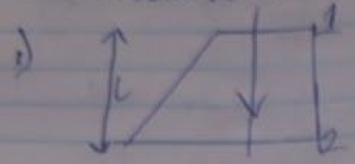
Ogu Kasarachi
18/ENG02/071

Computer

1)



Length $L = 20m$
The velocity flow at smaller end $= V_1 = 5m/s$
The velocity flow at larger end $= V_2 = 2m/s$
Let the pressure head at the smaller end $= P_S = 2.5m$ of liquid

Loss of head $= H_L = \frac{0.35(V_1 - V_2)^2}{2g} = \frac{0.35(5-2)^2}{2 \cdot 9.81} = 0.161$

Pressure head at the lower level $= P_L = ?$

Applying Bernoulli's equation

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

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

$Z_1 = 2.0$ and $Z_2 = 0$ (Datum line passes through section

$$2.5 + \frac{5^2}{2 \times 9.87} + 2.0 = P_L + \frac{2^2}{2 \times 9.87} + 0 + 0.161$$

$$2.5 + \frac{25}{19.62} + 2.0 = P_L + \frac{4}{19.62} + 0.161$$

2.5

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

$P_L = 5.774 - 0.365$

$= 5.407$m of fluid

2) Let inlet diameter $= D_1 = 20$cm

Let threat diameter $= D_2 = 10$cm

Let inlet area $= A_1 = \frac{\pi D_1^2}{4} = \frac{\pi (20)^2}{4} = 314.16\text{cm}^2$

Let throat area $= A_2 = \frac{\pi D_2^2}{4} = \frac{\pi (10^2)}{4} = 78.54\text{cm}^2$

Density of water, $\rho = 1000$ Kg/m³

Pressure of inlet $= 17.658\ \text{N/cm}^2 = 17.658 \times 10^4\ \text{N/m}^2$

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

$\frac{P_2}{\rho g} =$ 30cm of mercury, S.gHg = 13.6

$\frac{P_2}{\rho g} = -30 \times 10^{-2}$m of mercury $\times 13.6$

$= -4.08$m

Let differential head $= H_d = \frac{P_1}{\rho g} - \frac{P_2}{\rho g}$

$= 18 - (-4.08)$

$= 18 + 4.08 = 22.08\text{m} \times 100$

$H_d = 220.8$cm

Using $Q = \frac{cd\sqrt{2gh} \cdot A_1 . A_2}{\sqrt{A_1^2 - A_2^2}}$

$= 0.78 \times \frac{\sqrt{2 \times 981 \times 2208} \times 314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}}$

$= 0.78 \times \frac{2081.37 \times 24674.1264}{304.18411^2}$

$= 165455.3\ cm^3/s$

$= \frac{165455.3}{1000} = 165.455\ lt/sec$

3) Diameter of $d_1 = 30cm$

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi (30)^2}{4} = 1706.86\ cm$

Diameter of orifice, $d_2 = 15cm$

$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi (15)^2}{4} = 176.72cm$

Specific gravity of oil, $so = 0.9$

Specific gravity of mercury, $Shg = 13.6$

Differential manometer reading, $x = 50cm$ of mercury

Coefficient of discharge, $Cd = 0.64$

Differential of head, $h = x \left(\frac{Shg}{So} - 1\right)$

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

$h = 705.56cm$ of oil

∴ The r

$Q =$

$Q = 0$

$Q =$

$Q =$

4) T

h

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06·86 cm²

72cm

cury

∴ The rate of flow of oil is

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

$$Q = \frac{0.64 \times \sqrt{2 \times 981 \times 705.56} \times 706.86 \times 176.72}{\sqrt{(706.86)^2 - (176.72)^2}}$$

$Q = 137443.29\ cm^3/s$

$$Q = \frac{137443.29}{1000} = 137.44\ Ltr/s$$

4) The speed, $V = ?$

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

$$h = x\left[\frac{S_g}{S_0} - 1\right) = 0.17\left(\frac{13.6}{1.026} - 1\right) = 2.0834m$$

$$\therefore V = \sqrt{2 \times 9.81 \times 2.0834} = 6.393\ m/s$$

in Km/hr

$$V = \frac{6.393 \times 60^2}{1000} = 23.01\ Km/hr$$

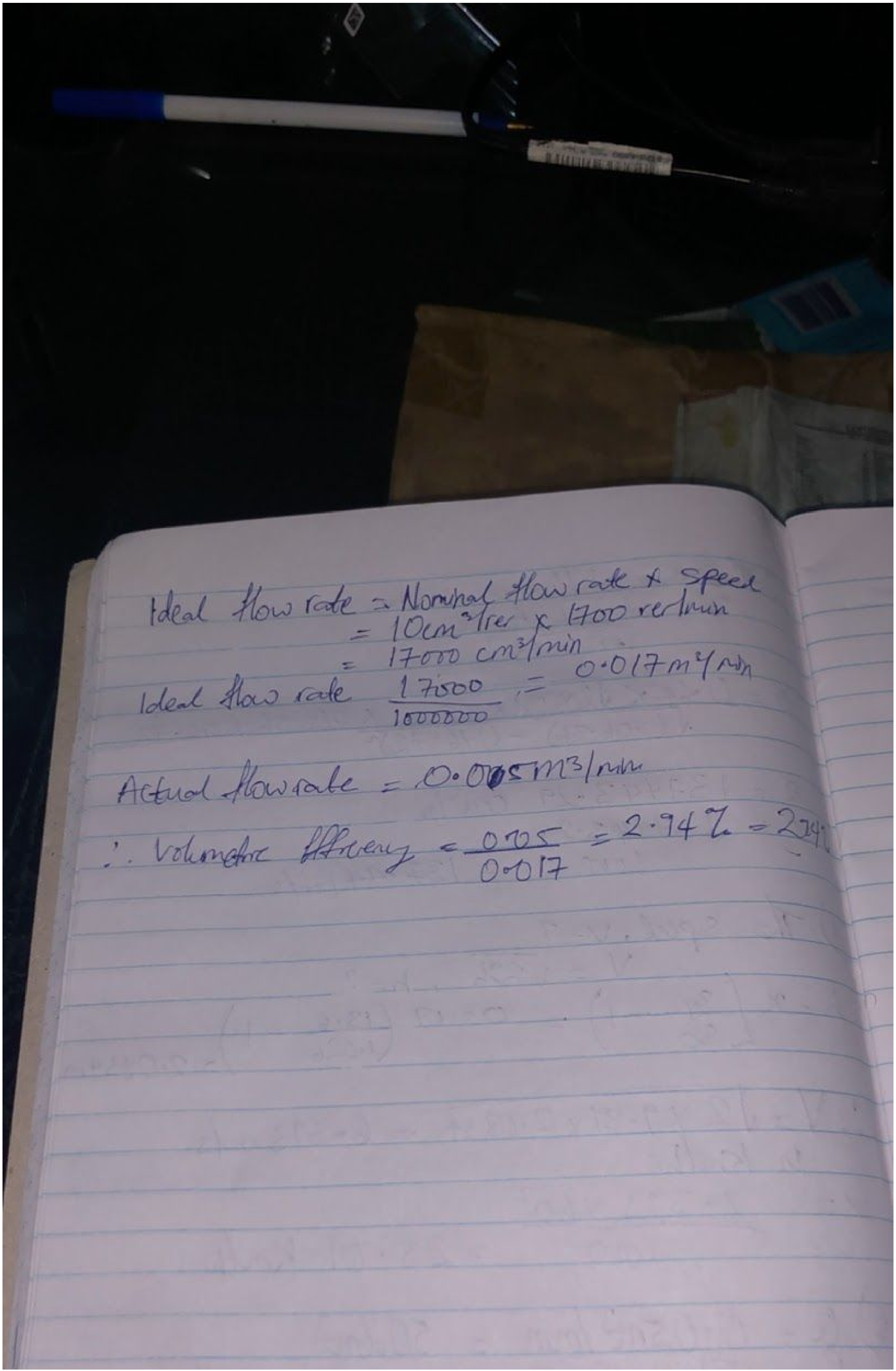
5) $Q = 0.05m^3/min = 50\,dm^3$

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

speed $= 1700\,rev/min$

$T = 15\,Nm$, $ND = 10\,cm^3/rev$

i) $$\text{Volumetric efficiency} = \frac{\text{Actual flow rate}}{\text{Ideal flow rate}}$$



Ideal flow rate = Nominal flow rate × speed

$= 10 \text{ cm}^3/\text{rev} \times 1700 \text{ rev/min}$

$= 17000 \text{ cm}^3/\text{min}$

Ideal flow rate $\dfrac{17000}{1000000} = 0{\cdot}017 \text{ m}^3/\text{min}$

Actual flow rate $= 0{\cdot}005 \text{ m}^3/\text{min}$

$\therefore$ Volumetric efficiency $= \dfrac{0{\cdot}05}{0{\cdot}017} = 2{\cdot}94\% = 2{\cdot}94$