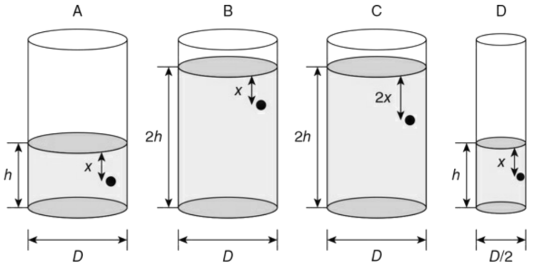
AP PHYSICS 2: FLUID MECHANICS

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and place the letter of your choice in the corresponding box on the student answer sheet.

Note: To simplify calculations, you may use $g = 10\,\text{m/s}^2$ in all problems.

1. The figure shows four cylinders of various diameters filled to different heights with water. A hole in the side of each cylinder is plugged by a cork. All cylinders are open at the top. The corks are removed. Which of the following is the correct ranking of the velocity of the water (v) as it exits each cylinder?



(A) $v_A > v_D > v_C > v_B$
(B) $v_A = v_D > v_C > v_B$
(C) $v_B > v_C > v_A = v_D$
(D) $v_C > v_A = v_B = v_D$

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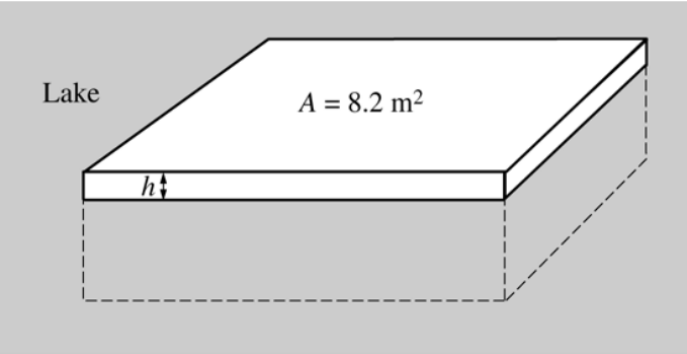
AP PHYSICS 2: Fluid Mechanics
SECTION II
5 Questions

Directions: Answer all questions. The parts within a question may not have equal weight. All final numerical answers should include appropriate units. Credit depends on the quality of your solutions and explanations, so you should show your work. Credit also depends on demonstrating that you know which physical principles would be appropriate to apply in a particular situation. Therefore, you should clearly indicate which part of a question your work is for.



Note: Figure not drawn to scale.

1. A large rectangular raft (density $650\ \text{kg/m}^3$) is floating on a lake. The surface area of the top of the raft is $8.2\ \text{m}^2$ and its volume is $1.80\ \text{m}^3$. The density of the lake water is $1000\ \text{kg/m}^3$.

   (a) Calculate the height h of the portion of the raft that is above the surrounding water.

   (b) Calculate the magnitude of the buoyant force on the raft and state its direction.

   (c) If the average mass of a person is 75 kg, calculate the maximum number of people that can be on the raft without the top of the raft sinking below the surface of the water. (Assume that the people are evenly distributed on the raft.)

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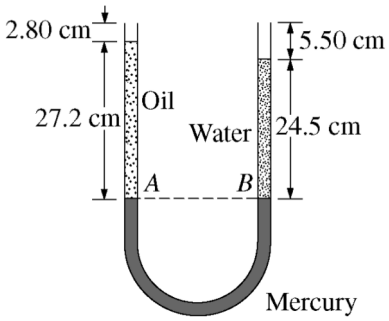
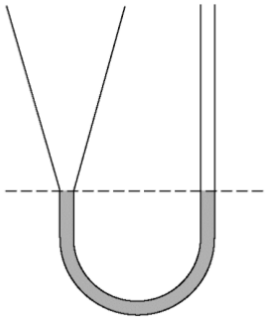


2. A glass U-tube with a uniform diameter of 0.850 cm is used to determine the density of an oil. As shown in the figure above, a 24.5 cm column of water balances a 27.2 cm column of the oil so that interfaces *A* and *B* of the mercury with the other liquids are at the same height. The density of water is 1.00×10^3 kg/m^3.

(a) Calculate the density of the oil.

(b) Calculate the absolute pressure at *B*, the interface between the water and the mercury.



A new tube, identical to the U-tube except for a cone shape on the left, as shown above, is filled with the same volume of mercury that was in the U-tube. The mercury is at the same height on both sides of the new tube as it was in the U-tube, as shown by the dashed line. The same volumes of oil and water that were in the U-tube are now poured into the new tube, on the left and right respectively.

(c) Indicate the new position of *B* relative to *A*.

____ Above *A* ____ Below *A* ____ At the same height as *A*

Justify your answer.

(d) A small piece of wood with density less than that of the oil is placed so that it floats in the left side of the tube. Indicate whether the pressure at the bottom of the tube increases, decreases, or remains the same.

____ Increases ____ Decreases ____ Remains the same

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