PHYS 1401 – General Physics I
Laboratory #1
Basic Measurements

In this laboratory exercise we will focus on practicing techniques of measurement. 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.

1. Measure the length and width of this piece of paper in centimeters. Compute the area of the paper using the formula A = L x W. Leave the length and width in centimeters to get the area in square centimeters.

2. You will be given a rectangular object to measure, such as a box or eraser. Use the vernier calipers to measure the length and width and height of the rectangular object. Write these dimensions in both centimeters (cm) and meters (m). Draw a diagram of the block, and label it to show what you mean by length and width and height. Calculate the volume of the block using the formula V = L x W x H. Use the dimensions in centimeters to get the volume in cubic centimeters (cc's).

3. You will be given seven round objects to measure, four spheres and three cylinders. Use the calipers to measure the longest distance across these round objects. This is called the diameter of the circle, sphere, or cylinder. Half of this diameter is called the radius. Record both the diameter and the radius of each object in meters.

4. Use string to measure the longest distance around each of the seven round objects from Question 3. This distance is called the circumference. Record the circumference of each object in meters.

5. Make a graph of your data from Questions 3 and 4 with circumference on the y-axis and radius on the x-axis. If a change occurs in radius, is there a predictable change in circumference? Draw a "best fit" line through the five points; do NOT just connect the dots! Find and record the slope of this line. For each round object, take the circumference and divide it by the radius. Do you get roughly the same number every time? Do your results, from the graph, and from computation, make sense? Explain why.

6. Measure the diameters and heights of the two cans of soda. Record the figures for diameter, radius, and height in centimeters. Calculate the volumes of the soda cans using the formula for the volume of a cylinder:

   $$V = (3.14159) \times (\text{radius}) \times (\text{radius}) \times \text{height}$$

   The volumes you get will be in cubic centimeters. Convert this volume into milliliters using the fact that 1 ml = 1 cubic centimeter. Does this volume in milliliters agree with the figure on the soda can? Calculate the percentage difference between the "calculated" volume and the volume "given" on the can, using the formula

   $$Percentage\_Difference = 100\% \times \frac{(Calculated - Given)}{Given}$$

   Why do you think there might be differences?

7. Use the balance to determine the mass of each soda can in grams. Record the masses in both grams and kilograms. Calculate the percentage difference between the two masses using the formula

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

   Is there a significant difference between the two masses? Why do you think that is so?

8. Use a timer to time one swing of a pendulum. 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 and divide this total time by 10. 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 and compare them to the "one swing" measurements. Which method is better for precisely determining the "period" (time for one swing) of the pendulum – that is, which method produces more consistent results? Defend your answer.

Materials List

Ruler
Calipers
Rectangular object
Four spheres of different sizes
Three cylinders of different sizes
Flexible ruler and / or string
Cans of Coke and Diet Coke
Electronic scale
Pendulums
Stopwatches