PHY131 Practicals Day 10
Student Guide

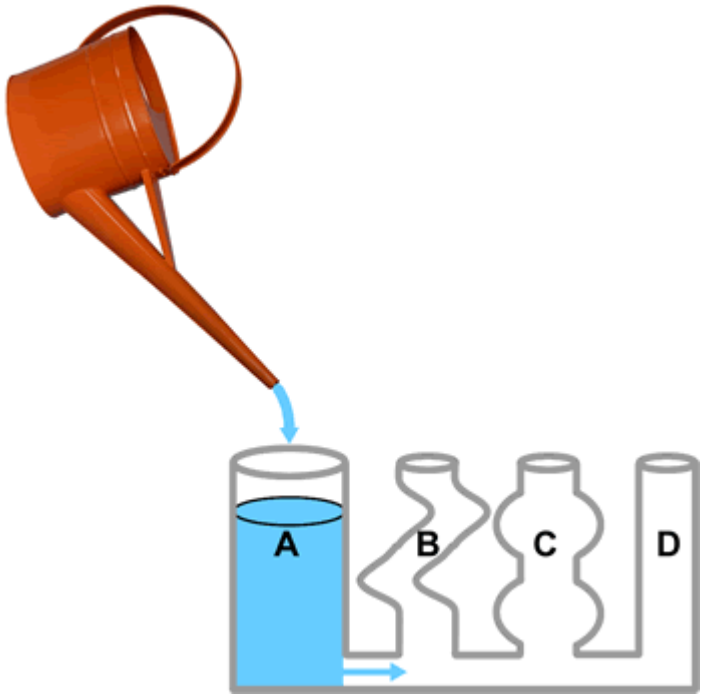
Summer 2009

Concepts of this week's Module

- Fluids
- Pressure
- Buoyancy

Fluids Module, Activity 2

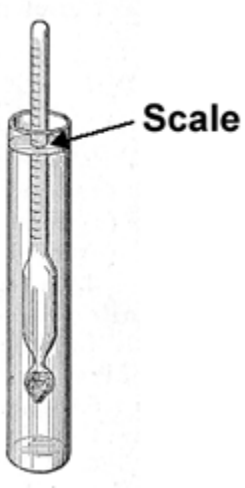
Cylinder **A** is being filled to the level shown. As the water is added to the cylinder it flows along the horizontal pipe and up **B**, **C** and **D**, which are all open at their tops.



Rank the heights of the water in **A**, **B**, **C**, and **D** when **A** is filled. Check your prediction using the supplied apparatus. Was your prediction correct? If yes, what physical principles did you use to make a correct prediction? If no, explain the actual result.

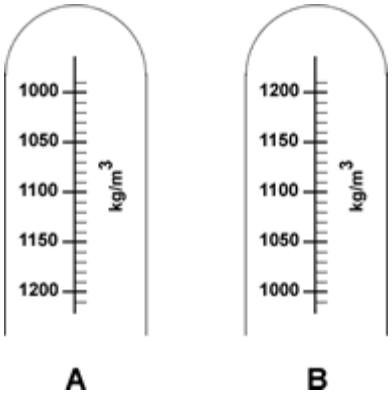
Fluids Module, Activity 6

A *hydrometer* measures the density of a liquid. They are widely used to measure the alcohol content in the brewing of beer, the electrolyte content of battery acid, and more.



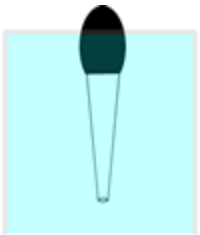
The device is placed in the liquid whose density is to be measured, and the density is read by the place on the scale where the surface of the liquid touches the stem.

On the next page is a close-up figure of two possible ways that the markings on the scale of the hydrometer can be arranged. Which of these arrangements are correct? Explain.



Fluids Module, Activity 7

Please do this Activity with all the apparatus in the supplied dishpan to minimize the water spilled onto the tabletop.



You are supplied with a beaker. You should fill it with water nearly to the top. Place the supplied medicine dropper in the water with the squeeze bulb on top. Suck enough water up into the medicine dropper that it *just barely* floats.

You are supplied with an empty 2 liter plastic pop bottle. Fill it to the brim with water. Transfer the filled medicine dropper to the water in the pop bottle.

Screw the top tightly on the bottle. Squeeze the bottle. What happens to the medicine dropper? What happens when you quit squeezing the bottle? Explain why squeezing the

bottle and increasing the pressure of all the fluids within would cause the observed motion. This is called a *Cartesian diver*.

The supplied toothpicks make it easy to "fish" the medicine dropper out of the bottle.

When you are finished with this Activity, *carefully* empty all the water into the sink.

Course Concepts *Fluids Module, Activity 9*

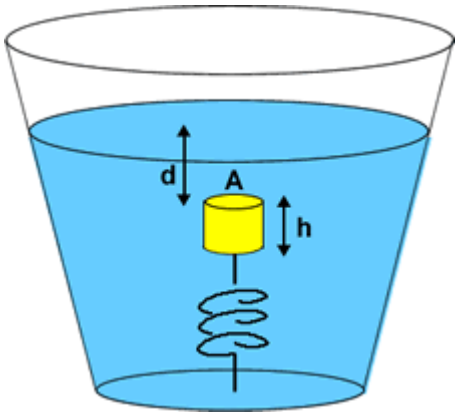
A ship is in a canal lock, which is only a little bit larger than the ship itself. The ship is loaded with steel ingots, which are large bars of steel. The crew becomes angry with the captain of the ship and throws the steel ingots overboard into the water of the lock.

Does the level of the water in the lock rise, lower, or stay the same?

Check your prediction. Place the supplied plastic tank in the dishpan and fill the tank about half-way with water. Place the supplied weight in the bottom of the supplied plastic boat and gently place it in the water. You may mark the height of the water in the tank with a small piece of masking tape. Carefully lift the boat out of the water, place the weight at the bottom of the tank, and put the boat back in the water.

When you are finished with this Activity, *carefully* empty the water into the sink.

Course Concepts *If you have time: Fluids Module, Activity 5*



A bucket of water has a spring soldered to the bottom. Attached to the other end of the spring is a cylindrical cork of mass *m*, height **h** and area **A** which is stationary below the surface of the water, as shown. The top of the cork is a depth **d** below the surface of the water. The spring has a spring constant *k* and is stretched a distance **x** from its equilibrium position. The density of the water is ρ.

A. Draw a free body diagram of all the vertical forces acting on the cork. Evaluate the magnitude of those forces. Determine **x**, the amount that the string is stretched from its equilibrium position.
B. Imagine you are holding the bucket by its handle, which is not shown. You go to the top of the CN tower and step off, still holding the bucket. As you and the

bucket fall towards the ground what is the motion of the cork? Does it move towards the bottom of the bucket, towards the top, or stay where it is? Explain.

If you have time: Fluids Module, Activity 8

You may have noticed that the bubbles in a glass of a carbonated beverage (soda, beer, champagne, etc) accelerate as they rise from the bottom. Explain.

Last revision to this write-up: June 9, 2009 by Jason Harlow.

This Fluids Module Student Guide was written by David M. Harrison, Dept. of Physics, Univ. of Toronto, May 2008. Last revision: November 27, 2008.

Activities 6 and 9 are based on David M. Harrison and William Ellis, **Student Activity Workbook**, 3rd ed. (Norton, 2008), 18.4 and 18.6.
The figure for Activity 6 is slightly modified from a figure from Wikipedia, http://en.wikipedia.org/wiki/Hydrometer, retrieved June 19, 2008.