Vector Golf

Purpose: To apply the process of adding vectors to a real world situation.

Overview: Vectors are an important mathematical concept. They allow us to represent position (as well as other vector quantities) in two and even three dimensions. Vectors are a good way to track straight line motion. We will map the motion of a golf ball on its way from tee to hole. The path can then be analyzed analytically and graphically.

Materials for each lab group:

- golf club and golf ball
- measuring tape
- large protractor
- paper, pencil, and calculator

Analysis:

1. Graphically find the sum of the vectors for each hole. Draw an accurate scale diagram using a protractor and a ruler. Then label the displacement vector based on your data.

2. Analytically find the sum of the vectors for each hole. Find the components of each vector and then proceed to find the resultant vector.

Conclusion:

You will have 3 final values: 1) Original Tee→Hole, 2) graphically added, and 3) analytically added results. Compare the two addition methods to each other. Also, compare them both to the original measurement you made. Explain any discrepancies.

Calculations:

There's not much to write for this lab. It's meant to be practice in adding vectors. So you must show your work for each of the analytical vectors.

To Hand in:

Rubric listed on back

Lab Procedure:

1 Set up a tee and a hole. We'll discuss limitations before we go outside. Your goal is to get the golf ball from the tee to the hole and to map the path that the ball takes in getting there.

2. Choose an x and y coordinate system. This is done easily if this lab is being done on a sports field.

3. Use the measuring tape to determine how far the hole is from the tee. Use the protractor to determine the angle between the tee and the hole relative to the coordinate axis. The tee should be the origin on your axis. Record this total distance and the angle. This is the displacement vector from the tee to the hole.

4. Draw a sketch of the "golf course". You will sketch each shot so that you will remember what the general path looked like.

5. Set up a data chart in your notes. The chart should include: shot #, distance, and angle relative to x -y axis.

6. Take your first shot. Use the string and meter stick to determine how far the ball is from the tee. Use the protractor to determine the angle of the shot relative to the x and y axis. Record the data in your data chart.

7. Continue to take shots, measure distances, and determine angles until you get the ball in the hole. (You are measuring from where the ball was hit to where the ball lands each time.) Be sure to record all of your data accurately. Rotate jobs as you proceed. Be sure that you are always measuring the angle relative to the x-y axis.

8. Take at least 3 shots to reach the hole. Extra credit for more holes. (attach after conclusion).

Vector Golf Rubric

_____ (5) Presentation: neatness, spelling, Graphical and Analytical on separate pages, in order shown below, etc.

_____ (5) Procedure: describe how you chose your x-y system, how shots were taken (be thorough), and your measuring technique (be explicit)

_____ (5) Map: (doesn't have to be to scale, but try to be realistic): drawing of entire field, x-y axis, tee & hole
- On Map: Displacement Vector From tee to hole
- On Map: sketch and number each shot

_____ (5) Data Chart with Units
- Include original tee-hole measurement and each individual shot's measurements

_____ (10) Graphical Analysis: draw map to scale, and state the scale used. Make it big-ish.
- Using one color: Draw and label the tee → hole vector as measured originally.
- Using another color: Draw each shot, label angle and magnitude on each vector.
- Using a third color: Draw and label resultant vector as determined by your graphical addition.
- Clearly state the Graphical answer somewhere on the page.

_____ (10) Analytical Analysis (separate page from Graphical): **Be sure to use degrees mode, not radians!** Add vectors analytically, and give resultant in polar notation. Show all work. Clearly state the Analytical answer.

_____ (10) Conclusion
- What was the purpose?
- Have you satisfied the purpose?
- Compare the results of the two methods of adding vectors: Graphical and Analytical. Find the *difference* between the two vectors: Calculate the distance *between the tips* of each. Then find % difference for each (difference/resultant x 100). This is your indicator of accuracy.
- Compare your (graphically and analytically) added vectors to your measured tee-hole vector.
- Sources of error?
- Suggestions for improved accuracy?
- Other comments/observations?
- Conclusion should be <u>at least</u> ½ page, double spaced.