No.

Date . .

流体力学　3回目

[1] (1) $mv = \rho \cdot \frac{\pi}{4} d^2 q \cdot q$ より,

運動量 : $\boxed{\frac{\pi}{4} \rho d^2 q^2}$

(2) ベルヌーイの定理より,

$$P_0 + \frac{1}{2}\rho V^2 = P_0 + \frac{1}{2}\rho (q-u)^2$$

$$\therefore \ V = \boxed{q-u}$$

流量保存より,

$$Q = \frac{\pi}{4}\rho d^2 q = 2 \cdot \pi h r \cdot (q-u)$$

$$\therefore \ h = \boxed{\frac{q d^2}{8r(q-u)}}$$

(3) 圧力最大の地点では, よどみ点より, 流速 0

ベルヌーイの定理より,

$$P_0 + \frac{1}{2}\rho (q-u)^2 = P_s + \frac{1}{2}\rho 0^2$$

$$\therefore \ P_s = \boxed{P_0 + \frac{1}{2}\rho (q-u)^2}$$

[2] (1) $W_1 = \boxed{Uz}$

(2) $W_2 = \boxed{m \log z}$

(3) $W = W_1 + W_2 = \boxed{Uz + m \log z}$

(4) $q = \frac{\partial W}{\partial z} = \boxed{U + \frac{m}{z}}$

(5) $q = U + \frac{m}{z} = 0 \rightarrow z = -\frac{m}{U} = x + iy$

$\therefore$ よどみ点 $(x, y) = \boxed{\left(-\frac{m}{U}, 0\right)}$

(6) 一様流れの無限遠での流量は, $Q_1 = UD$

$W_2 = m \log z$

$z = re^{i\theta}$ より,

$W_2 = m\log(re^{i\theta}) = m\log r + im\theta = \phi + i\psi$

$\rightarrow \phi = m\log r, \quad \psi = m\theta$

$u_\theta = \frac{\partial\phi}{\partial r} = \frac{1}{r}\frac{\partial\psi}{\partial\theta} = \frac{m}{r}$

$Q_2 = 2\pi r \cdot u_\theta = 2\pi m$

$Q_1 = Q_2$ より,

$UD = 2\pi m$

$\therefore D = \boxed{2\pi m/U}$

[3] (1) $u = \frac{\partial\phi}{\partial x} = \frac{\partial\psi}{\partial y}$, $v = \frac{\partial\phi}{\partial y} = -\frac{\partial\psi}{\partial x}$

$\Rightarrow \partial\psi = u\,\partial y$, $\partial\psi = -v\,\partial x$

以上より,

$\therefore \psi = \boxed{\int(u\,dy - v\,dx)}$

(2) $y=0$ のとき, $v=0$ となるので, $\psi = const$

$y=h$ のとき, $v=0$ となるので, $\psi = const$

$\Downarrow$

平行流より, $v=0$ なので, $\psi = const$

$y=h$ のとき, $v=0$ なので, $\psi = const$

(3) $u = \frac{G}{2\nu}y(h-y)$ ～ ①

(1)より, $u = \frac{\partial\psi}{\partial y}$

$\psi = uy + C$

$y=h$ のとき, $\psi = 0$ より,

$0 = uh + C \rightarrow C = -uh$

$\psi = uy - uh$

$\rightarrow h - y = -\frac{\psi}{u}$

①に代入

$u = \frac{G}{2\nu}y\cdot\left(-\frac{\psi}{u}\right)$

$= -\frac{y\psi}{2\nu u}\cdot\left(-\frac{dP}{dx}\right)$ $\rightarrow u^2 = \frac{y\psi}{2\nu}\cdot\frac{dP}{dx}$

$\therefore u = \boxed{\sqrt{\frac{y\psi}{2\nu}\cdot\frac{dP}{dx}}}$