

Right Triangle with Constant Legs vs Perimeter

by – Murney R Bell

Activity overview

Constructing a Right Triangle with the constraints that sum of the legs is kept constant, so when the length of the legs change the sum of the two legs remains constant but the perimeter will change. What will the minimum value for the perimeter be? What kind of relationships exists between the legs? In this activity, you will explore these questions, examining patterns using tables, graphs, and equations.

Concepts

- *Simple relationships between length and width, area, and perimeter.*
 - *Geometrical shape: rectangles and areas.*
 - *Algebraic modeling*
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Teacher preparation

- *This activity is designed to be used in a middle school or high school geometry/algebra classroom.*
- *Review the Right Triangle properties. This may be a good introduction to the Pythagoras theorem.*
- *Review perimeter and area of triangles.*

Classroom management tips

- *This activity is designed to be **student-centered** with the teacher acting as a facilitator while students work cooperatively. Use the following pages as a framework of how the activity will progress.*
- *Basic TI-Nspire operations are understood.*
- *The student worksheet helps guide students through the activity and provides a place for students to record their answers and observations.*
- *Depending on student skill level, you may wish to use points with integer coordinates, or only positive values.*

TI-Nspire Applications

Calculator, Graphs & Geometry, and Notes are used in the activity.

Step-by-step directions

Open a **Graphs & Geometry** page. Change and adjust the window to Quadrant 1.

Construct a line segment (at least half of the length of the window from left to right). Place a point on the segment. Label the three points, A, B, and C. Measure the lengths, which are AB, and BC.

[Menu]

[7:Measurement]

[1:Length].

The precision of this number can be changed, by moving the cursor to the measure and press esc or esc + .

Measurement transfer is located on menu

menu

[9:Construction]

[8:Measurement transfer].

Move the cursor over AB measurement and then move to the x-axis. A point will appear on that axis. Repeat, by moving over the BC measurement and then to the y-axis. A point will appear on that axis.

Construct a triangle on these two points and the origin.

Determine the perimeter of the triangle, with the following key strokes.

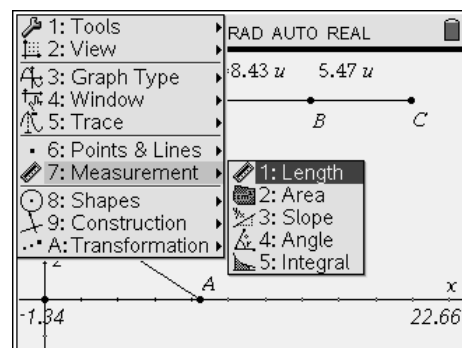
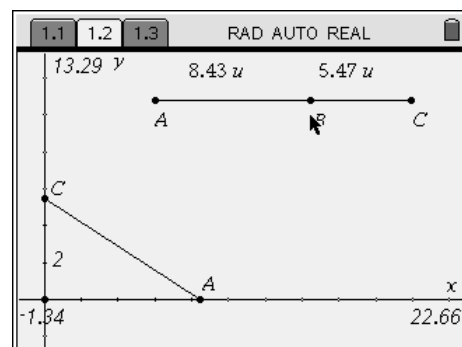
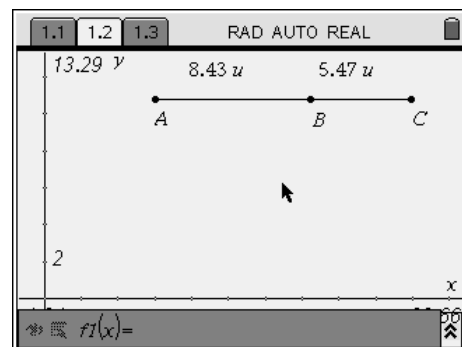
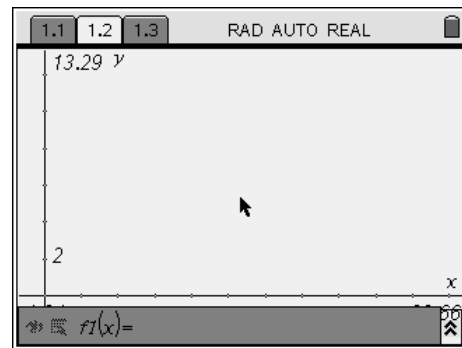
[Menu]

[7:Measurement]

[1:Length].

Move cursor to the hypotenuse of the triangle and a measurement will appear; click and move cursor to a convenient spot on the page. This measurement is the perimeter of the triangle.

To transfer the measurements to the spreadsheet, names will be needed to be assigned. (Variable



names must to be unique.)

Name AB: **leg** and perimeter: **peri**

Move point B on the slider to confirm that the triangle is attached to the transfer points and the measures change.


To collect data a **Lists & Spreadsheet** page needs to be open.



Name the first column: **Base**
Name the second column: **Perimeter**

In order to collect data from the Graphing page, the cursor is moved to the row below the column names.

The following key sequence is used:

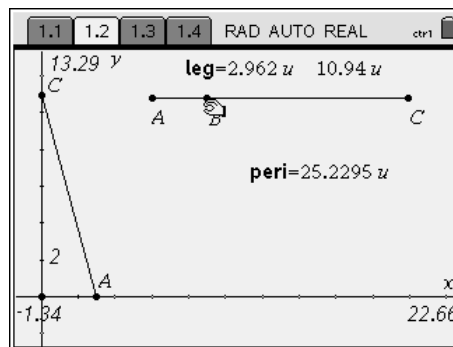
- [Menu]**
- [2:Data Capture]**
- [Manual Data Capture].**

The cursor will appear with **var** highlighted, press var () , **[3:Link To:]** in the first column [leg] and the second column [peri].

Returning to the graphing page, data can be collected by grabbing the point B and moving the point. The data is transfer with the following keystroke:   that is (control) (point). A new data pair is captured every time.

After 10 or more points are collected; these points should be taken from the about equal distances from the left to the right.

These points can be plotted on the **[Data & Statistics]** page. After the page is open, move the cursor to the bottom (the x-axis) and click. Choose



	A	B	C	D	E
	base	perimeter			
1					
2					
3					
4					
5					

- 1: Actions
- 2: Insert
- 3: Data
 - 1: Automated Data Capture
 - 2: Manual Data Capture

	A	B	C	D	E
	base	perimeter			
1	var				
2					
3					
4					
5					

base and then move to the y-axis and choose **perimeter**.

A quadratic shape will appear.

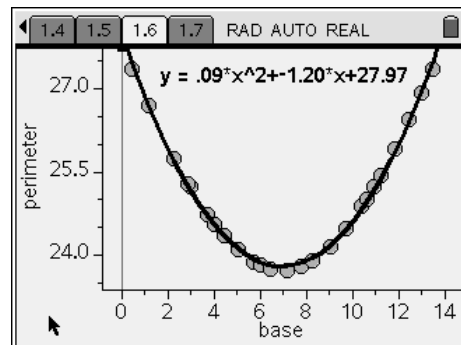
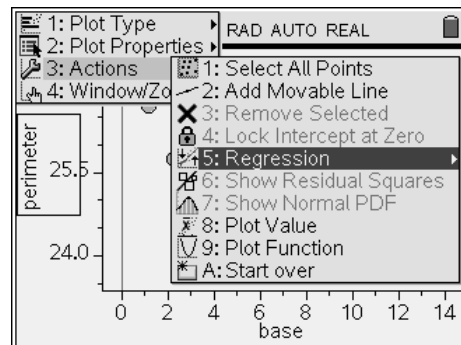
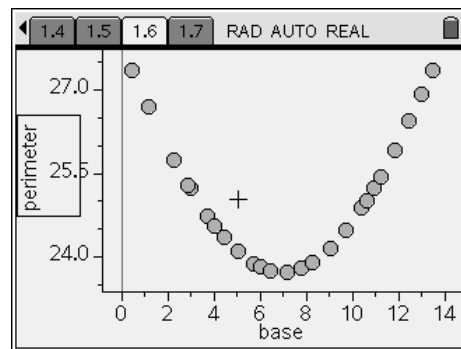
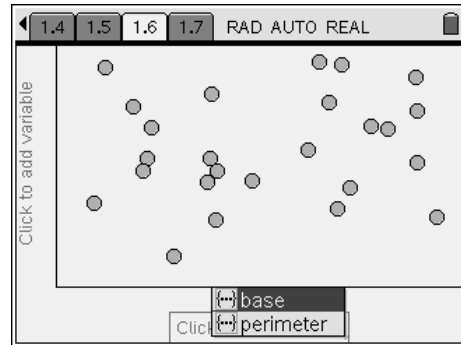
The quadratic regression equations can be found by **[Menu]**

[3:Actions]

[5:Regression]

{4:Show Quadratic}

The quadratic equation will appear, but grab the equation and move to a better location so all equation can be clearly read.



Assessment and evaluation

- *Change the length of the slider and have students create another similar file and write about the observed differences and similarity between the two problems.*
- *Have student work capture the length of each side the right triangle. Then plot pairs of measure against one another, in order to observe relationships between the sides. Discussion of Pythagoras Theorem will be a natural progression.*

Activity extensions

- *Use Constant Perimeter rectangle to extend concept of quadratic relationships.*
- *Use astronomy measure of brightness, to investigate the dimension value with the inverse of the distance square.*
- *This is an underpinning idea of a minimum-maximum value problems associated with Calculus.*

Student TI-Nspire Document

The screenshots show the following steps in the TI-Nspire document:

- Right Triangle with Constant Sum of the Two Legs vs Perimeter:** A diagram of a right triangle with vertices A, B, and C. The horizontal leg is labeled $leg = 7.672u$ and the vertical leg is $leg2 = 8.28u$. The hypotenuse is labeled $twolegs = 15.9494u$. The perimeter is $peri = 27.2355u$ and the area is $Tarea = 31.7522u^2$.
- Construction Instructions:**
 - Construct a line segment (at least half of the length of the window from left to right).
 - Place a point on the segment.
 - Label the three points, A, B, and C.
 - Measure the lengths: AB, and BC.
 - Measurement transfer is located on menu: [9:Construction]
- Data Capture Instructions:**
 - Name the first column: **Base**
 - Name the second column: **Perimeter**
 - To setup in order to collect data: [2:Data Capture] [2:Manual Data Capture]
- Data Table:**

A	base	B	perimeter	C	D	E
1	2.96203		25.2295			
2	.455696		27.3495			
3	1.13924		26.709			
4	2.27848		25.7403			
5	2.88608		25.2833			
- Quadratic Regression:** A graph showing the relationship between base (x-axis) and perimeter (y-axis). The data points are fitted with a parabola. The equation of the parabola is $y = .09x^2 - 1.20x + 27.97$.
- Instructions for Regression:**
 - on the **Data & Statistics** page
 - Choose **base** for the x-axis and the **perimeter** for y-axis.
 - To determine the quadratic regressions equation, do the following procedure: [3:Actions] [5:Regression]