Due in class Aug 24th
Assume that the density of water is 1 g/cm³.

1. Light passes through three polarizers. The first one has its axis oriented vertically, while the third one has its axis oriented horizontally. The polarizer in the middle rotates at an angular frequency of ω, so that its axis makes an angle ωt to the vertical. Unpolarized light of intensity $I_0$ falls on the first polarizer. What is the intensity $I(t)$ of the light that emerges through the third polarizer, as a function of time $t$?

2. A dam is 150 m in height, and has a span of 379 m. What is the total force that is exerted on the dam by the water behind it when the water level is 15 m below the top of the dam?

3. A U-shaped glass tube with open ends is filled with oil on one side of the U to a height of 25 cm and with water on the other side to the same height. Assume that the density of oil is 0.8 g/cm³. The water and oil are separated by a barrier that can slide back and forth in the glass tube, without letting the oil and water mix. When the system reaches equilibrium, what is the height of the liquid on each side?

4. The maximum gauge pressure in a hydraulic lift is 17.2 atmospheres. The diameter of the output line is 23 cm. What is the maximum weight that it can lift?

5. A block hangs from a spring balance, and is submerged in a liquid in a beaker. The beaker is, in turn, resting on a pan balance. The beaker has a mass of 100 g, and the liquid has a mass of 180 g. The spring balance shows a measurement of 350 g, while the pan balance reads 750 g. The volume of the block is 380 cm³. What is the density of the liquid? What will each balance read if the block is pulled out of the liquid?

6. Water flows continuously from the outlet of a faucet whose internal diameter is 1 cm. The initial speed of the water is 5 m/s. What is the diameter of the stream at a distance of 1.5 m below the outlet? Assume that droplets are not formed, and neglect air resistance.

7. An airplane has a total wing area of 17.8 m². When it is flying at steady altitude at a certain speed, air flows of the top surface of the wings at a speed of 50 m/s, and over the bottom surface at a speed of 39 m/s. If the density of air is 1.15 kg/m³, what is the weight of the airplane?
8. Two large tanks are filled with water. A horizontal pipe leads out of the first tank, and is open at its far end. There is a constriction in the middle section of the pipe. The diameter of the constricted section of the pipe is half the diameter of the rest of the pipe. Another pipe connects the top of the constricted section to the other tank. Assume (despite appearances) that the pipes are narrow compared to the sizes of the tanks, i.e. do not worry whether the height $h_1$ is measured from the top, bottom or middle of the horizontal pipe. What is $h_2$ in terms of $h_1$?