

Name: Alanza Ijesma Shalom  
18/SCIO11016

Computer Engineering

$$\begin{aligned}\text{Ideal flow rate} &= \text{normal displacement} \times \text{Speed} \\ &= 10 \times 1500 = 15 \text{ dm}^3/\text{min}\end{aligned}$$

$$\begin{aligned}\text{a. Volumetric efficiency} &= \frac{\text{Actual flow}}{\text{Ideal flow}} = \frac{10}{15} \\ &= 0.67 = 67\%\end{aligned}$$

$$\text{b. fluid Power} = \Delta P Q$$

$$\begin{aligned}\Delta P &= 1.2 \times 10^5 = 120000 \\ Q &= \frac{10 \times 10^{-3}}{60} = 1.67 \times 10^{-4}\end{aligned}$$

$$= \Delta P Q = 200.4 \text{ Watts}$$

$$\begin{aligned}\text{c. Shaft Power} &= \frac{2\pi NT}{60} = \frac{2\pi \times 1500 \times 12.5}{60} \\ &= 1964.3 \text{ Nm}\end{aligned}$$

$$\text{d) Overall Efficiency} = \frac{\text{fluid Power}}{\text{Shaft Power}}$$

$$\begin{aligned}&= \frac{200.4}{1964.3} \\ &= 0.102 = 10.2\%\end{aligned}$$

$$2. \quad 87\% = \text{F.P} / \text{S.P}$$

$$\text{Fluid Power} = \Delta P Q$$

$$P = 100 \times 10^5 \text{ N/m}^2$$

$$Q = \frac{3.5 \times 10^{-3}}{60} = 5.83 \times 10^{-4}$$

$$= 5833.5 \text{ Watts}$$

$$87\% = \frac{5833.3}{x}$$

$$0.87 = \frac{5833.3}{x}$$

$$\tau = \frac{58.33 \times 3}{0.87} \\ = 6705 \text{ Nm}$$

3. Ideal flow rate = Normal displacement  $\times$  speed  
 $= 50 \times 950 = 42.5 \text{ dm}^3/\text{min}$

$$\text{Volumetric efficiency} = \frac{\text{Actual flow}}{\text{ideal flow}} = \frac{35}{42.5} \\ = 0.82 \\ = 82\%$$

b. fluid power =  $\Delta P Q$   
 $\Delta P = 100 \times 10^3$   
 $Q = \frac{50 \times 10^{-3}}{60} = 8.3 \times 10^{-4}$   
 $\Delta P Q = 8300$

$$\text{Shaft} = 15 \text{ kWatt} = 15000 \text{ W}$$

$$\text{Overall efficiency} = \frac{\text{fluid Power}}{\text{Shaft Power}} \\ = \frac{8300}{15000} = 0.553 \\ = 55.3\%$$

6.  $h = 20 \text{ m}$   
 $d = 10 \text{ cm} = 0.1 \text{ m}$   
 $A = \frac{\pi d^2}{4} = 0.7854$

$$V_f = 0$$

$$W = ?$$

$$V_f^2 = V_i^2 - 2gh$$

$$V_i = \sqrt{V_f^2 + 2gh}$$

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

The flow rate is equal to the speed through the area

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

$$W = \rho g Q h$$

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

$$= 30478 \text{ kgm}^2/\text{s}^2$$

$$= 30 \times 10^3 \text{ W}$$

$$7. \quad P_1 = 19.62 \text{ N/m}^2$$

$$C_d = 0.96$$

$$d_1 = 0.3 \text{ m}$$

$$d_2 = 0.2 \text{ m}$$

$$u_1 = 0.0707$$

$$u_2 = 0.0314$$

$$P_1 + \rho g z_1 = P_2 + \rho g (z_2 + P_1 r) + \rho g h_1$$

$$P_1 - P_2 = 19.62(z_2 - z_1) + 587.423 \quad \dots \dots Q_1$$

For the venturimeter

$$\frac{P_1}{\rho g} + \frac{u_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{u_2^2}{2g} + z_2$$

$$P_1 - P_2 = 19.62(z_2 - z_1) + 0.803 u_2^2 \quad \dots \dots Q_2$$

Combine  $Q_1$  and  $Q_2$

$$0.803 u_2^2 = 587.423$$

$$u_2^2 = 27.047 \text{ m/s}$$

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

$$= 0.85 \text{ m}^3/\text{s}$$

$$Q = C_d Q_{\text{ideal}} = 0.96 \times 0.85 = 0.816 \text{ m}^3/\text{s}$$

$$8. \quad d_1 = 0.152 \text{ m}$$

$$A_1 = 0.01814 \text{ m}^2$$

$$d_2 = 0.076 \text{ m}$$

$$A_2 = 0.00454 \text{ m}^2$$

$$\rho = 800 \text{ kg/m}^3$$

$$C_d = 0.97$$

Applying Bernoulli method

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z_2$$

a.  $P_1 = P_2$

$$\frac{V_1^2}{2g} + z_1 = \frac{V_2^2}{2g} + z_2$$

$$Q = V_1 A_1 = V_2 A_2$$

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

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

$$= 1.0934 \text{ m/s}$$

$$Q = C_d A_1 V_1$$

$$Q = 0.96 \times 0.018101 \times 1.0934$$
$$= 0.019 \text{ m}^3/\text{s}$$

b.  $P_1 - P_2 = 15170$

$$\frac{P_1 - P_2}{\rho g} = \frac{V_2^2}{2g} - \frac{V_1^2}{2g} - 0.914$$

$$\frac{15170}{\rho g} = \frac{Q^2}{2g} (220.43^2 - 55.11^2) - 0.914$$

$$Q = 0.035 \text{ m}^3/\text{s}$$

9. At section 1

$$D_1 = 0.3 \text{ m}$$

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

$$z_1 = 10 \text{ m}$$

$$P_1 = 400 \times 10^3 \text{ N/m}^2$$

$$V_1 = ?$$



At section 2

$$D_2 = 0.15 \text{ m}$$

$$\text{Area} = \frac{\pi \times (0.15)^2}{4} = 0.01767 \text{ m}^2$$

$$Z_2 = 6 \text{ m}$$

$$V_2 = ?$$

$$P_2 = ?$$

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

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

$$= 0.566 \text{ m/s}$$

$$V_2 = \frac{40 \times 10^{-3}}{0.01767}$$

$$= 2.274 \text{ m/s}$$

Applying Bernoulli's theorem.

$$\frac{400 \times 10^3}{9800} + \frac{(0.566)^2}{2 \times 9.8} + 10 = \frac{P_2}{\rho} + \frac{(2.274)^2}{2 \times 9.8} + 6$$

$$P_2 = 436.8 \text{ kN/m}^2$$

10. Reading of the manometer = 170 mm

S.g. of mercury  $S_m = 13.6$

S.g. of water  $S_1 = 1.026$

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

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

$$h = 2.083$$

velocity of submarine

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

$$= \sqrt{2 \times 9.81 \times 2.083} = 6.39 \text{ m/s}$$