③ Orificemeter,

$d_o = 15cm = 15\times10^{-2}m$, $d_p = 30cm = 30\times10^{-2}m$

$A_o = \frac{\pi \times (15\times10^{-2})^2}{4}$ $A_p = \frac{\pi\times(30\times10^{-2})^2}{4}$

$= 0.01767\ m^2$ $= 0.07069\ m^2$

S.P.G of oil $= 0.9$ (So)

Coefficient of discharge $= 0.64$

Reading of differential $= 50cm\ hg$

Differential head $h_u = y\left[\frac{Shl}{So} - 1\right]$

$Shl = 13.6$

$y = 50\times10^{-2}$

$h = 50\times10^{-2}\left[\frac{13.6}{0.9} - 1\right]$

$h = 50\times10^{-2} \times 14.11$

$= 7.055\ m$

$Q = \frac{C_d A_o A_p \sqrt{2gh}}{\sqrt{A_p^2 - A_o^2}}$

$= \frac{7.994\times10^{-4}\times11.765}{\sqrt{4.68\times10^{-5}}}$

$= 0.1374\ m^3/s$

④ $y = 170mmHg = 0.17mHg$

$S.g_{Hg} = 13.6$

$S.g_{sw} = 1.026$

$\Delta h = y\left(\frac{S.g_{Hg}}{S.g_{sw}} - 1\right)$

$\Delta h = 0.17\left(\frac{13.6}{1.026} - 1\right)$

$\Delta h = 2.08\ m$

$V = \sqrt{2g\Delta h}$

$V = \sqrt{2\times9.81\times2.08} = 6.388\ ms^{-1}$ //

⑤ $Q = 0.05\ dm^3/mm = 8.33\times10^{-5}\ m^3/sec$

Speed of Rotation $= 1700\ Rev/min = 28.3\ Rev/s$

Nominal Displac. $= 10cm^3/rev = 10^{-5}\ m^3/rev$

Torque Input $= 15\ Nm$

Pressure Change $= 15bar = 15\times10^5\ Nm^2$

Ideal flowrate = Nominal displacement × Speed rotation $= 10^{-5}\times28.3 = 2.83\times10^{-4}\ m^3/sec$

(a) Volumetric Efficiency $= \frac{\text{Actual f.r}}{\text{Ideal f.r}} \times 100$

$= \frac{8.33\times10^{-5}}{2.83\times10^{-4}} \times 100 = 29.45\%$

(b) Fluid Power, $P_F = Q \times \Delta P$

$= 8.33\times10^{-5}\times15\times10^5$

$= 124.95$ Watts

(c) Shaft power $= T \times \omega$

$\omega = 2\times\pi\times$ Speed of rotation

$\omega = 2\times\pi\times28.3 = 177.81\ rad/sec$

$\therefore$ Shaft power $= 15\times177.81$

$= 2667.2$ watts

(d) Overall efficiency $= \frac{\text{fluid power}}{\text{Shaft power}} \times 100$

$= \frac{124.95}{2667.2} \times 100$

$= 4.68\%$

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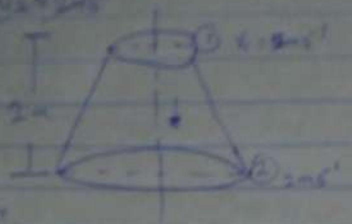
~~① $V_1 = 3ms^{-1}$, $V_2 = 2ms^{-1}$~~

①



$$\frac{P_1}{W} = \frac{P_2}{W} = 2.5m$$

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

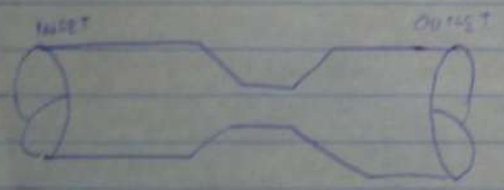
$$\frac{P_1}{W} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{W} + \frac{V_2^2}{2g} + Z_2 + H_L$$

$$\frac{P_2}{W} = \frac{P_1}{W} = \frac{V_1^2 - V_2^2}{2g} + (Z_1 - Z_2) - \frac{0.35(V_1 - V_2)^2}{2g}$$

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

$$\frac{P_2}{W} = 5.409 \text{ m of Liquid}$$

②



Inlet ⇒ $d_1 = 20cm ⇒ 20 \times 10^{-2} m$

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

$$A_1 = 0.0314 m^2$$

$P_1 = 17.668 N/cm^2$

$= 17.668 \times 10^4 N/m^2$

$Cd = 0.98$

Throat Diameter, $d_2 = 10cm = 10 \times 10^{-2} m$

$$A = \frac{\pi d^2}{4}$$

$$A_2 = 7.85 \times 10^{-3} m^2$$

$$\frac{P_1}{W} - \frac{P_2}{W} = h$$

$P_1 = 17.668 \times 10^4 Nm^{-2}$

$W = 9.81 \times 10^3 N/m^3$

But, throat vacuum pressure $= 30cm$ of Hg

$= 0.3m\,Hg$

$= 0.3 \times 13.6 = 4.08$

$$\frac{P_2}{W} = -4.08$$

Then $\frac{P_1}{W} = \frac{17.698 \times 10^4}{9.81 \times 10^3} = 18$

$\therefore \frac{P_1}{W} - \frac{P_2}{W} ⇒ 18 + 4.08 = 22.08$

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

$= 0.98 \times 0.0314 \times 7.85 \times 10^{-3}$ ⟶

⟶ $\times \sqrt{\frac{2 \times 9.81 \times 22.08}{(0.0314)^2 - (7.85 \times 10^{-3})^2}}$

$= 0.1653 \ m^3/s$ //