TEACHER'S GUIDE

MATH SERIES 2

TRIGONOMETRY, Part 2:

29 Minutes

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FOR USE IN: Mathematics

LEVEL: Grades 7-9

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EDUCATIONAL OBJECTIVES:

To help the students understand:

- **tangent, sine, and cosine ratios**
- **Knowing an angle and one side length of a right triangle, we can calculate the lengths of either of the other two sides by selecting the correct trigonometric ratio.**
- **Knowing 2 side lengths of a right triangle, we can calculate an unknown angle by selecting the correct trigonometric ratio.**
- **Using the mnemonic acronym SOHCAHTOA to select the correct trigonometric ratio in a given problem**

BACKGROUND INFORMATION:

The solution of many problems requires the measurement of line segments and angles. When we use a ruler or tape measure to determine the length of a segment, or a protractor to find the measure of an angle, we are taking a ***direct measurement*** of the segment or the angle. In many situations, however, it is inconvenient or impossible to make a measurement directly. For example, it is difficult to make the direct measurements needed to answer the following questions:

What is the height of a 100-year-old oak tree?

What is the width of a river?

What is the distance to the sun?

We can answer these questions by using methods that involve ***indirect measurement.*** Starting with some known lengths of segments or angle measures, we apply a formula or a mathematical relationship to *indirectly* find the measurement in question. In geometry,

when we worked with similar triangles and the Pythagorean Theorem, we used indirect measurement.
One application of ***trigonometry*** relates the ratio of the lengths of two sides of a right triangle to an acute angle of the triangle. By combining a knowledge of trigonometry with that of similar triangles, we can measure line segments and angles indirectly. Engineers, surveyors, physicists, and astronomers frequently use these trigonometric methods in their work.

BEFORE SHOWING THE VIDEO

Since the sine and cosine ratios each have the length of the hypotenuse of a right triangle as the second term of the ratio, we can use these ratios to solve problems in the following cases:
1.We know the length of one leg and the measure of one acute angle and want to find the length of the hypotenuse.
2.We know the length of the hypotenuse and the measure of one acute angle and want to find the length of a leg.
3.We know the lengths of the hypotenuse and one leg and want to find the measure of an acute angle.

CONTENT OF THE VIDEO:

Part 2 begins with a summary of what was presented in Part 1: similar triangles; finding an unknown height in a similar triangle; tangent ratios of varying angles; hypotenuse, adjacent, and opposite sides; using a calculator to find the tangent ratio of any angle; using tangent ratios to find either an unknown adjacent or opposite side length.
In a museum's architecture, an angle is measured to be 10 degrees. Adjacent and opposite sides to that angle are identified, as is the hypotenuse. The tangent ratio is the opposite side length divided by the adjacent side length Other right triangle ratios include the sine ratio of the angle, which is the ratio of the opposite side length to the hypotenuse length. . The cosine ratio of the angle is the ratio of the adjacent side length to the hypotenuse length. The sine ratio of the known angle 10 degrees and the known length of the hypotenuse are used to find the unknown length of the opposite side. How to use a calculator to do that is shown. The cosine ratio of the known angle 10 degrees and the known length of the hypotenuse are used to find the unknown length of the adjacent side. How to use a calculator to do that is shown. The mnemonic acronym, SOHCAHTOA, for recalling the ratio formulas for sine, cosine, and tangent is introduced, and repeatedly referred to thereafter. An exercise is given for: finding the unknown angle in a right triangle using a calculator. Given that the opposite and adjacent side lengths are known, the tangent is used; SOHCAHTOA. How to use a calculator to do that in its inverse trigonometric function, is explained, step by step. . Another exercise is given for: finding

the unknown angle in a right triangle, given that this time the opposite side and hypotenuse lengths are known, the sine ratio is used; SOHCAHTOA. How to use a calculator to do that in is explained. And finally, an exercise is given for: finding the unknown angle in a right triangle, given that this time the adjacent side and hypotenuse lengths are known, the cosine ratio is used; SOHCAHTOA. How to use a calculator to do that in is explained. Additional exercises involving the unknown length of a bridge support using trigonometric ratios are given. Given a known angle and its opposite side length, to find the hypotenuse length, the bridge support, the sine ratio is used, SOHCAHTOA. The calculations and use of a calculator to solve the problem are shown. In another problem involving a bridge, the angle measurement and the hypotenuse length are known, and the adjacent side length is unknown, so the cosine ratio is used SOHCAHTOA. In another application, the angle and opposite side length are known, the hypotenuse is unknown, so the sine ratio is used, SOHCAHTOA. The use of the calculator to solve all the above exercises is explained. There are intermittent reviews and at the end an overall review of Part 2.

AFTER SHOWING THE VIDEO:

Review that when the conditions of a problem can be modeled by a right triangle for which the measures of one side and an acute angle or of two sides are known, the trigonometric ratios can be used to find the measure of another side or of an acute angle. Remind the students that when solving a problem by using trigonometric ratios to follow this procedure:

1. Draw the right triangle described in the problem.
2. Label the sides and angles with the given values.
3. Assign a variable to represent the measure to be determined.
4. Select the appropriate trigonometric ratio.
5. Substitute in the trigonometric ratio, and solve the resulting equation.

The students may be given the following problems:

A wooden beam 6 meters long leans against a wall and makes an angle of 710 with the ground. Find to the *nearest tenth of a meter* how high up the wall the beam reaches.

A boy flying a kite lets out 400 feet of string, which makes an angle of 520 with the ground. Assuming that the string is stretched taut, find to the *nearest foot* how high the kite is above the ground.

A ladder that leans against a building makes an angle of 75^{0} with the ground and

reaches a point on the building 9.7 meters above the ground. Find to the *nearest meter* the length of the ladder.

From an airplane that is flying at an altitude of 3,000 feet, the angle of depression of an airport ground signal measures 27^0. Find to the *nearest hundred feet* the distance between the airplane and the airport signal.

The legs of a right triangle measure 3 and 4. Find to the *nearest degree* the measure of the smallest angle of this triangle.

The length of hypotenuse *AB* of right triangle *ABC* is twice the length of leg *BC.* Find the number of degrees in angle *B.*

The longer side of a rectangle measures **10,** and a diagonal makes an angle of 27^0 with this side. Find to the *nearest integer* the length of the shorter side.

Math Series 1, consists of 10 videos:

ALGEBRA: A Piece of Cake Part 1
ALGEBRA: A Piece of Cake Part 2
SLOPES: That's a Bit Steep!
PERCENTAGES: That Make Sense
LINEAR EQUATIONS and Their Graphs: Let's Get It Straight Part 1
LINEAR EQUATIONS and Their Graphs: Let's Get It Straight Part 2
INTEGER OPERATIONS: Into the Negative Zone Part 1 Adding and Subtracting
INTEGER OPERATIONS: Into the Negative Zone Part 2 Multiplying and Dividing
FACTORING IS FANTASTIC Part 1: Common Factors
FACTORING IS FANTASTIC Part 2: Quadratic Trinomials

Math Series 2, consists of 12 videos:

PROBABILITY, Parts 1 & 2
RATIOS
TRIGONOMETRY, Parts 1 & 2
STATISTICS Parts 1 & 2
PROBLEM SOLVING Parts 1 & 2
GEOMETRIC SOLIDS Parts 1, 2, &3

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