2022 ENTRANCE EXAMINATION FOR INTERNATIONAL MASTER'S PROGRAM
Departments of Mechanical Engineering and Hydrogen Energy Systems

# Fluids Engineering (Group A) [11:10~12:40]

## Question I

Consider the case that two tanks are connected through an orifice, as shown in Figure 1. The right and the left tanks each have an orifice open to the atmosphere on their outer wall. All the orifices are located at the same height under the water surfaces. The area and flow coefficient of all orifices are given as $a$ and $c$, respectively. Note that the gravitational acceleration is $g$. When the volumetric flow rate of water poured into the right tank is $Q$ and the heights of water surfaces in both tanks are constant, express the height of water surface of the right tank $H_1$ and the left tank $H_2$ relative to the orifices by $a$, $c$, $Q$, and $g$. (25 Points)

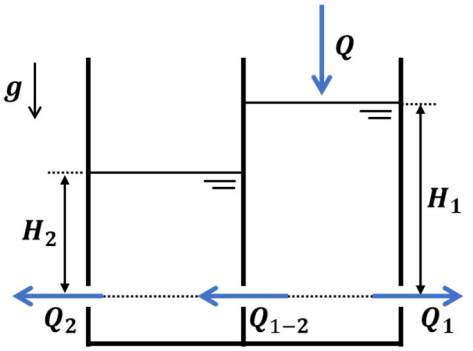

Figure 1

## Question II

A two-dimensional air jet with uniform velocity $u_1$ and width $b_1$ blown from a nozzle into the atmosphere is decelerated due to a drag force $F$ when it passes through a wire mesh placed at right angles to the jet, as shown in Figure 2. The velocity of the jet sufficiently downstream of the wire mesh is uniform with the magnitude of $u_2$. The density of air is denoted as $\rho$. Losses upstream and downstream of the mesh including those due to friction between the jet and the surrounding atmosphere are negligible. Note that the ambient atmosphere velocity of downstream $u_{atmosphere}$ is 0. Answer the following questions. (25 Points)

(1) Find the magnitude of the drag force $F$.

(2) Find the uniform velocity $u_m$ of the jet as it passes through the wire mesh by considering the local pressure difference just before and after the wire mesh.

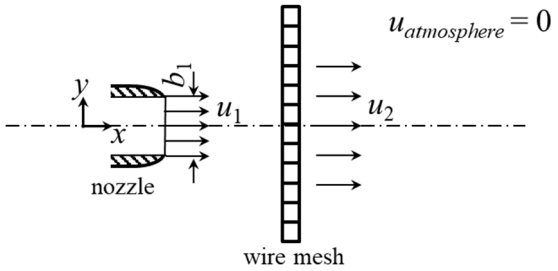

Figure 2