Alani Abdulsalam Alibola
18/ENG031010
Civil Engineering

1.) Ideal flow rate = normal displacement x Speed
$= 10 \times 1500 = 15 dm^3/mm$

i) Volumetric Efficiency = $\frac{\text{Actual flow}}{\text{Ideal flow}} = \frac{10}{15}$
$= 0.67 = 67\%$

ii) fluid power = $\Delta P Q$
$\Delta P = 12 \times 10^5 = 1200{,}000$
$Q = \frac{10 \times 10^{-3}}{60} = 1.67 \times 10^{-4}$
$= \Delta P Q = 200.4$ watts

iii) Shaft power $= \frac{2\pi N T}{60} = 2\pi T \times 1500 \times 12.5$
$= 1964.3 Nm$

iv) Overall efficiency = $\frac{\text{fluid power}}{\text{Shaft power}}$
$= \frac{200.4}{1964.3}$
$= 0.102 = 10.2\%$

2.) $87\% = F.P/S.P$
Fluid power = $\Delta P Q$
$P = 100 \times 10^3 N/m^2$
$Q = 35 \times 10^{-3} = 5.83 \times 10^{-4}$
$= 5833.5$ watts
$87\% = \frac{5833.3}{x}$
$0.87 = \frac{5833.3}{x}$

$$x = \frac{5 \times 33.3}{0.87}$$

$= 6705 Nm$

3) Ideal flow rate

= normal displacement × speed

$= 50 \times 850 = 42.5\ dm^3/mn$

Volumetric Efficiency $= \frac{\text{Actual flow}}{\text{Ideal flow}} = \frac{35}{42.5}$

$= 0.82 = 82\%$

fluid power $= \Delta P Q$

$\Delta P = 100 \times 10^3$

$Q = \frac{50 \times 10^{-3}}{60} = 8.3 \times 10^{-4}$

$\Delta PQ = 8300$

Shaft = 15 kwatts = 15000

Overall efficiency $= \frac{\text{fluid power}}{\text{shaft power}}$

$= \frac{8,300}{15000} = 0.553 = 55.3\%$

6 $h = 20\ m$

$d = 10cm = 0.1\ m$

$A = \frac{\pi}{4} d^2 = 0.7854$

$v_f = 0$

$w = ?$

$v_f^2 = v_1^2 - 2gh$

$v_1 = \sqrt{v_f^2 + 2gh}$

$v_1 = \sqrt{0^2 + 2(9.8 m/s^2)(20m)} = 19.80 m/s$

The flow rate is equal to the speed through the area

$Q = VA = (19.80 m/s)(7.854 \times 10^{-3} m^2) = 0.155 m^3/s$

$W = \rho g Q h$

$= (1000) \times (9.8) \times (0.155) \times (20)$

$= 30478 kg m^2/s^3$

$= 30 \times 10^3 W$

7 $\rho_1 g = 19.62 N/m^2$

$C_d = 0.96$

$d_1 = 0.3 m$

$d_2 = 0.2 m$

$u_1 = a_1 0.0707 \quad v_2 = a_1 0.0314$

$P_1 + \rho_1 g_2 = P_2 + \rho_2 g (z_2 + z_1) + \rho_w g a_1$

$P_1 - P_2 = 19.62(22 - 21) + 587.423$ --- a_1

for the venturimeter

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

$P_1 - P_2 = 19.62(22 - 21) + 0.803 v_a^2$

--- Q_2

Combine Q_1 and Q_2

$0.803 v_2^2 = 587.423$

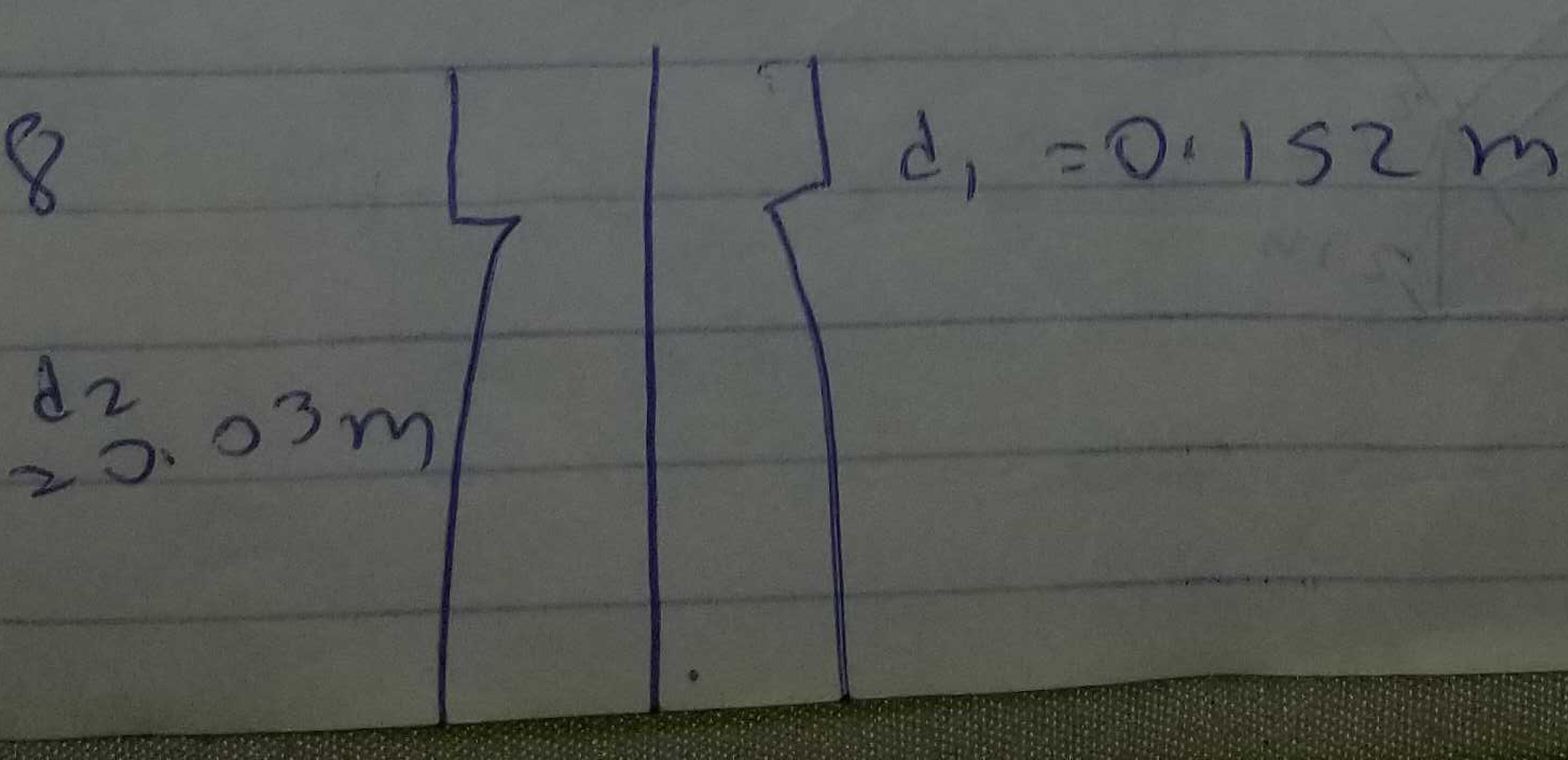
u_2 ideal $= 27.047 m/s$

Q ideal $= 27.047 \times \pi \left(\frac{0.2}{2}\right)^2$

$= 0.85 m^3/s$

$Q = C_d Q$ ideal $= 0.96 \times 0.85 = 0.816 m^3/s$

8



$d_1 = 0.152\ m$

$d_2 = 0.076\ m$

$\rho = 800 kg/m^3$

$C_d = 0.97$

Apply Bernoulli method

$$\frac{P_1}{\rho g} + \frac{u^2}{2g} + z_1 = \frac{P^2}{\rho g} + \frac{u_2^2}{2g} + z_2$$

a) $P_1 = P_2$

$$\frac{u_1^2}{2g} + z_1 = \frac{v_2^2}{2g} + z_2$$

$Q = v_1 A_1 = u_2 A_2$

$V_2 = V_1 \frac{A_1}{A_2} = u_1 4$

$$V_1 = \sqrt{\frac{0.914 \times 2 \times 9.81}{15}}$$

$= 1.0934\ m/s$

$q = C_d A_1 V_1$

$Q = 0.96 \times 0.1814 \times 1.0934$

$= 0.019\ m^3/s$

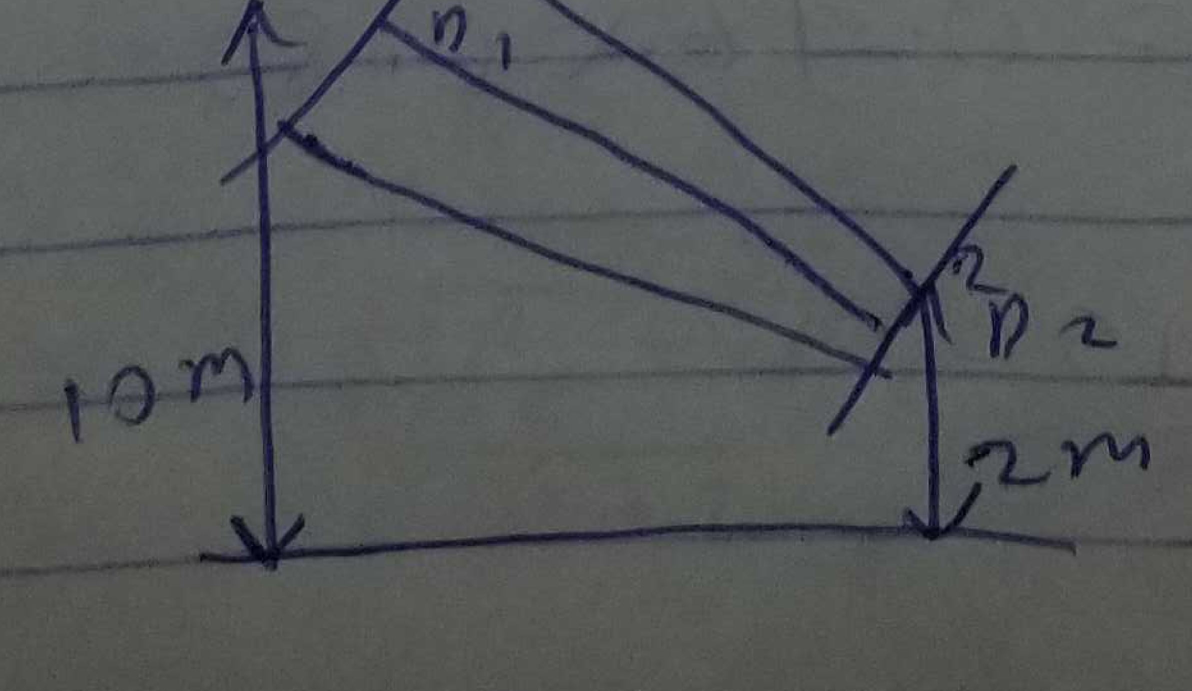
$P_1 - P_2 = 15170$

$$\frac{P_1 - P_2}{\rho g} = v_2^2 - u_1^2 = -0.914$$

$$\frac{15170}{\rho g} = Q_2 \frac{(~~220.243^2~~ - 55.11^2)}{2g} - 0.914$$

$Q = 0.035\ m^3/s$

q



At Section 1

$D_1 = 0.3\,m$

$A = \frac{\pi (0.3)^2}{4} = 0.707\,m^2$

$Z_1 = 10\,m$

$V_1 = ?$

$P_1 = 400 \times 10^3\,N/m^2$

At Section 2

$D_2 = 0.15\,m$

$Area = \frac{\pi \times (0.13)^2}{4} = 0.1767\,m^2$

$Z_2 = 6\,m$

$V_2 = ?$

$P_2 = ?$

$A_1 V_1 = A_2 V_2 = 40\,m/s = 40 \times 10^{-3}\,m/sec$

$V_1 = \frac{40 \times 10^{-3}}{0.707}$

$= 0.566\,m/s$

$V_2 = \frac{40 \times 10^{-3}}{0.01761}$

$= 2.264\,m/s$

Apply Bernoules method

$\frac{400 \times 10^3}{9800} + \frac{(0.556)^2}{2 \times 9.8} + 10 = \frac{P_2}{W} + \frac{(1.276)^2}{2 \times 9.8} + 6$

$P_2 = 436.8\,KN/m^2$

10. Reading of the manometer = 170 mm
Specific gravity of mecury S_{h_1} = 13.6
Specific gravity of water S_1 = 1.020

$$h = y\left[\frac{S_{h_1}}{S_1} - 1\right]$$

$$h = 0.17\left[\frac{13.6}{1.020} - 1\right]$$

$h = 2.083$

Velocity of submarine

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

$h = 2.083$

Velocity of Submarine

$$V = \sqrt{2gh}$$

$$= \sqrt{2 \times 9.81 \times 2.083}$$

$= 6.39$ m/s