工程流体力学　邹佳驹 12012127

HW 1

Q1.

解: $u = 12y^{\frac{1}{4}}$ mm/s

$$\frac{\partial u}{\partial y} = 12 \cdot \frac{1}{4} \cdot y^{-\frac{3}{4}} s^{-1} = 3y^{-\frac{3}{4}} s^{-1}$$

$$\tau = \mu \frac{\partial u}{\partial y} = 0.5 \times 10^{-3} \times 3y^{-\frac{3}{4}} = 1.5y^{-\frac{3}{4}} \times 10^{-3} \ N/m^2 = \frac{1.5 \times 10^{-3}}{y^{\frac{3}{4}}} \ N/m^2$$

τ min, so $y^{\frac{3}{4}}$ max, $y = 16$ mm

$$\therefore \tau_{min} = \frac{1.5 \times 10^{-3}}{16^{\frac{3}{4}}} \ N/m^2 = 1.875 \times 10^{-4} \ N/m^2$$

Q2.

解:

$$\tau_A = \mu_A \frac{\partial u_A}{\partial y} = 1.15 \times 10^{-3} \times 10 \cos(2.5\pi y) \times 2.5\pi = 2.875\pi \cdot \cos(2.5\pi y) \times 10^{-2} \ N/m^2$$

$$\tau_B = \mu_B \frac{\partial u_B}{\partial y} = 0.47 \times 10^{-3} \times 4 \times 10^3 (0.1 - 2y) = 1.88(0.1 - 2y) \ N/m^2$$

代入 $y_A = 0.1$ m, $y_B = -0.1$m

$\Rightarrow \tau_A = 0.09031 \ N/m^2$

$\tau_B = 0.564 \ N/m^2$

$\tau_C = \tau_B + \tau_A$

$\tau_C = \frac{F}{A} = \frac{F}{L \cdot b}$

$\Rightarrow \frac{F}{L} = 3 \times (0.09031 + 0.564) = 1.963 \ N/m$

Q3

解: $w = \frac{1800 \times 2\pi}{60}$ rad/s $= 60\pi$ rad/s

$u_0 = r \cdot w = 8 \times 10^{-3} \times 60\pi = 0.48\pi$ m/s

$$\tau = \mu \cdot \frac{u - 0}{h_0} = 18.1 \times 10^{-6} \times \frac{0.48\pi}{0.04 \times 10^{-6}} = 217.2\pi \ N/m^2$$

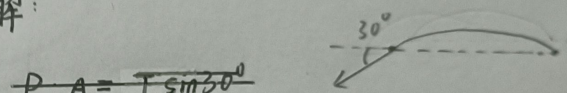
$F = \tau \cdot A = 217.2\pi \times 0.44 \times 10^{-6} = 3.002 \times 10^{-4}$ N

$T = F \cdot r = 2.402 \times 10^{-6}$ N·m

方向如题目中所示方向

Q4.

解:



~~$P \cdot A = T \sin 30^0$~~

~~$T = \frac{PA}{\sin 30^0} = \frac{105 \times \pi \times (1.5 \times 10^{-3})^2}{\frac{1}{2}} = 1.484 \times 10^{-3}$ N~~

$P \cdot A = 2\pi r \cdot 6 \cdot \sin 30^\circ$

$$6 = \frac{P \cdot \pi r^2}{2\pi r \sin 30^\circ} = P \cdot r = 105 \times 1.5 \times 10^{-3} = 0.1575 \ N/m$$