

$$\therefore 2.5 + \frac{5^2}{2 \times 9.81} + 2.0 = \frac{P_2}{P_g} + \frac{2^2}{2 \times 9.81} + 0 + 0.16$$

$$2.5 + 1.27 + 2.0 = \frac{P_2}{P_g} + 0.204 + 0.16$$

$$5.77 = \frac{P_2}{P_g} + 0.364$$

$$\therefore \frac{P_2}{P_g} = 5.77 - 0.364 = 5.406 \text{ m of liquid}$$

2. ~~Diameter of inlet = $\frac{\pi}{4} \times (20)^2 =$~~

2. $d_{\text{inlet}} = \frac{20\text{cm}}{100} = 0.2\text{m}$

$$a_{\text{inlet}} = \frac{\pi}{4} \times (0.2)^2 = 0.0314\text{m}^2$$

$$d_{\text{throat}} = \frac{10\text{cm}}{100} = 0.1\text{m}$$

$$a_{\text{throat}} = \frac{\pi}{4} \times (0.1)^2 = 7.85 \times 10^{-3}\text{m}^2$$

ρ for water = 1000kgm^{-3}

$$P_1 = 17.658\text{N/cm}^2 = 17.658 \times 10^4\text{N/m}^2$$

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

$$\frac{P_2}{\rho g} = -30\text{cm of mercury}$$

$$= -0.3\text{m of mercury}$$

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

$$\therefore \text{Differential head}(h) = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 18 + 4.08$$

$$= 22.08\text{m of water}$$

Using discharge equation

$$Q = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

~~$$= 0.98 \times \frac{0.314 \times 7.85 \times 10^{-3}}{\sqrt{0.314^2 - (7.85 \times 10^{-3})^2}}$$~~

$$= 0.98 \times \frac{0.0314 \times 7.85 \times 10^{-3}}{\sqrt{0.0314^2 - (7.85 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 22.08}$$

~~$$= 0.98 \times 8.107 \times 20.81$$

$$= 165.333 \text{ m}^3/\text{s} = 165.333 \text{ lit/s}$$~~

$$= 0.98 \times 8.107 \times 10^{-3} \times 20.81$$

$$= 0.1653 \text{ m}^3/\text{s} = 165.3 \text{ lit/s}$$

3. $A_{\text{orifice}} = \frac{\pi \times (15)^2}{4} = 176.714 \text{ cm}^2$ (A_0 area of orifice)

$$A_{\text{pipe}} = \frac{\pi \times (30)^2}{4} = 706.858 \text{ cm}^2 \text{ (} A_p \text{ area of pipe)}$$

$$\text{differential head (h)} = \left[\frac{13.6}{0.9} - 1 \right] \times 50 \text{ cm of oil}$$
$$= 705.556 \text{ cm of oil}$$

$$Q = C_d \times \frac{A_0 A_p}{\sqrt{A_p^2 - A_0^2}} \times \sqrt{2gh}$$

$$= 0.64 \times \frac{176.714 \times 706.858}{\sqrt{706.858^2 - 176.714^2}} \times \sqrt{2 \times 9.81 \times 705.556}$$

$$= 0.64 \times 182.5094 \times 117.656$$

$$= 13742.96 \text{ cm}^3/\text{sec}$$

$$= 13.74296 \text{ lits/sec}$$

4. Difference of mercury level $x = 170 \text{ mm} = 0.17 \text{ m}$

Sp. gr. of mercury $S_g = 13.6$

Sp. gr. of sea-water $S_{sw} = 1.026$

$$\therefore h = x \left[\frac{S_g}{S_{sw}} - 1 \right] = 0.17 \left[\frac{13.6}{1.026} - 1 \right] = 2.0834 \text{ m}$$

Using $V = \sqrt{2gh}$

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

Converting to km/hr

$$\frac{6.393 \times 60 \times 60}{1000} = 23 \text{ km/hr}$$

5.

Volumetric flow rate

Changing from dm^3/min to m^3/min

$$10 \text{ dm} = 1 \text{ m}$$

$$\therefore 10^3 \text{ dm}^3 = 1 \text{ m}^3$$

$$1000 \text{ dm}^3 = 1 \text{ m}^3$$

$$5 \text{ dm}^3 = ?$$

$$? = \frac{5}{1000} = 0.005$$

$$\therefore \text{Volumetric flow rate} = \frac{0.005 \text{ m}^3}{\text{min}} = 0.005 \text{ m}^3/\text{min}$$

$$\text{Actual flow rate} = \frac{0.005}{60} = 8.33 \times 10^{-5} \text{ m}^3/\text{sec}$$

Speed = 1700 rpm

changing to rps

$$\frac{1700}{60} = 28.33 \text{ rev/sec}$$

$$\Delta P = 15 \text{ bar} \equiv 15 \times 10^5 \text{ N/m}^2$$

Nominal displacement = $10 \text{ cm}^3/\text{rev}$

Note that $100 \text{ cm}^3 = 1 \text{ m}^3$

$$10 \text{ cm}^3 = x$$

$$x = \frac{10}{100} = 1 \times 10^{-5} \text{ m}^3/\text{rev}$$

\therefore Ideal flow rate = Nominal Displacement \times Speed

$$= 28.33 \times 1 \times 10^{-5} \\ = 2.833 \times 10^{-4}$$

$$\begin{aligned}
 \text{a) Volume Efficiency} &= \frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\% \\
 &= \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100 \\
 &= 29.4\%
 \end{aligned}$$

$$\begin{aligned}
 \text{b) Fluid Power} &= Q \cdot \Delta P \\
 &= 8.33 \times 10^{-5} \times 15 \times 10^5 \\
 &= 124.95 \text{ Nm lsec}
 \end{aligned}$$

$$\text{c) Shaft Power} = T \cdot \omega$$

$$T = 15 \text{ Nm}$$

$$\omega = 2 \times \frac{22}{7} \times 28.33 = 178.07 \text{ rad/sec}$$

$$\therefore \text{Shaft Power} = 15 \times 178.07 = 2671.05 \text{ watts}$$

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

$$= \frac{124.95}{2671.05} \times 100 = 4.67\%$$

CHIOKE VICTOR U.P.

18/ENGG02/031

COMPUTER ENGINEERING

ENGG 214 ASSIGNMENT SOLUTION

1. Let smaller end be represented by (1) and lower end by (2)

Given parameters

$$L = 2.0 \text{ m}$$

$$V_1 = 5 \text{ m/s}$$

$$r_1/r_2 = 2.5 \text{ m of liquid}$$

$$V_2 = 2 \text{ m/s}$$

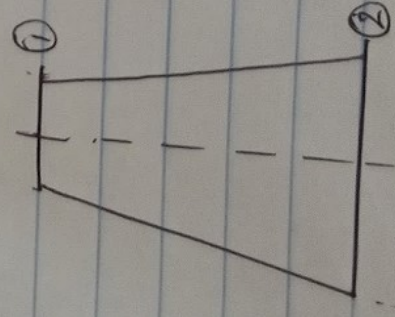
$$P_2/r_2 = ?$$

$$\text{Loss of head } (h_L) = \frac{0.35(v_1 - v_2)^2}{2g}$$

$$h_L = \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16 \text{ m}$$

Using bernoulli's equation

$$\frac{P_1}{\rho g} + \frac{v_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{v_2^2}{2g} + z_2 + h_L$$



Letting the line pass through the section, Then $z_1 = 2.0$, $z_2 = 0$