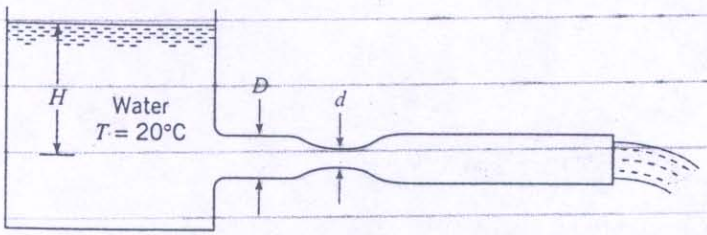
7.51 In this system $d = 20$ cm, $D = 40$ cm, and the head loss from the venturi meter to the end of the pipe is given by $h_L = 0.9V^2/2g$, where V is the velocity in the pipe. Neglecting all other head losses, determine what head H will first initiate cavitation if the atmospheric pressure is 100 kPa absolute. What will be the discharge at incipient cavitation?



PROBLEM 7.51

$p_v = 2340$ Pa abs

$p_{vg} = 2340 - 100{,}000$

$= -97{,}660$ Pa

0 = top reservoir

1 = throat

2 = exit

$$p_1/\gamma + \frac{V_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_L \qquad z_1 = z_2 \quad h_L = 0$$

$p_1 = p_{vg}$ for incipient cavitation

$$p_1/\gamma + \frac{V_1^2}{2g} = \frac{V_2^2}{2g} + .9\frac{V_2^2}{2g} = 1.9\frac{V_2^2}{2g}$$

$$V_1 A_1 = V_2 A_2 \qquad V_1 = V_2 A_2/A_1 = 4V_2$$

$$-97{,}660/9790 + \frac{16V_2^2}{2g} = 1.9\frac{V_2^2}{2g} \Rightarrow V_2 = 3.73 \text{ m/s}$$

$$0\text{–}2 \qquad H = \frac{V_2^2}{2g} + .9\frac{V_2^2}{2g} = 1.9\frac{V_2^2}{2g} = \frac{1.9 \times 3.73^2}{2 \times 9.81}$$

$$= 1.34 \text{ m}$$