

SMS-204, 2014: Integrative marine sciences, physics. Lab 1

Knowledge: mass, volume, and density; no-slip condition; sinking in a highly viscous fluid.

Skills: basic statistics, propagation of errors, graphing of data.

The lab is performed in groups of 3-4 students. Choose a name for your group. By the end of the lab you will take a quiz (as individuals first and then as a group) to assess your understanding of the class and lab exercises. The quiz will *not* affect your grade but may result in your group all getting a pizza dinner.

Station 1: Density rods.

In this station you have 8 rods.

Measure the mass of each, and estimate the uncertainty of the mass (see Appendix).

Measure the diameter and length of each rod and their uncertainties (See Appendix).

Rod #	1	2	3	4	5	6	7	8
mass								
length								
diameter								

Uncertainty in measuring length or diameter _____

Uncertainty in measuring mass _____

Discuss with your group and agree on how you would compute the uncertainty in the volume of the rods and the uncertainty in their density (you will need to do it for your homework). To do it you will need to **propagate** the uncertainties (see appendix).

Be sure to enter your data in the class data spreadsheet + uncertainties. You will need them to complete the homework.

Station 2: No slip condition

You are about to turn on a rotating table over which a tank full of water is set.

- What do you expect will happen to the water in the tank as it starts rotating? Will the water rotate as well? Will there be a difference between fluid right next to the boundary vs. in the center of the tank?
- Put some wood shaving or dye next to the rim of the tank and some further towards the center. Start the rotation of the tank and observe the motion. How would you explain it? How is it related to the no-slip condition?
- You will soon stop the tanks rotation. What do you expect will happen in the fluid when you do it?
- Stop the tank's rotation and watch the sawdust to investigate the fluid's response.

Station 3: Sinking in a viscous fluid

Measure the mass and diameters of 5 different size beads. Then measure their sinking speeds in Glycerin using a stopwatch and a ruler. Measure the sinking speed three times to establish some confidence in the sinking speeds you are getting (You will need it for the homework). Start measuring after the beads have attained a constant settling speed (denoted by a tape). Make sure to have input the units into the table below. Note the uncertainties in mass, distance and time and add them to the table below. Discuss within your group the balance of the forces acting on the bead when it reaches constant settling velocity. Why does it keep sinking and why doesn't it sink faster with time?

Distance bead falls each time _____ (remember: sinking speed = distance/time)

Bead Size	Bead diameter	Bead Mass	Sinking time (1)	Sinking time (2)	Sinking time (3)	Sinking speed (1)	Sinking speed (2)	Sinking speed (3)
Size 1								
Size 2								
Size 3								
Size 4								
Size 5								

Uncertainty in measurements: diameter _____ mass _____ time _____

Copy the data from this table to the laptop in the lab. I will aggregate the data so that you can use them in your homework. Use the data collected at station 1 and 3 (including the data from other groups that will be posted shortly on the WWW) in the homework assignment.

Station 4: Densities of oceanic and continental crust.

- a. Determine the densities of the two rock samples (basalt and granite) with the materials provided to you. How do they compare?

- b. The average elevation of land *above* sea level is 875m (average density of rocks is about 2.8g cm^{-3}). The average depth of the ocean floor is 3795m *below* sea level and water density is about 1.02g cm^{-3} . Given that, which crust (oceanic or continental) would you expect to be denser? Is it consistent with what you found?