You Dropped the Ball

Name: Date: Class:

You already know the standard value for "g" the acceleration due to gravity but today you will actually get to measure it. Even though we aren't conscious of it, gravity is always pulling us down. The way we can determine "g" is to drop an object and time how long it takes to fall. (see page 22 in the textbook).

Use this handy formula: $\mathbf{d=1/2at^2}$ Or $\mathbf{d=1/2gt^2}$

Where: **d** is the distance an object falls or the height from which it falls (m)
a or **g** is acceleration due to gravity (m/s^2)
t is time (sec)

Solve the above equation for g, the acceleration due to gravity.

We will also compare the difference between dropping a ball and throwing the ball and the time that it takes for different sized objects fall.

Pre-lab:

1. Write out three hypotheses addressing experiments A, B and C below. How accurate will your "g" be? Which do you think will take longer to fall, large vs. small? Dropped vs. thrown? Why? Record your hypotheses and your reasoning on the back of this sheet.
2. Prepare a data table on the back of this sheet.

Procedure: (SHOW ALL OF YOUR WORK for each step on the back of this sheet)

3. Measure and record the height of the drop zone
4. **Expt. A**: calculating "g"
   - Drop a small bean bag from that height and record the time it takes to hit the ground. Do three trials and calculate the average time. Make sure to always drop the bean bags from the same height.
   - **Calculate** acceleration due to gravity ("g") and record in your data table
5. **Expt. B:** different-sized bean bags
   - Drop two different-sized bean bags from the drop zone. Make sure that the bottoms of the bags are level when you drop them. Do three trials. (You will not be timing these – just observe.)
   - **Determine** which object (one with more or less mass) hits the ground first.
6. **Expt. C**: Straight drop vs. thrown horizontally.
   - Throw a small bean bag out horizontally (from the same height you dropped the bag) and measure the time it takes to fall (do three trials and take the average time) and the distance from the building
   - **Calculate** the horizontal velocity of the bean bag (velocity = horizontal distance ball travels /time) and record it in your data table.

Questions: answer on a separate sheet of paper

1. How does your calculated value for "g" compare to the standard value? Calculate your percent error. (absolute value of: (expected value for **g** – calculated value for **g**)/expected value for **g** x 100)
2. Provide several reasons why your value for gravity differs from the accepted value. Which is most likely to most important factor? Why?
3. Compare the time taken for different sized objects to fall. Mathematically prove why or why not the mass of the falling object affects the time it will take to fall. (solve the above equation for **t**) See page 24 in the book.
4. How does the time taken to reach the ground compare when the bean bag is dropped vs. when it is thrown. Explain. See page 86 in the textbook.
5. If you threw the bean bag harder, what affect would this have on the distance and time that the bean bag traveled? The horizontal velocity?
6. Suggest an object(s) that you could have used in the lab that would have given you much different results? Explain
7. If gravity were not present, describe what would happen when you throw a bean bag horizontally.
8. If you throw a ball straight up, what is its kinetic energy at the highest point? Explain

Calculations- *use the accepted value for "g" to calculate the following:*

1. Solving the equation above for time (t), calculate the time it takes for an object to fall from the drop zone. How does this compare to your measured value for time?
2. How long (sec) has an object been falling after it has fallen 10m and 25m? If velocity can be determined by v=gt then how fast will an object be going if it has fallen 10m? 25?

Hypothesis: accuracy of "g" calculation _____

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Hypothesis: large vs. small objects _____

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Hypothesis: horizontal vs. straight drop _____

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DATA TABLE

CALCULATIONS