Projectile Motion Preliminary Lab

Physics

In your final lab report for this activity, your job will be to use an initial set of measurements to predict the motion of a ball shot from a projectile launcher. For this preliminary lab, you will need to work in groups to collect initial data and make some calculations about a different object – one that you select and will toss at various speeds and angles.

You will be using the Big 4 to analyze the motion of the object. Since the ball is moving in two dimensions (horizontally and vertically), the measurements and calculations you make will need to correspond to x- and y-variables that describe positions, velocities, acceleration, and time.

1. Use the video capture function in the Logger Pro application to collect data and plot that data for an object that you toss. The object should have both vertical and horizontal motion. Make sure to correctly graph the motion and set your initial time, x-, and y-coordinates to 0. **In your notes, show how you can use the data from the video analysis along with the Big 4 equations to complete a variable inventory for both the x- and y-components of the motion of the object (there are several equations you can use to do this – you should be able to develop multiple equations using your data – for example, use the first Big 4 equation to model the vertical position of the object and use the coefficients from a quadratic curve fit to find the variables). Make sure to include a diagram showing your frame of reference for both the x- and y-axes.**

2. As part of this lab, you will need to be able to predict the location of a ball (not the object you threw above) at various times and points in its trajectory. With your group, discuss how you could calculate:
    a. How far away the ball will be horizontally from its starting position at any time
    b. How far above or below its starting position the object will be at any time
    c. How far above or below its starting position the object will be at any horizontal position (you will need to use the Big 4 twice for this!)
    d. How far away from its starting position the object will be at any vertical position (you will need to use the Big 4 twice for this – any there might be two answers!)

    (It might help you to think of the final position variables – x and y – as functions of time; i.e., x_t and y_t. and therefore the *t* variable in both of your variable inventories will always have the same value at any *x*- and *y*- coordinate pairs.) **In your notes, derive formulas for these quantities. Make sure to identify all measured and calculated values, including numbers that will be unknown until acquire more information (such as from a video analysis).**

3. For the final report, the ball will be launched at an angle. Therefore, you will need to include trigonometric formulas where necessary in your equations in order to break an initial velocity vector into x- and y- components, and in order to combine the final x- and

y- components into a final velocity vector. Discuss with your group how you could modify your formulas from part 2 above to incorporate the vector nature of initial velocity. **In your notes, record the equations you derive.**

4. Test your equations above by using the video analysis and variable inventories you created in part 1. See if the results of the equations match up with the actual locations of the object (in both the horizontal and vertical dimension) by using your data and the video