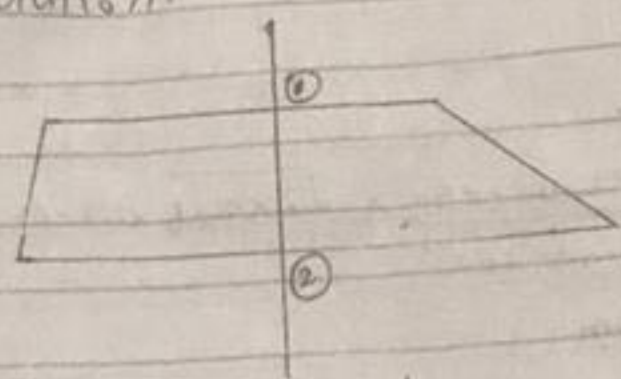
OLOTU OLAMIDE FIYINFOLUWA.
18/ENG06/058.
MECHANICAL ENGINEERING.
FLUID MECHANICS ASSIGNMENT.

1) Solution.



$v_1 = 5ms^{-1}$ $v_2 = 2ms^{-1}$

P. at smaller end = 2.5m

$h_L = 0.35(v_1 - v_2)^2$

Pressure at $2g$, $L = 2.0m$
lower end

$L = Z_1 - Z_2$

$= \frac{0.35(5-2)^2}{2g} = \frac{0.35(3)^2}{2 \times 9.81} = \frac{0.35(9)}{2 \times 9.81} = 0.16m.$

Pressure head $= P_2/\rho g = ?$, applying Bernullis Equation:

$\frac{P_1}{w} + \frac{v_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{v_2^2}{2g} + Z_2 + h_L$

$Z_2 = 0, Z_1 = 2.0$

$2.5 + \frac{(5)^2}{2 \times 9.81} + 2.0 = \frac{P_2}{\rho g} + \frac{(2)^2}{2 \times 9.81} + 0.016.$

$2.5 + 1.27 + 2.0 = \frac{P_2}{\rho g} + 0.203 + 0.16$

$\frac{P_2}{\rho g} = (2.5 + 1.27 + 2.0) - (0.203 + 0.16)$

$= 5.77 - 0.363 = \underline{5.407 bar.}$

(2) Inlet diameter = ~~20cm~~ 20cm = 0.2 m

Throat diameter = ~~mm~~ 10 cm = 0.10 m

~~[illegible]~~ Area of inlet $= a_1 = \pi/4 \times (0.2)^2 = 0.03146m^2$

$v = \sqrt{2gh}$

$= \sqrt{2 \times 9.81 \times 2.08} = 6.39 m/s$

5) Rate of Pump = $0.05 m^3/min = 500 cm^3/min$

Pressure change = 15bar

Speed rotation = 1700 rev

normal displacement = $10 cm^3/rev$.

torque input = 15 N/m

Solution

flow rate = Normal displacement × speed

$= 15 \times 1700 = 25,500 cm^3/min = 25.5000 cm^3/min$

$= 25.5$

Volumetric efficiency

$= \frac{\text{Actual flow}}{\text{ideal flow}} = \frac{500}{25.5} = 19.60$

$Q = \frac{(500 \times 10^{-3})}{60 m^3/s} = 33.3 \times 10^{-4} m^3/s$

fluid Power

$\Delta P = 100 \times 10^5 N/m^2$, fluid Power $= Q\Delta P = 83.3 \times 10^{-4} \times 100 \times 10^5$

fluid Power = 83 300W.

Shaft Power

$= 2\pi N T / 60 = \frac{2\pi \times 1700 \times 25.5}{60} = 4541.4 N/m$

Overall efficiency

$= \frac{\text{fluid Power}}{\text{Shaft Power}} = \frac{83300}{4541.4} = 18.342$

Overall efficiency = 18.342 or 1834.2 %.

Area of throat $= \frac{\pi d^2}{4} = \frac{22}{7} \times \frac{1}{4} \times (0.1)^2$
$= 0.0785 cm^2$

Cd = 0.98, Pressure $(P_1) = 17.658 \times 10^4 N/m^2$, $\rho = 1000 kg/m^3$

$P_1/\rho g = \frac{17.658 \times 10^4}{9.81 \times 1000} = 18m$

$P_2/\rho g$ = 30cm of mercury $= -0.3 \times 13.6 = -4$

differential head

$h = P_1/\rho g - P_2/\rho g = 18 - (-4) = 22$ cm of water

$$Q = \frac{Cd \times a_1 a_2 \sqrt{2gh}}{\sqrt{(a_1)^2 - (a_2)^2}} = \frac{0.98 \times 314.16 \times 0.007854}{\sqrt{(314.16)^2 - (0.007854)^2}} \times \sqrt{2 \times 9.81} \times 22.08 m$$

$$= \frac{50328837.21}{304} \times 165555 = 0.165m$$

$= 165.56$ lit/s

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

Cd = 0.64, S.g = 0.9

Solution.

$A_1 = \pi d^2/4 = \pi \times (0.15)^2/4 = 176.714 mm^2$

$A_2 = \pi d^2/4 = \pi \times (0.3)^2/4 = 0.0706 m^2$

$$H = \pi \left[\frac{13.6}{0.9} - 1\right]$$

~~H = π [13.6 / 0.9]~~ = 7.05

$$Q = \frac{Cd \cdot A_0 A_P \cdot \sqrt{2gh}}{A_P^2 - (A_0)^2}$$

$$Q = \frac{0.64 \times 0.0176 \times 0.0706}{\sqrt{(0.0706)^2 - (0.070)^2}} \times \sqrt{2 \times 9.81 \times 7.05}$$

$$Q = \frac{9.35 \times 10^{-3}}{40.112} = 2.33 \times 10^{-3} m^3/s$$

(4) Diff of mercury level, $x = 170mm = 0.17m$, S.g of mercury = 13.6,

Specific gravity = 1.026, Solution:

$$H = x\left[\frac{S_g}{S_0} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right]$$

$= 2.0834m$

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

5) Rate of P

Pressure ch

Speed rotat

normal d

torque i

flow ra

Volumet

= Ac

q =

fluid

ΔP =