**PHYSICS 1D03 LAB 4 WRITE-UP**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**   **Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Partner:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Lab Section:\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Student No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**EXPERIMENTAL SETUP**

**WARNING: please name the balls an appropriately self-evident name. Otherwise, you will lose marks.** Also remember to include the units in all your measurements.

**Ball #1: mass** $m\_{1}=$ **name:**

**Description –**

**Ball #2: mass** $m\_{2}=$ **name:**

**Description –**

**Ball #3: mass** $m\_{3}=$ **name:**

**Description –**

**RESULTS FOR ANALYSIS 1**

Present your graphs for the three different balls here. Make sure they are properly labeled and to the correct scale.

Graph 1

Graph 2

Graph 3

**RESULTS FOR ANALYSIS 2**

$t\_{o}=\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_\\_$, and $E\left(t\_{0}\right)=$ \_\_\_\_\_\_\_\_\_

Place your graph of your various energies versus time with the two points highlighted here.

Place your graph for the difference in initial energy and final energy after the drop here.

**DISCUSSION AND CONCLUSIONS**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Question*** 1.Although we are ignoring uncertainties during this experiment, there are systematic uncertainties that affect our measurements. What sort of systematic uncertainties are associated with the Capstone software and our procedure/setup? List at least two causes of systematic uncertainties and elaborate on your answers.

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***Question*** 2.The motion sensor measures the position of the ball at specific times but does not directly measure the velocity. How does it calculate the velocity (and kinetic energy) of the ball? Hint: How is velocity numerically calculated from position and time?

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***Question*** 3.In step 4 of the Procedure, why do we delete the data collected after the ball hits the guard? Explain why you think the data appears as it does after the collision and what the motion sensor is detecting.

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***Question*** 4. Based on the discussion of isolated systems in the Theory section, does your data justify treating each falling ball as an isolated system within this experiment? Compare and contrast between the different balls used. Which type of graph (position, velocity or energy versus time) justifies your answer the best and why?

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***Question*** 5.Based on your results, which of the three balls is affected the most by the drag force from air resistance? How does the geometry and material of the balls affect the drag force? Hint: Consider Equation (5) in your arguments.

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***Question*** 6. Does your plot of the difference in energy as a function of time demonstrate the effects of air resistance? Justify why or why not based on your data. Discuss if it is consistent with your expectations based on the type of ball used and the experimental setup.

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***Question*** 7. The drag force from air resistance is usually described as a quadratic or linear function of velocity, as stated in Equations (6) and (7). Does the data collected in this experiment support a quadratic relation between the drag force and the velocity? Explain why or why not. Would this experiment be sufficient to distinguish between linear and quadratic models for the drag force from air resistance? Explain why or why not.

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