$H = 7.055\,m$

$$Q = \frac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}}$$

$$Q = \frac{0.64 \times 0.0176 \times 0.0707 \sqrt{2 \times 9.81 \times 7.055}}{\sqrt{(0.0707^2 - 0.0176^2)}}$$

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

(4) $y = 170\,mmHg = 170 \times 10^{-3}\,mHg$

S.g of mecury = 13.6 Hg

S.g of Sea water = 1.026

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

$H = 170 \times 10^{-3} \times \left(\frac{13.6}{1.025} - 1\right)$

$H = 2.08\,m$

$V = \sqrt{2gH}$

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

$V = 6.39\,m/s$

(5) Actual Flowrate Q = ~~0.05m³~~ $5\,dm^3/min = 8.33 \times 10^{-5}\,m^3/sec$

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

$V = 1700\,rev/min = 28.33\,rev/Sec$

$T = 15\,N/m$ Normal displacement $= 100\,cm^3/rev = 1 \times 10^{-5}\,m^3/rev$

(i) Volumetric Efficiency = $Q = 1 \times 10^{-5} \times 28.33 = 2.833 \times 10^{-4}\,m^3/sec$

$$\frac{\text{Actual flowrate}}{\text{Ideal Flowrate}} \times 100\%$$

$$\text{Volumetric efficiency} = \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100 = 29.4\%$$

(ii) Fluid Power = $(Q \times \Delta P)$

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

(iii) Shaft Power = $T \times \omega$

$\omega = 2 \times \pi \times V$

$\omega = 2 \times \pi \times 28.33 = 178.$

shaft Power = $T \times \omega$

$= 15 \times 178 = 2670$ watts

(iv) Overall efficiency

$$\frac{\text{Fluid Power}}{\text{Shaft Power}} \times 100\%$$

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

$= 4.68\%$

LEGHEMO SOLOMON
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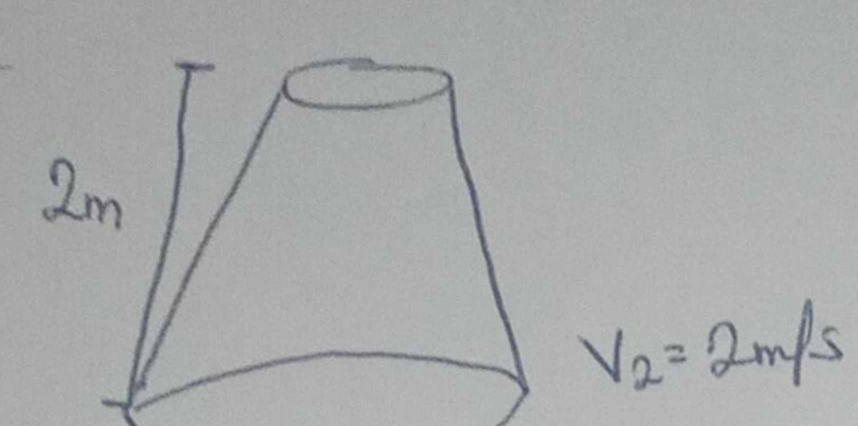
Solution

(1)



$P_T = P_1/w = 2.5m$

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

Using Bernoulli's Equation

$$\frac{P_1}{w} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + Z_2 + H_L$$

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

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

$$\frac{P_2}{w} = 2.5 + 1.07 + 2 - 0.161$$

$$\frac{P_2}{w} = 5.409m$$

(2.) $P_1 = 17.658N/Cm^2 = 17.658 \times 10^4 N/m^2$ $Cd = 0.98$ $P_2 = 30cmHg = 30 \times 10^{-2} m Hg$

$Q = ?$

$A_1 = \frac{\pi \times (20 \times 10^{-2})^2}{4} = 0.03m^2$ $A_2 = \frac{\pi \times (10 \times 10^{-2})^2}{4} = 7.85 \times 10^{-3} m^2$

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

$\frac{P_1}{w} = \frac{17.058 \times 10^4}{4.81 \times 10^3} = 18$ $h = P_1/w - P_2/w = 18 - -4.08 = 22.08$ //

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

$$Q = \frac{0.98 \times 0.03 \times (7.85 \times 10^{-3}) \times \sqrt{2 \times 9.81 \times 22.08}}{\sqrt{(0.03^2 - (7.85 \times 10^{-5})^2}}$$

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

(3) $A_0 = 15 \times 10^{-2} m$ $d_1 = 30 \times 10^{-2} m$ $Cd = 0.04$

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

$A_0 = \frac{\pi \times (15 \times 10^{-2})^2}{4} = 0.01767m^2$ S.G of Oil $= 0.9$

$A_1 = \frac{\pi \times (30 \times 10^{-2})^2}{4} = 0.0707m^2$ $H = y\left[\frac{S_{hi}}{S_o} - 1\right]$ $S_{hi} = 13.6$

$S_o = 0.9$