

# SMS-204: Integrative marine sciences.

## Lab 3, Buoyancy lab.

**For homework- remember to provide uncertainties in graphs and display only significant figures for all your results.**

Station 1: Archimedes ball (Note: data will be used in homework).

- Obtain the approximate weight and volume of the dry ball. What is its density? How does it compare with that of water?
- Empty all the air from the syringe. Place the ball in the water and slowly evacuate air out of the ball using the syringe until the ball starts sinking. Note how much air volume was displaced (about equals to the air in the syringe).



*Figure 1. Michael, Ben and Joe (left panel) and Madye and Hope (left panel) are experimenting with a ball which has a valve on the bottom. As they pull on the syringe, water gets into the ball making it less buoyant (sink a submarine getting ready to dive). The reading on the syringe provides the volume of air that was replaced by water within the ball allowing the student to quantitatively test Archimedes's principle.*

Station 2: A hydrometer is a device to obtain the densities of fluid.

- a. Speculate on how it works. Why does it have a limited range of densities for which it provides a useful reading? Estimate the density of the hydrometer itself. Why does the scale mention a specific temperature?
- b. In a graduated cylinder measure the density of water. How does it compare with a?
- c. Suppose you added salt or ice into the water. Would the hydrometer float higher or lower? Try it. Hydrometers are used in the beer industry. Can you speculate why?



*Figure 2. Abigail and Jonathan (left panel) and Dominique and Jen (right panel) observe how buoyancy determine the height of a hydrometer. The reading on the hydrometer provides a quantitative estimate of the fluid's density relative to a reference fluid (e.g. water at 60F). Hydrometers are used in the beer industry to monitor sugar content as the density of the fluid is reduced as sugar is fermented into alcohol.*

### Station 3: Cartesian diver

- a. Squeeze the bottle. Why is the half closed pipe inside the bottle sinking?
- b. How is it related to Archimedes's principle and to last week Pascal's press?



*Figure 3. Marion, Jenna and Nicole (left panel) and Andrew and Ruth (right panel) squeeze on a bottle full of water and observe how that squeezing causes an upside-down pipette full of air but open to the water on the bottom that usually floats to sink. At least two physical concepts are demonstrated: 1. Pressure is transmitted throughout the fluid no matter where we squeeze. 2. When the air within the pipette compresses and water fills in part of the pipette, the buoyancy of the pipette is reduced changing the force balance and causing it to sink.*

### Station 4: Weight in and outside water (Note: data will be used in homework).

- a. Measure/compute the box's volume and weight, and the weight of the metal pieces used as weights.
- b. For a series of 4 different amounts of internal weights (making sure in all cases that the box floats), measure: a. the weight outside water using the spring. b. the weight of the box in water, and c. the depth to which the box is immersed in water (each mark on the box is 1cm).
- c. Now add enough weights so that the box sinks in water.
- d. What is the weight of the box when immersed in water and outside water? b. What is the difference between the weights?



*Figure 4. Jeremy and Matthew (left panel) and Chris, Dominique and Alyssa (right panel) measure weight of a box and observe how it is different in air than when immersed into a fluid due to the added buoyancy force which equals to the weight of the volume displaced by the box.*

Station 5: Floating disks.

- a. Can you make foil float on water? Can you make it sink?
- b. What is the physics involved?



Figure 5. Ryan, Wes and Carlie, and Andrew, Ruth and Sonja observe how high density material can float on water. This is possible due to a property of water we did not discuss in class, namely surface tension (e.g. [http://en.wikipedia.org/wiki/Surface\\_tension](http://en.wikipedia.org/wiki/Surface_tension)). Adding soap to the water decreases surface tension and will cause the disk to sink.

---

©Boss, 2008

This page was last edited on 4/10/2008