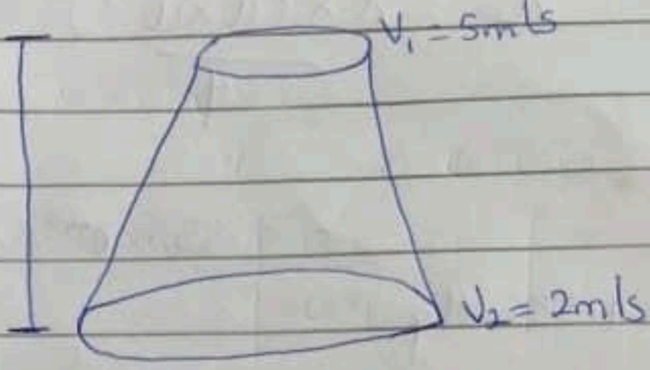
1.



$P_{1} = P_1/w = 2.5m$

$H_L = \frac{0.35(V_1 - V_2)^2}{2g}$

Using Bernoulli's equation $P_2/w = ?$

$$P_1/w + V_1^2/2g + Z_1 = P_2/w + V_2^2/2g + Z_2 + H_L$$

$$P_2/w = P_1/w + \left[\frac{V_1^2 - V_2^2}{2g}\right] + [Z_1 - Z_2] - H_L$$

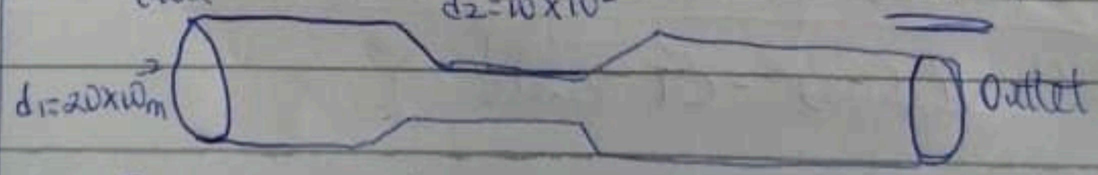
$$P_2/w = 2.5 + \left[\frac{5^2 - 2^2}{2 \times 9.81}\right] + 2 - \frac{0.35(5-2)^2}{2 \times 9.81}$$

$$P_2/w = 2.5 + 1.07 + 2 - 0.161$$

$$P_2/w = 5.409m$$

∴ The pressure head at the lower end $= 5.409m$

2.



$P_1 = 17.658 N/cm^2 = 17.658 \times 10^4 N/m^2$ $\quad C_d = 0.98$

$P_2 = 30 cmHg = 30 \times 10^{-2} m Hg$ $\quad Q = ?$

$$A_1 = \frac{\pi \times (20\times10^{-2})^2}{4} \qquad A_2 = \frac{\pi \times (10\times10^{-2})^2}{4}$$

$$= 0.03 m^2 \qquad = 7.85\times10^{-3} m^2$$

$$\frac{P_2}{\omega} = 0.3\times13.6 = 4.08 mHg$$

$$\frac{P_2}{\omega} = -4.08 \text{ (Since vacuum pressure)}$$

$$P_1/\omega = \frac{17.058\times10^4}{4.81\times10^3} = 18$$

$$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = 18 - -4.08$$

$$= 22.08$$

$$Q = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$Q = \frac{0.98\times0.03\times(7.85\times10^{-3})\times\sqrt{2\times9.81\times22.08}}{\sqrt{(0.03)^2-(7.85\times10^{-3})^2}}$$

$$Q = 0.166 m^3/s$$

3. $d_0 = 15 \times 10^{-2} m$ $d_1 = 30 \times 10^{-2} m$ $C_d = 0.64$

$y = 50 \times 10^{-2} m Hg$ $Q = ?$

Sg of Oil $= 0.9$ $S_m = 13.6$

$S_0 = 0.9$

$A_0 = \frac{\pi \times (15 \times 10^{-2})^2}{4} = 0.01767 m^2$

$H = y \left[\frac{S_{m}}{S_0} - 1 \right]$

$A_1 = \frac{\pi \times (30 \times 10^{-2})^2}{4} = 0.0707 m^2$

$H = 50 \times 10^{-2} \left[\frac{13.6}{0.9} - 1 \right]$

$H = 7.055 m$

$Q = \frac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}} = \frac{0.64 \times 0.0176 \times 0.0707 \sqrt{2 \times 9.81 \times 7.055}}{0.0707^2 - 0.0176^2}$

$Q = 0.0137 m^3/s$

(4) $y = 170 mmhg = 170 \times 10^{-3} mhg$

Sg of mecury $= 13.6 hg$

Sg of Sea water $= 1.026$

$H = y \times \frac{S_m}{S_0} - 1$

$H = 170 \times 10^{-3} \times \left(\frac{13.6}{1.026} - 1 \right)$

$H = 2.08 m$

$V = \sqrt{2gH}$

$V = \sqrt{2 \times 9.81 \times 2.08}$

$V = 6.39 m/s$

(5) ~~Actu~~ Actual flowrate $Q = 5 dm^3/min = 8.33 \times 10^{-5} m^3/sec$

$P = 15 bar = 15 \times 10^5 N/m^2$

$V = 1700 rev/min = 28.33 m/sec$

$T = 15 N/m$ Nomal displacement $= 100 cm^3/rev$

$= 1 \times 10^{-5} m^3/rev$

~~Wednesday - Carrofile~~

Volumetric Efficiency

$\frac{\text{Actual flowrate}}{\text{ideal flowrate}} \times 100\%$ ideal flowrate = displacement × speed

$Q = 1\times10^{-5} \times 28.33$

$= 2.833\times10^{-4} m^3/sec$

Volumetric Efficiency $= \frac{8.33\times10^{-5}}{2.833\times10^{-4}} \times 100$

$= 29.4\%$

fluid power $(Q \times \Delta P)$

$= 8.33 \times 10^{-5} \times 15 \times 10^5 = 124.95$ watts

Shaft power $= T \times \omega$

$\omega = 2\times\pi\times v = 2\times\pi\times 28.33 = 178$ rad/sec

$= T \times \omega$

$= 15 \times 178 = 2670$ watts

Over-all Efficiency.

$\frac{\text{fluid power}}{\text{shaft power}} \times 100\%$

$= \frac{124.95}{2670} \times 100$

$= 4.68\%$