PROBLEM 5.73

5.73 When gage A indicates a pressure of 100 kPa, the cavitation just starts to occur in the venturi meter. $D = 40.$ cm and $d = 10$ cm, what is the water discharge in the system for this condition of incipient cavitation. The atmospheric pressure is 100 kPa, and the water temperature is 10°C. Neglect gravitational effects.

$$p_A + \frac{\rho}{2} V_A^2 = p_t + \frac{\rho}{2} V_t^2 \qquad t = throat$$

$$V_A = Q/A_A \qquad A_A = \pi(.4)^2/4$$

$$V_t = Q/A_t \qquad A_t = \pi(.1)^2/4$$

$$\frac{\rho}{2}(V_t^2 - V_A^2) = p_A - p_t \qquad\qquad p_t = 1230 \text{ Pa abs}$$

$$p_A = 200,000 \text{ Pa abs}$$

$$\rho Q^2/2 \left(A_t^{-2} - A_A^{-2} \right) = 198,770 \qquad \gamma = 9810$$

$$500 \, Q^2 \left(16,211 - 63 \right) = 198,770 \qquad \frac{p_v}{\gamma} = .1254$$

$$Q = .157 \text{ m}^3/s$$