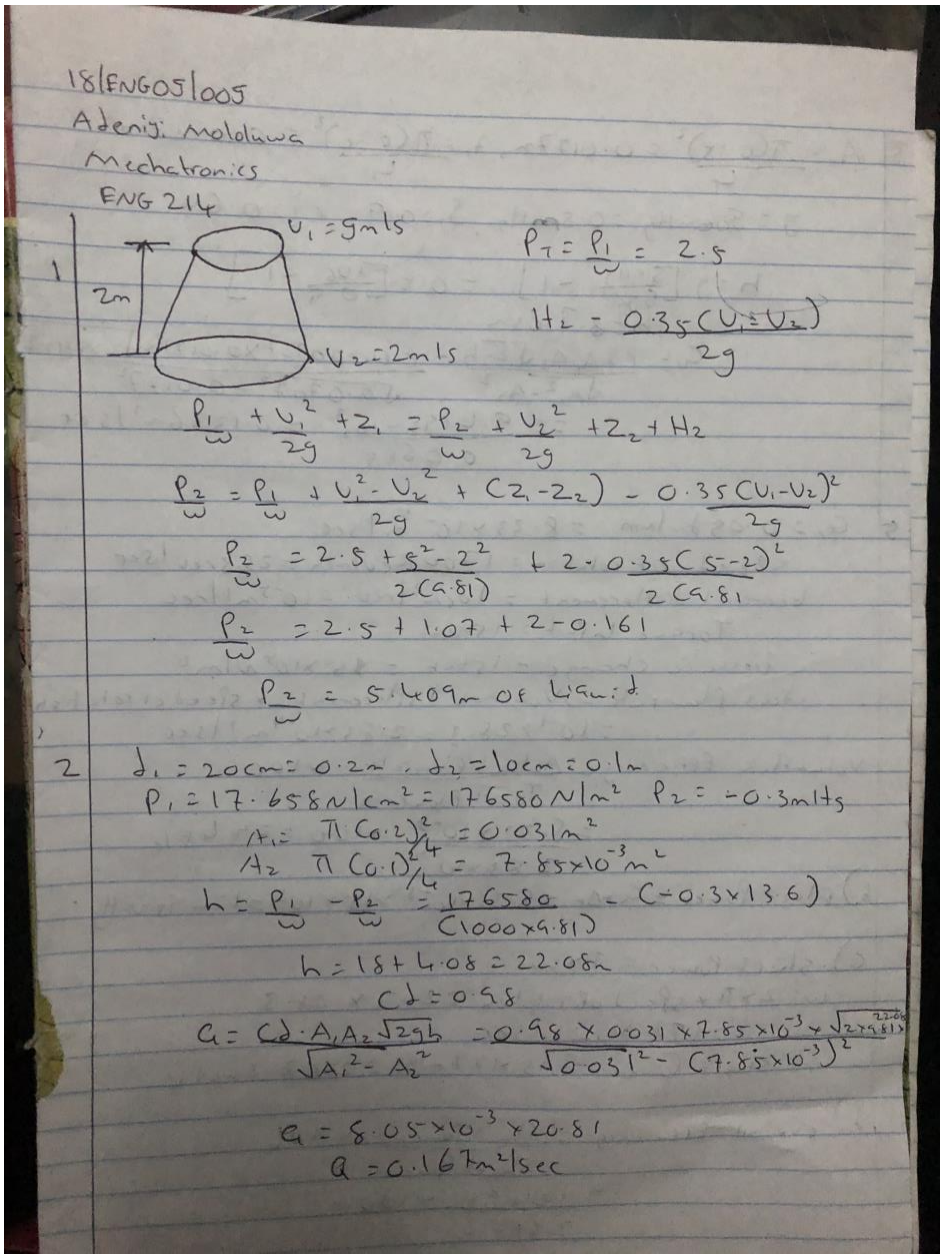
Mololuwa Adeniyi
18/ENG05/005
ENG214



18/ENG05/005
Adeniyi Mololuwa
Mechatronics
ENG 214

1

$P_T = \frac{P_1}{\omega} = 2.5$

$H_2 = \frac{0.35(V_1 - V_2)}{2g}$

$\frac{P_1}{\omega} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + Z_2 + H_2$

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

$\frac{P_2}{\omega} = 2.5 + \frac{5^2 - 2^2}{2(9.81)} + 2 - \frac{0.35(5-2)^2}{2(9.81)}$

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

$\frac{P_2}{\omega} = 5.409m$ of Liquid

2

$d_1 = 20cm = 0.2m$, $d_2 = 10cm = 0.1m$

$P_1 = 17.658N/cm^2 = 176580 N/m^2$ $P_2 = -0.3m/s$

$A_1 = \pi(0.2)^2/4 = 0.031m^2$

$A_2 = \pi(0.1)^2/4 = 7.85 \times 10^{-3} m^2$

$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = \frac{176580}{(1000 \times 9.81)} - (-0.3 \times 13.6)$

$h = 18 + 4.08 = 22.08m$

$Cd = 0.98$

$Q = \frac{Cd \cdot A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}} = \frac{0.98 \times 0.031 \times 7.85 \times 10^{-3} \times \sqrt{2 \times 9.81 \times 22.08}}{\sqrt{0.031^2 - (7.85 \times 10^{-3})^2}}$

$Q = 8.05 \times 10^{-3} \times 20.81$

$Q = 0.167 m^3/sec$

3] $A_0 = \frac{\pi(0.15)^2}{4} = 0.0177m$, $A_1 = \frac{\pi(0.30)^2}{4} = 0.0707m^2$

$y = 500mHg = 0.5mHg$, $S_y = 0.9$ $cd = 0.64$

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

$h = 7.05m$

$Q = \frac{cd A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}} = \frac{0.64 \times 0.0707 \times 0.0177 \times \sqrt{2 \times 9.81 \times 7.05}}{\sqrt{0.0707^2 - 0.0177^2}}$

$= \frac{9.4193 \times 10^{-3}}{0.0685} = 0.1376m^3/sec$

5] $Q_1 = 0.05cm^3/mm = 8.33 \times 10^{-5} m^3/sec$

Speed of rotation = 1700 Rev/min = 28.3 rev/sec

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

Torque Input = 15Nm

Pressure change = 15bar = $15 \times 10^5 N/m^2$

Ideal flow rate = Nominal displacement x speed of rotation

$= 10^{-5} \times 28.3 = 2.83 \times 10^{-4} m^3/sec$

Volumetric Efficiency = $\frac{\text{Actual flowrate}}{\text{Total flowrate}} \times 100$

$= \frac{8.33 \times 10^{-5}}{2.83 \times 10^{-4}} \times 100 = 29.45\%$

6) Fluid Power = $Q \times \Delta P = 8.33 \times 10^{-5} \times 15 \times 10^5 = 124.95Nm/s$

c) Shaft Power = $T \times w$

$w = 2 \times \pi \times$ Speed of rotation $= 2 \times \pi \times 28.3$

$= 177.81 rad/sec$

$\therefore$ Shaft Power $= 15 \times 177.81 = 2667.2$ watts

d) overall Efficiency = $\frac{\text{Fluid Power}}{\text{Shaft Power}} \times 100$

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

$= 4.68\%$