Right Triangle Trigonometry Project
Due Date:

Background:

Trigonometry is the only way to mathematically figure out the length of a side in a right triangle given another side and an angle or to find out the measure of an angle given two sides. Sometimes special triangles can be used instead. You will be using these methods to complete this project.

Project:

There are two parts to this project. In Part 1, you will be completing several problems involving real-life applications of trigonometry. In Part 2, you have choices of which project you will complete. The different projects are listed below.

Part 1:

You will receive a worksheet with various problems showing how trigonometry can be used in real life. This part of the project must be completed by everyone individually and is worth 24 points.

Part 2-A: Calculating the Angle of Elevation of the Sun

Trigonometry is all around us! Right triangles can be found in many daily situations. In this project you will apply your knowledge of trigonometry to shadows in order to calculate the angle of elevation to the sun at different times of day.

To calculate the angle of elevation of the sun, use the following procedure:
- Measure your height and the length of the shadow you cast at two different times of day (at least 3 hours apart) on two different days.
- Record the times and measurements (with units).
- Draw a sketch of the right triangle in this scenario.
- Label the sides of your sketch with your measurements and angle of elevation.
- Solve for the angle of elevation while clearly showing all of your steps.

Do not forget that you need to do the procedure above for two different times of day on two different days!

Once you have completed the calculations above, answer the following questions:
1. In several sentences, explain the right triangle drawings you used to model the shadow scenario. Make sure it answers the following:

a) What does each side length signify? In particular, explain what does the hypotenuse in your drawing signify in the real world?

b) Explain why the angle you chose is the angle of elevation of the sun.

2. From your measurements, when was your shadow the longest? What was the angle of elevation of the sun at this time?

3. From your measurements, when was your shadow the shortest? What was the angle of elevation of the sun at this time?

4. During what time of day do you think the shadow you cast will be longest? Use your knowledge of trigonometric ratios in your explanation.
(Hint: Make sure you mention the angle of elevation, your height and a trig ratio that will help explain why the shadow is longest at this time of day).

5. During what time of day do you think the shadow you cast will be the shortest? Use your knowledge of trigonometric ratios in your explanation. (Use the hint from above, except this time you are explaining why the shadow is shortest at this time of day.)

Below is a checklist of all the components you will need to submit for grading:

☐ Tables of your height, shadow length (with units) and time of day. (9 pts)
☐ Sketches of the four right triangles. (14 pts)
☐ Label the sketches with your measurements and angle of elevation. (9 pts)
☐ Use the correct trigonometric ratio. (5 pts)
☐ Show all steps and calculations when solving for the angle of elevation. (14 pts)
☐ Answers to questions #1-5. (25 pts)

Developing a Trigonometry Table

A trigonometry table is a powerful tool used by mathematicians and was first developed by Hipparchus, who lived in the 2nd century, B.C. In this project, you will be creating a trigonometry table like Hipparchus. However, unlike Hipparchus, we already know three important trigonometric ratios that exist.

To create a trigonometry table, use the following procedure:
- Write down the formulas for sine, cosine, and tangent.
- For each of the following angle measurements (5°, 15°, 30°, 45°, 60°, 75°, 85°) draw a right triangle with one acute angle of that measurement. Make sure to use rulers and protractors and be exact as possible in your constructions.
- For each triangle label the side opposite, adjacent, and the hypotenuse in relation to the acute angle (5°, 15°, 30°, 45°, 60°, 75°, 85°).
- Measure the length of each side and write that on your triangles.
- Calculate sine, cosine, and tangent for the angles 5°, 15°, 30°, 45°, 60°, 75°, 85° using the triangles and side lengths you must measured. Show all your work and calculations!
- Present your calculations of sine, cosine, and tangent and the angles in a table.

Once you have completed the procedure above, answer the following questions:
1. What pattern do you see for sine, cosine, and tangent as the angle increases (look at each trig ratio individually, three patterns total)?
2. For each of the three patterns noticed in #1, explain why this pattern occurs using you knowledge for trigonometric ratios. (Hint: Make sure your response talks about the trigonometric relationship. Use the definition of the trig ratio and what happens to the overall ratio as you keep one of it two side lengths constant, while the angle changes).
3. What pattern do you see for sine, cosine, and tangent as the angle decreases (look at each trig ratio individually, three patterns total)?
4. For each of the three patterns noticed in #3, explain why this pattern occurs using your knowledge of trigonometric ratios. Use the same hint as in #2.
5. Write your own real-world problem that involves a right triangle.
6. Solve your problem using trigonometry and show all steps!

Below is a checklist of all the components you will need to submit for grading:

- ☐ Formulas for sine, cosine, and tangent (3 pts)
- ☐ Draw seven right triangles with an acute angle measurement of 5°, 15°, 30°, 45°, 60°, 75°, 85°. (7 pts)
- ☐ All seven triangles are labeled with opposite, adjacent, hypotenuse (7 pts)
- ☐ Sides of all seven triangles are measured and labeled on the drawing. (7 pts)
- ☐ Sine, cosine, and tangent are calculated for 5°, 15°, 30°, 45°, 60°, 75°, 85° using the triangles and sides you measured (show all your work!) (15 pts)
- ☐ Present the calculated values of sine, cosine, and tangent of 5°, 15°, 30°, 45°, 60°, 75°, 85° in a table (7 pts)
- ☐ Answer questions #1-6 (30 pts)

To turn in:

Part 1 (you will receive in class): 24 points (3 pts/problem)

Part 2 (your choice of A or B): 76 points

Total: 100 points (test grade)

Late projects will be graded accordingly.

Right Triangle Trigonometry Project: Part 1   Name:_____

Directions: Complete the following problems using a pencil. You must draw and label a sketch of the scenario for each problem. You must show your work in order to receive credit (no work – no credit!).

1) Tom wants to reach a second floor window on a house that is 20 feet above ground. If he must put the ladder at a 70° angle to the ground, how long must the ladder be?

2) Sue wants to determine the height of a tree indirectly. Its shadow is 15 feet when she is at a 48° angle of elevation with the sun that is behind the tree.

3) A pilot is beginning his descent to a nearby airport when he is 6.5 miles away. He knows he must have no more that a 3° angle of depression. How high is he above the ground?

4) A 25-foot pole is supported by a 40-ft. guy wire that is anchored to the ground a certain distance away from the pole. What angle does the guy wire make with the ground?

5) An airplane is at an elevation of 35,000 ft. when it starts its descent at a 20 degree angle of depression. What is the air distance and between the airplane and the airport in miles?

6) A lighthouse keeper has a 10° angle of depression between the horizontal light beam and the line of sight from the ship. If the keeper is 19 m above water, how far is the ship from the base of the lighthouse?

7) A surveyor wants to measure the distance from the north end (point B) to the south end (point C) of a body of water. He creates a right triangle by using point A which is 17.5 m due west of point C and at a 30 degree angle with point B. Find the distance across the lake.

8) If you want to put a 4 x 8 piece of plywood through a 3-foot square opening in your ceiling by turning it diagonally, is the opening big enough? Use a 45-45-90 triangle since it is a square.