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18/ENG05/031

MECHATRONICS ENGINERRING

$$Q_{Actual} = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$$

$$= 0.98 \times \frac{0.0314 \times 7.85 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.85 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 4.080}$$

$$= 0.071087$$

(3) $d_1 = 150mm = 0.15m$

Pipe diameter $d_2 = 300mm = 0.30m$

$$A_1 = \frac{\pi d_1^2}{4} = \frac{3.142 \times (0.15)^2}{4} = 0.0177m^2$$

$$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi \times (0.30)^2}{4} = 0.0707m^2$$

$y = 500mm\ Hg = 0.50m\ Hg$, $C_d = 0.84$

$$h = \frac{\text{S.g of Hg} - \text{S.g of oil}}{\text{S.g of oil}} \times y$$

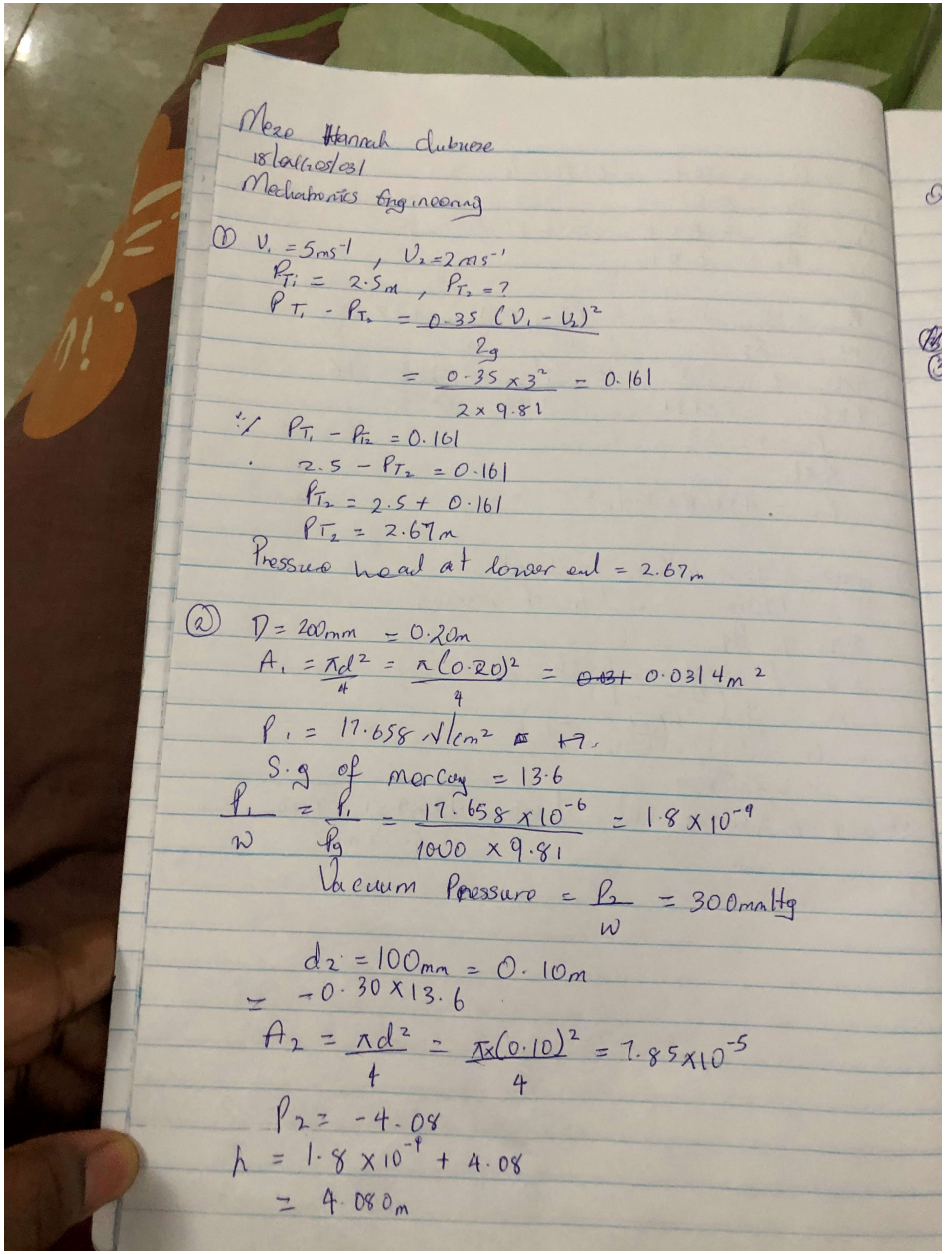
$$= \frac{13.6 - 0.9}{0.9} \times 0.5$$

$$= 7.06m$$

Rate of flow $= Q_{ac} = C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$

$$Q = 0.84 \times \frac{0.0707 \times 0.0177}{\sqrt{(0.0707)^2 - (0.0177)^2}} \times \sqrt{2 \times 9.81 \times 7.06}$$

$$= 01377$$



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Mechatronics Engineering

① $V_1 = 5ms^{-1}$, $V_2 = 2ms^{-1}$
$P_{T_1} = 2.5m$, $P_{T_2} = ?$
$P_{T_1} - P_{T_2} = \frac{0.35(V_1 - V_2)^2}{2g}$
$= \frac{0.35 \times 3^2}{2 \times 9.81} = 0.161$
$\therefore P_{T_1} - P_{T_2} = 0.161$
$2.5 - P_{T_2} = 0.161$
$P_{T_2} = 2.5 + 0.161$
$P_{T_2} = 2.67m$
Pressure head at lower end = 2.67m

② $D = 200mm = 0.20m$
$A_1 = \frac{\pi d^2}{4} = \frac{\pi(0.20)^2}{4} = 0.0314m^2$
$P_1 = 17.658 N/cm^2$
S.g of mercury = 13.6
$\frac{P_1}{w} = \frac{P_1}{\rho g} = \frac{17.658 \times 10^{-6}}{1000 \times 9.81} = 1.8 \times 10^{-9}$
Vacuum Pressure = $\frac{P_2}{w}$ = 300mmHg
$d_2 = 100mm = 0.10m$
$= -0.30 \times 13.6$
$A_2 = \frac{\pi d^2}{4} = \frac{\pi(0.10)^2}{4} = 7.85 \times 10^{-5}$
$P_2 = -4.08$
$h = 1.8 \times 10^{-9} + 4.08$
$= 4.080m$

(4) $V = \sqrt{2gh}$

$H = y\left(\frac{\text{S.g of mercury} - \text{s.g of water}}{\text{S.g of water}}\right)$

$H = 0.17\left(\frac{13.6 - 1.026}{1.026}\right)$

$= 0.17 \times 12.26$

$= 2.0842\,m$

$V = \sqrt{2 \times 9.81 \times 2.0842}$

$= 6.39\,m/s$