Physics 1 – Vectors and Scalars Activity

Purpose of Activity: This activity will help you understand the differences between distance and displacement, and speed and velocity.

Reference: Before doing this activity, you should have
- Read chapter 2, sections 2.1 and 2.2 in College Physics, Wilson & Buffa, 5th Ed.
- Done the Chapter Outline for Sections 2.1 and 2.2, including objectives, vocabulary and Questions 1 – 5.

Before starting, answer these questions. (These questions appear on the Vectors and Scalars Pre–Lab Activity on Webassign. You should carefully read this handout before you try to do the Pre–Lab Activity.)

1. Is distance a vector quantity, or a scalar?
2. Is displacement a vector quantity, or a scalar?
3. Is speed a vector quantity, or a scalar?
4. Is velocity a vector quantity, or a scalar?
5. Which of these quantities has magnitude only?
6. Which of these quantities has magnitude and direction?

If you don't know the answers to these questions, please look them up. The following activity requires an accurate understanding of these terms.

Preparation:

You will measure long distances in this lab. They are too long to measure with a measuring tape. So, you will use the length of your stride as a unit, and then convert that to meters.

1. Choose one member of your team to be the official "strider."
2. Use a measuring tape to measure 10 meters in the hallway.
3. Your "strider" should walk those 10 meters, counting the number of steps.
4. Write down how many steps it takes to cover 10 meters.
5. Do this two more times. Write down the number of steps each time.
6. Average the three step–counts.
7. Divide this average number of steps into 10 meters. That tells you how many meters each stride is.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Number of Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Average number of steps = __________

\[
(meters) = \frac{10}{steps_{avg}}
\]

This is your conversion factor.

The Pre–Lab Activity has some practice for you.
This is a map of the LBJ Building's first floor.

Procedure

1. Your team will measure the **distance** from position 1 to position 2 on the first floor.
2. Walk from position 1 to position 2. Choose a route that turns at least one corner. Mark your route on the map. It can be as complicated as you like. Just remember to turn *at least* one corner.
3. Measure the time that it takes to walk from position 1 to position 2 along your route.
4. Count your steps along your route between position 1 and position 2.
5. Convert your steps to meters. To do this conversion, use the conversion factor that you just calculated.

\[
\text{Number of steps} \times \text{conversion factor} = \text{distance in meters.}
\]

6. Do the same thing for position 2 to position 3, and position 3 to position 4. (Each time you must turn *at least* one corner!) Measure the time for each distance.
7. Determine the **displacements** from position 1 to positions 3 and 4. Remember that the displacement is the *straight-line separation of the points*. How will we figure this out? (Hint: Think of a giant right triangle.)
8. Calculate the average speed for each trial.
9. Calculate the average velocity for each trial.

<table>
<thead>
<tr>
<th>Starting position</th>
<th>Ending position</th>
<th>Distance</th>
<th>Displacement</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
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</tr>
<tr>
<td>3</td>
<td>4</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Starting position</th>
<th>Ending position</th>
<th>Speed</th>
<th>Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
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<td>2</td>
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</tr>
<tr>
<td>1</td>
<td>4</td>
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</tbody>
</table>
Answer these questions.

1. For each trial, which is larger, distance or displacement?

2. Can you explain why this is so? (Hint: Compare the smallest possible value of distance to the displacement. Is it possible for distance to be less than the displacement?)

3. 
   a. Describe a pair of positions that would give you an average velocity of zero.
   b. Mark them on your maps.
   c. Explain why the velocity must be zero for these positions.
   d. Explain whether the speed would also be zero, or could be greater than zero.