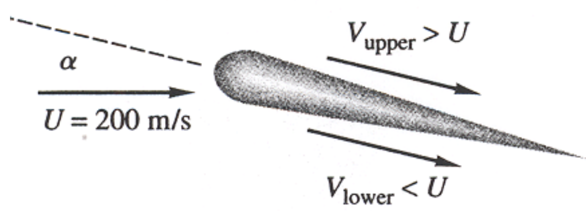
#1.

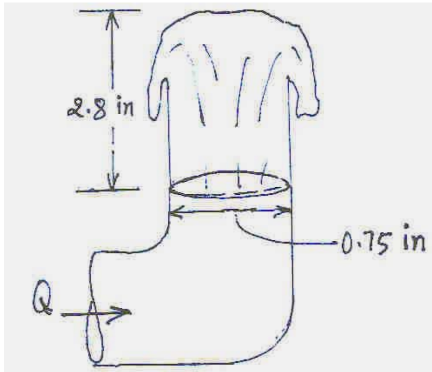
An airfoil at an angle of attack α, as shown in the Fig., provides lift by Bernoulli effect, because of lower surface slows the flow (high pressure) and the upper surface speeds up the flow (low pressure). If the foil is 1.5 m long and 18 m wide into the paper, and the ambient air is 5000 m standard atmosphere, estimate the total lift if the average velocities on upper and lower surfaces are 215 m/s and 185 m/s, respectively. Neglect gravity.

Note: For this case, the angle α is approximately 3°.



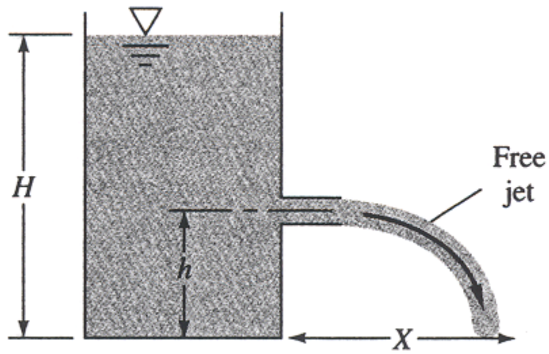
#2.

Water flowing from the 0.75 inch-dia. outlet rises 2.8 inches above the outlet. Determine the flow rate.



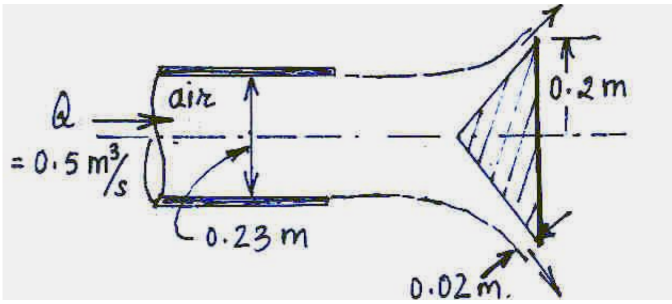
#3.

For the container of the Fig. use Bernoulli's equation to derive a formula for the distance *X* where the free jet leaving horizontally will strike the floor, as a function of *h* and *H*. For what ratio *h/H* will *X* be maximum? Sketch the three trajectories for *h/H* = 0.4, 0.5, and 0.6.



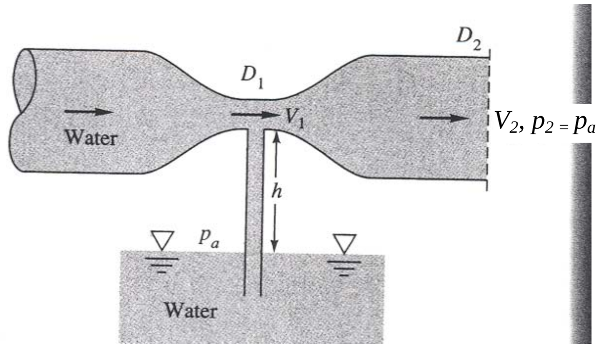
#4.

A conical plug is used to regulate the air flow from the pipe shown. The air leaves the edge of the cone with a uniform thickness of 0.02 m. If viscous effects are negligible and the flow rate is 0.50 m^3/s, determine the pressure within the pipe.



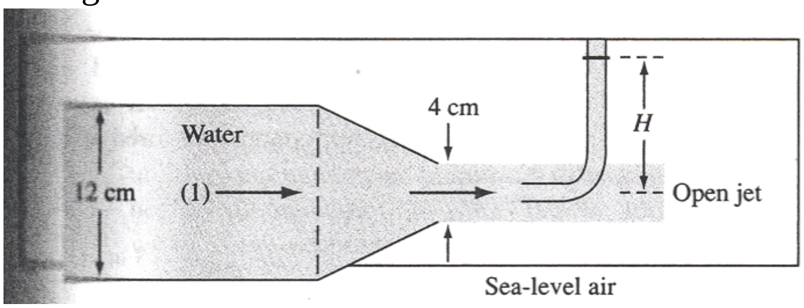
#5

A necked-down section in a pipe flow, called a *venturi*, develops a low pressure that can aspirate fluid upward from a reservoir, as in Fig given. Using Bernoulli's equation with no losses, derive an expression for the velocity V_1 that is just sufficient to bring reservoir fluid into the throat.



#6.

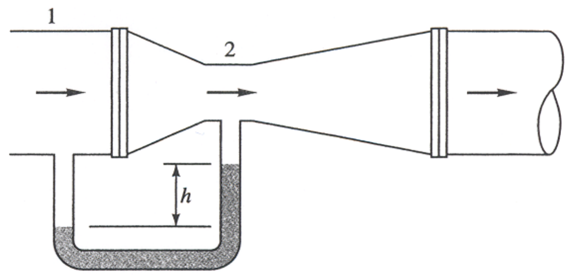
In Fig. given the open jet of water at 20°C exits a nozzle into sea-level air and strikes a stagnation tube as shown. If the pressure at the centerline at section 1 is 110 kPa, and losses are neglected, estimate *(a)* the mass flow in kg/s and *(b)* the height *H* of the fluid in the stagnation tube.



#7.

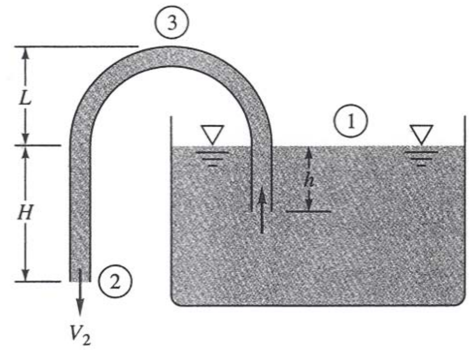
A *venturi meter*, shown in Fig., is a carefully designed constriction whose pressure difference is a measure of the flow rate in a pipe. Using Bernoulli's equation for steady incompressible flow with no losses, show that the flow rate Q is related to the manometer reading h by

$$Q = \frac{A_2}{\sqrt{1-(D_2/D_1)^4}}\sqrt{\frac{2gh(\rho_M - \rho)}{\rho}}$$



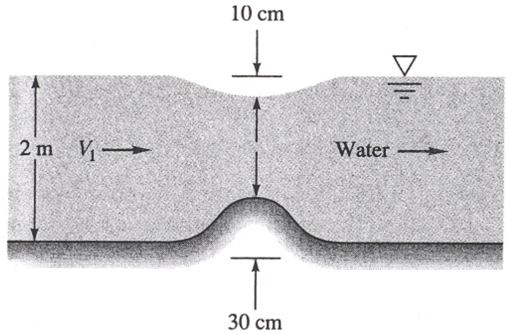
#8.

Once it has been started by sufficient suction, the *siphon* in Fig. given will run continuously as long as reservoir fluid is available. Using Bernoulli's equation with no losses, show *(a)* that the exit velocity V_2 depends only on gravity and the distance H and *(b)* that the lowest (vacuum) pressure occurs at point 3 and depends on the distance $L+H$.



#9.

If the approach velocity is not too high, a hump in the bottom of a water channel causes a dip Δh in the water level, which can serve as a flow measurement. If, as shown in the Fig., Δh = 10 cm when the bump is 30 cm high, what is the volume flow Q_1 per unit width, assuming no losses? In general, is Δh proportional to Q_1?



#10.

The incompressible flow form of Bernoulli's relation is accurate only for Mach numbers less than 0.3. At higher speeds, variable density must be accounted for. The most common assumption for compressible fluid is *isentropic flow of an ideal gas*. Show that the compressible isentropic Bernoulli relation can be written as

$$C_p T + \frac{1}{2}V^2 + gz = const.$$