$H = 7.055\,m$

$Q = \dfrac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}} = \dfrac{0.64 \times 0.0176 \times 0.0207 \times \sqrt{2 \times 9.81 \times 7.055}}{\sqrt{0.0207^2 - 0.0176^2}}$

$Q = 0.137\,m^3/s$

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

Sg of mecury $= 13.6$

Sg of sea water $= 1.026$

$H = y \times \left(\dfrac{S_H}{S_o} - 1\right)$

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

$H = 2.08\,m$

$v = \sqrt{2gH}$

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

$v = 6.39\,m/s$

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

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

$v = 1700\,rev/min = 28.33\,n/sec$

$T = 15\,N/m$ Normal displacement $= 100\,cm^3/rev$

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

Volumetric efficeency

$\dfrac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100\%$

Ideal flowrate = displacement × speed

$Q = 1 \times 10^{-5} \times 28.33$

$= 2.833 \times 10^{-4}\,m^3/sec$

$\frac{P_2}{w} = 0.3 \times 13.6 = 4.08 \, mHg$

$\frac{P_2}{w} = -4.08$ (since vacuum pressure)

$P_1/w = \frac{17.058 \times 10^5}{4.81 \times 10^3} = 18$

$h = \frac{P_1}{w} - \frac{P_2}{w} = 18 - -4.08$
$= 22.08$

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

$Q = \frac{0.98 \times 0.03 \times (7.85 \times 10^{-3}) \times \sqrt{2 \times 9.81 \times 22.08}}{\sqrt{(0.03)^2 - (7.85 \times 10^{-3})^2}}$

$Q = 0.166 m^3/s$

3 $d_1 = 15 \times 10^{-3} m$

$d_1 = 30 \times 10^{-2} m$
$y = 50 \times 10^{-2} \, mHg$
Sg of oil $= 0.9$

$C_d = 0.64$
$Q = ?$
$S_m = 13.6$
$S_o = 0.9$

$A_1 = \frac{\pi \times (15 \times 10)^2}{4} = 0.01767 m^2$

$H = y \left[\frac{S_m}{S_{o}} - 1\right]$

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

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

Volumetric efficience $= \frac{8.33\times10^{-3}}{2.833\times10^{-4}} \times 100$

$= 29.4\%$

Fluid power $(Q \times \Delta p)$

$= 8.33\times10^{-5} \times 15\times10^{5} = 124.95$ watts

Shaft power $= T\times\omega$

$\omega = 2\times\pi\times N = 2\times\pi\times 2800/33 = 178$ rad/sec

$= T\times\omega$

$= 15\times178 = 2670$ watts

Overall Efficiency

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

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

$= 4.68\%$

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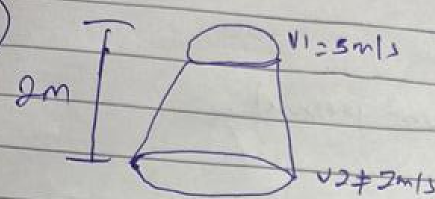
18/ENG03/027
Civil Engineering

1)



$P_1/w = 2.5m$

$h_L = \frac{0.35(v_1 - v_2)^2}{2g}$

Using Bernolli's equation P_2/w = ?

$P_1/w + v_1^2/2g + z_1 = P_2/w + v_2^2/2g + z_2 + h_L$

$P_2/w = P_1/w + \left[\frac{v_1^2 - v_2^2}{2g}\right] + [z_1 - z_2] - h_L$

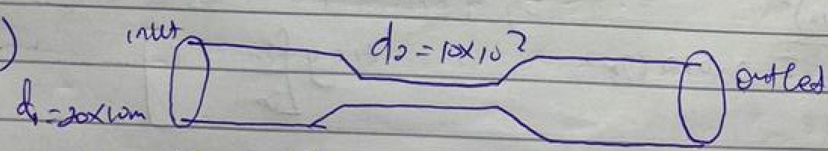
$P_2/w = 2.5 + \left[\frac{5^2 - 2^2}{2 \times 9.81}\right] + 2 - \frac{0.35(5-2)^2}{2 \times 9.81}$

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

$P_2/w = 5.409m$

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

2)



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

$P_2 = 30cmHg = 30 \times 10^{-2}$ mHg $Q = ?$

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

$= 0.03m^2$ $= 7.85 \times 10^{-3} m^2$