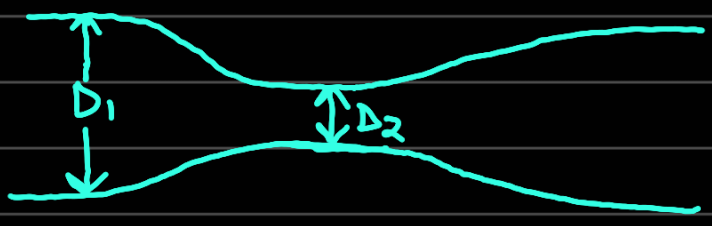
Day 10



$D_1 = 0.1\ m \qquad D_2 = 0.05\ m$

$P_{gauge} = 200\ kPa$

$\dot{V} = \frac{1}{60}\ m^3 s^{-1}$

$$v_1 = \frac{1/60}{\pi (0.1)^2/4}\ ms^{-1} = \frac{20}{3\pi}\ ms^{-1}$$

$$v_2 = 4v_1 = \frac{80}{3\pi}\ ms^{-1}$$

$$P_1 = 2\times10^5\ Pa$$

$$P_2 = 2\times10^5 + \frac{1000}{2}\left[\left(\frac{20}{3\pi}\right)^2 - \left(\frac{80}{3\pi}\right)^2\right]$$

$$= 2\times10^5 - \frac{10^3}{2}\times\left(\frac{20}{3\pi}\right)^2\times 15$$

$$= 2\times10^5 - \frac{10^5}{2}\times\frac{4}{9\pi^2}\times 15$$

$$= 10^5\left[2 - \frac{10}{3\pi^2}\right]$$

$$= 1.662\times10^5\ Pa$$

$$F_x = \rho A_2 v_2^2 + P_2 A_2 - \rho A_1 v_1^2 - P_1 A_1$$

$$= 10^3\times\frac{\pi}{4}\times 0.0025\times\left(\frac{80}{3\pi}\right)^2$$

$$+ 1.662 \times 10^5 \times \frac{\pi}{4} \times 0.0025$$

$$- 10^3 \times \frac{\pi}{4} \times 0.01 \times \left(\frac{20}{3\pi}\right)^2$$

$$- 2 \times 10^5 \times \frac{\pi}{4} \times 0.01$$

$$= \frac{\pi}{4} \times \left(\frac{20}{3\pi}\right)^2 \left[2.5 \times 16 - 10\right]$$

$$+ \frac{\pi}{4} \left[16.62 \times 25 - 2000\right]$$

$$= \frac{\pi}{4} \times \frac{400}{9\pi^2} \times 30 - \frac{\pi}{4} \times 1584.5$$

$$= \frac{1000}{3\pi} - \frac{1584.5\pi}{4}$$

$$= -1138.36 \text{ N}$$