ME2240: Fluid Mechanics
Assignment - 2

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Due date: 20th September 2022, before the class begins.

Note: Please write your solutions on a neat blank sheet of paper (preferably on both sides) with the roll number and name clearly written at the top. Loose sheets will not be accepted, so make sure you staple the sheets. And don't forget to number the sheets. Any evidence of copying will result in getting a zero mark for the entire assignment. Make sure that you work out the solutions on your own. Draw the plots on a graph paper or neatly on a plane sheet of paper with the axis clearly marked.

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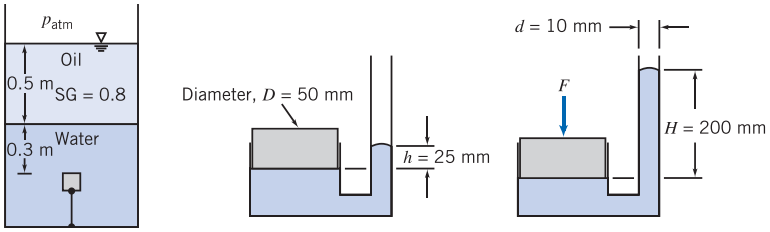
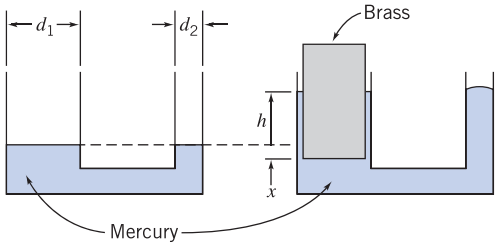
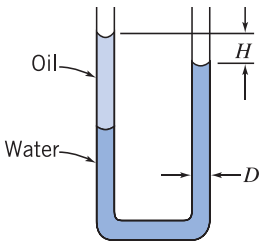
1. A 125-mL cube of solid oak is held submerged by a tether as shown. Calculate the actual force of the water on the bottom surface of the cube and the tension in the tether.



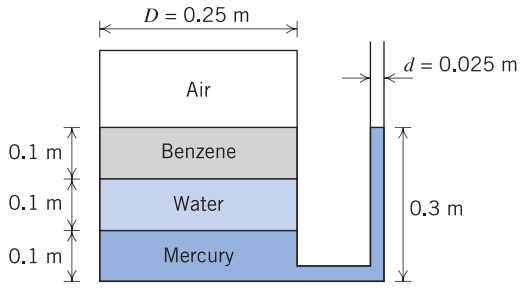
2. A container with two circular vertical tubes of diameters $d_1 = 39.5mm$ and $d_2 = 12.7mm$ is partially filled with mercury. The equilibrium level of the liquid is shown in the left diagram. A cylindrical object made from solid brass is placed in the larger tube so that it floats, as shown in the right diagram. The object is $D = 37.5mm$ in diameter and $H = 76.2$ mm high. Calculate the pressure at the lower surface needed to float the object. Determine the new equilibrium level, h, of the mercury with the brass cylinder in place.



3. A manometer is formed from glass tubing with uniform inside diameter, $D = 6.35mm$, as shown below. The U-tube is partially filled with water. Then a volume of $V = 3.25cm^3$ of Meriam red oil is added to the left side. Calculate the equilibrium height, H, when both legs of the U-tube are open to the atmosphere.



4. Consider a tank containing mercury, water, benzene, and air as shown. Find the air pressure (gage). If an opening is made in the top of the tank, find the equilibrium level of the mercury in the manometer.



5. A student wishes to design a manometer with better sensitivity than a water-filled U-tube of constant diameter. The student's concept involves using tubes with different diameters and two liquids, as shown. Evaluate the deflection h of this manometer, if the applied pressure difference is $\Delta p = 250 N/m^2$. Determine the sensitivity of this manometer. Plot the manometer sensitivity as a function of the diameter ratio d_2/d_1.