Group A /Fluids Engineering

(I).

Consider a system, as shown in the right figure, in which water is released into the atmosphere through horizontally allined water tanks connected with orifices. The total number of the tanks and that of the orifices are both n. The first water tank is sufficiently large and is open to the atomsphere at the top. The other tanks are fully filled with water and are sufficiently large compared to the orifice size. The height of the center of each orifice is the same for all orifices. The pressure at the height of each orifice of the *i*-th water tank is p^i ($1 \le i \le n$), the area of the *i*-th orifice is a^i , the flow coefficients when passing through



the orifices are all c, and the height of the water surface from each orifice is h. Note that the gravitational acceleration is g. Express the flow rate of water Q by using a_i , c, h, n, and g. (30 points)

(II).

A two-dimentional plate with a concentric semi-cylindrical curved plate, as shown in the figure, is supported so that it can rotate around a point *O*. When water ejected from the bottom nozzle into the atmoshere collides with the curved plate and flows along the curved surface and then flows away in the opposite direction to the nozzle jet,

- (1) Find the magnitude of fluid force acting on the semi-cylindrical curved plate per unit length in the vertical direction of paper.
- (2) Find the magnitude of necessary moment of force around the point *O* per unit length in the vertical direction of paper to prevent the plate from being rotated around the point *O*.

Let the flow rate of incoming water per unit length in the vertical direction of the paper be Q, the incoming water velocity V, and the distances along the direction perpendicular to the nozzle axis from the entrance and exit of the curved plate to the point O be y_1 and y_2 , respectively. The density of water is denoted by ρ , and losses are assumed to be negligible. (20 points)

