

Activity Overview:

This activity provides the steps to create a TI-Nspire document that will be used to investigate side length and area in a rectangle with a fixed perimeter. An algebraic approach is used so that findings can be generalized to other rectangles.

Materials

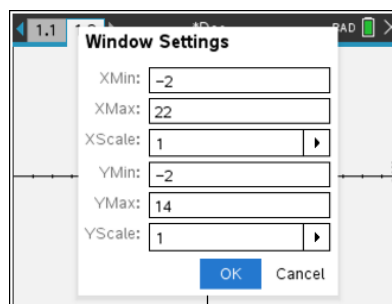
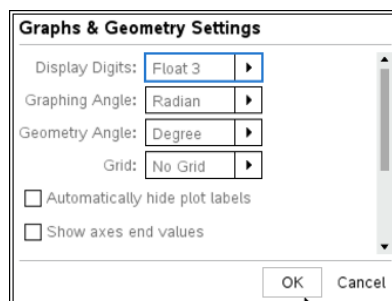
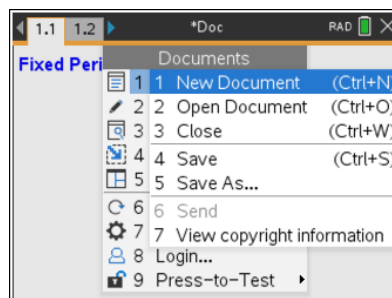
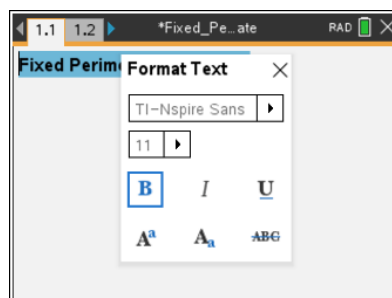
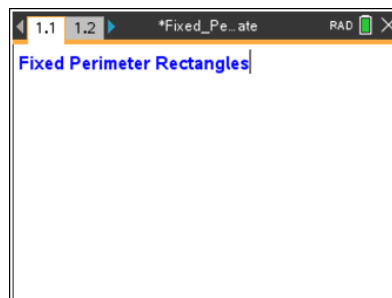
- Technology needed (TI-Nspire™ handheld, computer software)

Step 1: Preparing the document




- Open a new document by pressing **[on]** > **New Document** > **Add Notes**.
- Type Fixed Perimeter Rectangles.

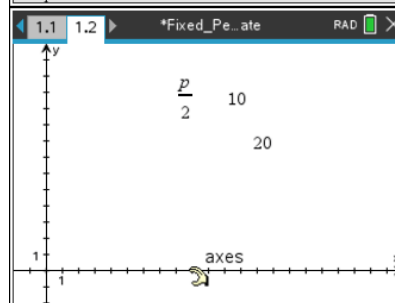
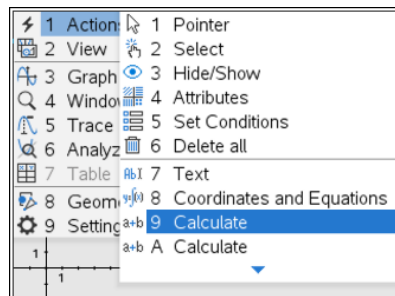
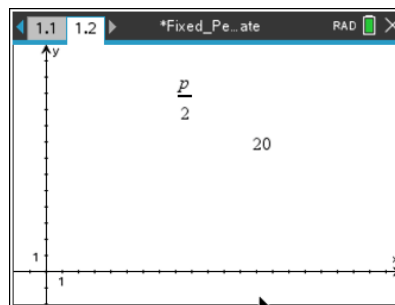
Note: To format the text, first select the text by holding down the shift key (**[shift]**) and pressing the right or left arrow key on the Touchpad. Then, press **Menu** > **Format** > **Format text**, and select **B** for bold. Press **[esc]** to exit **Format text**. To select a color for the text, press **Menu** > **Format** > **Text color**. Click the desired color, and then press **[deselect]** to deselect the text.
- Press **[doc]** > **File** > **Save**. Type **Fixed_Perimeter_Rectangles**. Tab to **[save]**, and press **[enter]**.

Note: To obtain the underscore, press **[ctrl]** **[_]**.
- To add a new page, press **[ctrl]** **[doc]**, and select **Add Graphs**.
- Press **Menu** > **Settings**. Select **Float 3** for display digits. Tab to **Graphing Angle**. Select **Radian**. Tab to **Geometry Angle**. Select **Degree**. Press **[tab]** to move from one field to the next, and press **[checkbox]** to uncheck each of the boxes. Tab to **OK** and press **[checkbox]** or **[enter]**. Hide the entry line by pressing **[ctrl]** **[G]**.
- Change the graphing window to the settings shown to the right by pressing **Menu** > **Window / Zoom** > **Window Settings**. Press **[tab]** to advance to the next input box. When completed, tab to **OK**, and press **[checkbox]** or **[enter]**.







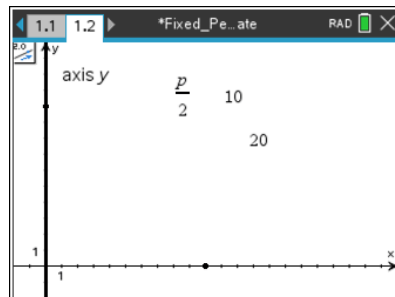
Step 2: Assigning a value to the perimeter

1. Move the cursor toward the right middle side of the screen.
2. Press **Menu > Actions > Text**. Press .
3. Type **20** in the text box, and then press .
4. Move the cursor toward the top middle of the screen. Press . Type $\frac{P}{2}$ in the text box, and press .
5. Press to exit the **Text** tool.
6. Press **Menu > Actions > Calculate**. Move the cursor near the expression $\frac{P}{2}$. When the word **expression** appears, press .
7. Move the cursor near the number **20**. When the **Select p?** appears, press  to choose this value for p .
8. Move the value **10** near the expression $\frac{P}{2}$, and press .
9. Press to exit the **Calculate** tool.





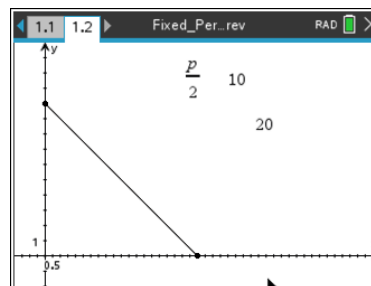
Step 3: Transferring a measurement

1. To mark a point on each axis that corresponds to the value of $\frac{P}{2}$, press **Menu > Geometry > Construction > Measurement Transfer**. This is the maximum value that either dimension can have,
2. Move the cursor to the number **10**, and press  to select the value. Move to the x-axis ("**axis x**" appears), and press .
3. Move the cursor to the number **10** again. Press  to select the value. Move to the y-axis ("**axis y**" appears), and press .
4. Press to exit the **Measurement Transfer** tool.



Step 4: Drawing a segment

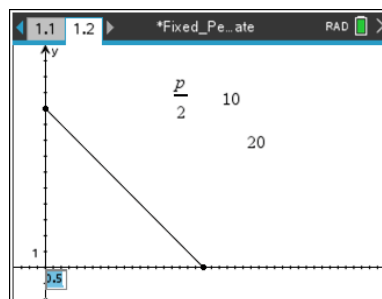
1. Press **Menu > Geometry > Points & Lines > Segment**.
2. Move the cursor to the point on one of the axes, and press . Move the cursor to the point on the other axis. Press .
3. Press **esc** to exit the **Segment** tool.











Step 5: Changing the scale

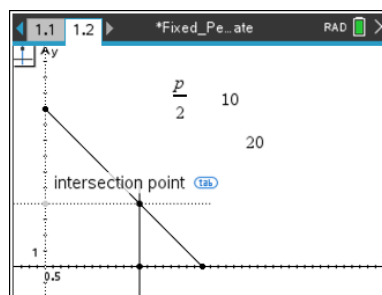
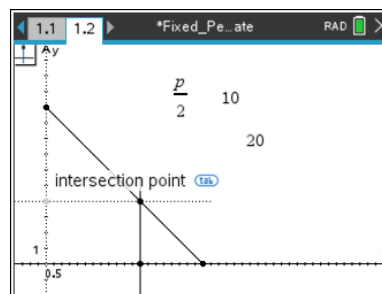
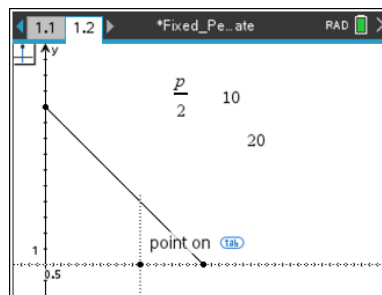
1. Change the scale on the x-axis to 0.5 by double-clicking on the current scale of 1 and typing **.5**. Then press **enter**.

(This will allow the base measurement of the soon-to-be constructed rectangle to increase/decrease in increments of 0.5 units. In some cases, you may choose to change this value to 1 for whole-number values or to 0.1 to have the base and height measured to tenths.)



Step 6: Constructing perpendicular segments




1. Make a line perpendicular to the x-axis through a point on the x-axis by pressing **Menu > Geometry > Construction > Perpendicular**.
2.  on the x-axis to select it and then move along the x-axis until the words **point on** are displayed. Press .
3. Move towards the intersection of the line perpendicular to the x-axis and the segment. When the words **intersection point** appear, press . Move to the y-axis, and press .
4. Press **esc** to exit the **Perpendicular** tool.
5. Find the point of intersection of the y-axis and the line perpendicular to the y-axis by pressing **Menu > Geometry > Points & Lines > Intersection Point(s)**. Move the cursor to the perpendicular line and press  on the line; then move the cursor to the y-axis and press . Then, find the point of intersection of the x-axis and y-axis by pressing  on the x-axis and pressing  again on the y-axis.
 Press **esc** to exit the **Intersection Point** tool.

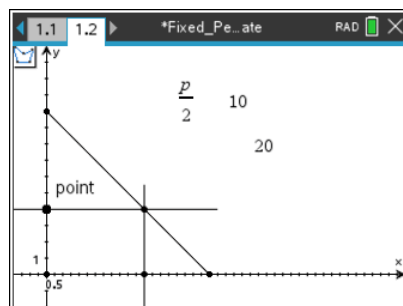


Step 7: Drawing a rectangle with the Polygon tool


1. A rectangle will be drawn using the point on the diagonal segment, the point on the x-axis determined by the perpendicular, the point on the y-axis determined by the perpendicular, and the origin.

Press **Menu > Geometry > Shapes > Polygon**.


2. Beginning with the point of intersection of the perpendicular line and the y-axis, move in a counterclockwise direction around the vertices, pressing  at each vertex point.
3. Return to the first vertex point marked, and press  to “close” the rectangle.
4. Press  to exit the **Polygon** tool.

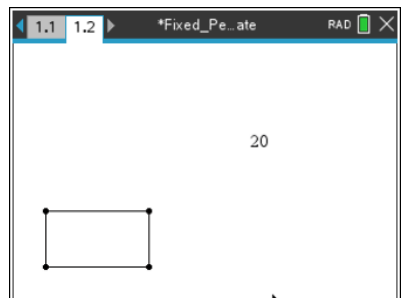


Step 8: Hiding objects





1. Press **Menu > Actions > Hide/Show**.
2. Move around the screen and press  to hide each object *except* the rectangle, the points which are the vertices of the rectangle, and the number **20**, which indicates the perimeter of the rectangle.

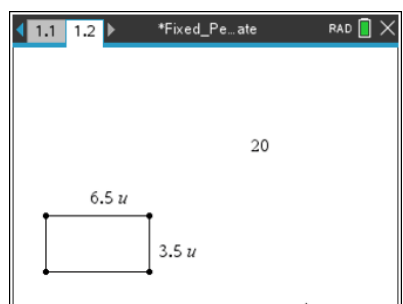
Note: See the figure to the right to see what should be hidden.

2. Press  to exit the **Hide/Show** tool.



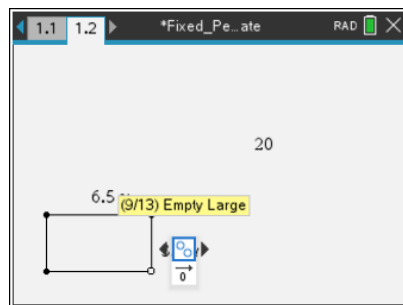
Step 9: Measuring base and height of the rectangle

1. Press **Menu > Geometry > Measurement > Length**.
2. Move to a vertex and press . Move to an adjacent vertex and press . Move the measurement to the desired location then press .
3. Repeat for the other dimension.
4. Press  to exit the **Length** tool.




Step 10: Changing dimensions of the rectangle

1. The point that was marked on the x -axis will be used to change the dimensions of the rectangle. Move to that point, right-click (**ctrl** **menu** on the handheld), and choose **Attributes**.
2. Press **▶** until “**Empty Large**” appears. Press **enter**.
3. Hide the other three vertices by pressing **Menu > Actions > Hide/Show** and select the other three vertices, which are no longer needed. Then, press **esc**.
4. Grab and drag the point left and right to change the dimensions of the rectangle.



Step 11: Adding text and fixing measurements

Press **Menu > Actions > Text** to add text to the screen to help you organize the information.

1. Move the cursor to the top of the screen. Press  and type the text below.

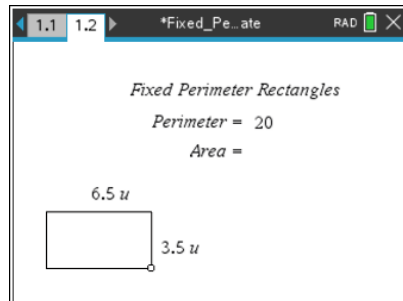
Fixed Perimeter Rectangles

Perimeter =

u (placed to the right of the value 20)

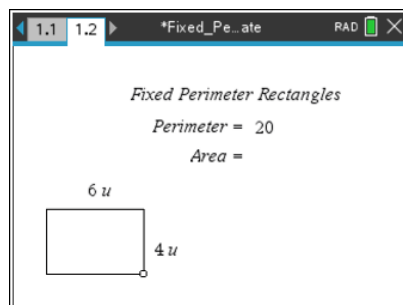
Area =

2. Press **esc** to exit the **Text** tool.
3. Drag the point on the rectangle to these measurements for base and height: base = $6u$ and height = $4u$.



Step 12: Saving the document

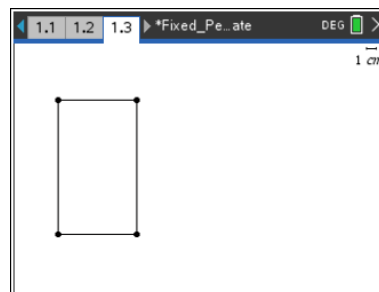
1. Press **ctrl** **S**.






Alternate Method of Constructing a Rectangle with Fixed Perimeter

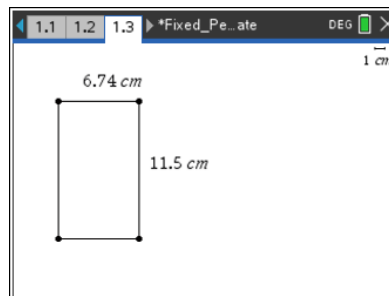
Step 1: Add a Geometry page

1. Press **ctrl** **doc** > **Add Geometry**
2. Press **Menu** > **Shapes** > **Rectangle** and draw a rectangle on the page.



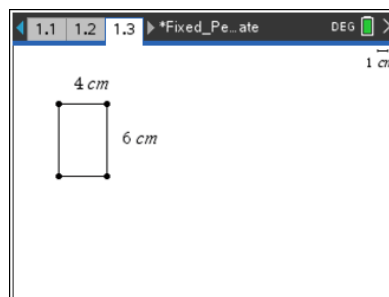
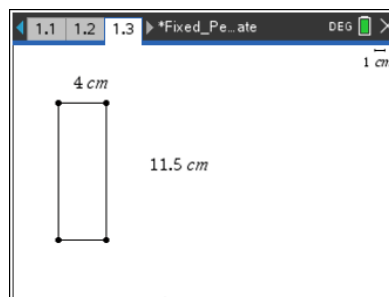
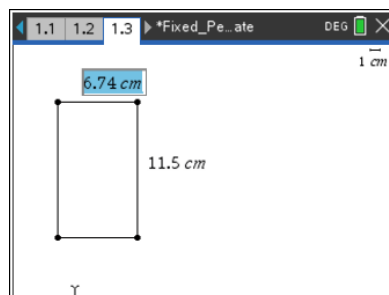
Step 2: Measure the lengths of the sides

1. Press **Menu** > **Measurement** > **Length**. Move to a vertex, and press . Move to an adjacent vertex, and press . Move the measurement to the desired location, and then press .
2. Repeat for the other dimension.
3. Press **esc** to close the tool.



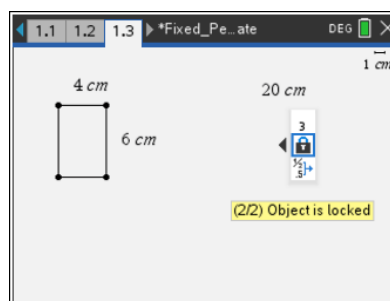
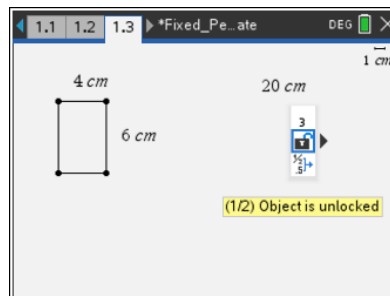
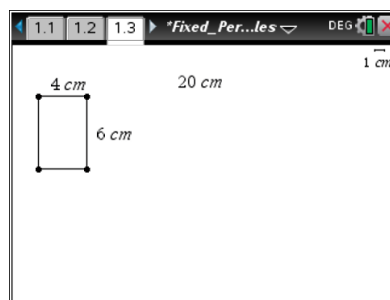
Step 3: Changing the measurements

1. Move the cursor over the width measurement, and double click. This will open the text box for editing. Delete the numerical value and change it to 4 cm. **Note:** Make sure there is a space between the numerical value and the label.
2. Move to the measurement for the length, and change it to 6 cm.



Step 4: Measuring the perimeter and locking its value.

1. Press **Menu > Measurement > Length**, and determine the perimeter of the rectangle.
2. Place the measurement on the page, and then close the tool by pressing **esc**.
3. Move the cursor to the perimeter measurement and right click. Select **Attributes** from the menu. Press **▼** to move to the second icon, the padlock, as shown in the accompanying diagram.
4. Set the padlock to the locked position by clicking on the arrow to the right of the icon. Alternatively, press **▶** on the Touchpad.
5. The message, **(2/2) Object is locked**, will be displayed. Press **enter**.



Step 5: Changing the point's attribute

1. Right click on the vertex in the top right corner of the rectangle, and change its attribute to **"Empty Large."**
2. Label the perimeter, and add a text box containing **area=**.
3. Grab and drag the open point to verify that the rectangles drawn all have a constant perimeter of 20 cm.

Note: When the left and right base vertices are selected first when the rectangle is constructed, the upper vertices may be dragged to change the dimensions after the perimeter measurement is locked.

