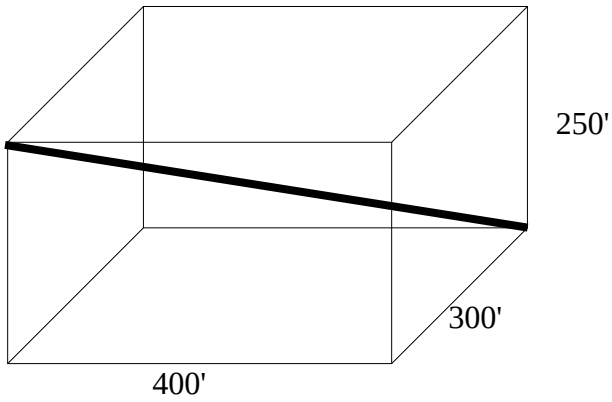
Math 253 Lab #3 Vectors Names: _____

Work in groups of 2-4 for full credit and 5% bonus if turned in by Fri. of week 5. Make sure everyone in your group understands the question and its answer. Work neatly and in pencil, with any additional work attached to this lab. Your score will depend upon: Neatness, Clarity, Organization, Thoroughness, and Correctness. Labs turned in after Friday are reduced by 25% and only accepted through week 6. (100 points, 25 points per page)

Part 1:

(1) What is the length of the diagonal? Units?



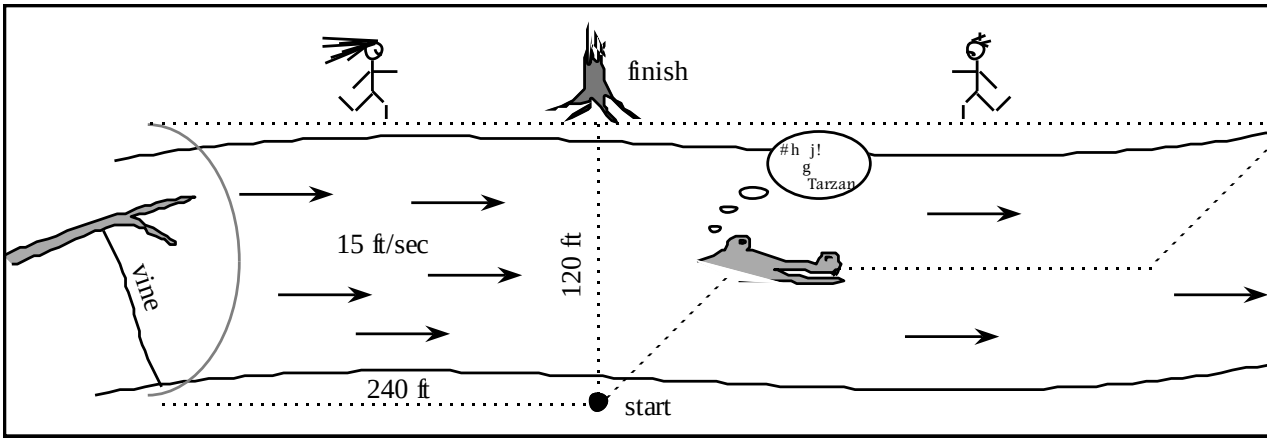
(2) Find the length of wire needed between two telephone poles (of same height), when the first pole is 280 ft north, 370 ft east and 250 ft above (up the hill from) the other. A picture may be helpful.

Part 2:

(1) A swimmer can maintain a constant speed of 4 miles per hour. If the swimmer heads directly across a river that has a current moving at the rate of 3 miles per hour, what is the actual speed and direction of the swimmer? Draw and label vectors in a picture to represent the situation.

(2) If the river is 1 mile wide, how far downstream will the swimmer end up from the point directly across the river?

(3) Tarzan vs. Jane



Tarzan and Jane are having a race to the stump on the other side of the river. Tarzan thinks he can win any race (after all he IS Tarzan). So, he dives in and tries to swim straight across the river fighting a crocodile along the way. Tarzan can swim at 10 ft/sec. But it takes him 20 seconds to dispatch the crocodile. Naturally, Tarzan didn't think things through and was carried downstream by the current as he swam. On top of that, while he was fighting the croc he drifted with the current. Thus, he landed much farther downstream than he ever expected and had to run back upstream to the stump. He can run at 30 ft/sec. Jane used her head. She ran 240 ft upstream to a vine and swung across the river and then ran back downstream to the stump. She runs at 20 ft/sec and the vine swing took 5 sec. Who won the race and by how much? Make sure to write out your work clearly! (problem and illustration courtesy of Franz Helfenstein.)

Write your work clearly on your own paper, and attach to this lab. Be organized! Explain what you're doing!

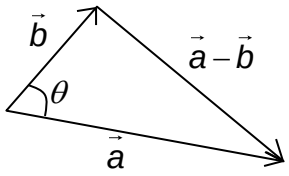
Write the total length of time for each here:

Tarzan:

Jane:

Part 3: Prove that $\vec{a}\bullet\vec{b} = \left\|\vec{a}\right\|\left\|\vec{b}\right\|\cos(\theta)$ in $\mathbb{R}^2$ by filling in the following steps:

Hint:



$\vec{a} = \langle a_1, a_2 \rangle$

$\vec{b} = \langle b_1, b_2 \rangle$

$\vec{a} - \vec{b} = \langle a_1 - b_1, a_2 - b_2 \rangle$

First, find the norm (magnitude) of each of the vectors (leave in terms of $a_1, a_2, b_1, \& b_2$):

$\left\|\vec{a}\right\| =$

$\left\|\vec{b}\right\| =$

$\left\|\vec{a}-\vec{b}\right\| =$

Then use the law of cosines (by making the appropriate replacements):

$$c^2 = a^2 + b^2 - 2ab\cdot\cos(\theta)$$

$$\left\|\vec{a}-\vec{b}\right\|^2 = \left\|\vec{a}\right\|^2 + \left\|\vec{b}\right\|^2 - 2\underbrace{\left\|\vec{a}\right\|\cdot\left\|\vec{b}\right\|\cos(\theta)}$$

leave this part alone, simplify the rest