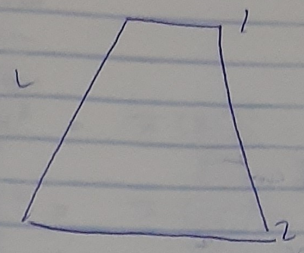
ADEYEMI OLUWATOBI DANIEL 19/ENG06/063 MECHANICAL ENGINEERING

1)



Given

$l = 2.0m$

The velocity flow at smaller end => 5m/s

the velocity flow at 2 => V_2 = 2m/s

Let the loss of head => $H_L = \frac{0.35(V_1 - V_2)^2}{2g}$

$= \frac{0.35(5-2)^2}{2 \times 9.81} = 0.161m$

(P_1) Pressure head at smaller end = 2.5m

(P_L) = ?

Using Bernoulli's equation

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

$P_S = \frac{P_1}{\rho g}$ and ; $P_L = \frac{P_2}{\rho g}$

$Z_1 = 2.0$, and $Z_2 = 0$

$$2.5 + \frac{5^2}{2 \times 9.81} + 2.0 = P_L + \frac{2^2}{2 \times 9.81} + 0 + 0.161$$

$$2.5 + \frac{25}{19.62} + 2 = P_L + \frac{4}{19.62} + 0.161$$

$$2.5 + \frac{25}{19.62} + 2 - \left(\frac{4}{19.62} + 0.161\right) = P_L$$

$5.774 - 0.365 = P_L$

$P_L = 5.409m$

Q2)

Given

$D_1 = 20\,cm$

$D_2 = 10\,cm$

$A_1 = \dfrac{\pi D^2}{4} = \dfrac{\pi (20)^2}{4} = 314.16\,cm^2$

$A_2 = \dfrac{\pi D^2}{4} = \pi \dfrac{(10)^2}{4} = 78.54\,cm^2$

$\rho_w = 1000\,kg/m^3$

P at inlet $= 17.658\,N/cm^2 = 17.658 \times 10^4\,N/m^2$

$\dfrac{P}{\rho g} = \dfrac{17.658 \times 10^4}{1000 \times 9.81} = 18\,m$

$\dfrac{P_2}{\rho g} = -30\,cm\,Hg \times 13.6$

$= -4.08\,m$

Let, $H_d = \dfrac{P_1}{\rho g} - \dfrac{P_2}{\rho g}$

$= 18 - (-4.08)$

$= 18 + 4.08 = 22.08\,m \times 100$

$H_d = 2208\,cm$

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

$$= \frac{0.98 \times \sqrt{2 \times 981 \times 2208} \times 314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}}$$

$= 165455.3\,cm^3/s$

$= \dfrac{165455.3}{1000} = 165.4553\,Lt/sec$

Q3) Given

$D_1 = 30 cm$

$D_2 = 15 cm$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi (30)^2}{4} = 706.86 cm^2$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi (15)^2}{4} = 176.72 cm^2$

So of Oil = 0.9

Sg of Mercury = 13.6

Manometer reading x = 50cm Hg

Cd = 0.64

$h = x\left(\frac{S_{hg}}{S_0} - 1\right)$

$h = 50\left(\frac{13.6}{0.9} - 1\right)$

h = 705.56cm of oil

The rate of flow of oil is given

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

$Q = \frac{0.64 \sqrt{2 \times 9.81 \times 705.56} \times 706.86 \times 176.72}{\sqrt{(706.86)^2 - (176.72)^2}}$

$Q = 137443.29 \ cm^3/s$

$Q = \frac{137443.29}{1000} = 137.4433$ Litr/s

Q4)

Given: x = 170 mm = 0.17m

$S_{hg} = 13.6$

$S_{H_2O} = 1.026$

Speed v = ?

$v = \sqrt{2gh}$, h = ?

$h = x\left(\frac{S_{hg}}{S_{H_2O}} - 1\right) = 0.17\left(\frac{13.6}{1.026} - 1\right)$

h = 2.0534 m

$V = \sqrt{2 \times 9.81 \times 2.0834}$

$V = 6.393$ m/s

$V = \frac{6.393 \times 60^2}{1000}$

$V = 23.01$ km/hr

Q5

Given $Q = 0.05 m^3/min = 50 dm^3/min$

$P_0 = 15$ bar $= 15 \times 100000 = 15 \times 10^5 N/m^2$

$V = 1700$ rev/min

$T = 15$ Nm   ND = 10 cm³/rev

i) volumetric Efficiency = $\frac{\text{Actual flow rate}}{\text{Ideal flow rate}}$

Ideal F.R. = Nominal F.R × V

= 10 cm³/rev × 1700 rev/min

= 17000 cm³/min

Ideal F.R = $\frac{17000}{1000000}$ = 0.017 m³/min

Actual F.R. = 0.55 m³/min

V.E = 0.05/0.017 = 2.94 %

ii) Fluid Power = P × Q

$P = 15 \times 10^5 N/m^2$

$Q = 0.05 m^3/min = 0.05/60 = 8.33 \times 10^{-4}$

$F.P = 15 \times 10^5 \times 8.33 \times 10^{-4}$

F.P = 1249.5 watts

iii) shaft Power = $\frac{2\pi NT}{60} = \frac{2 \times \pi \times 1700 \times 15}{60}$

S.P = 2670.35 watts.

iv) Overall Efficiency = Fluid Power / shaft Power

= 1249.5 / 2670.35

O.E. = 0.468 × 100

= 46.8 %