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

PH at smaller end = 2.5m

$hf = \frac{(0.35(v_1 - v_2))^2}{2g}$ $l = 2.0m$

PH at lower end:

$l = t_1 - t_2 = 2m$

$\frac{P_1}{w} + \frac{v_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + Z_2 + hf$

$\frac{P_2}{w} = \frac{P_1}{w} + \frac{1}{2g}(v_1^2 - v_2^2) + (Z_1 - Z_2) - hf$

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

$= 2.5 + 1.07 + 2 - 0.16055$

$P_2 = 5.409bar$

Pressure at lower end ∴ = 5.409bar

2) Inlet diameter = 200m

throat diameter = 100m

$P_1 = 17.658m$

$y = 300m$ of mecury

$Cd = 0.98$

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

$= 0.0314m$

$A_2 = \frac{\pi d^2}{4} = \frac{(\frac{10}{100})^2 \times 3.14}{4}$

$= 7.853 \times 10^{-3}$

$y = 30cm$ (0.3m of mecury)

$P_1 = 17.658$

$= \frac{17.658}{1000} = 1.7658 \times 10^{-3} N/m$

$\frac{P_1}{w} = \frac{1.7658 \times 10^{-3}}{9.81} = 1.8 \times 10^{-4}m$

$P_2/w = 0.3 \times 13.6 = -4.08$ of H_2O

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

$h = 4.08018m$

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

$Q = 0.98 \times \frac{0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.853153)^2}} \times \sqrt{2 \times 9.81 \times 4.08018}$

$Q = \frac{0.000241 \times 8.947}{0.0304}$

$Q = 0.0709m^3/s$

3) $D_1 = 15cm$ $D_2 = 30cm$

500m of mercury = 0.5m $q = ?$

$S.G = 0.9$ $Cu = 0.64$

$A_1 = \frac{\pi d^2}{4} = \frac{(15/100)^2 \times 3.14}{4} = 0.0176m$

$A_2 = \frac{\pi d^2}{4} = \frac{(30/100)^2 \times 3.14}{4} = 0.0706m$

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

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

$= 7.05m$ of 0.1

$q = Cd \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$

$q = \frac{0.64 \times 0.0176 \times 0.070 \sqrt{2 \times 9.81 \times 7.05}}{\sqrt{(0.0700)^2 - (0.0170)^2}}$

$q = \frac{9.35 \times 10^{-3}}{4011.2}$

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

4) Axis = 15m

170mm of mecury (0.17m)

S.G of mecury (13.6)

SG of sea water = 1.026 v = ?

$h = y\left(\frac{S_h}{S} - 1\right)$

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

$h = 2.083m$

$V = \sqrt{2gh}$

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

$V = 6.39ms^{-1}$

~~4) 0.05m³/min~~
~~15 bar~~
~~1700upm~~
~~10cm³ Prv~~
~~15Nm~~

5) $Q = 8.33 \times 10^{-5} m^3/sec$

Speed of rotation = 28.3Rev/sec

normal displacement = $10^{-5} m^3/rev$

Torque Input = 15Nm

Pressure change = $15 \times 10^5 Nm^2$

Ideal flow rate = normal displacement × Speed rotation = $2.83 \times 10^{-4} m^3/sec$

a) Volumetric efficiency = $\frac{\text{Actual flowrate} \times 100}{\text{Ideal flowrate}}$

= 29.43%

b) fluid power, $Pf = Q \times \Delta P$

$8.33 \times 10^{-5} \times 15 \times 10^5$

= 124.95 watts

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

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

$\omega = 177.81$ rad/sec

Shaft power = 15×177.81

= 2667.2 watts

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

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

= 4.68%