Projectile Motion
What is the acceleration in the horizontal and vertical directions?

Materials:
Vernier loggerpro and basketball clip

Problem:
If a basketball is thrown upward into the air at an angle (with both a horizontal and vertical component), will it accelerate in both directions (horizontal and vertical), just one direction, or neither direction?

Hypothesis:
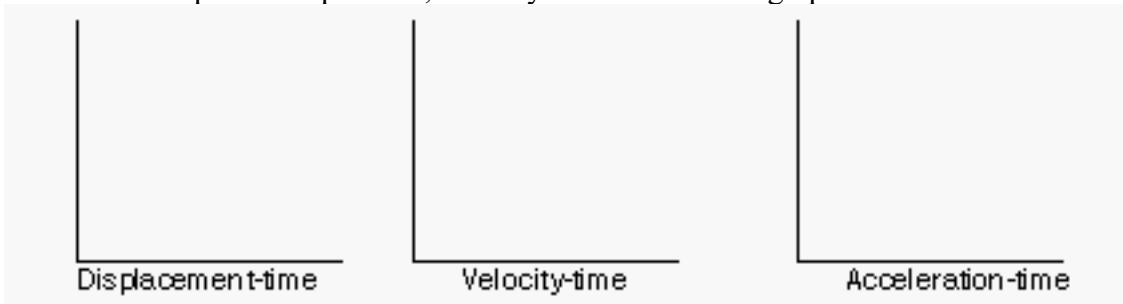Using the problem above, write a hypothesis about the acceleration of a basketball thrown into the air. This should be in the form: If _____, then _____, because _____.

Pre-lab questions
1. What do you predict should be the acceleration in the y-direction (vertically)?_____

2. What do you predict should be the acceleration in the x-direction (horizontally)?_____

3. Sketch the predicted position, velocity, and acceleration graphs for the y-direction.

Displacement-time	Velocity-time	Acceleration-time
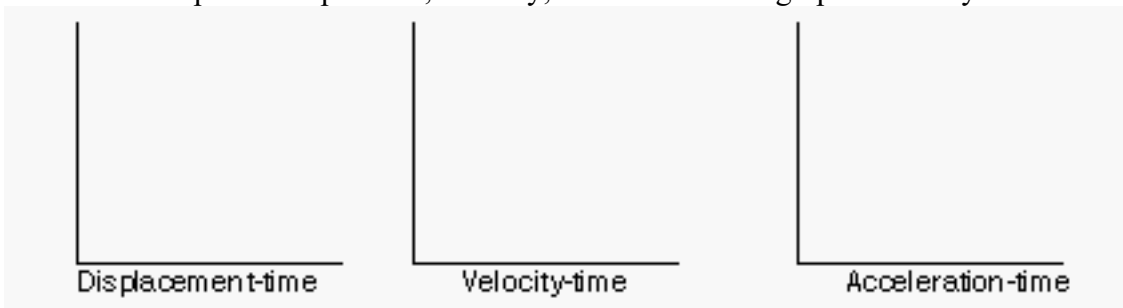
4. Sketch the predicted position, velocity and acceleration graphs for the x-direction.

Displacement-time	Velocity-time	Acceleration-time

Have instructor sign after s/he checks your pre-lab questions_____

Procedure
1. Open Logger Pro
2. Open movie from file => open => sample movies => basketball shot => basketball shot
3. Expand the video window to fit most of the screen
4. Watch the movie.
5. Scale the movie: Click on the meter stick icon (Set scale) on the right. You should notice two meter sticks in the video end to end on the floor at the right of the person. Click and drag from one end to the other so that the green line that appears reaches from one end of the meter sticks to the other end.
6. Enter a 2 for the number of meters measured.

7. Click on the red dot icon (Add Point) on the right side of the video window. Advance the video frame-by-frame until the ball has left the person's hand.
8. Once the ball is in the air, click on the center of the ball. A blue dot should be added at that position, and the video should automatically advance to the next frame.
9. Continue collecting data by clicking on the center of the ball in each new position. The video should continue to advance one frame each time you click. Take data until just before the ball hits the ground.
10. As you add data, a graph should automatically appear showing two sets of data: vertical (Y) position vs. time and horizontal (X) position vs. time.
11. Given that there was uncertainty in the measurement of the meter stick and in the scaling (since you likely didn't click on the exact beginning and end), estimate the percentage uncertainty. Add error bars to your graphs by right-clicking on a point on each graph, then going to options. **Use your estimated % uncertainty for both X and Y values.**
12. Click on the y axis label to change the graphs from X,Y to velocity X and Velocity Y. You should now be able to see your velocity vs. time graphs for both the vertical and horizontal directions.
13. Use the R= button to find the equation of a line of best fit for each of these graphs. From these equations, you should be able to find the acceleration for each direction. (Think: How do you find acceleration from a velocity vs. time graph?)
14. If the equation doesn't list an uncertainty for slope and y-intercept, right click on the box with the equation in it, click on "Linear Fit Options", and then "Show Uncertainty"
15. Copy and paste your finished graph into a Word Document to share at the end of the lab.

Data
Acceleration in the y direction (with uncertainty) = _____

Expected acceleration in the y direction=_____

Acceleration in the x direction (with uncertainty) = _____

Expected acceleration in the x direction=_____

Analysis (explanation of how the raw data is interpreted)
Explain (in your Word Document) how you determined the acceleration in each direction from your data. What data was used in calculating the acceleration? How did you find it? (This can probably be done in 2-3 sentences)

Conclusion (explanation of final value compared to expected results)

Hypothesis is restated
Hypothesis is supported or rejected by the data with reasoning
All statements are supported by data and range of uncertainty
Sources of error are identified
Discuss how sources of error may have impacted data

In the "all statements supported by data and range of uncertainty" answer the following

Does the value for the acceleration in the y direction from the video fall within error of the expected y value?
Does the value for the acceleration in the x direction from the video fall within error of the expected x value?
Also include discussion of how you arrived at your range of uncertainty. Use actual data (number values) to support your conclusions.

Expected Elements of CPHS Lab Write Ups

MUST be typed or the work is incomplete and will not be scored. We have computers in class.

Section of Lab	Criterion	Check when complete
Title (1)	Clearly stated title using scientific wording (How does…. affect….?)	
Hypothesis (1)	If…then….because statement predicting the outcome of the lab	
Lab Description(4)	Independent variable identified *for this lab it's time*	
	Dependent variable identified *for this lab it's acceleration*	
	List 3 or more constants *no wind, same ball, on Earth*	
	Summary of background information pertinent to lab (may include an equation and labeling of variables/units in the equation) *the slope of the velocity graph is the acceleration*	
Materials & Procedure (4)	List materials needed	
	Procedure is well organized and concise (so another scientist could repeat it) *does not have to be too detailed - generalize*	
	Procedure is in a chronological sequence	
	Diagrams (not hand drawn) of materials are clearly labeled *include a picture of the basketball toss*	
Data (3) *Not from logger pro from excel there should be 4 data values*	Data table is organized and contains all raw data (includes qualitative and quantitative data) *insert graphs from logger pro*	
	Data tables are titled with description of contents	
	Data table correctly displays all units of measurement (including significant figures)	
Results (4)	Appropriate type of graph used with clear title and labeled axes	
	Error bars are included on the graph	
	Summary statement explaining trends in **GRAPHS or DATA**	
	Identify outlying data *is there a bad data point?*	
Conclusion(5)	Hypothesis is restated	
	Hypothesis is supported or rejected with reasoning	
	All statements are supported by data and range of uncertainty	
	Sources of error are identified	
	Discuss how sources of error may have impacted data	
Presentation(3)	Grammar and spelling correct	
	Report is word processed and organized	
	Explanations are concise	
	Total of criterion satisfied	