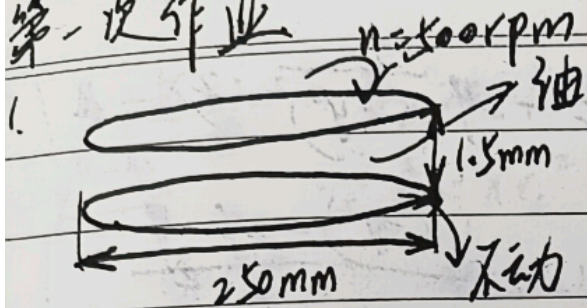


# 流体力学

## 第一次作业



$P = 500W$   
取环带

$v = \omega r$

$$dP = \mu \frac{v^2}{\delta} \cdot 2\pi r dr$$

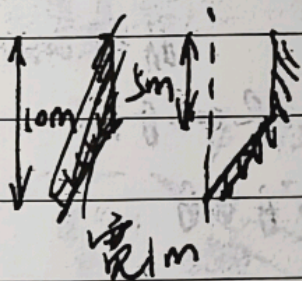
$$= \mu \frac{\omega^2}{\delta} \cdot 2\pi r^3 dr$$

$$P = \mu \frac{\omega^2}{\delta} \cdot 2\pi \cdot \frac{1}{4} r_0^4$$

$$\mu = \frac{2P\delta}{\pi \omega^2 r_0^4} = 0.713 Pa \cdot s$$

$n = 500 \text{ rpm}$

$\omega = 52.36 \text{ rad} \cdot s^{-1}$

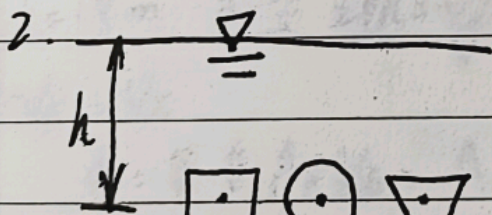


$F_y = \rho g V = 3.75 \times 10^5 N$

$V = 37.5 m^3$

$F_x = \rho g h S = 5 \times 10^5 N$

$S = 10 m^2 \quad h = 5m$



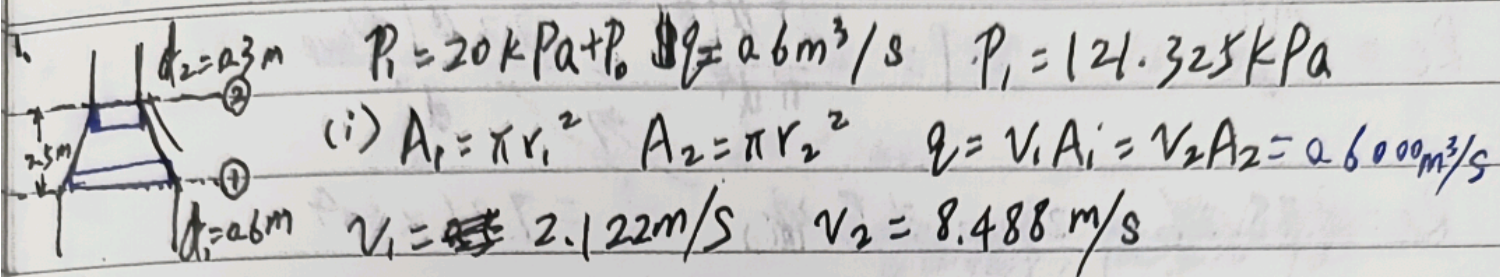
三者受到的静压力相同

都为  $F = \rho g h A$

面积都为A



# 作业 2 道题 流体力学第二次作业



$$(i) A_1 = \pi r_1^2 \quad A_2 = \pi r_2^2 \quad Q = V_1 A_1 = V_2 A_2 = 0.6000\text{m}^3/\text{s}$$

$$V_1 = 2.122\text{m/s} \quad V_2 = 8.488\text{m/s}$$

(ii)

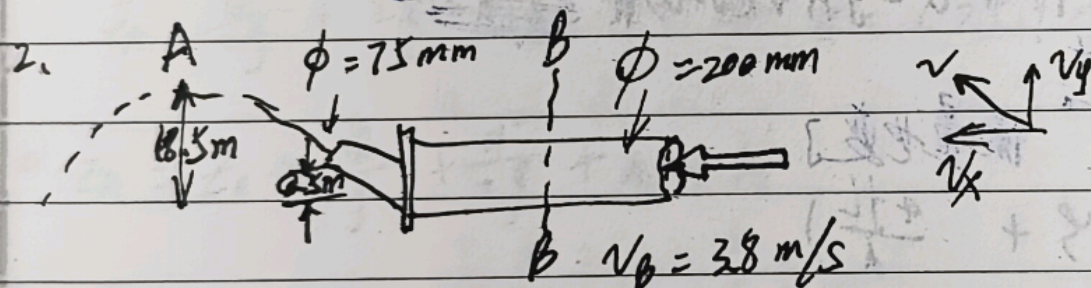
$$\rho g h_1 + p_1 + \frac{\rho V_1^2}{2} = \rho g h_2 + p_2 + \frac{\rho V_2^2}{2} \quad Q = A_1 V_1 = A_2 V_2$$

$$p_2 = p_1 + \rho g (h_1 - h_2) + \frac{\rho}{2} (V_1^2 - V_2^2) = 6305\text{kPa}$$

$$F_{\text{net}} = \rho Q (V_2 - V_1) \quad p_1 A_1 - p_2 A_2 - F - \rho Q g = \rho Q (V_2 - V_1)$$

$$F = (p_1 + \rho V_1^2) A_1 - (p_2 + \rho V_2^2) A_2 = 26.0276\text{kN}$$

$$\text{方向是直向上} \quad \rho Q g = 5.8798\text{kN} \quad F = 20.1478\text{kN}$$



$$h = 18\text{m} \quad \frac{1}{2} 2gh = V_y^2 \quad V_y = 18.783\text{m/s}$$

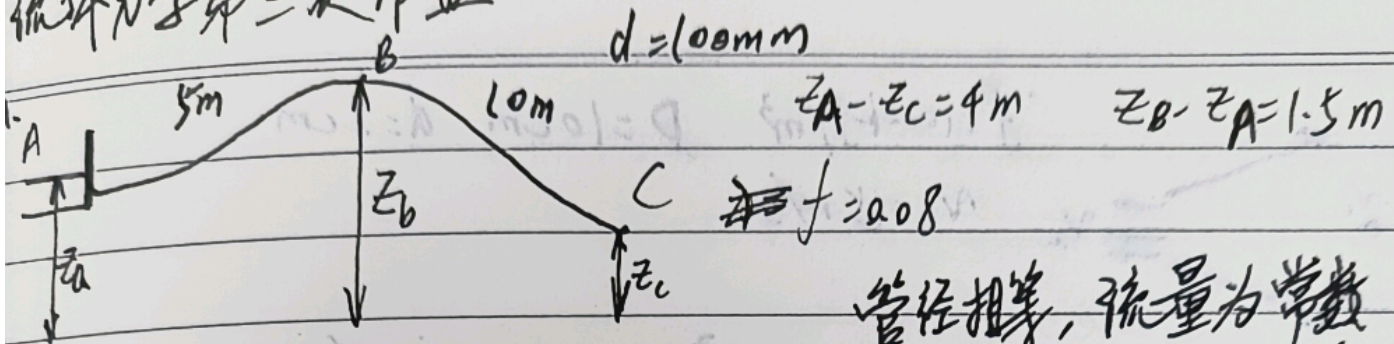
$$V_A = V_x$$

$$Q = A_B V_B = A_1 V \quad V = V_B \left( \frac{\phi_B}{\phi_1} \right)^2 = 27.022\text{m/s}$$

$$\therefore V_x = 19.427\text{m/s} \quad \therefore V_A = 19.427\text{m/s}$$



# 流体力学第三次作业



a)  $V_c$  b)  $P_b$

管径相等, 流量为常数  
管中流速处处相等, 记为  $u$

$$\rho g z_A + P_A = \rho g z_C + P_C + \frac{\rho u^2}{2}$$

$$\frac{64}{Re} \quad \rho = 10^3 \text{ kg/m}^3 \quad Re = \frac{\rho u d}{\mu} \quad \Delta P = \frac{32 \mu L u}{d^2}$$

$Re = 800 < 2300$ , 为层流  $h_L = \frac{u^2}{2g}$  求得  $\gamma = 0.5$   $h_f = \frac{4 f L u^2}{2g d}$

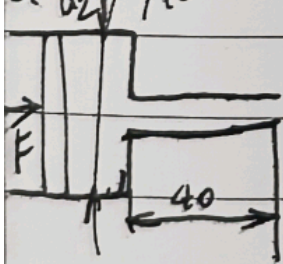
由伯努利方程

$$z_A = \frac{u^2}{2g} + z_C + h_L + h_f \Rightarrow u = 1.259 \text{ m/s}$$

b)  $z_A = z_B + \frac{P_B}{\rho g} + \frac{u^2}{2g} + h_L + h_f$

$$P_B = -28.559 \text{ kPa}$$

2.  $d_2 = \phi 10$



$\mu = 10^{-3} \text{ Ns/m}^2$   
 $Q = 500 \text{ mm}^3/\text{s}$

$\mu = 10^{-3} \text{ Ns/m}^2$   
 $Q = \frac{u}{\rho} = 10^{-6} \text{ m}^3/\text{s}$

$$\Delta P = \frac{32 \mu L u}{d^2} = 13.03552 \text{ kPa}$$

$\frac{\pi}{4} d_1^2 \cdot v = Q \Rightarrow v = 2.546 \text{ m/s}$

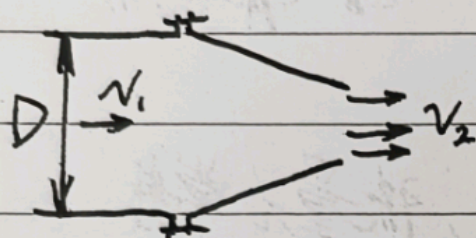
$Re = \frac{v d}{\nu} = 1273 < 2300$

∴ 为层流

$F = \Delta P \cdot \frac{\pi}{4} d_2^2 = 1.0238 \text{ N}$



3.



$$\rho = 1000 \text{ kg/m}^3 \quad D = 10 \text{ cm} \quad d = 2 \text{ cm}$$

$$v_2 = 15 \text{ m/s}$$

$$Q_v = S_1 v_1 = S_2 v_2 \rightarrow D^2 v_1 = d^2 v_2 \quad v_1 = 26 \text{ m/s}$$

$$p_1 + \frac{\rho v_1^2}{2} = p_2 + \frac{\rho v_2^2}{2} \quad p_2 = 0$$

$$p_1 = \frac{\rho}{2} (v_2^2 - v_1^2) = 112.32 \text{ kPa}$$

喷嘴作用力  $F$ , 由动量守恒

$$p_1 S_1 - F = \rho Q_v (v_2 - v_1)$$

$$F = p_1 S_1 - \rho S_1 v_1 (v_2 - v_1) = 814.30 \text{ N}$$

P193 例 3-4

$$v_1 = 10 \text{ m/s} \quad F dt = dm \Delta v$$

排水量与排水速度

$$v_2 \cdot \frac{\pi}{4} d^2 = Q_v$$

$$F = \rho Q_v \Delta v$$

$$P_{\text{出}} = F v_1 \quad P_{\text{入}} = \frac{1}{2} \rho Q_v (v_2^2 - v_1^2)$$