

Course: Pre-Calculus

Topic: Using Trig to Solve Electrical Problems

Subject Area: Math

Grade Levels: 10 – 12

Dates: October 14, 17, 18

Lesson Overview

Students will learn how to set up and solve trigonometric functions in relation to right triangles. Then, students will apply this skill to finding the height of a tall object by measuring the horizontal distance to the object and the angle of elevation using a clinometer. Students will then compile their process and results in either a poster or PowerPoint.

Materials Included in this Lesson

- Warm up worksheet
- Guided trig notes for students
- Textbook
- Project information

Other Materials for this Lesson

- LCD Projector
- Document camera
- Graphing calculators (with trig functions)

Skills the Student will Learn

- Students will learn to set up and solve trig functions
- Students will learn occupations that use trig

Student Deliverables

- Completed practice and application worksheets related to electrical problems
- PowerPoint slides documenting their research and creating a problem involving trig in the respective occupation

Length of Lesson: 3 Days

Activity Day One (Pythagorean Theorem and Trig Functions)

- Warm up: Find the missing side of a right triangle using the Pythagorean Theorem
- Notes: Trig functions and solving trig equations
- Homework: From textbook (Pg 274: 1-4, 9-15, 42, 44, 46, 53-56)

Activity Day Two (Trig Applications)

- Warm up: Set up and solve for the missing side of a right triangle using trig
- Notes: Applications of trig
- Homework: Application problems from textbook (Pg 276: 57-63)

Activity Day Three (Finding Heights for Tall Objects)

- Warm up: Solve a trig application problem.
- Notes: Application problems involving trig.
- Handout: Pair Project Information

Enrichment Suggestions

Have students research other occupations that utilize trig and make up an application problem or situation that the particular occupation would solve and present it to the class.

Student Resources

Pre-calculus textbook (PreCalculus with Limits, A graphing approach, 4th edition, Larson, et al, 2005)

California State Math Standards

<http://www.cde.ca.gov/ci/ma/cf/documents/math-ch2-8-12.pdf>

- Trig standard #12: Students use trigonometry to determine unknown sides or angles in right triangles.
- Trig standard #19: Students are adept at using trigonometry in a variety of applications and word problems.

CTE Pathway Standards

<http://www.cde.ca.gov/ci/ct/sf/documents/ctestandards.pdf>

1.0 Academics

Students understand the academic content required for entry into postsecondary education and employment.

Mathematical Reasoning

- (2.1) Use estimation to verify the reasonableness of calculated results.
- (2.6) Express the solution clearly and logically by using the appropriate mathematical notation and terms and clear language; support solutions with evidence in both verbal and symbolic work.
- (2.8) Make precise calculations and check the validity of the results from the context of the problem.
- (3.1) Evaluate the reasonableness of the solution in the context of the original situation.
- (3.2) Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.

Geometry

- (15.0) Students use the Pythagorean theorem to determine distance and find missing lengths of sides of right triangles.
- (19.0) Students use trigonometric functions to solve for an unknown length of a side of a right triangle, given an angle and a length of a side.

Communication

Students understand the principles of effective oral, written, and multimedia communication in a variety of formats and contexts.

- (2.6) Deliver multimedia presentations:
 - a. Combine text, images, and sound and draw information from many sources (e.g., television

broadcasts, videos, films, newspapers, magazines, CD-ROMs, the Internet, electronic media-generated images).

- b. Select an appropriate medium for each element of the presentation.
- c. Use the selected media skillfully, editing appropriately and monitoring for quality.
- d. Test the audience's response and revise the presentation accordingly.

Lesson Plan Relevance To Externship

I was placed at WECA (Western Electrical Contractor's Association) in the first semester of their 3rd year apprenticeship program. In taking this course, I learned how to use the National Electrical Code book, read blueprints and job specifications related to the electrician. In addition, I learned that electricians also utilize quite a bit of mathematics, especially trigonometry. They have to have some understanding of sine functions in relation to phase shifts of alternating currents, finding the missing lengths or angles of right triangles (related to bending wire). Since trigonometry is within our pacing in pre-calculus, this lesson plan will build on the math standards and show students some additional applications of the trig that they will learn.

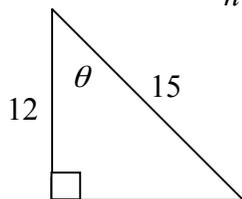
Pre-Calculus Warm – up (Day 1)

Ch 4.3 Trig Functions

Name _____

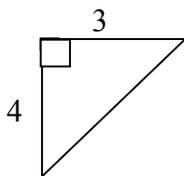
Date _____ Period _____

Recall that $\sin \theta = \frac{o}{h}$, $\cos \theta = \frac{a}{h}$, $\tan \theta = \frac{o}{a}$. Find the exact values of the following trig functions.

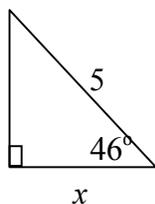
A) $\sin \theta$ B) $\cos \theta$ C) $\tan \theta$

Pre-Calculus Warm – up (Day 2)

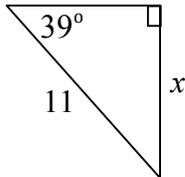
Ch 4.3 Trig Functions

1. Find $\sec \theta$.2. Solve for x .

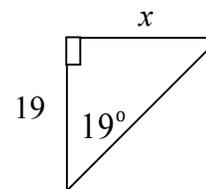
A)



B)

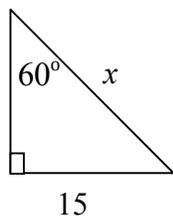


C)



Pre-Calculus Warm – up (Day 3)

Ch 4.3 Trig Applications

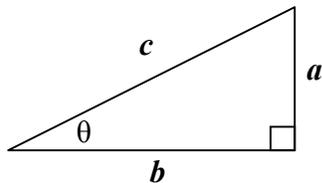
1. Solve for x . Show all work.

2. You are standing 60 ft from the base of a building. You estimate the angle of elevation to the top of the building to be 72° . What is the approximate height of the building? If a rope was connected to the point where you are standing to the top of the building, what would the rope's length be?

RIGHT TRIANGLE TRIG

Trigonometric Ratio ~ a ratio of the lengths of two sides of a right triangle

Using the right triangle below, name:



- 1) Side opposite angle θ _____
- 2) Side adjacent angle θ _____
- 3) Hypotenuse _____
- 4) Longest side _____

There are six trig functions:

SINE

$$\sin \theta = \frac{\text{side Opposite } \angle \theta}{\text{Hypotenuse}} = \underline{\hspace{2cm}}$$

COSINE

$$\cos \theta = \frac{\text{side Adjacent } \angle \theta}{\text{Hypotenuse}} = \underline{\hspace{2cm}}$$

TANGENT

$$\tan \theta = \frac{\text{side Opposite } \angle \theta}{\text{side Adjacent } \angle \theta} = \underline{\hspace{2cm}}$$

SOH-CAH-TOA

COSECANT

$$\csc \theta = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

SECANT

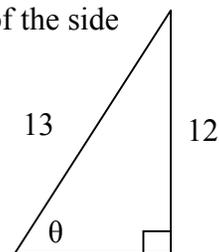
$$\sec \theta = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

COTANGENT

$$\cot \theta = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}} = \underline{\hspace{1cm}}$$

Ex1) Find the six trig functions of the angle θ .

Before you start, how would you find the length of the side opposite angle A?



$$\sin \theta = \hspace{15em} \csc \theta =$$

$$\cos \theta = \hspace{15em} \sec \theta =$$

$$\tan \theta = \hspace{15em} \cot \theta =$$

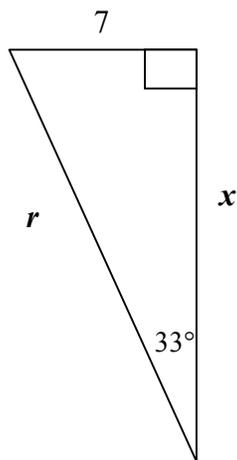
Ex2) Calculate the following expressions.

(Make sure your calculator is in degree mode.)

$$\sin 35^\circ = \hspace{5em} \cos 40^\circ = \hspace{5em} \tan 64^\circ =$$

$$\csc 15^\circ = \hspace{5em} \sec 25^\circ = \hspace{5em} \cot 82^\circ =$$

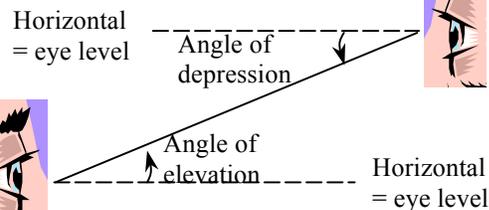
Ex3) Solve for the variables.



$$x = \underline{\hspace{2cm}}$$

$$r = \underline{\hspace{2cm}}$$

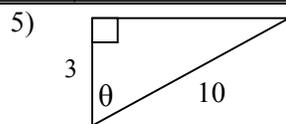
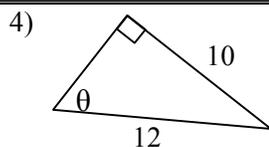
Pre-Calculus Ch 4.3 Notes (Day 2) – Right Triangle Trig Applications

To Find a Missing Distance

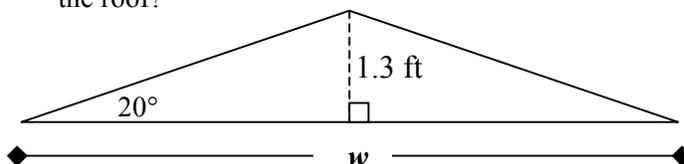
- Draw a picture of the situation
- Set up a trig equation
- Solve for the missing side.

To Find a Missing Angle

- Draw a picture.
- Set up a trig equation
- Solve using inverses
($\arcsin=$, $\arccos=$,
 $\arctan=$)

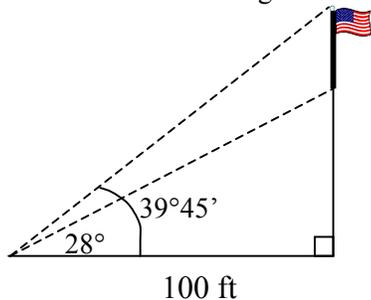


- 6) A roof on a storage shed is 1.3 feet high with an incline of 20° for drainage. What is the width (w) of the roof?



- 7) The height of an outdoor basketball backboard is $12\frac{1}{2}$ feet and casts a shadow $17\frac{1}{3}$ feet long. Find the angle of elevation of the sun.

- 8) From a point 100 feet in front of a public library, the angles of elevation to the base of the flagpole and the top of the flagpole are 28° and $39^\circ 45'$, respectively. The flagpole is mounted on the front of the library's roof. Find the height of the flagpole.



- 9) A passenger in an airplane flying at an altitude of 10 kilometers sees two towns directly to the east of the plane. The angles of depression to the towns are 28° and 55° . How far apart are the towns?

Applications of Trigonometry ~ Project Information

Purpose: To apply our knowledge of right triangle trig since there are numerous “real world” situations in areas such as architecture, landscape design, engineering, and electrical installations.

Directions: You may choose to complete this project by yourself or with one other classmate.

- 1) Do research on occupations or trades that use trigonometry.
- 2) Create or find a problem that the trade may encounter in their job.
- 3) Solve the problem, showing your work.
- 4) Create a PowerPoint with the following slides.
 - Slide 1: Title of powerpoint (include name of occupation), name(s) of students
 - Slide 2: Very basic information about occupation/trade and training required.
 - Slide 3: Trig problem that the occupation may encounter
 - Slide 4: Set up of trig function, work and solution with appropriate units.

Due: Submit this project electronically through Schoolloop by ***11:59 pm on Wed., Oct. 26.***

Grading: Be sure to follow the above directions. Your project will worth 20 points according to the rubric below.

Rubric for the Trig Applications Project

PowerPoint	4 Exceeds Expectations	3 Meets Expectations	2 Approaches Expectations	1 Fails to meet Expectations
Occupation That Uses Trig	Slide includes accurate information about occupation that uses trig and the training required for the particular occupation	Slide includes information about occupation that uses trig and the training required for the particular occupation	Slide includes information about occupation that uses trig but not the training required for the particular occupation	Slide includes information about occupation that uses trig
Mathematical Content	Trig problem selected is at a similar level to the application problems that are in our unit and is in the context of the occupation	Trig problem selected is at a similar level to the application problems that are in our unit	Trig problem selected is an application problem written in context	Trig problem has been selected
Mathematical Accuracy	Trig problem is solved correctly with the proper units in context	Trig problem is solved correctly	There are errors in the set up for the solution	Trig problem is solved incorrectly
Drawings	Drawing of problem with - labels and units of measurements - variable for the unknown - fairly correct scale is part of the solution	2 of the elements from the exceeds expectations description	1 of the element from the exceeds expectations description	No drawing or diagram of any kind is included in the solution
Aesthetics	Font style is easy to read Font size is easy to read Color(s) chosen enhances powerpoint Slide background or pattern does not distract from content	3 of the elements from the exceeds expectations description	2 of the elements from the exceeds expectations description	1 of the element from the exceeds expectations description