解答例

問題１

(1)

$$v_1 = v_2 + v_3$$

(2)

$$\frac{p_1}{\rho g} + \frac{v_1^2}{2g} = \frac{p_2}{\rho g} + \frac{v_2^2}{2g}$$

$$\frac{p_1}{\rho g} + \frac{v_1^2}{2g} = \frac{p_3}{\rho g} + \frac{v_3^2}{2g}$$

(3)

$$p_2 = p_1 + \frac{1}{2}\rho\left(v_1^2 - v_2^2\right)$$

$$p_3 = p_1 + \frac{1}{2}\rho\left(-v_2^2 + 2v_1 v_2\right)$$

(4)

$$F_x = \left(1-\sqrt{3}\right)p_1 A - \rho A\left(\frac{\sqrt{3}}{2}v_2^2 - \frac{\sqrt{3}}{2}v_1 v_2 + \left(\frac{3\sqrt{3}}{4} - 1\right)v_1^2\right)$$

(5)

$$v_2 = \frac{1}{2}v_1$$

$$F_x = \left(1-\sqrt{3}\right)p_1 A - \rho A\left(\frac{5\sqrt{3}}{8} - 1\right)v_1^2$$

問題２

(1).

$$\dot{m}_{AB} = \int_0^h \rho u_\infty dy = \rho u_\infty h$$

$$\dot{m}_{CD} = \int_0^h \rho u dy = \int_0^h \rho u_\infty \frac{y}{h} dy = \frac{\rho u_\infty h}{2}$$

$$\dot{m}_{DA} = \dot{m}_{AB} - \dot{m}_{CD} = \frac{\rho u_\infty h}{2}$$

(2).

$$\dot{p}_{AB} = \int_0^h \rho u_\infty \cdot u_\infty dy = \rho u_\infty^2 h$$

$$\dot{p}_{CD} = \int_0^h \rho u \cdot u dy = \frac{\rho u_\infty^2 h}{3}$$

$$\dot{p}_{DA} = \int_0^h \left(\rho u_\infty - \rho u\right) \cdot u_\infty dy = \frac{\rho u_\infty^2 h}{2}$$

(3).

$$\dot{p}_{DA} + \dot{p}_{CD} - \dot{p}_{AB} = -F$$

$$\therefore F = -\dot{p}_{DA} - \dot{p}_{CD} + \dot{p}_{AB} = \frac{\rho u_\infty^2 h}{6}$$

(4).

$$\frac{\delta}{h} = 6$$

(5).

$$\tau_w = \mu \frac{u_\infty}{h}$$

(6).

$$\rho u_\infty^2 \frac{d}{dx}\left(\frac{h}{6}\right) = \mu \frac{u_\infty}{h}$$

$$\therefore \frac{h}{x} = \sqrt{\frac{12}{R_e}}$$