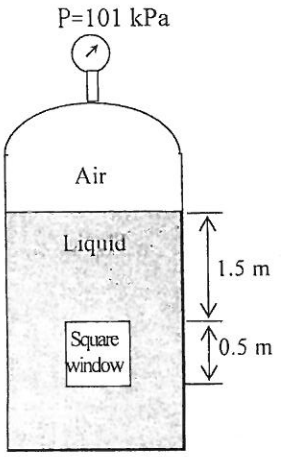
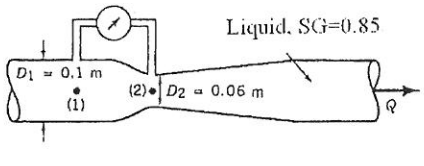
1. A pressurized tank contains liquid (SG=1.5) and has a 0.5m × 0.5m square window mounted to its side, as shown in the following figure. When the pressure gage on the top of the tank reads 101 kPa, what is the magnitude of the resultant force on the window? The outside of the tank is at atmosphere pressure. [15%]

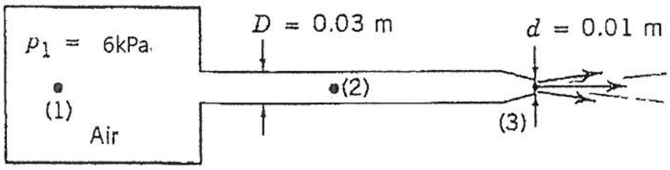



2. A liquid (SG=0.85) flows through the Venturi meter, as shown in the following figure, with flow rates between 0.001 $m^3/s$ and 0.01 $m^3/s$. please determine the range in pressure difference, p1-p2, needed to measure the flow rates. [15%]



3. Air flows steady from a large tank, through a hose of diameter D=0.03m and exits to the atmosphere from a nozzle of diameter d=0.01m as shown in the following figure. The pressure in the tank remains constant at 6.0 kPa and the atmospheric conditions are standard temperature and pressure(15℃, 101kPa).

(1) Please find the air flow velocity at the outlet (Point 3) [10%]
(2) Please determine the air flow velocity and pressure in the hose (point 2) [10%]




4. A diverging nozzle a throat exit diameter of $D' = D_e = 4\text{cm}$ and inlet diameter of $D_i = 10\text{cm}$,

(a) What conditions to drive that $\rho AV = \dot{m} = \text{constant}$ on 1-D air flow. [6%]
(b) Give exit velocity $V_e = 330\text{m/sec}$, find inlet velocity for incompressible flow.[ 6%]
(c) For compressible flow of ideal gas by air fluid, find the exit temperature by $V_e = 330\text{m/sec}$, hint：
  (1) the molecular weight of air is 29 g/gmole
  (2) the mach number of exit $M_e$=1.0 [6%]
(d) Find inlet temperature $T_i$, inlet velocity $V_i$ for isentropic flow. [6%]
(e) What conditions to drive that

$$C_p T_i + \frac{1}{2g_c} v_i^2 = C_p T_e + \frac{1}{2g_c} v_e^2 = C_p T_t, \text{ where}$$

$T_i$ is inlet static temperature,
$T_e$ is exit static temperature,
$T_t$ is total temperature,
$C_p$ is specific heat of constant pressure,
$g_c$ is universal unit constant. [6%]

5. For single-suction pump giving in the flowing Figures , for steady, adiabatic process, and no internal energy change of incompressible fluid flow.

(a) Find the conditions and to drive the inlet shaft work, $\underset{1\rightarrow 2}{\dot{W}_{s,in}}$, as flowing equation as

$$\underset{1\rightarrow 2}{\dot{W}_{s,in}} = \dot{m}\left[\left(\frac{P_2-P_1}{\rho}\right)+\left(\frac{V_2^2-V_1^2}{2g_c}\right)+\frac{g(Z_2-Z_1)}{g_c}\right] = P$$

where P is input power by electric energy [10%]

(b) Define Head of pump is $H_t$, and $H_t \equiv \frac{P}{\dot{m}g}$, prove that flowing equation $H_t = \frac{P_2-P_1}{\gamma}+\frac{V_2^2-V_1^2}{2g}+(Z_2-Z_1)$, and what is conditions. [10%]