# 第一&二讲作业参考答案

1.2

$$\nabla P = \frac{\partial P}{\partial x}\vec{e}_x + \frac{\partial P}{\partial y}\vec{e}_y$$

$$\nabla P(a,b) = \rho_\infty v_\infty^2 \left[ \left( \frac{1}{a}\cos 1 \sin 1 + \frac{2}{a} \right) \vec{e}_x + \frac{1}{b}\sin 1 \cos 1 \vec{e}_y \right]$$

1.8

TRANSFORMATION FROM (x,y) TO (r,θ)

$$\frac{\partial}{\partial x} = \frac{\partial r}{\partial x}\frac{\partial}{\partial r} + \frac{\partial \theta}{\partial x}\frac{\partial}{\partial \theta}$$

$$\frac{\partial}{\partial y} = \frac{\partial r}{\partial y}\frac{\partial}{\partial r} + \frac{\partial \theta}{\partial y}\frac{\partial}{\partial \theta}$$

$$r^2 = x^2 + y^2,\ \theta = \tan^{-1}\frac{y}{x}$$

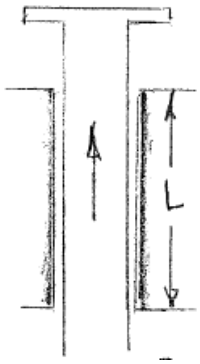
$$\frac{\partial r}{\partial x} = \frac{x}{(x^2+y^2)^{1/2}} = \frac{r\cos\theta}{r} = \cos\theta$$

$$\frac{\partial \theta}{\partial x} = -\frac{y}{x^2+y^2} = -\frac{r\sin\theta}{r^2} = -\frac{\sin\theta}{r}$$

$$\frac{\partial r}{\partial y} = \sin\theta,\ \frac{\partial \theta}{\partial y} = \frac{\cos\theta}{r}$$

$$\begin{cases} \dfrac{\partial}{\partial x} = \cos\theta\dfrac{\partial}{\partial r} - \dfrac{\sin\theta}{r}\dfrac{\partial}{\partial \theta} \\ \dfrac{\partial}{\partial y} = \sin\theta\dfrac{\partial}{\partial r} + \dfrac{\cos\theta}{r}\dfrac{\partial}{\partial \theta} \end{cases}$$

7. 15




$$t = GAP = \frac{D_{OUTSIDE} - D_{INSIDE}}{2} = \frac{36.04 - 36.02}{2} = 0.01 \text{ cm}$$

$$F = \tau A = \tau \pi DL$$

$$\tau = \mu \frac{du}{dy} = \mu \frac{\Delta u}{\Delta y} = \mu \frac{v}{t} \text{ (Assumes Laminar Profile)}$$

$$F = \frac{\mu v \pi DL}{t} = \frac{\rho \upsilon v \pi DL}{t} = \frac{0.85 \times 1000 \times 3.7 \times 10^{-4} \times 0.15 \times \pi \times 0.3602 \times 3.14}{1 \times 10^{-4}} = 1676N$$

2. 1

$$P = \rho gh = 101325Pa$$

$$\rho_{air@STP} = 1.29kg / m^3$$

$$h = \frac{P}{\rho_{air@STP} g} = \frac{101325}{1.29 \times 9.81} = 8006.78m$$

2. 8

$$\begin{aligned} P_A &= P_{ATM} + [\rho_{Hg} g(1) - \rho_{H_2O} g(5) - \rho_{oil} g(10)] \times 0.3048 \\ &= P_{ATM} + \rho_{H_2O} g(13.6 \times 1 - 5 - 0.8 \times 10) \times 0.3048 \\ &= P_{ATM} + 1788.67Pa \end{aligned}$$

2. 13

$$\begin{aligned} P_A - P_B &= [\rho_{H_2O} g(4) + \rho_{Hg} g(10) - \rho_{H_2O} g(10)] \times 0.0254 \\ &= \rho_{H_2O} g(-6 + 13.6 \times 10) \times 0.0254 \\ &= 32295.44Pa \end{aligned}$$