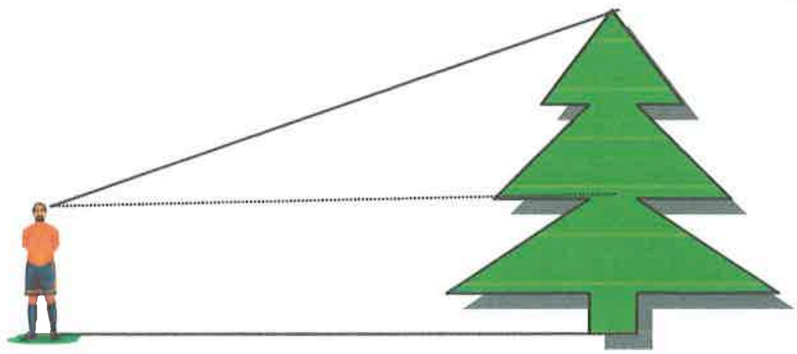
Jessica Savage
Mathematical Modeling Worksheet

- CCSS.Math.Content.HSG-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.★
- CCSS.Math.Content.HSG-SRT.D.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

The Thomases are retiring and are planning on building a new house in Hatteras, NC. While the real estate is affordable, it is also susceptible to hurricanes. On their new property there is a large cedar tree. Mrs. Thomas does not want to build their house in range of the tree falling.

Too cheap to hire a surveyor, Mr. Thomas is convinced he can figure out how tall the tree is himself. He stands at the base of the tree and walks 20 feet. Using a clinometer, he looks up at the top of the tree and gets an angle of elevation to be approximately 67°.

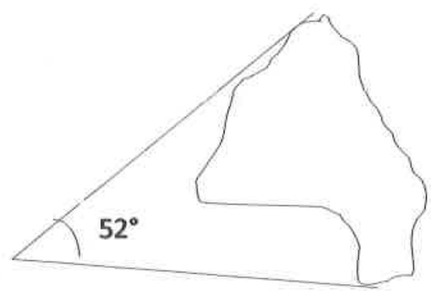


Mr. Thomas measures his eye level to be 68 inches off the ground. How tall is the tree? Explain.

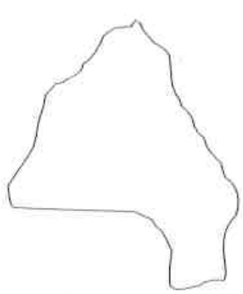
Mrs. Thomas wants to double check her husband's math. If she only stands 10 feet from the tree, at what angle of elevation will she be looking up at the top of the tree? (assume Mrs. Thomas's eyes are 5 feet about the ground).

Mrs. Thomas does not want their new house to be near the tree in case it falls. Given the height of the tree, how much surrounding area is susceptible to the tree? (assume the tree can fall in any direction). Is this a realistic request?

The property is so large that there is also a small pond. Mr. Thomas wants to figure out how far apart the farthest ends of the lake are. He starts at one end of the pond and walks 102 yards. He puts a stake in the ground and then walks 64 yards to the other end of the lake. His wife measures the angle between his two paths to be about 52°. How long is the lake?

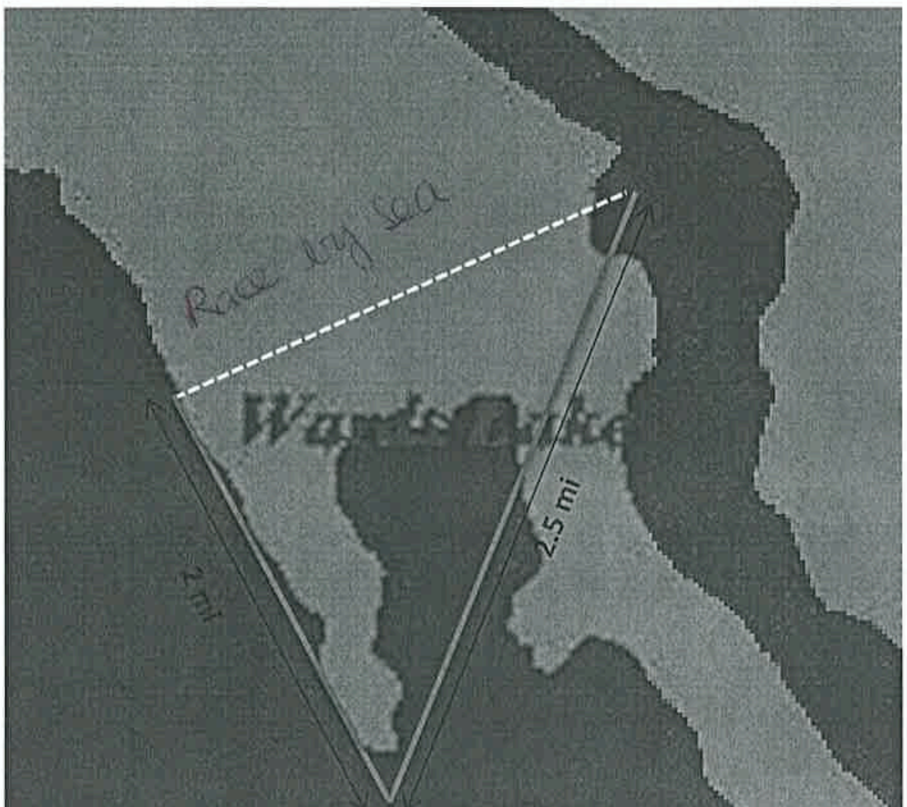


What are ways in which the Thomases can figure out how wide the lake is? Explain your answer below.



The Race

Jack and Jane are competing in a very unique race. The race is unique because each competitor can choose one of two very unique courses. Competitors can complete the course by land or sea. If a competitor chooses land, they must run. If they choose to race by sea, they must swim. The "Race by Sea" course is marked with a white dashed line and the "Race by Land" course is marked with a red line. A bridge exists anywhere the "Race by Land" course crosses water. Note: The "Race by Sea" and "Race by Land" courses form a right triangle. A diagram of the course can be found below:



1. **After examining the course map, Jack plans to complete the "Race by Sea" course and Jill plans to complete the "Race by Land" course. Who do you think will win the race? Why?**

2. **How far will Jill have to swim in the "Race by Sea" course? How do you know?**

3. **Jack finished the "Race by Land" course in 27 minutes. How fast, in miles per hour, did he run?**

4. **Jill believes she can swim at the same average rate of speed as Jack can run. Since they have the same average speed, Jill told Jack that they will finish at the same time. Jack disagrees. Who's correct? Why?**

5. **Jack and Jill both crossed the finish line at the same time. How much faster, in miles per hour, did Jack run?**

Melissa Hertel

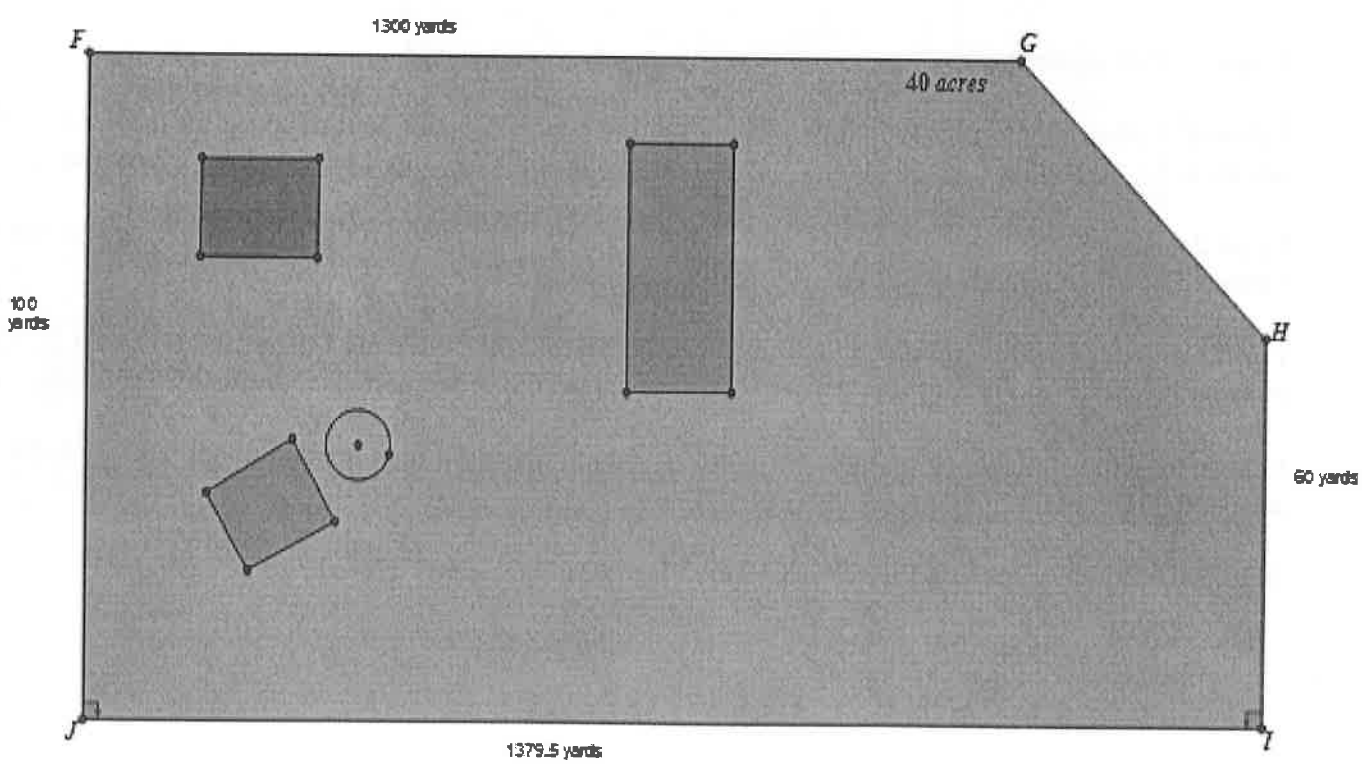
Farm Scenario

Your family has left you a 40 acre plot of land.

It currently has a house, barn (small animals), a cow barn and a Silo.

You would like to add animals to the farm; the animals must be fenced in and be separated.

1. Determine the necessary amount of fence in order to fence in the entire property.
2. You want to have cows and pigs the number of pigs must be greater than the number of cows. You may not use more than 20 acres for animals. You must have fencing for each of the animals. The two areas can not touch. Prior to fencing in your lot you where allotted 4,000 linear yards of fencing.
   a. You are allowed to have 1-2 cows per five acres of land.
      i. Determine how many cows you want.
      ii. Determine how much land is necessary.
      iii. Where you want the cows to graze. Draw the dimensions on the grid.
      iv. How much additional fencing is needed?
      v. Show all work, and explain why you chose where you placed the cows area.
   b. You are allowed to have 7-10 pigs per one acre of land.
      i. Determine how many pigs you want.
      ii. Determine how much land is necessary.
      iii. Where you want the pigs to graze. Draw the dimensions on the grid.
      iv. How much additional fencing is needed
      v. Show all work, and explain why you chose where you placed the pigs area.
3. How many total yards of fencing did you use?



Julien Colvin – Math 680 – PS #4

In this problem, we are going to model a football field by a coordinate plane, where the x-axis is the 50-yard line and the y-axis is the exact middle of the field. 1 unit will represent 1 yard.

At the start of a play, the ball is snapped from the origin (0, 0). Wide Receiver Jacoby Jones is located at coordinates (8, 0). When the ball is snapped (t = 0), Jones begins running at a speed and in a direction given by the vector (-1, 6). Two seconds after the play begins (t = 2), Quarterback Joe Flacco is located at coordinates (0, -4). He throws the football at a speed and in a direction given by the vector (2, 14).

1) Give the speed at which Jones is running and the speed at which Flacco throws the ball in yards per second.

2) On graph paper, draw a coordinate plane from [-10, 10] in the x-direction and [-5, 50] in the y-direction. On that plane, draw two directed rays that give the paths travelled by Jones and the football.

3) Locate the intersection of the rays and give the coordinates of that point.

4) The position of Jacoby Jones at time *t* is given by $J(t) = \begin{bmatrix} 8 \\ 0 \end{bmatrix} + \begin{bmatrix} -1 \\ 6 \end{bmatrix} t$. Find the time *t* when Jones will be at the point of the intersection of the paths.

5) The position of the football at time *t* is given by $F(t) = \begin{bmatrix} 0 \\ -4 \end{bmatrix} + \begin{bmatrix} 2 \\ 14 \end{bmatrix} (t-2)$ when $t \geq 2$. Verify that, at the time *t* found in question 4, the ball is at the same location as Jones.

6) Jones will score a touchdown when his y-coordinate is 50. Assuming he continues to run along the same path at the same speed, how long after he catches the ball will he score?

Create an activity (e.g., a worksheet, a computer program, etc) that uses mathematical modeling of another context. Identify the Common Core State Standards content standards that your activity addresses. Provide solutions for your activity. (3 points)

Tasha and Brian went for vacation. They camped near a swampy forest. It is rectangular in shape and Tasha ~~went~~ walked around the swamp and discover that the length of the swamp is twice its width. Brian found out that the perimeter of the swamp is ~~63ft.~~ 126 ft.

Answer the following questions.

(a) Write ~~the~~ equations that can be used to determine the length of the swamp.

(b) Solve the system to determine the length and the width of the swamp.

(c) Use table to explain your solution.

This activity addresses common core content 8.E.E.8 (Analyze and Solve pairs of simultaneous linear equations).