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]

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

[6]

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

宿題（３）（提出日:５月３１日）

[7]

$$-Adz = Qdt, \quad Q = cav = ca\sqrt{2gz}$$
$$-Adz = ca\sqrt{2gz}dt, \quad dt = -\frac{A}{ca\sqrt{2g}}\frac{dz}{\sqrt{z}}$$
$$T = \frac{2A}{ca\sqrt{2g}}\sqrt{(H-0)}$$
$$T = \frac{2(\pi 1^2/4)}{0.6(\pi 0.05^2/4)\sqrt{2g}} \times \sqrt{2} = 426sec$$

[16]

$$p_A + \rho_o g(3.33) + 10^3 g(1.67) = p_a + \rho_a g(5.00 - 0.33) + \rho_{Hg} g(0.33)$$
$$p_{gage} = p_A - p_a = 1.2g(4.67) + 13.6 \times 10^3 g(0.33) - 798g(3.33) - 10^3 g(1.67)$$
$$= (44.03 - 42.40) \times 10^3 = 1.63kPa$$

[17]

$$P = \rho g \overline{z} A, \quad \overline{z} = H + 1.5\sin 60^o = 2 + 1.3 = 3.3m$$
$$P = 10^3 g \times 3.3 \times 6 = 194.04kN$$
$$\eta = \frac{I_G}{A\overline{y}} + \overline{y}, \quad I_G = \frac{3^3 \times 2}{12} = 4.5$$
$$\eta = \frac{4.5}{6 \times 3.8} + 3.8 = 4.0m$$

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]

$$\overline{y} = \frac{1}{\sin 45^o} + \frac{2}{3} \times 2 = 1.414 + \frac{4}{3} = 2.75m$$
$$\overline{z} = \frac{\overline{y}}{\sin 45^o} = 1.94m, \quad A = \frac{1.2 \times 2}{2} = 1.2m^3, \quad I_g = \frac{1.2 \times 2.0^3}{36} = 0.27$$
$$P = \rho g \overline{z} A = 10^3 g(1.94)(1.2) = 22.8kPa$$
$$\eta = \frac{I_g}{\overline{y}A} + \overline{y} = \frac{0.27}{2.75(1.2)} + 2.75 = 2.83m, \quad z_c = \frac{2.83}{\sin 45^o}$$

[B-2]

$$h = -\frac{p}{\rho g} = -\frac{15 \times 10^3}{10^3 g} = -1.53m, \quad 5.5 - 1.53 = 3.97m(0 - gage)$$
$$\overline{z} = (3.97 - 1.8) + \frac{1.8}{2} = 3.07m$$
$$P_w = \rho g \overline{z} A = 10^3 g(3.07)(1.8 \times 1.0) = 54.2kPa$$
$$z_c = \frac{I_g}{\overline{z}A} + \overline{z} = \frac{1.0 \times (1.8^3/12)}{3.07(1.8 \times 1.0)} + 3.07 = 3.15$$
$$P_o = \rho g \overline{z} A = 0.8 \times 10^3 g(\frac{1.8}{2})(1.8 \times 1.0) = 12.7kPa$$
$$z_c = \frac{1.0 \times (1.8^3/12)}{0.9(1.8 \times 1.0)} + 0.9 = 1.2m$$
$$(3.15 - 2.17)P_w = 1.2P_o + 1.8F, \quad F = 21.0kN \; to \; the \; left.$$

[B-3]

$$\eta = \frac{Ig}{\overline{y}A} + \overline{y} = \frac{\pi d^3/64}{(h+1)(\pi d^2/4)} + (h+1)$$
$$\eta - (h+1) = \frac{(\pi \times 2^4/64)}{(h+1)(\pi \times 2^2/4)} = 0.12, \quad h = 1.08m$$

宿題（６）（提出日:６月２１日）

[11]

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

[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]

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