Physics 200 Name (s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Bottle Analysis, Part 1

Sensor and Spreadsheet Analysis

Part 3: Spreadsheet Analysis. Use recorded data, previous answers, and your spreadsheet for these questions. To make your spreadsheet more responsive, you may want to download it and open it in Excel.

17. What was your rocket’s mass after all of the water left the rocket (its dry mass)? \_\_\_\_\_\_\_\_ kg

18. Your rocket’s cross-sectional area = \_\_\_\_\_\_\_\_m2

19. We will assume that the density of the surrounding air was = 1.22 kg/m3.

20. Inferring Cd using time aloft:In your spreadsheet, enter your rocket’s dry mass, cross-sectional area, starting y position, starting y velocity, and the air density for the coasting phase. Also enter the starting time for your rocket’s coasting phase (from #12). Then manipulate your rocket’s drag coefficient until the spreadsheet time aloft matches your rocket’s actual time aloft. According to this method, what is your rocket’s drag coefficient? Enter all of the following data for this method the middle column of Data Table 1, below. Make a copy of this spreadsheet and give it an appropriate name so that you can find it later.

Part 4: Comparison of rocket data and spreadsheet output with Clifford Heath’s rocket simulator (website).

21. Use your Cd from #20, along with your other rocket data, to run the online simulator. Record the simulator data in the far right column of Data Table 1, Below. Don’t forget to record initial thrust.

22. Use your Cd from #21, along with your other rocket data, to run the online simulator. Record the simulator data in the far right column of Data Table 2, Below.

|  |  |  |
| --- | --- | --- |
| DATA TABLE 1 | Your Measurements, Calculations, and Spreadsheet Results | Online Simulation Data |
| Cd (based on total flight time) |  |  |
| Total Flight Time (s) |  |  |
| Actual Apogee (highest point reached – meters) |  |  |
| Crashdown Speed (m/s) |  |  |
| Initial Thrust (N) |  |

23. In #3, you calculated average thrust for the water-thrust phase. The online simulator provides a value for initial thrust, and it also provides a graph of thrust vs. time.

 a. Find the water thrust that you calculated in number 9 and write it here. Fthrust = \_\_\_\_\_\_\_\_\_\_\_\_\_

 b. Do the values provided by Clifford Heath’s simulator agree with your calculated water-thrust? Provide evidence/reasoning to support your answer.

24. The goal of this activity was to confidently determine your rocket’s drag coefficient. List some potential sources of error in achieving that goal. Indicate the ones that you think are most important.

Sketches of Free-Body Diagrams: In each free body diagram, use labeled arrows to show all of the individual forces – and the net force – acting on your rocket. Each arrow must be labeled with a reasonable magnitude, the correct name of the force, and correct units. To obtain reasonable values, you may use your data and/or Clifford Heath’s online simulator.

25. Create a free body diagram of your rocket at the beginning of the water thrust phase – just after the first bit of water escapes.

26. Create a free body diagram of your rocket at the end of the water thrust phase (beginning of the air thrust phase).

27. Create a free body diagram of your rocket just before it hit the ground.