Trajectory

In Physics class, we often say “ignore air resistance.” Sometimes the approximation of negligible air resistance is a reasonable approximation. At other times, the declaration to ignore air resistance leads to unrealistic results. In this assignment, you will use a computer modeling program that incorporates air resistance into its calculations. The program uses values that you provide regarding an airborne object to calculate heights, speeds, air resistance forces, net forces, and acceleration values as a function of time. You can use the program to ask (and answer) inquisitive questions pertaining to the effect of a varying quantity on the motion of a real-world object through the air in the presence of air resistance.

Input Parameters and Output Parameters

The modeling program can be found in the Physics Interactives section at The Physics Classroom. See the Vectors and Projectiles section.

http://www.physicsclassroom.com/Physics-Interactives/Vectors-and-ProjectilesTrajectory.

The program requires the following information in order to perform its calculations: Initial Height (m), Initial Speed (m/s), Launch Angle (°), Object Mass (kg), Value of g (N/kg), Drag Coefficient, Profile Area (m^2), and Air Density (kg/L). Detailed information about each of these information bits can be found on the **Parameters** page at the website. Calculations will be performed every X seconds. X is known as the Δtime or time increment and is the final input parameter. The program will *output* the values of the x- and y-components of position, velocity, acceleration, and air resistance as a function of time and in tabular and graphical form. Your study will involve studying the effect of varying an input parameter upon an output parameter for a realistic motion scenario for an object moving through the air in two dimensions.

Overview of Assignment:

1. Introduce activity and become familiar with the use of the program.
2. Brainstorm an ambitious and testable question that centers around a 2-dimensional airborne motion. After brainstorming several possibilities, isolate the one question that you wish to study.
3. Transform your testable question into a Purpose statement. A good format for a Purpose statement is …

   > To study the effect of varying _____ (a variable) upon the _____ (a measurable quantity) for the motion of a _____ (a realistic object and 2-dimensional motion scenario).

4. Determine reasonable values for the input parameters. Use your noodle (that’s your brain), Google, and the Parameters page at The Physis Classroom (and the links provided there).

5. Develop an initial plan for how to conduct your study. Give thought to …
   - What output variables are important?
   - What input parameters will you modify and what parameters will remain constant?
   - How many trials will you need to perform to accomplish your purpose?
   - What output values should be plotted?

   Develop a plan for review and approval by your teacher.

6. Execute your plan. Make changes in the plan as needed. Record any relevant information as the result of your trials; this will include input parameters, constant quantities, and relevant output parameters. Take screenshots of strategic plots for inclusion in your final report. You will be required to include and discuss at least two plots that are relevant to your question/purpose and associated answer/conclusion.
7. Prepare your written report. The report should include the following sections:
   - The Question
   - Purpose
   - Description of Study
   - Data and Graphs
   - Conclusion (answer to the question; "claim")
   - Discussion (discuss the evidence and reasoning that supports your claim)

   You must run a sufficient number of trials (which would be at least two trials) as a comparison-contrast associated with your **Question**. The **Purpose** should be a succinct statement that focuses on an intriguing and ambitious question that can be answered by the program. The **Description of Study** section should discuss how you conducted your study in order to accomplish the Purpose. Part of this section should include a discussion of the logic that was used to determine the input parameters. The **Data and Graphs** section should list the input parameters used and the pertinent output parameters that are related to your purpose. At least two relevant graphs should be included for discussion and analysis. The **Conclusion** should include a succinct discussion of the answer to the question. The **Discussion** section should address details associated with your study. The evidence and reasoning for the claims you have made in the conclusion should be discussed. The graphical displays should be discussed and analyzed in light of the Physics principles you have learned. Draw the connection between the data that was collected and the claims that were made in the Conclusion section.

Scoring Rubric

Trajectory	**Score:**
____ Included, labeled, and organized all parts of the lab report. ____ Developed and ambitious and testable **Question** centered around a realistic 2-dimension motion scenario. ____ **Purpose** statement includes a succinctly worded statement that clarifies the intention of the study. ____ The **Description of Study** section describes details related to how the study was conducted. Rationale for the values of strategic input parameters is explained. The procedure that was used is related to the **Purpose**. ____ **Data and Graphs** section includes input values for all trials, expressed in the form of a table. Column headings are clear; units are stated. Relevant output parameters are clearly stated and organized. Included at least two plots that are relevant to the study. ____ **Conclusion** provides an answer to the Question described by the **Purpose** statement. Answer is complete. ____ **Discussion** presents the evidence and reasoning that logically support that claims that are made in the **Conclusion**. The graphs were intelligently analyzed and discussed; a solid understanding of physics was evident in the discussion. Writing is rational and scientifically-minded. Demonstrated great skill and understanding of how evidence can be used to logically support a claim.	____/____