SMS-204: Integrative marine sciences.

Lab 3, Buoyancy lab (and homework).

For homework- please provide uncertainties and display only significant figures for all your results.

**Station 1:** Archimedes ball.

a. Obtain an approximate weight and volume of the dry ball. What is its density? How does it compare with that of water?

b. Place the ball in the water. Slowly evacuate air out of the ball using the syringe until the ball starts sinking. Note how much air volume was displaced.

c. For homework:

   Work out how much air needs to be evacuated in order for the ball to barely start sinking in the surrounding water. How does it compare to (b)?

**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. Does it make sense?

c. Suppose you added salt or ice into the water. Would it float higher or lower? Try it.

   Hydrometers are used in the beer industry. Can you speculate why?

**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 Pascal’s press?
Station 4: Weight on a spring.

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 internal amounts of 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).

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<th># and type of weights</th>
<th>Weight in air</th>
<th>Weight in water</th>
<th>Immersion depth</th>
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c. For **homework**: plot the depth of the box as function of the weight of the (box + weights). Obtain the slope from your regression program. What should the slope be based on Archimedes’s principle in each case? How does it compare to your findings?

d. Now add enough weights so that the box sinks in water.

e. For **homework**: a. What is the weight of the box when immersed in water and outside water? b. What is the difference between the weights? c. Is this difference reasonable given what you learned in class?
Station 5: Floating disk.

a. Can you make foil float on water? Can you make it sink?

b. What is the physics involved?

Station 6: Bernoulli’s principle (3-branched manometer).

a. Predict, based on the principle of continuity, where in the glass pipe the velocity of a flowing fluid will be maximal.

b. Predict, based on Bernoulli’s principle, where in the pipe would the pressure be highest and where lowest. Use that to predict the height of water in the different branches of the manometer (remember, for fluid at rest (that in the monometer), the pressure at the bottom of all the branches = weight of water + air pressure has to be the same in all branches).

c. Clean the tip and blow air through the pipe. How does it compare with your predictions?

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