distance **PA + PB + PC** for P being at the coordinates (t,s).

7. Now create this situation in the Nspire, using Graphs and Geometry, Measurement, Calculate, and Auto Data Collection.

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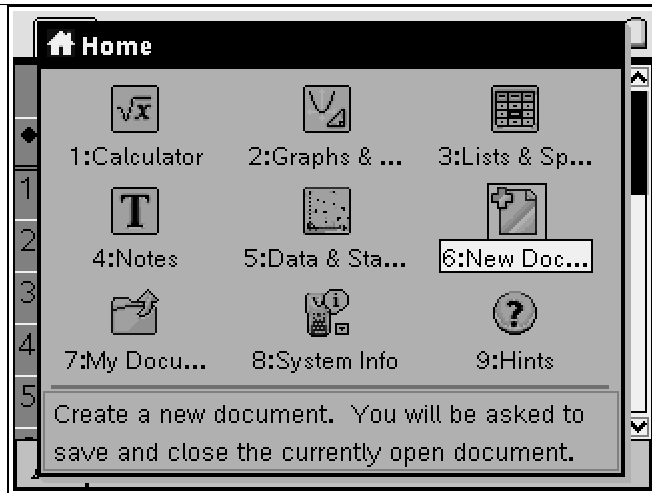
<table>
<tr>
<td>Open a new document by pressing and selection option 6: New Document.</td>
<td>



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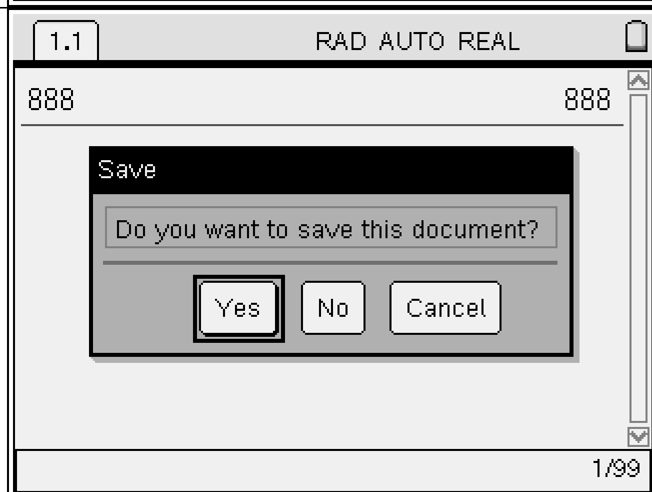
<tr>
<td>If prompted to save the previous document, either save it or press tab to select NO.</td>
<td>



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<tr>
<td>Now select 4: Add Notes as the first application.</td>
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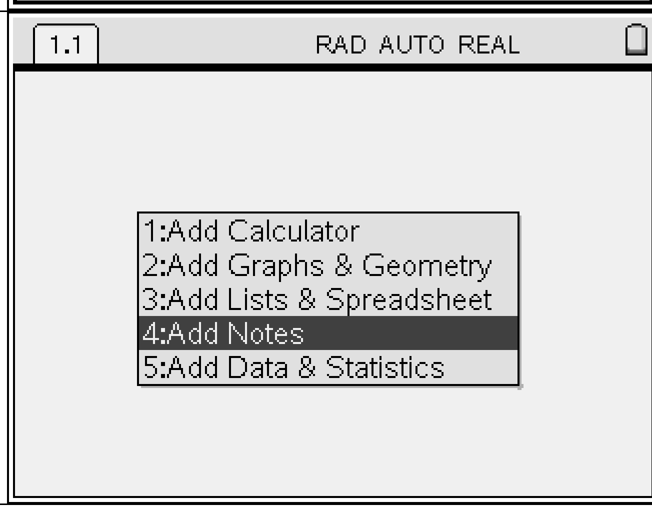

</td>
</tr>
</table>

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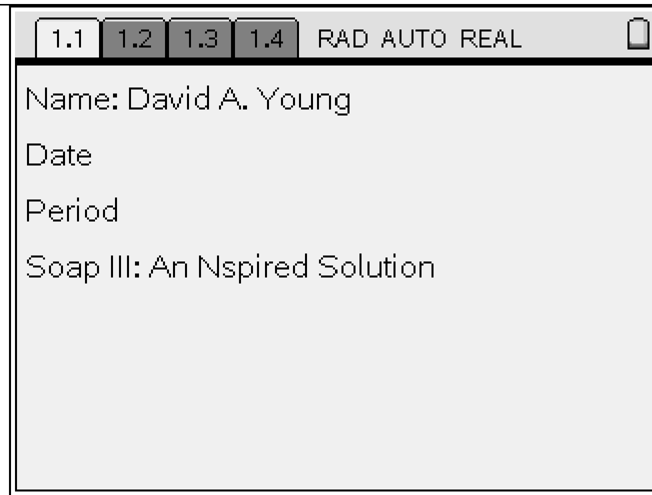
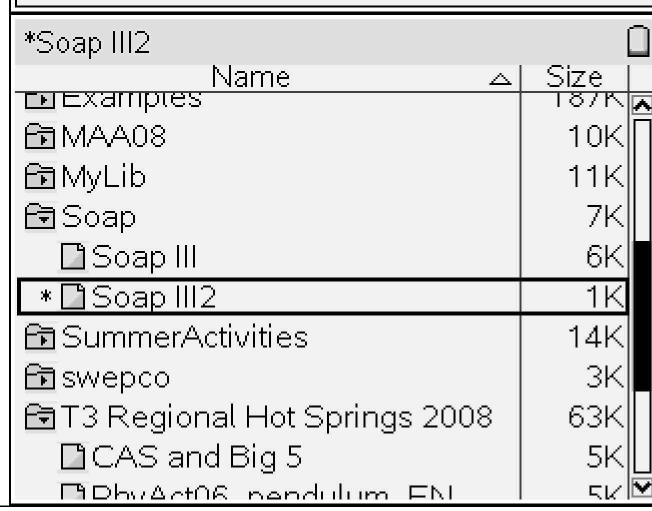
Fill in the appropriate information. Use CAPS ⇧ to get capital letters and ␣ to get a space.



Now save the document by pressing ctrl S. At the prompt enter the document name. Use tab to change the Folder and then tab to OK and press enter to save. Now as you work on the document periodically press ctrl S to save the changes. When you do this, nothing will appear to happen. To check to see if the document has been saved, find it in My Documents [Press ⌂ 7] and look for an * to indicate the file has NOT been saved to record recent changes.



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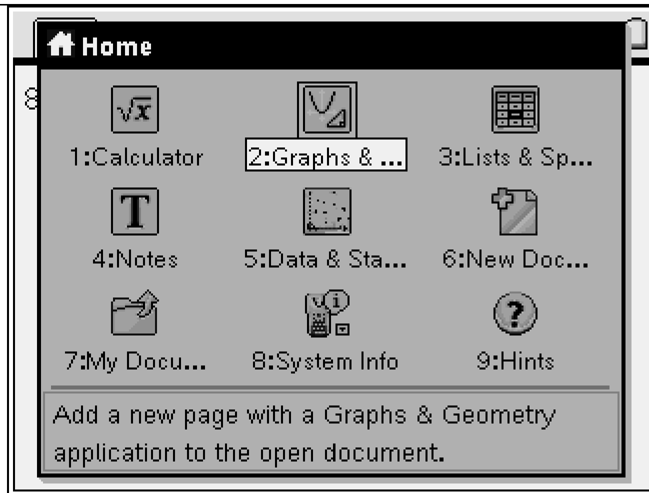
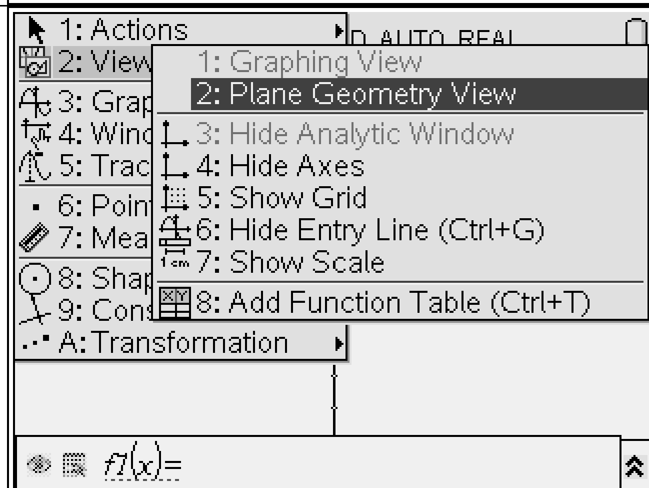
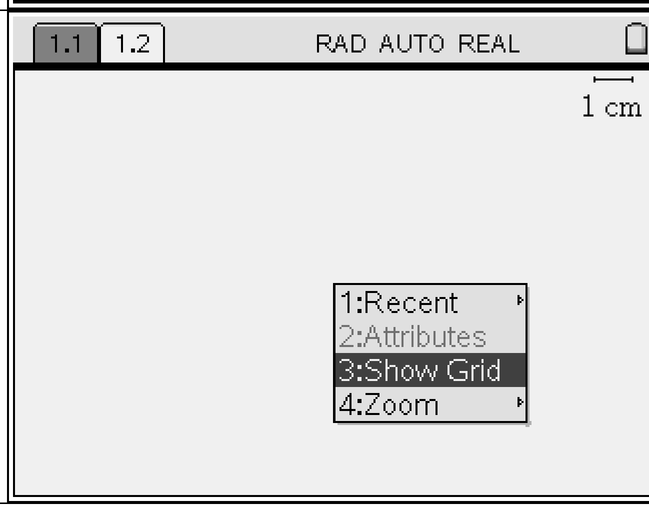
Now add the Graphs & Geometry application by pressing ⌂❷.	
You have the Graphing View but we want the Plane Geometry View. Press (menu) and then under View select the correct view.	
Now we want to create the image in question 1 above. To see the Grid press (ctrl)(menu) and select 3: Show Grid.	

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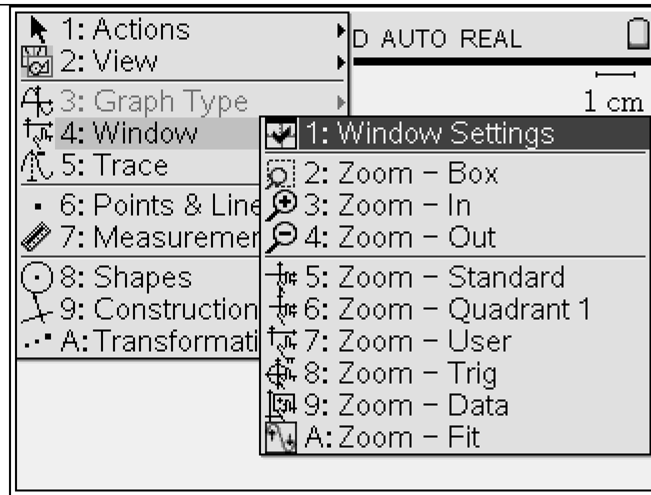
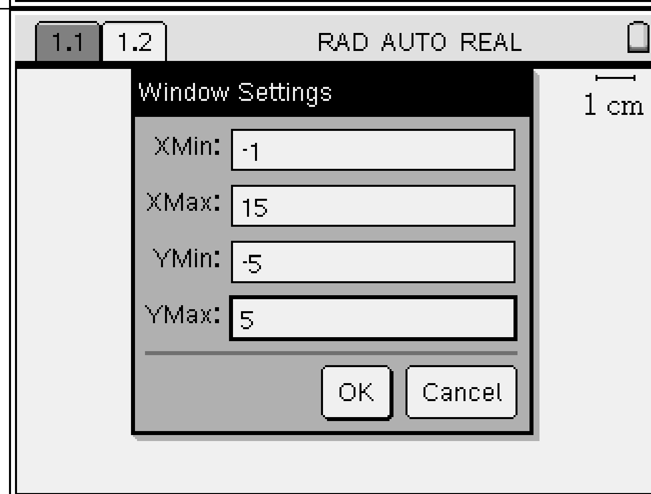
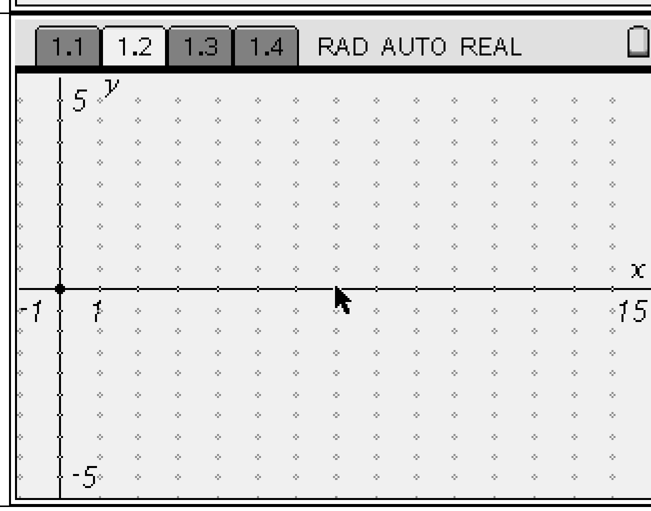
To adjust the Window press menu and select from Window option 1.



Set the Window as shown to the right. Make sure you use (-) for negative numbers.



Place the three stores and the Warehouse on the grid. Recall that A (0,3), B (0,-3), C (10,0), and P is any place on the x-axis between the origin and store C.



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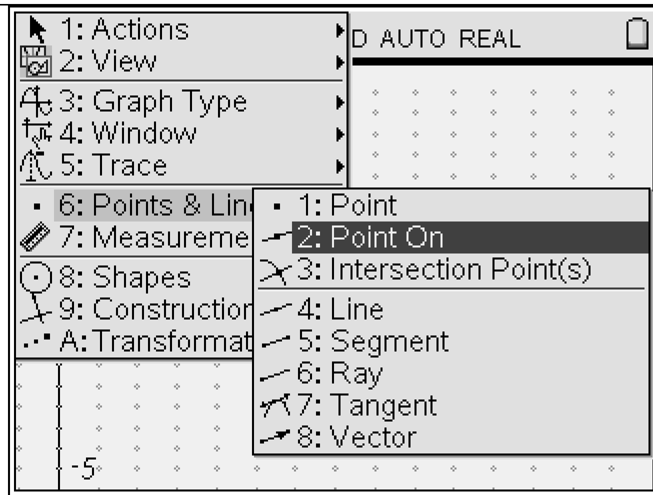
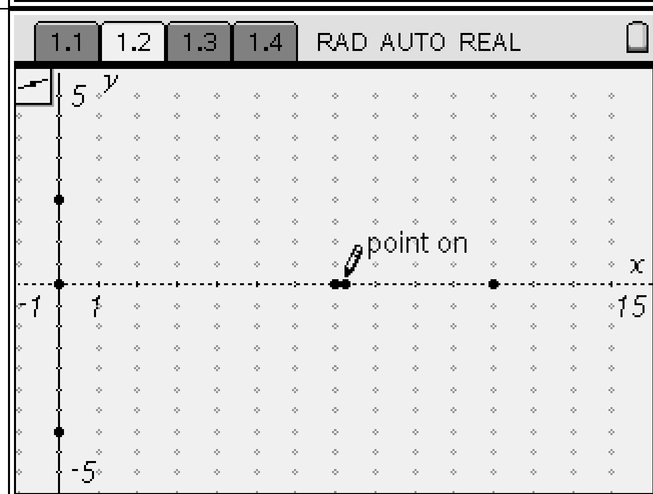
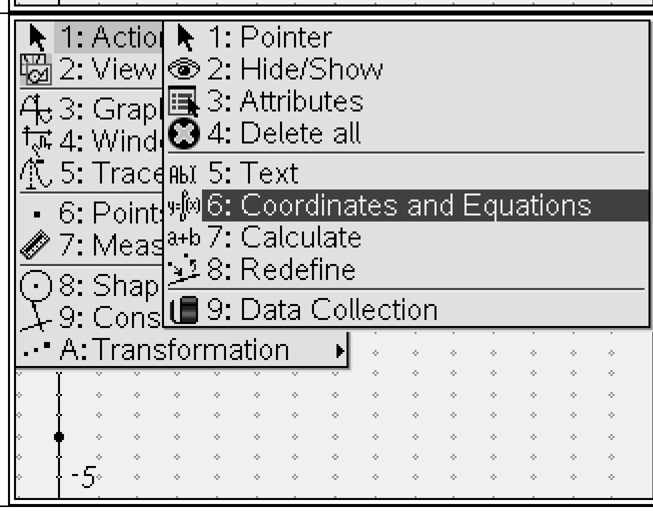
From (menu) select the 2:Point On option under Points & Lines.	
You don’t have to get the points at the exact place initially. We will adjust and label them next. Notice the Tool icon in the upper left corner. It is important to know what tool you have selected as you do things in G&G.	
Press (esc) to give up the Point On tool and then press (menu) and select 6: Coordinates and Equations from the Action choice.	

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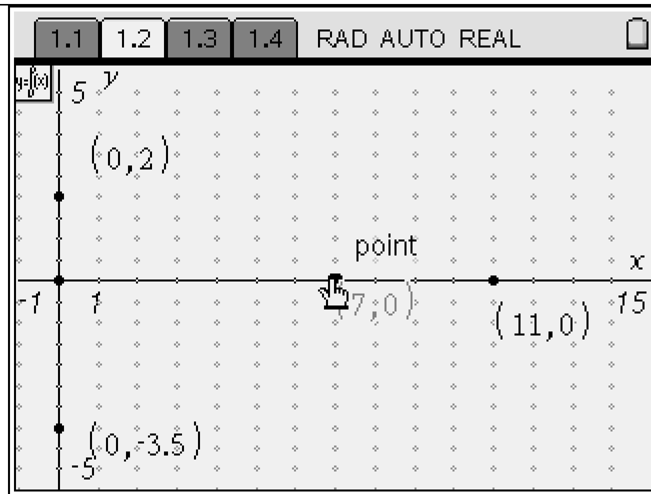
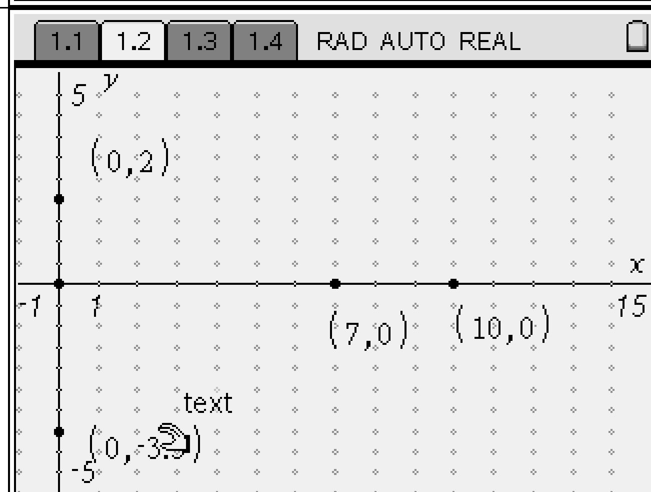
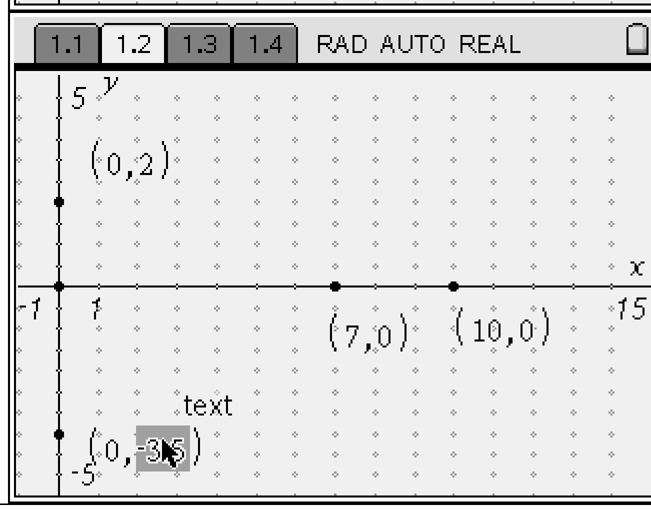
Place the points in the approximate positions. Once you press you will need to move the text that shows the coordinates away from the point to a place that it can be seen. Then press again to place the text.	
To adjust the points to their correct locations, assuming you didn't get them all in the right place, press esc to give up the tool and then point at the value you want to change, then press once and then again to edit the coordinate.	 

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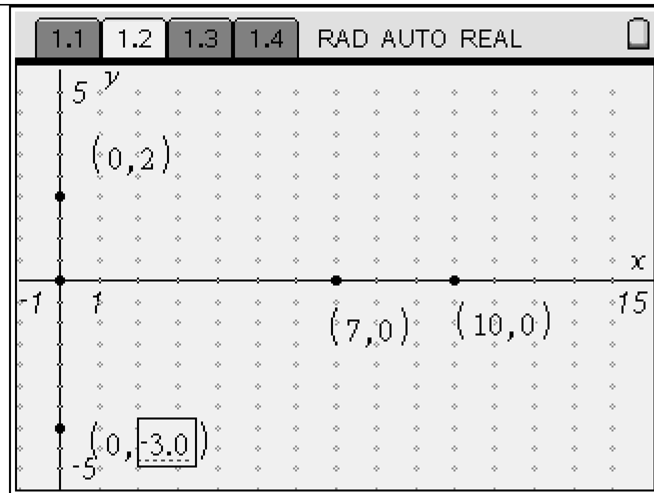
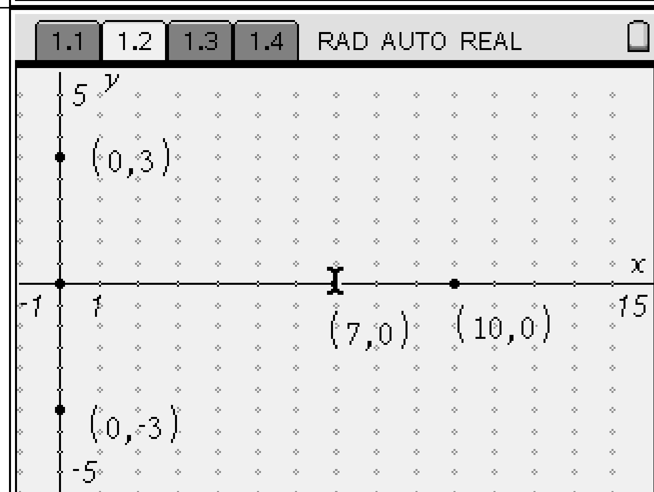
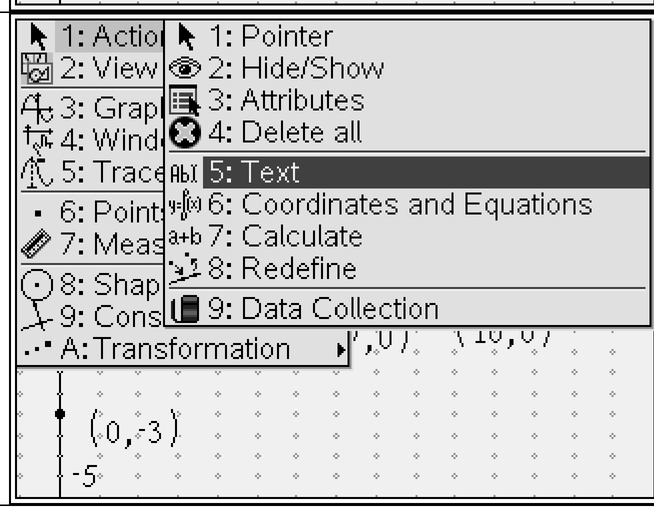
	
Now we want to label the points. Recall that P – the Warehouse can be at any point on the x-axis between store C and the origin.	
To label the points press menu and then select the 5: Text option from the Action choice.	

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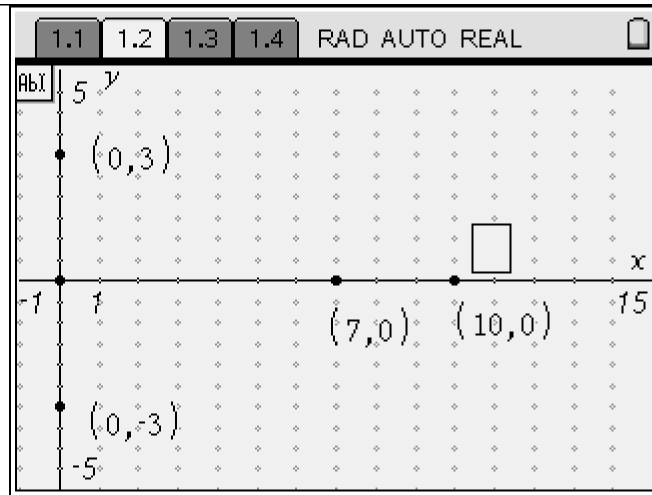
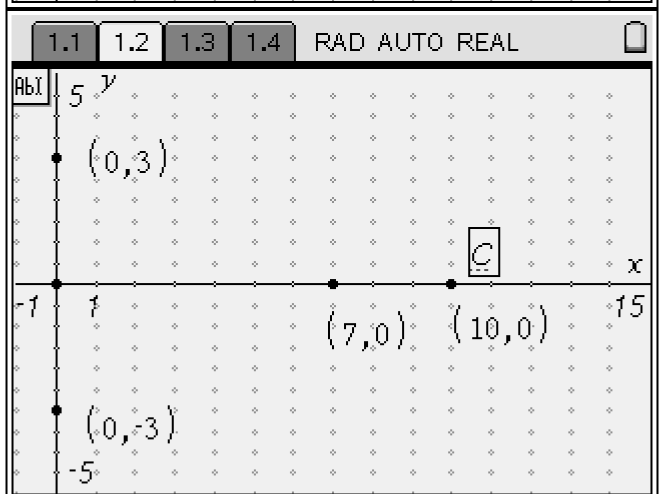
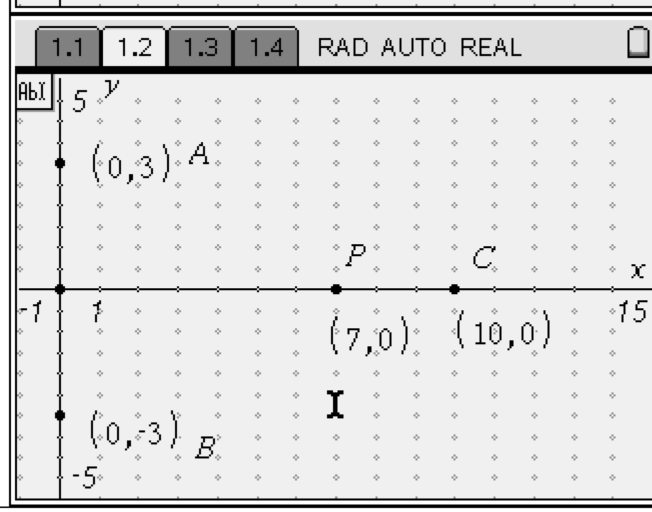
Now move close to the point you want to label and press then key in the letter and enter to save it.







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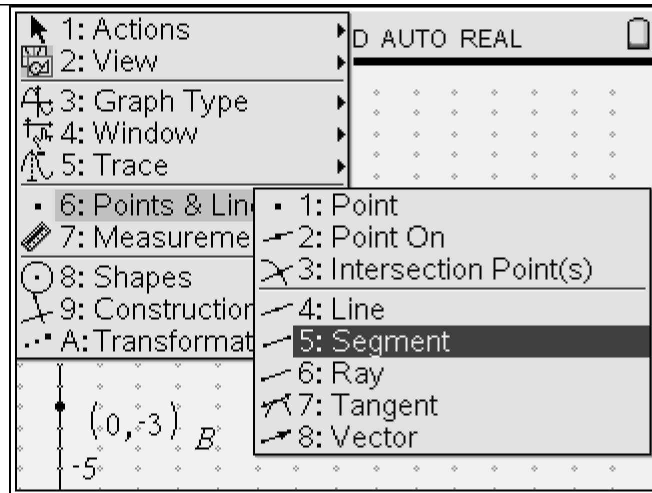
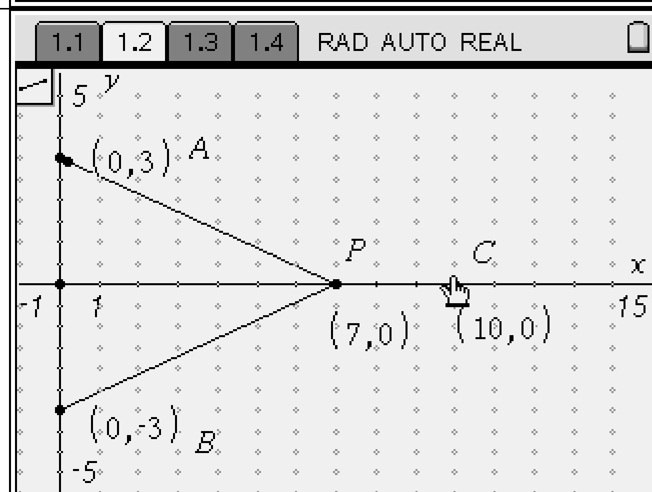
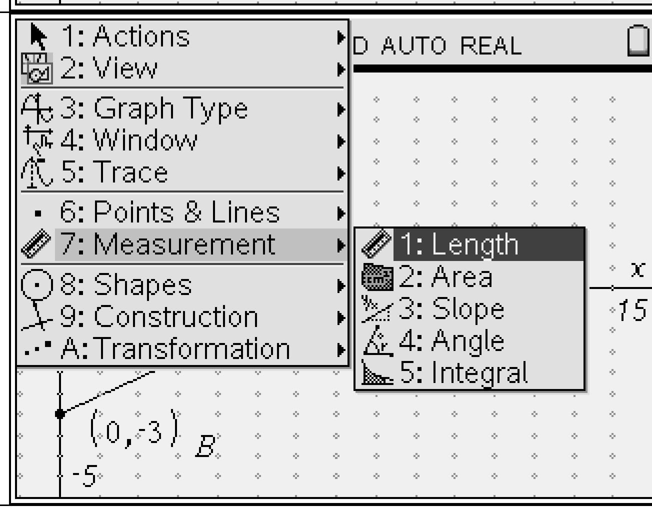
To draw the roads to the Warehouse we will press menu and select the 5: Segment option from the Points & Lines choice.



Click on the first point (a store) and then the Warehouse as the second point. Repeat for all three roads. Don't forget to get the road from store and the Warehouse.



To determine the shortest distance to the three stores we will need to collect the lengths of the three line segments. Press menu and select option 1:Length from the Measurement choice.



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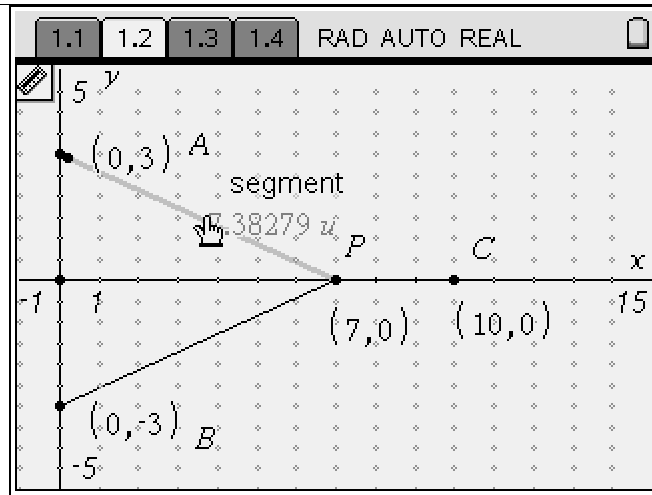
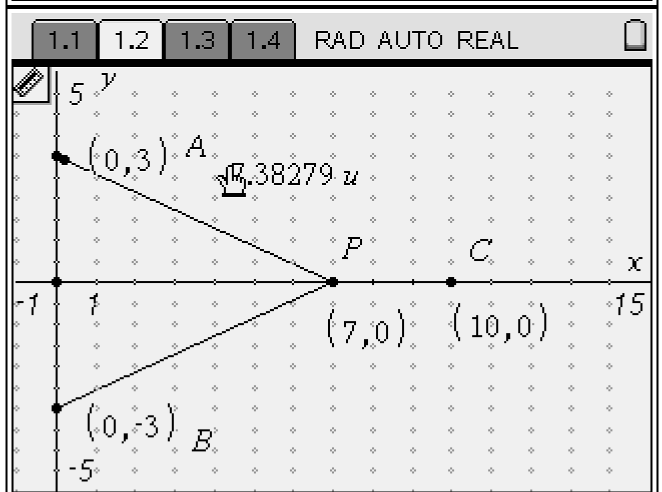
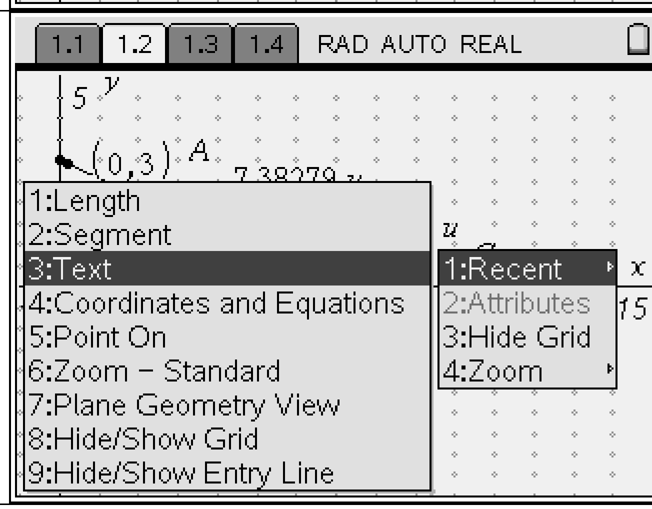
Point at each line segment and then press . Before you leave this line segment, move the measurement to an appropriate place. Repeat for all three roads/line segments. If you make a mistake you can undo the action by pressing ctrl Z.





To get the total distance we want to type in the expression AP + BP + CP. To do this, select the Text option as before. You can also get to the Text tool by pressing ctrl menu and picking it from the Recent tab.



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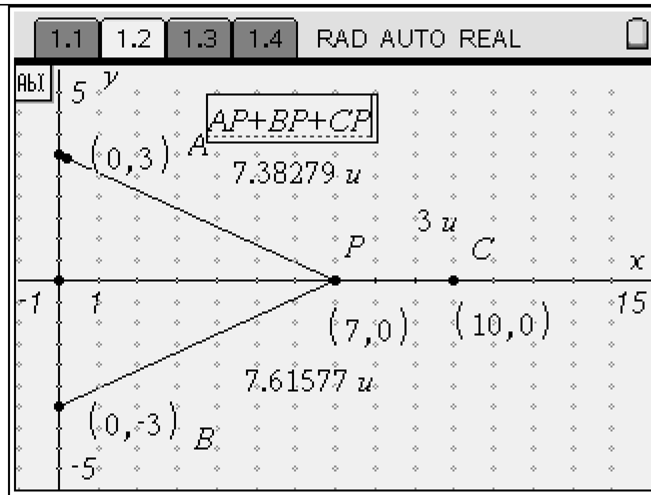
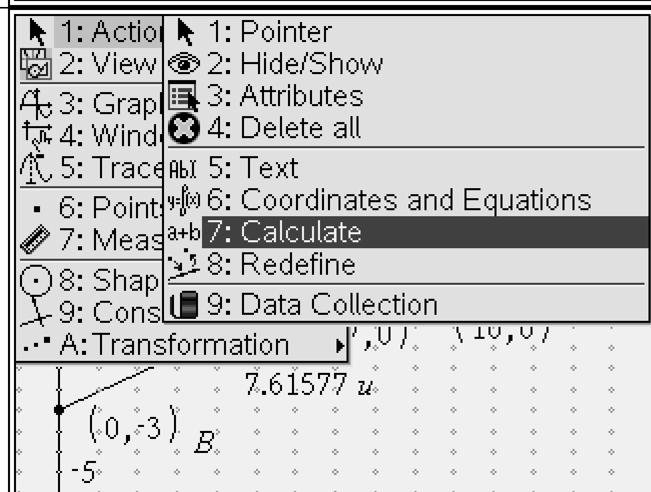
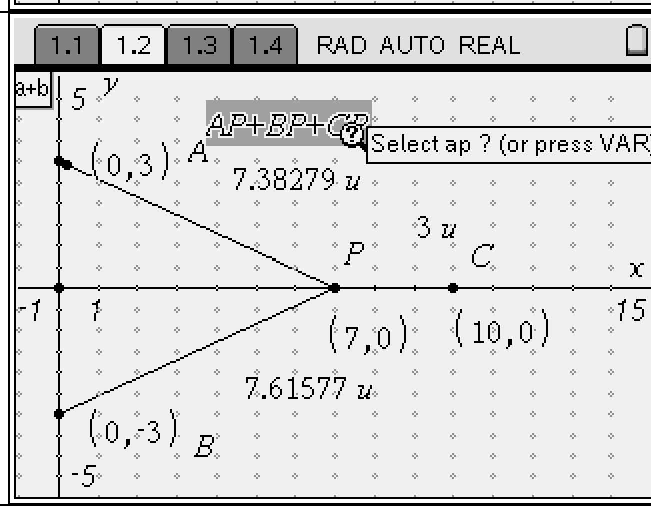
	
The Nspire will do this addition for you if you select the 7: Calculate option from the Action choice.	
Now press on the expression AP + BP + CP. Then you will be prompted to identify the three lengths. Just click on each of the three measures and then finally place the total in an appropriate location.	

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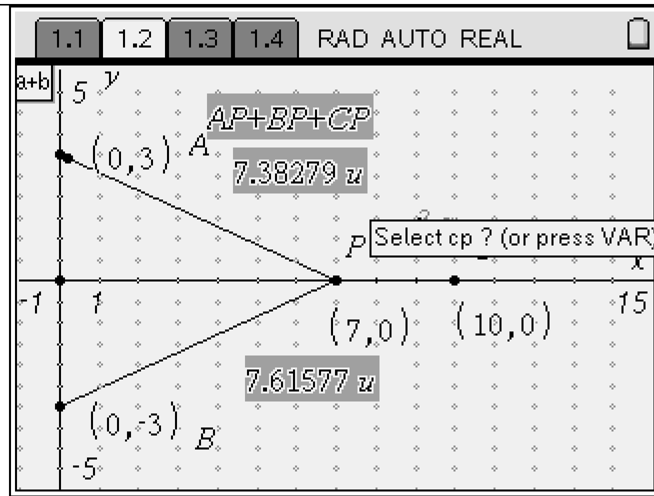
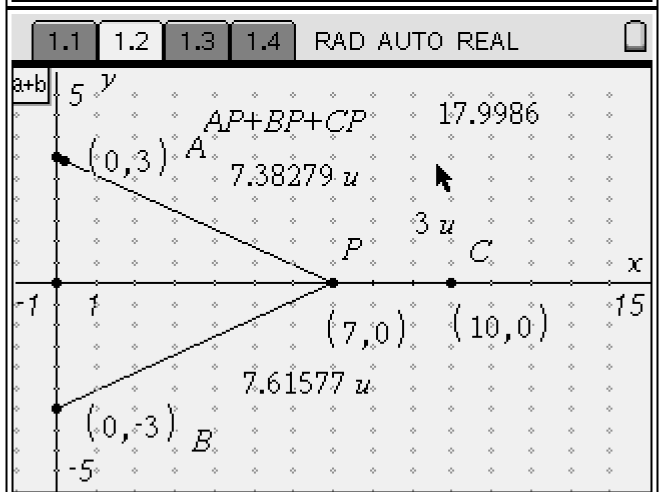
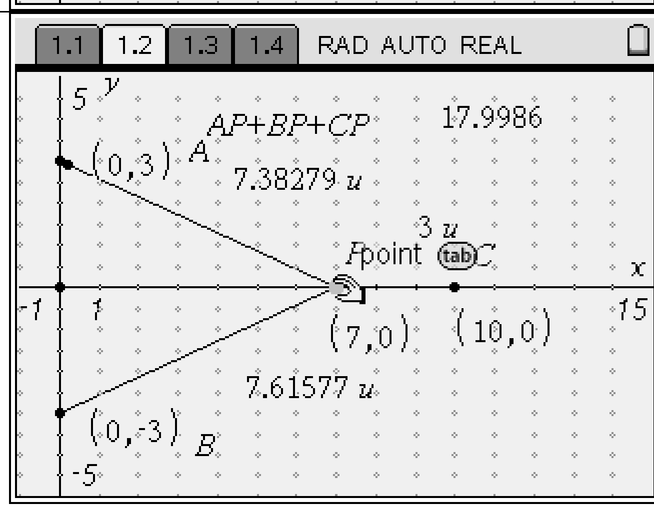




Press esc to give up the tool and then you can grab the point for the Warehouse and move it until you get the smallest distance. To grab it press ctrl and the hand will close. Use the tab key if the point is not the option that is offered to be grabbed.
Move the point to the place that gives you the smallest distance. In the example to the right we have 15.773. Can you beat that? If not it appears that the Warehouse should be at (4,0).



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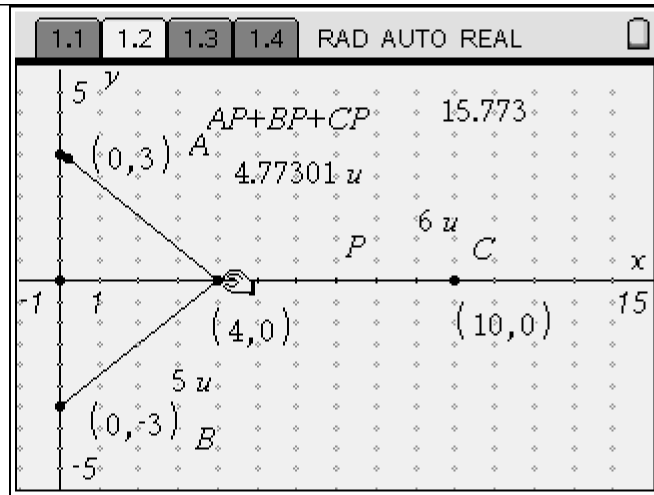
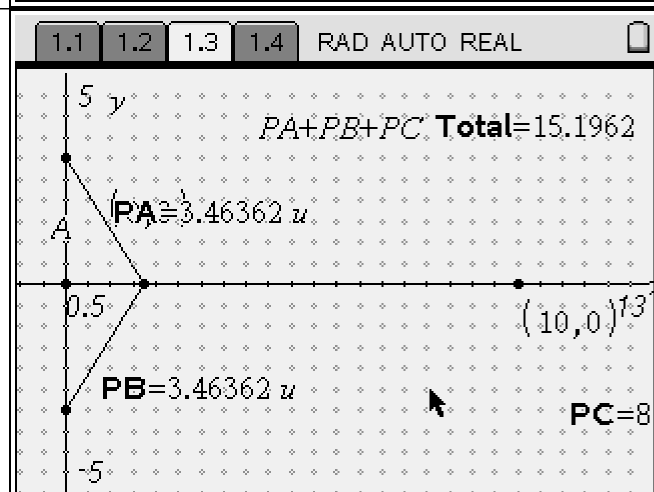
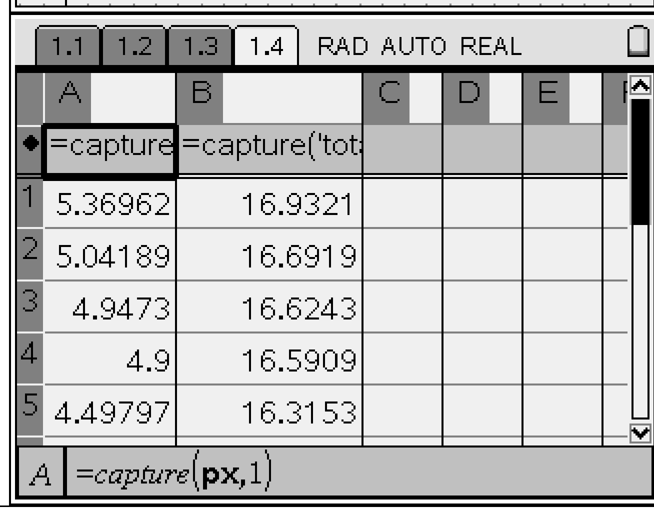


You may also setup the x-coordinate of P and the Total as variables and then with the Auto Data Collection get all the distances so you can narrow in on the best place for the Warehouse.





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