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1) $V_1 = 5ms^{-1}$, $V_2 = 2ms^{-1}$

Smaller end = 2.5m

$h_f = \frac{(0.35\ (v^1 - v^2))^2}{2g}$ L = 2.0m

P at lower end

L - $t_1 - t_2$ = 2m

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

$\frac{P_2}{w} = \frac{P_1}{w} + \frac{1}{2g}(V_1^2 + V_2^2) + (Z_1 - Z_2) h_f$

$2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + 2 = \frac{(0.35\ (5-2))^2}{2 \times 9.81}$

$= 2.5 + 1.07 + 2 - 0.16055$; $P_2 = 5.409$ bar

Pressure at lower end = 5.049bar

2) inlet diameter = 20cm

Inreact diameter = 10cm

$P_1 = 17.658N$

g 30cm 300mm of Mecury

$Q = Cd = 0.98$, $A_1 = \frac{\pi d^2}{4} = \frac{(\frac{20}{100})^2 \times 3.14}{4}$

$= 0.0314m^2$

$A_2 = \frac{(\frac{10}{100})^2 \times 3.14}{4} = 7.853 \times 10^{-3}$

g = x 300 and 0.3m of mecury

$P_1 = 17.658$

$= \frac{17.658}{1000} = 1.7658 \times 10^{-3} N/m$ & $\frac{P_1}{w} = \frac{17658 \times 10^{-3}}{9.81} = 1.8 \times 10^{-4} m$

$P_2 = 0.3 \times 13.6 = -4.08 \text{ of } H_2O$

$h = \frac{P_1}{w} - \frac{P_2}{w} = 1.8 \times 10^{-4} (-4.08)$; $h = 4.0801 m$

$Q = C_1 \cdot \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$; $Q = \frac{0.98 \times 0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314^2) - (7.853 \times 10^{-3})^2}} \times$

$\sqrt{2 \cdot 9.81 \cdot 4.0808}$

$= 0.0709 m^3/s$

3) $D_1 = 15cm = 0.015m$

$D_2 = 30cm = 0.030m$

$500mm$ of mercury $= 0.5m$, $u = ?$

$S_G = 0.9$ $Q = 0.64$

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

$A_1 = \frac{\pi (0.015)^2}{4} = 0.0176 m^2$

$A_2 = \frac{\pi (0.030)^2}{4} = 0.0706 m^2$

$h = g \left[\frac{13.6}{0.9} - 1\right] = 0.5 \left[\frac{13.6}{0.9} - 1\right]$

7.0556

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

$Q = 0.64 \frac{(0.0176)(0.0706)}{\sqrt{(0.0176^2) - (0.0706^2)}} \sqrt{2 \times 9.81 \times 7.0556}$

$Q = 2.33 \times 10^{-3} m^3/s$

4 A = 15m
Hammer mecury (0.17m)
SG of mercury (13.6)
SG of sea water = 1.026 v=?

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

$= 2.083m$

$v = \sqrt{2gh}$

$v = \sqrt{2 \times 9.81 \times 2.083}$

$v = 6.39 m/s$

5. $Q = 0.05 dm^3/mm = 8.33 \times 10^{-5} m^3/sec$
Speed of rotation = 1700 Rev/min = 28.3 rev/sec
Nominal displacement = $10 cm^3/rev = 10^{-5} m^3/rev$,
Torque input = 15 Nm
Pressure change = 15 bar = $15 \times 10^5 N/m^2$
Ideal flow rate = Nominal dis placement x speed rotation/
$= 10^{-5} \times 2.83 = 2.83 \times 10^{-4} m^3/sec$

⑥ Volume Efficiency = $\frac{\text{Actual flowrate}}{\text{Ideal flowrate}} \times 100$

$= \frac{8.33 \times 10^{-5}}{2.83 \times 10^{-4}} \times 100 = 29.43\%$

5) Fluid Power, $P_f = Q \times \Delta P = 8.33 \times 10^{-5} \times 15 \times 10^5$
$= 124.95$ watt

9) Shaft power = $T \times \omega$
$\omega = 2\pi \times$ speed of rotation
$\omega = 2\pi \times 28.3$
$\omega = 177.81$ rad/sec
∴ Shaft power = $15 \times 177.81 = 2667.2$ watt

d Overall efficiency = $\frac{\text{Fluid Power}}{\text{Shaft power}} \times 100$

$= \frac{124.45 \times 100}{2667.2}$

$= 4.65\%$