

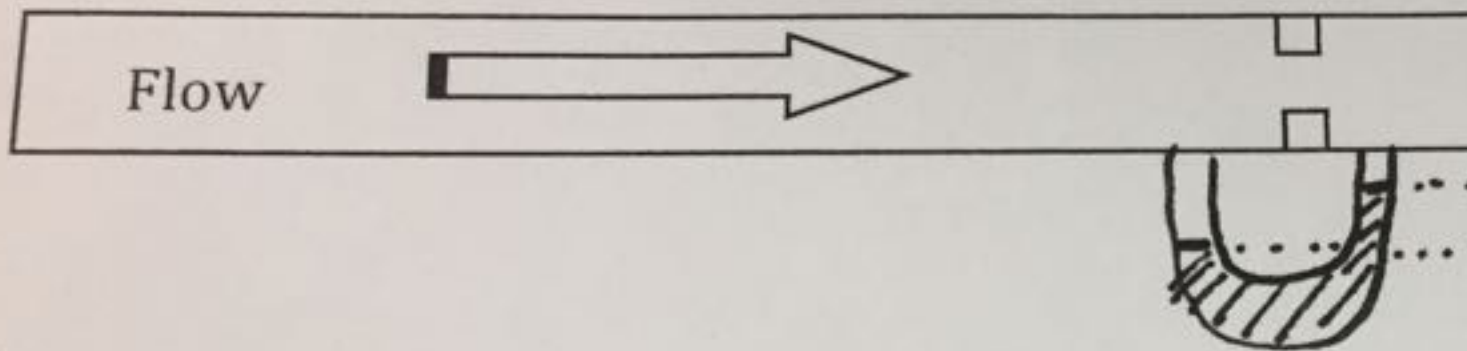


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- 1) (10 points) A water manometer is used to measure the pressure drop across a constriction in a pipe as illustrated below. What is the pressure drop in square inch?



2) (10 points) For a flowing fluid, going from a  
in class, under what conditions would the  
larger pipe to the smaller pipe?

3) (25 points) A hollow concrete sphere is made that are 0.5 inches thick. If it does not leak, what is water? (The density of concrete is  $144 \text{ lbm/ft}^3$ ). Ign

- 4) (30 points) The equation for flow in a circular pipe for a "power-law" fluid, is given by the following equation

$$v = \left( \frac{\Delta P}{2mL} \right)^{1/n} \left( \frac{n}{n+1} \right) \left[ R^{\frac{n+1}{n}} - r^{\frac{n+1}{n}} \right]$$

Where  $m$  and  $n$  are constants of the fluid, and  $\Delta P/L$  is the pressure drop per unit length (or pressure drop per unit length) and  $R$  is the radius of the pipe. What value of  $n$  that causes this expression to become similar to the velocity profile in a pipe? What is  $v_{\max}$  in this case? Use this expression for a power law fluid to determine the flow rate.

- 5) (25 points) A typical hot air balloon has a volume of 2000 m<sup>3</sup>. If the ambient air temperature is 60F, the burners heat the air in the balloon up to about 200F. What is the total mass of the air in the balloon? Please give your answer in kg. You can assume standard conditions for these conditions.



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