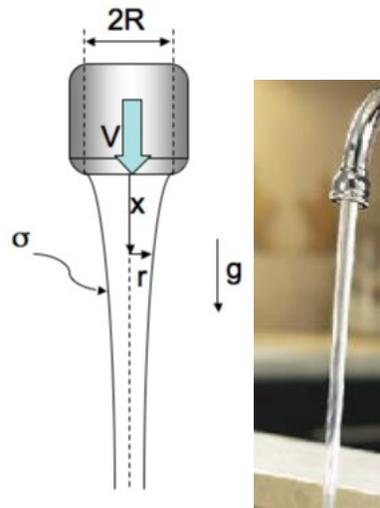


MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Problem 4.11

This problem is from “Advanced Fluid Mechanics Problems” by A.H. Shapiro and A.A. Sonin



An incompressible, inviscid liquid flows with speed V vertically downward from the nozzle of the radius R . The liquid density ρ is high compared with that of the ambient air. The surface tension between the liquid and the air is σ .

- (a) Obtain an expression which relates the local radius r of the liquid stream to the distance x from the nozzle.
- (b) Show that for sufficiently large x ,

$$r \approx R \left(\frac{V^2}{2gx} \right)^{\frac{1}{4}}, \quad (4.11a)$$

- (c) (Optional-Since you need to use dimensional analysis for this part and it is not covered yet in the class) Write down all the criteria which must be satisfied for this expression to be a good approximation. State each criterion as ‘ x must be very large compared with y ’, where y is some combination of the given quantities V , R , g , and σ .

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Fall 2013

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