

宿題（2）（提出日:5月24日）

[1]

$$Q = \frac{60}{30} = 2l/s, \quad v = \frac{60 \times 10^{-3}}{\pi \times 0.05^2/4} = 1.02m/s$$

[2]

$$\frac{p}{\rho g} + h = p_a, \quad p = p_a \varepsilon, \quad h = \frac{p_a - p}{\rho g} = \frac{p_a}{\rho g} (1 - \varepsilon)$$

[3]

$$Q = CA\sqrt{2gH}, \quad C = \frac{0.42/60}{(\pi 0.05^2/4)\sqrt{2g \times 2}} = 0.569$$

[4]

$$H = \frac{v_a^2}{2g} = \frac{c_v^2(2gH')}{2g}, \quad H' = \frac{H}{c_v^2} = \frac{10}{0.9^2} = 12.34m$$
$$p = \rho g H' = 121.1kPa(1.234kgf/cm^2)$$

[5]

$$v_1 = \frac{Q}{\pi d_1^2/4} = \frac{0.01 \times 4}{\pi 0.075^2} = 2.26m/s, \quad v_2 = \frac{Q}{\pi d_2^2/4} = \frac{0.01 \times 4}{\pi 0.05^2} = 5.09m/s$$
$$\frac{p_1 - p_2}{\rho g} = 1.06 = h\left(\frac{\rho g}{\rho} - 1\right), \quad h = 84.2mmHg$$

[6]

$$v = \sqrt{2gh\left(\frac{\rho g}{\rho} - 1\right)} = \sqrt{2g \times 0.1\left(\frac{1594}{998} - 1\right)} = 1.08m/s$$
$$Q = \frac{\pi 0.15^2}{4} \times 1.08 = 0.0191m^3/s$$

宿題（3）（提出日:5月31日）

[7]

$$-Adz = Qdt, \quad Q = cav = ca\sqrt{2gz}$$

$$-Adz = ca\sqrt{2gz}dt, \quad dt = -\frac{A}{ca\sqrt{2g}} \frac{dz}{\sqrt{z}}$$

$$T = \frac{2A}{ca\sqrt{2g}} \sqrt{(H-0)}$$

$$T = \frac{2(\pi 1^2/4)}{0.6(\pi 0.05^2/4)\sqrt{2g}} \times \sqrt{2} = 426 \text{sec}$$

[16]

$$p_A + \rho_o g(3.33) + 10^3 g(1.67) = p_a + \rho_a g(5.00 - 0.33) + \rho_{Hg} g(0.33)$$

$$p_{gauge} = p_A - p_a = 1.2g(4.67) + 13.6 \times 10^3 g(0.33) - 798g(3.33) - 10^3 g(1.67)$$

$$= (44.03 - 42.40) \times 10^3 = 1.63 \text{kPa}$$

[17]

$$P = \rho g \bar{z} A, \quad \bar{z} = H + 1.5 \sin 60^\circ = 2 + 1.3 = 3.3 \text{m}$$

$$P = 10^3 g \times 3.3 \times 6 = 194.04 \text{kN}$$

$$\eta = \frac{I_G}{A\bar{y}} + \bar{y}, \quad I_G = \frac{3^3 \times 2}{12} = 4.5$$

$$\eta = \frac{4.5}{6 \times 3.8} + 3.8 = 4.0 \text{m}$$

宿題（４）（提出日：６月７日）

$$p_A + \rho g(0.46) - \rho' g(0.16) + \rho_w g(0.20) - \rho' g(0.30) - \rho g(0.74) = p_B$$

$$p_A - p_B = \rho' g(0.46) + \rho g(0.28) - \rho_w g(0.20) = 10^3 g(6.26 + 0.24 - 0.2) = 61.7kPa$$

宿題（５）（提出日：６月１４日）

[B-1]

$$\bar{y} = \frac{1}{\sin 45^\circ} + \frac{2}{3} \times 2 = 1.414 + \frac{4}{3} = 2.75m$$

$$\bar{z} = \frac{\bar{y}}{\sin 45^\circ} = 1.94m, \quad A = \frac{1.2 \times 2}{2} = 1.2m^2, \quad I_g = \frac{1.2 \times 2.0^3}{36} = 0.27$$

$$P = \rho g \bar{z} A = 10^3 g(1.94)(1.2) = 22.8kPa$$

$$\eta = \frac{I_g}{\bar{y} A} + \bar{y} = \frac{0.27}{2.75(1.2)} + 2.75 = 2.83m, \quad z_c = \frac{2.83}{\sin 45^\circ}$$

[B-2]

$$h = -\frac{p}{\rho g} = -\frac{15 \times 10^3}{10^3 g} = -1.53m, \quad 5.5 - 1.53 = 3.97m(0 - \text{gage})$$

$$\bar{z} = (3.97 - 1.8) + \frac{1.8}{2} = 3.07m$$

$$P_w = \rho g \bar{z} A = 10^3 g(3.07)(1.8 \times 1.0) = 54.2kPa$$

$$z_c = \frac{I_g}{\bar{z} A} + \bar{z} = \frac{1.0 \times (1.8^3/12)}{3.07(1.8 \times 1.0)} + 3.07 = 3.15$$

$$P_o = \rho g \bar{z} A = 0.8 \times 10^3 g\left(\frac{1.8}{2}\right)(1.8 \times 1.0) = 12.7kPa$$

$$z_c = \frac{1.0 \times (1.8^3/12)}{0.9(1.8 \times 1.0)} + 0.9 = 1.2m$$

$$(3.15 - 2.17)P_w = 1.2P_o + 1.8F, \quad F = 21.0kN \text{ to the left.}$$

[B-3]

$$\eta = \frac{I_g}{\bar{y} A} + \bar{y} = \frac{\pi d^3/64}{(h+1)(\pi d^2/4)} + (h+1)$$

$$\eta - (h+1) = \frac{(\pi \times 2^4/64)}{(h+1)(\pi \times 2^2/4)} = 0.12, \quad h = 1.08m$$

宿題（6）（提出日:6月21日）

[11]

$$H_p = \frac{v_2^2 - v_1^2}{2g} + \left(\frac{p_2}{\rho g} + z_2\right) - \left(\frac{p_1}{\rho g} + z_1\right)$$
$$\frac{\Delta p}{\rho g} = \left(\frac{p_2}{\rho g} + z_2\right) - \left(\frac{p_1}{\rho g} + z_1\right) = h\left(\frac{\rho g}{\rho g} - 1\right) = 1.3(13.6 - 1) = 16.38$$
$$v_1 = \frac{7.0/60}{\pi 0.2^2/4} = 3.71 \text{ m/s}, \quad v_2 = \frac{7.0/60}{\pi 0.15^2/4} = 6.60 \text{ m/s}$$
$$H_p = 0.70 + 2.22 + 16.38 = 17.9$$
$$L = \rho g Q H_p = 10^3 g \times 0.1166 \times 17.9 = 20.5 \text{ kw}$$

[20]

$$P_x = \rho Q(v_1 - v_2 \cos \theta) + p_1 A_1 - p_2 A_2 \cos \theta$$
$$-P_y = \rho Q v_2 \sin \theta + p_2 A_2 \sin \theta + Mg$$

[21]

$$P = 0 - \rho Q v = -C \rho A (2gh) = -0.95 \times 10^3 \left(\frac{\pi 0.05^2}{4}\right) (2g \times 1.5) = -54.8 \text{ N}$$