CE 3305 Engineering Fluid Mechanics
Exercise Set 13
Summer 2018 – GERMANY

Purpose : Conservation of mass and energy
Assessment Criteria : Completion, plausible solutions, use **R** as a calculator.

Exercises

1. (Problem 5.74 pg 202) Figure 1 is a schematic of a pipe with a series of holes used to sparge (introduce gas bubbles) gas into a larger volume. The volumetric flow rate through each hole depends on the pressure difference across the hole and is given by

$$Q = 0.67 A_0 (\frac{2\Delta p}{\rho})^{\frac{1}{2}} \tag{1}$$

where A_0 is the area of a hole, Δp is the pressure difference across the hole, and ρ is the density of gas in the pipe. If the pipe is sufficiently large, the pressure will be uniform along the pipe. A distribution pipe for air at 20° C is 0.5 meters in diameter and 10 m long. The gage pressure in the pipe is 100 Pa. The pressure outside the pipe is atmospheric at 1 bar. The hole diameter is 2.5 cm, and there are 50 holes per meter length of pipe. The pressure is constant in the pipe. What is the velocity of air entering the pipe?
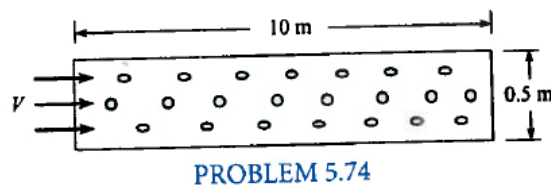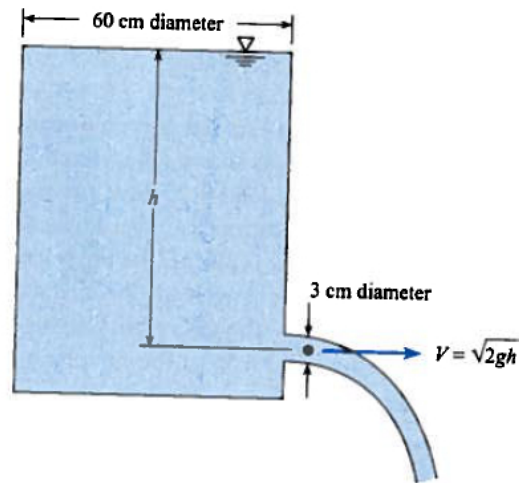

Figure 1: Gas sparger

2. (Problem 5.80 pg 203) Figure 2 is a tank with a hole in the side. Develop an apply an equation that predicts the time for the water surface in the tank to drop from $h = 3m$ to $h = 0.5m$.

Figure 2: Tank draining