PHYS 1405 – Conceptual Physics I
Laboratory #1
Basic Measurements

In this laboratory exercise we will focus on practicing techniques of measurement and graphing. You will be measuring many of the basic quantities of physics, using some of the basic tools. Be as accurate as you can with all your measurements. Each person in the lab group should make these measurements, and you should compile all your answers.

Investigation 1: Is there a significant difference between the mass of regular Coke and the mass of Diet Coke?

What to measure: Masses of a can of Coke and a can of Diet Coke
Measuring device(s): Scale
Calculations: Percentage difference

Procedure: Measure the masses of the two cans of soda as accurately as you can. Calculate the percentage difference between the two using this formula:

$$Percentage\_Difference = 100\% \times \frac{(Coke - Diet)}{Diet}$$

Show your measurements, calculations, and results in your lab report.

Question 1: Do you think that this is a significant percentage difference? If not, why not? If so, what do you think accounts for the difference?

Investigation 2: Does the measured volume of a can of soda agree with the value on the can?

What to measure: Diameter and height of a can of soda
Measuring devices: Calipers
Calculations: Radius, Volume of cylinder, percentage difference

Procedure: Use the calipers to measure the height of a can soda, and its widest diameter.

Question 2: How can we use the diameter of the can to find its radius?

Question 3: We will want to calculate the volume of the can in units of cubic centimeters, so that we can compare this to the milliliters on the can. Therefore, our measurements of height and diameter / radius must be in what units?

Question 4: How can we convert from the units on the calipers to the units we need?

Calculate the volume of the can using the formula:

$$V = \pi r^2 h$$

Where r is the radius, h is the height, and pi (π) is 3.14159. The units will be in cubic centimeters, and 1 cubic centimeter (cc) is equal to 1 milliliter (ml). Calculate the percentage difference between the value you calculated and the given value on the can using the formula:

$$Percentage\_Difference = 100\% \times \frac{(calculated - given)}{given}$$

Present your measurements and results in your lab report.

Question 5: How significant is the difference between the two volumes? Give at least two reasons for the difference.

Investigation 3: What is the best way to measure the time it takes a pendulum to swing back and forth?

What to measure: The amount of time it takes a pendulum to make one complete swing, called the *period* of the pendulum
Measuring devices: Stopwatch
Calculations: Average period

Procedure: Take turns with the people at your table measuring how long it takes a pendulum to swing. First, measure the time for one swing only. Let each person in the group try it once and record the results for each person in seconds.

Now time 10 complete swings non-stop. Again, let every person in the group do it. Make sure you really time 10 swings, not just 9! Record these results for every member of your group. Present all your measurements in your report.

Question 6: How can you use your second set of measurements (the 10-swing times) to find the average time for one swing for each person?

Question 7: Which method of measurements produces the most consistent results? Use your measurements to support an argument favoring one method over the other.

Investigation 4: Is there a relationship between the diameter of a round object and its circumference?

What to measure: The diameters and circumferences of a number of objects
Measuring devices: Calipers, string or ribbon ruler, and ruler
Calculations: Ratio of circumference to diameter, slope of a line

Procedure: You will be given seven round objects to measure, four spheres and three cylinders. Use the calipers to measure the diameter of each object. Remember from Investigation 2 how to convert this into centimeters. Then use the string and ruler to measure the distance around each object, called the circumference. Record all your measurements. Divide the circumference of each object by the diameter of each object. Record these numbers in your data table as well.

Object	Diameter (mm)	Diameter (cm)	Circumference (cm)	C/D

Question 8: Is the ratio of the circumference to the diameter roughly the same number each time? Does this number look familiar?

Create a graph with diameter on the x-axis and circumference on the y-axis. Use graph paper for this graph.

Question 9: Do you see a trend in the graph? If so, what is the trend?

Draw the best straight line you can through the data points. Do *not* just connect the dots! Find the slope of this graph using the equation:

$$Slope = \frac{Vertical\_change}{Horizontal\_change}$$

Question 10: How does the slope compare to your answer for Question 8? Does this make sense, given the equation for circumference?

Present your data table, your graph, and your calculations in your lab report.

Materials List

Cans of Coke and Diet Coke
Electronic Scale
Calipers
Pendulums
Stopwatches
String or flexible ruler
Four Spheres of Different Sizes
Three Cylinders of Different Sizes