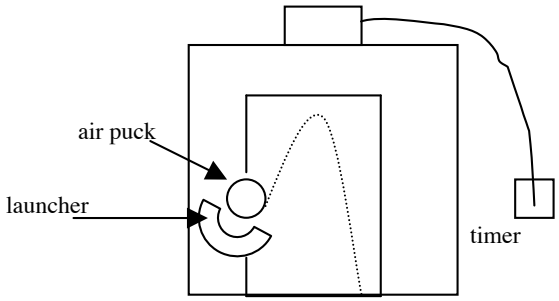
Physics: Lab A4 - Projectile Motion

Problem
How do the horizontal and vertical components of velocity change when a projectile is launched?

Experimental Design
An air table with a spark apparatus is set at a vertical angle. One air puck is launched as shown in the diagram. The horizontal and vertical displacement can be measured relative to an initial reference position and used to calculate velocity.



Procedure

1. Place the paper flat on the air table. Make sure it is square to the table.
2. Set the spark timer at 25 Hz.
3. Turn on the air pump and timer.
4. Practice shooting the air puck up the incline such that it stays on the paper for the entire trip "down" the paper. Make sure it does not hit the launcher on the way down the incline.
5. Start the timer and then launch the air puck.
6. Stop the timer when the puck has reached the bottom of the paper.
7. Repeat 4-6 for each member in your group.

Evidence/Analysis
Note: Careful drawing and measuring is essential. Please measure to the appropriate precision for the ruler being used.

1. Draw a <u>horizontal</u> line through the "dark" dot that appears to be the start.
2. Starting from the first dot (t = 0.00 s) circle each successive 6^{th} dot. (1, 6, 11, 16...). This will give <u>five</u> time intervals between circled dots for a total time interval of 0.200 s (5 x 1/25 s = 5/25 s = 0.200 s). Label each circled dot with the corresponding time. (0.00 s, 0.200 s, 0.400 s, ...)
3. Carefully draw vertical lines from each circled dot to the horizontal line drawn in step 1.
4. Carefully measure the vertical length of each position vector for each 0.200 s. Include + or - signs to indicate direction above or below the horizontal start line.
5. Carefully measure the horizontal length of each position vector for each 0.200 s. Remember to measure length from the start dot (t = 0.00 s).

For both horizontal and vertical evidence,

6. Calculate the displacement, $\Delta d = d_2 - d_1$, and then the average velocity, $v_{avg} = \frac{\Delta d}{\Delta t}$
7. Draw a velocity – time graph for the average vertical velocity versus the midpoint of the time interval. On the same graph and using the same scale, draw a velocity – time graph for average horizontal velocity versus the midpoint of the time interval. Label each graph. Remember to draw best-fit lines or curves.
8. Please provide a sample calculation for each column required.
9. Answer the problem stated in sentence form.

Evidence/Analysis

time (s)	Δt (s)	Vertical d (cm)	Vertical Δd (cm)	Horizontal d (cm)	Horizontal Δd (cm)	Midpoint of time interval (s)	Vertical V_{avg} (cm/s)	Horizontal V_{avg} (cm/s)
0.00	----	0.00	-------	0.00	------	------	-----	-----
0.200								
0.400								
0.600								
0.800								
1.00								
1.20								
1.40								
1.60								
1.80								
2.00								

Marking Rubric

Category	***Maximum***	***Score***
Evidence Horizontal and vertical positions are measured "correctly", neatly displayed and include appropriate units. Values recorded are to the correct precision for the instrument used. (1 point is deducted for each area of infraction.)	3	
Analysis 1 Δd, average velocity and midpoint of time are calculated correctly for each interval. A sample calculation is provided and values are reported with appropriate units and to the correct number of significant digits. (1 point is deducted for each area of infraction.)	3	
Analysis 2 The graphs of velocity-time for both horizontal and vertical velocity follow all key areas as outlined in the graphing process. (1 point is deducted for each area of infraction.	4	
Analysis 3 The answer to the problem is communicated in sentence format and in a clear and appropriate manner. (1 point is deducted for each area of infraction.)	2	
Total This assignment is worth 6 marks on Portfolio A2.	12	