Trigonometric Ratios

ID: 10276

Time required
60 minutes

Activity Overview

In this activity, students discover the trigonometric ratios through measuring the side lengths of similar triangles and calculating their ratios. The formal definitions of the sine, cosine, and tangent or an angle are presented and applied to find the missing side lengths.

Topic: Rational Functions & Equations

- *Use the primary trigonometric ratios to express the ratios of the lengths of pairs of sides of a right triangle.*
- *Solve any right triangle given an angle and the length of an opposite or adjacent side.*

Teacher Preparation and Notes

- *This activity assumes knowledge of similar triangles. Students are asked to use t handheld to measure the lengths of segments and angles, write and evaluate simple formulas, and perform a data capture. If students are unfamiliar with these functions of the handheld, extra time should be taken to explain them.*
- *This activity is designed for use in an Algebra 1 classroom. It can also be used as a review in Algebra 2.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "10276" in the keyword search box.***

Associated Materials

- *TrigRatios_Student.doc*
- *TrigRatios.tns*
- *TrigRatios_Soln.tns*

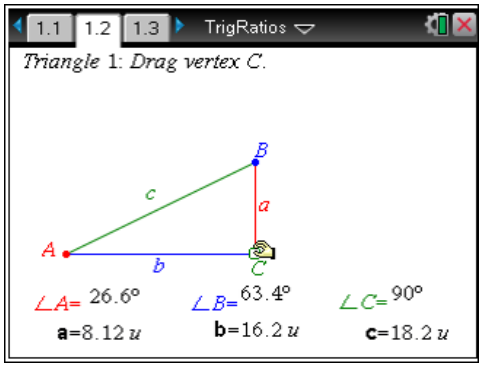
Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Exploration of Trig Ratios (TI-Nspire technology) — 13419*
- *Exploring Trigonometric Ratios (TI-Nspire technology) — 9400*
- *Right Triangle Trig (TI-84 Plus family) — 5463*

Problem 1 – Exploring a Triangle

Introduce the geometric model on page 1.2. Dragging the green point adjusts the dimension of the triangle. Review the terms *right triangle, hypotenuse,* and *legs* with the class.



Directs students to explore the model independently and answer the questions on their worksheets. Some questions appear on page 1.3 as well. Students should conclude that all the different triangles they create by dragging vertex *C* are similar because they have the same angle measures.

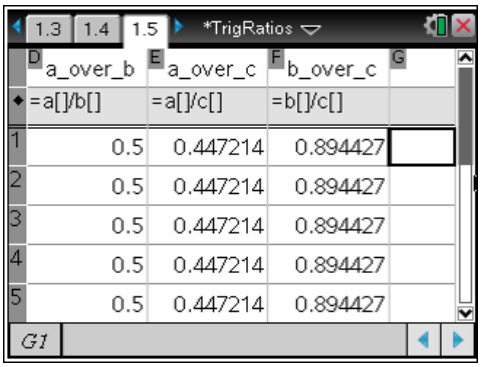
Page 1.4 directs students to perform a data capture of the side lengths a, b and c.

Demonstrate capturing one or two sets of side length values. Then allow students to work independently to capture more values, for a total of 10 sets.

To capture a set of values, return to page 1.2 and press ctrl + . This stores the current values of *a*, *b*, and *c* in the spreadsheet on page 1.5.

To capture another set of values, drag vertex *C* to a new location and press ctrl + . again.

Page 1.6 directs students to compare the calculated ratios on page 1.5



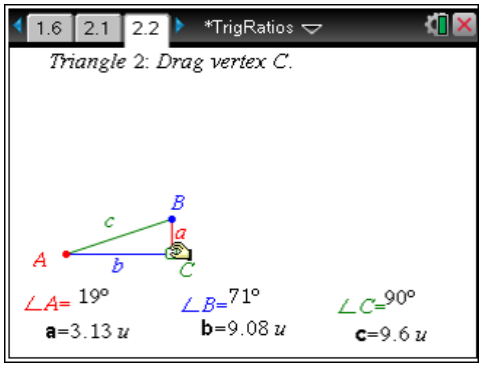
Students should find that the ratios are the same for all of the different similar triangles.

TI-Nspire Navigator Opportunity: *Live Presenter* and *Screen Capture*

See Note 1 at the end of this lesson.

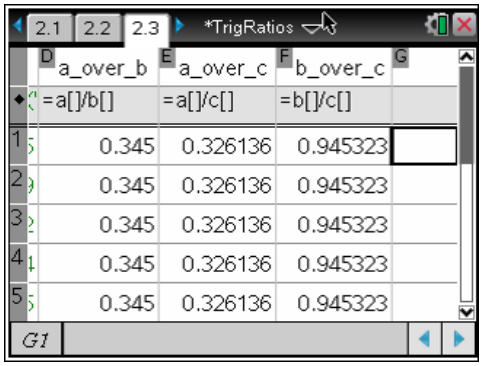
Problem 2 – Exploring Another Triangle

Students are to repeat the steps from Problem 1 with a new triangle model on page 2.2. Ask questions like: *Is this triangle a right triangle? Is this triangle similar to Triangle 1? Why or why not?*



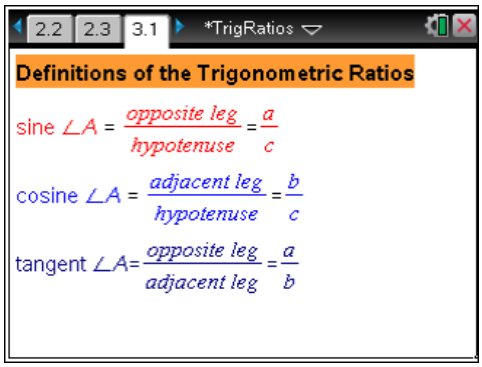
The purpose of repeating the steps is to show students that the ratios of the side lengths depend upon the angle measures of the triangle. Students should realize that if the angle measures are the same, the ratios of the sides are the same, and if the angle measures are different, the ratios of the sides are different.

These screenshots show sample data capture results.



Problem 3 – Introducing the Trigonometric Ratios

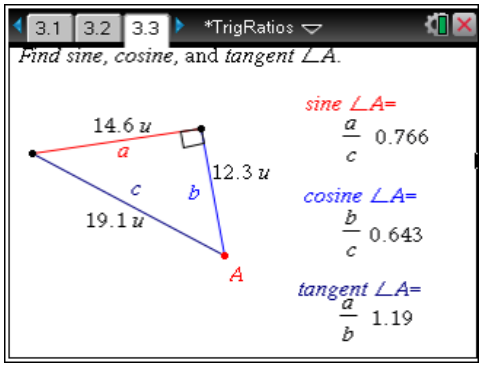
Page 3.1 introduces the definitions of the three basic trigonometric ratios. Take time to be sure that students understand the meaning of opposite and adjacent side.



On page 3.3, guide students to calculate each trigonometric ratio. Have them refer back to the definitions on page 3.1 to make sure that *a*/*c* does represent the opposite side divided by the hypotenuse, and therefore is equal to the sine of angle *A*, etc.

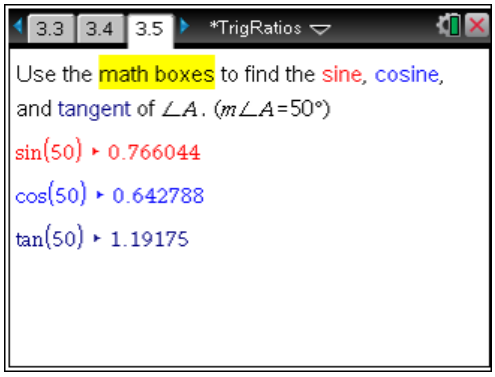
To calculate a ratio, go to **MENU > Actions > Calculate** and click on the formula (such as $\frac{a}{b}$).

The handheld will prompt for the values of the variables. Click on the corresponding length measurements.



Demonstrate how to calculate trigonometric ratios in math boxes on a *Notes* page, with calculator commands. Take this opportunity to reinforce the idea that the trigonometric ratios of are function of the angle measure.

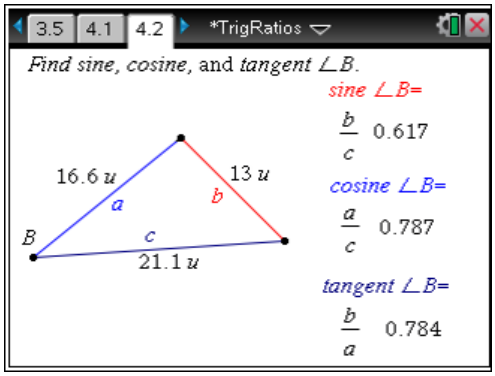
The commands for each of the basic trigonometric ratios are shown in the screenshot. Students should calculate the sine, cosine, and tangent of 50° on page 3.5 and compare the results with those they found by measuring the side lengths and calculating the ratios directly.



Problem 4 – Calculating the Trigonometric Ratios of a Different Angle

Page 4.1 challenges students to find the sine, cosine, and tangent of a different angle. They should use the definitions of each ratio in terms of opposite side, adjacent side, and hypotenuse on page 3.1 to write formulas for each ratio.

As in problem 3, students use calculator commands in the math boxes on page 4.3 to check their answers.



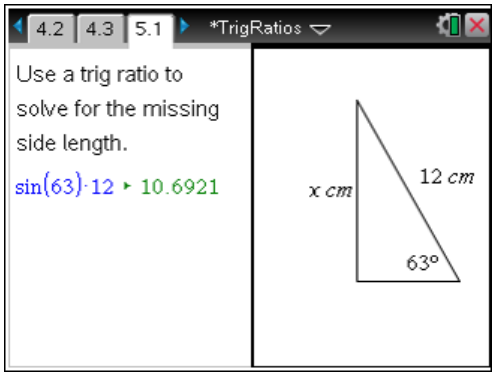
TI-Nspire Navigator Opportunity: *Live Presenter* and *Screen Capture*

See Note 2 at the end of this lesson.

Problem 5 – Finding Missing Side Lengths

This problem introduces an application of the trigonometric ratios: finding missing side lengths. Point out that this triangle is not drawn to scale, so simply measuring the side with the length tool will not yield the correct answer.

Ask questions like: *What do we know? What do we want to find? What trigonometric ratio uses the opposite side and the hypotenuse?* Students should realize that they can use sine to write an equation using the measures of opposite side, hypotenuse, and the angle, as:



$$\sin 63° = \frac{opp}{hyp} = \frac{x}{12}.$$

Students should then use the math boxes to solve the equation.

TI-Nspire Navigator Opportunity: *Screen Capture*

See Note 3 at the end of this lesson.

TI-Nspire Navigator Opportunities

Note 1
Problem 1, Live Presenter and *Screen Capture*

Use *Live Presenter* to demonstrate how to grab point C as well as how to capture the data. Use *Screen Capture* to display the captured data to guide students in the discussion of the ratios always being equal.

Note 2
Problem 4, *Screen Capture and Quick Poll*

Use *Screen Capture* to check on student progress with placing the correct variables in each ratio. Remediate with students as needed. Use *Live Presenter* to demonstrate how to calculate the ratios.

Note 3
Problem 5, *Screen Capture*

Use *Screen Capture* to monitor student progress as they move through problems 5.1 and 5.2. Offer help to individual students as needed.