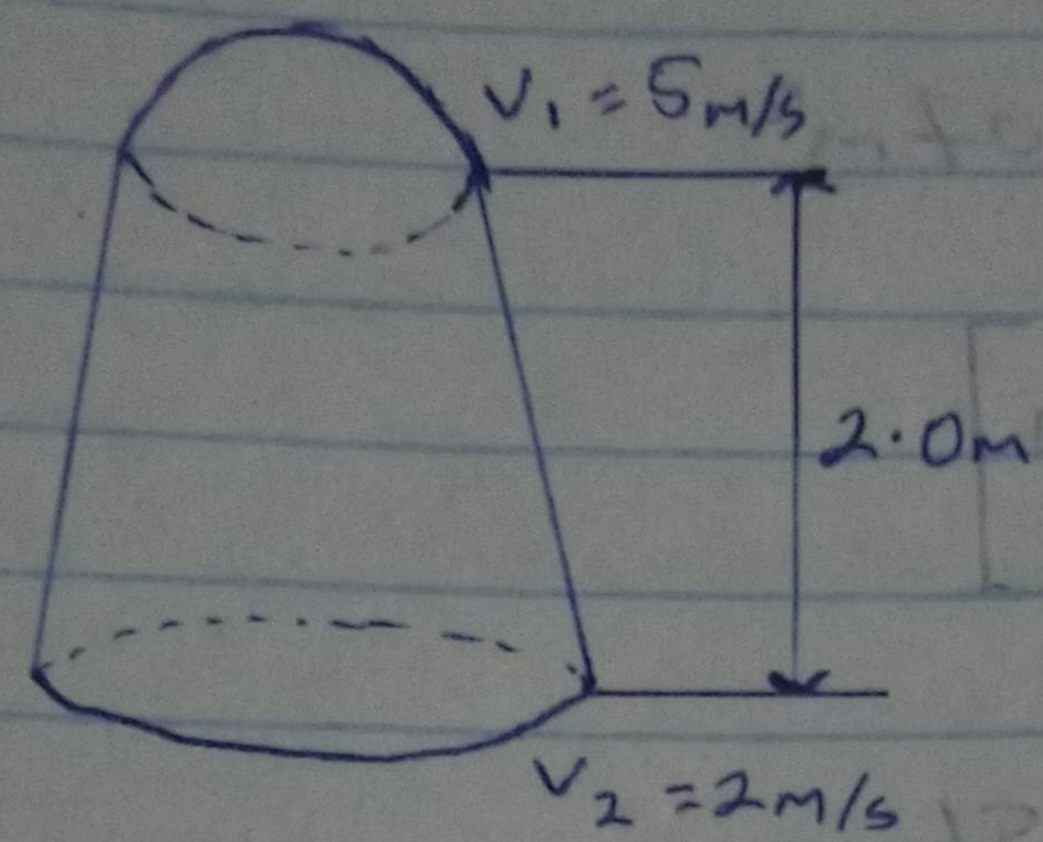
CHIMA WISDOM ENYICHE
18/ENG04/025
Electrical/Electronics engineering
ENG 214

①



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

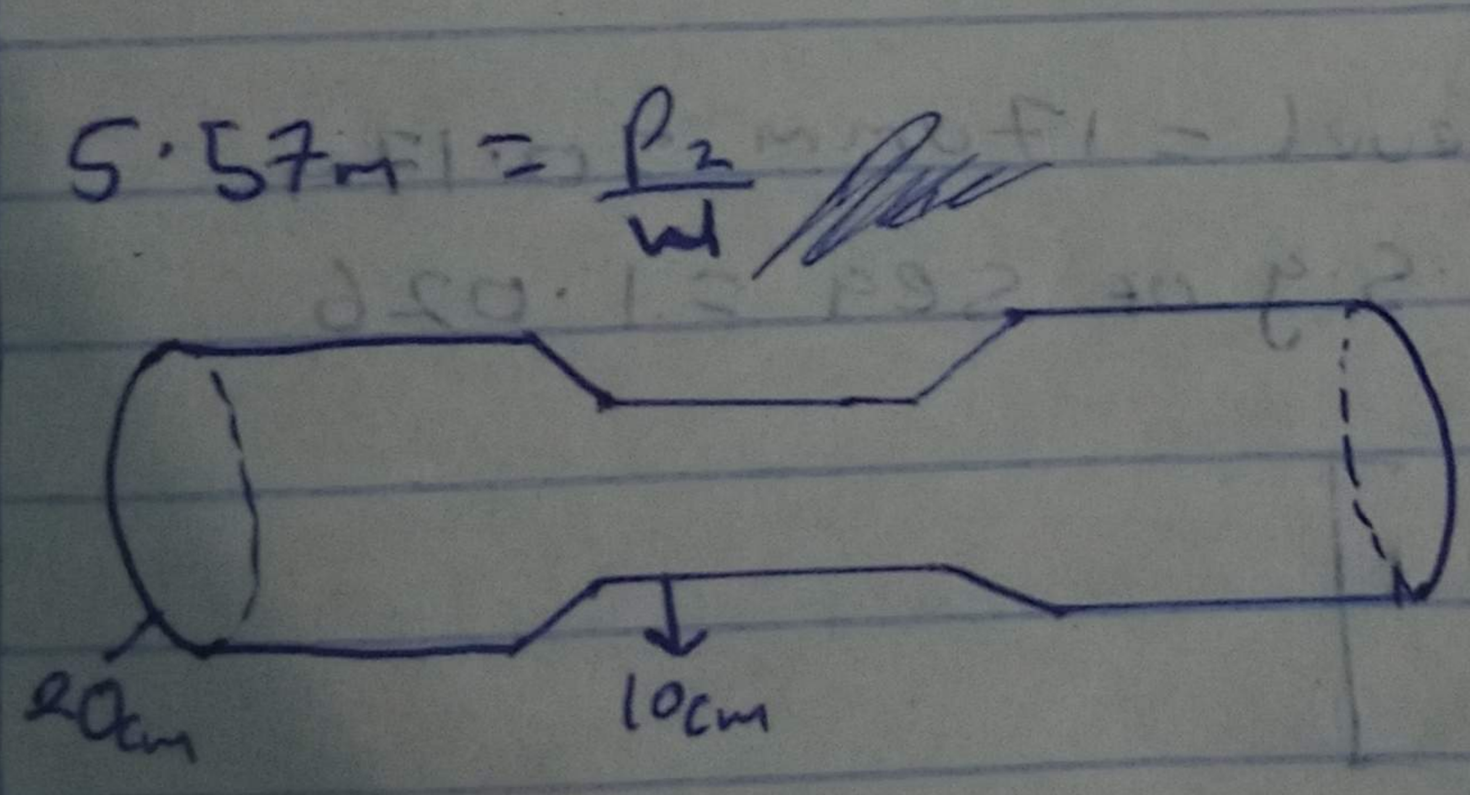
$$2.5 + 2.0 + \frac{5^2}{2\times 9.81} = \frac{P_2}{w} + 0 + \frac{2^2}{2\times 9.81}$$

$$5.774 = \frac{P_2}{w} + \frac{2^2}{2\times 9.81}$$

$$5.774 - 0.204 = \frac{P_2}{w}$$

$$5.57m = \frac{P_2}{w}$$

②



Inlet diameter = 20cm $P_1 = 17.658N$...

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

$$A_1 = \frac{\pi (0.2)^2}{4} = 0.0314 m^2$$

$$A_2 = \pi (0.1)^2 / 4 = 7.854 \times 10^{-3} m^2$$

$$\frac{P_1}{w} = \frac{176580}{1000\times 9.81} = 18$$

$$\frac{P_2}{w} = -0.3 \times 13.6 = -4.08 \text{ m of water}$$

$$h = 18 - (-4.08) = 22.08$$

$$Q = \frac{0.0314 \times (7.854\times 10^{-3}) \times (\sqrt{2\times 9.81 \times 22.08})}{\sqrt{0.0314^2 - (7.854\times 10^{-3})^2}}$$

$$Q = 0.17 \, m^3/s$$

③ Orifice diameter = 15cm = 0.15m S.G of oil = 0.9
Pipe diameter = 30cm = 0.3m Coefficient of discharge = 0.64
y = 50cm = 0.5m

$$A_o = \frac{\pi (0.15)^2}{4} = 0.0177 m^2$$

$$A_1 = \frac{\pi (0.3)^2}{4} = 0.0707 m^2$$

$$h = y\left[\frac{\text{S.G of mecury}}{\text{S.G of oil}} - 1\right]$$

$$h = 0.5\left[\frac{13.6}{0.9} - 1\right] = 7.056$$

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

$$Q = \frac{0.64 \times 0.0177 \times 0.0707 \times \sqrt{2 \times 9.81 \times 7.056}}{\sqrt{0.0707^2 - 0.0177^2}}$$

$$Q = \frac{0.64 \times 0.0177 \times 0.0707 \times 11.766}{0.0685}$$

$$Q = 0.1376 \, m^3/s$$

④ difference of mecury level = 170mm = 0.17m
S.g of mecury = 13.6 , S.g of sea = 1.026

$$h = y\left[\frac{\text{S.G of mecury}}{\text{S.G of sea water}} - 1\right]$$

$$h = 0.17\left[\frac{13.6}{1.026} - 1\right] = 2.083m$$

$$V = c_v \sqrt{2 \times g \times h}$$

$$V = 1\left(\sqrt{2 \times 9.81 \times 2.083}\right)$$

$$V = 6.39 \, m/s$$

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(5) Volumetric flow rate = 0.05 dm^3/min = 8.3333×10^{-5} m/s

pressure change of 15 bar = 1.5×10^6 N/m^2

speed of rotation = 1700 rev/min = 28.333 rev/s

normal displacement = 10 cm^3/rev = 1×10^{-5} m^3/rev

torque input = 15 Nm

(a) Volumetric efficiency = $\frac{\text{Actual flowrate}}{\text{theoretical flowrate}} \times \frac{100}{1}$

theoretical flowrate = speed of rotation × displacement

= $28.333 \times (1 \times 10^{-5})$

= 2.83×10^{-4} m^3/sec

volumetric efficiency = $\frac{8.33 \times 10^{-5}}{2.83 \times 10^{-4}} \times 100$

= 29.45 %

(b) fluid Power = $Q(P_2 - P_1)$

= $8.3333 \times 10^{-5} (1.5 \times 10^6)$

= 124.95 watts

(c) shaft Power = $\Upsilon \times \omega$

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

$\omega = 2 \times \pi \times 28.3$ = 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 %