Problem No. 1

A fluid device has two inlets of the areas $A_1, A_2$ and an outlet of the area $A_o$. Piston of area $A_3$ can move into this device (see Figure). Two different incompressible fluids enter the device through the inlets with densities $\rho_1, \rho_2$ and normal components of velocities $v_1, v_2$ respectively. The piston moves with the velocity $v_3$. In the device two fluids are perfectly mixed and at the outlet the mixture has some density $\rho_o$. Find fluid velocities at the inlets, $v_1, v_2$, if the velocity of the piston, $v_3$, the velocity at the outlet, $v_o$, the densities $\rho_o, \rho_1, \rho_2$, and the areas of the inlets, the outlet and the piston are given.
Problem No. 2

A cylinder of radius $R$ and width $w$ separates two different levels of water. Which force must be applied to the cylinder to keep it at equilibrium?

What is the point of application of the force?

Assume that the bottom of the cylinder is sealed so that there is no connection between water on the right and on the left of the cylinder.
Problem No. 5
The flow condition in a capillary viscometer is illustrated in the schematic. (a) Calculate the fluid viscosity. (b) Calculate the Reynolds number based on the averaged velocity.

Flow rate = 560 mm³/sec per unit depth into the diagram
The length (L) = 1 m
The width (d) = 0.6 mm
Pressure drop (P₁-P₂) = 1 M Pa
Fluid density = 990 kg/m³
Problem No. 4

Two tanks shown in the figure contain ethanol at 70 °C. Diameters of the two tanks are much larger than the pipe diameter. Assuming that the flow from the smaller tank to the larger tank is steady, find the volume flow rate of this steady flow.
Problem No. 3

Water is flowing steadily through the 120° elbow shown. At the inlet, the gage pressure is 100 kPa. The water is discharged to atmospheric pressure. $A_1 = 2600 \text{ mm}^2$, $A_3 = 650 \text{ mm}^2$, $V_1 = 3.05 \text{ m/sec}$. Find the horizontal and vertical forces needed to hold the elbow in place.