[illegible]

Hameed [illegible]

18/ENG06/025

MECHANICAL ENG

(i) Flow rate = [illegible] displacement × speed

$10 \times 1500 = 15m^3/min$

(ii) Volumetric efficiency = actual flow / ideal flow $= \frac{10}{15}$

$= 0.67 = 67\%$

(i) Fluid Power = $\Delta P Q$

$\Delta P = 12 \times 10^5 = 1200000$

$Q = \frac{10 \times 10^{-3}}{60} = 1.67 \times 10^{-4}$

$= \Delta P Q = 200.4$ watts

(ii) Shaft Power $= \frac{2\pi NT}{60} = 2\pi \times 1500 \times 12.5$

$=$ [illegible]

(iii) Overall efficiency = Fluid Power / Shaft Power $= \frac{200.4}{1964.5} = 0.102$

$= 10.2\%$

(2) $87\% = F.P/S.P$

Fluid Power $= \Delta P Q$

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

$Q = 35 \times 10^{-3} = 5.83 \times 10^{-4}$

$= 58333$ watts

$87\% = \frac{58333}{x}$

$0.87 = \frac{58333.3}{x}$

$x = \frac{58333.3}{0.87}$

$= 67050 W$

(3) Ideal flow rate = actual displacement x speed

$50 \times 850 = 42.5\,dm^3/min$

volumetric efficiency = $\frac{\text{Actual flow}}{\text{Ideal flow}} = \frac{35}{42.5}$

$0.82 = 82\%$

Fluid Power = ΔPQ

$\Delta P = 10 \times 10^5$

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

$\Delta PQ = 8300$

Shaft = 15 kwatt = 15000

Overall Efficiency = $\frac{\text{Fluid Power}}{\text{Shaft Power}}$

$\frac{8300}{15000} = 0.553 = 55.3\%$

(4)

(1) $h = 20m$

$d = 10cm = 0.1m$

$A = \frac{\pi}{4} d^2 = 0.7857$

$v_f = 0$

$w = P$

$v_f^2 = v_i^2 - 2gh$

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

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

The flow rate through the area

$Q = vA = (19.80m/s)(7.854 \times 10^{-5} m^2) = 0.155 m^3/s$

$w = \rho g Q h$

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

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

$= 30 \times 10^3 W$

(2) $\rho g = 19.62 N/m^2$

$Cd = 0.96$

$d_1 = 0.3m$

$d_2 = 0.2m$

$U_1 = 0.0707 \qquad U_2 = 9.10314$

$P_1 + \rho_1 g x_2 = P_2 + \rho_2 g (z_2 - h_1) + \rho_w g x_1$

$P_1 - P_2 = 19.62(z_2 - z_1) + 587.423$

For the venturimeter

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

$P_1 - P_2 = 19.62(z_2 - z_1) + 0.803 v_2^2 \quad \cdots Q_2$

Combine Q_1 and Q_2

$0.8 \cdot 03 v_2^2 = 587.433$

v_2^2 ... $= 27.047$ m/s

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

$= 0.85 \, m^3/s$

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

(6)

d_2 $\quad d_1 = 0.152m$

$d_1 = 0.152m \quad A_1 = 0.018\,m$

$d_2 = 0.076m \quad A_2 = 0.0045\,m$

$\rho = 800 kg/m^3$

$C_d = 0.97$

Apply Bernoulli method

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

(1) $P_1 = P_2$

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

$Q = v_1 A_1 = v_2 A_2$

$v_2 = v_1 \frac{A_1}{A_2} =$ ~~0.014~~ 0.914

$$v_1 = \sqrt{\frac{0.014 \times 2 \times 9.81}{15}}$$

$= 1.0734$ m/s

$q = C_d A_1 v_1$

$q = 0.96 \times 0.0814 \times 1.07$

$= 0.0182 \, m^3/s$

$P_1 - P_2 = 15170$

$\frac{P_1 - P_2}{\rho g} = \frac{v_2^2 - v_1^2}{2g} = 0.914$

$\frac{15170}{\rho g} = Q^2 \frac{(222.4^2 - 55.1^2)}{2g} = 0.914$

$Q = 0.0283\ m^3/s$

(9)

At section 1

$D_1 = 0.3m$

$A = \frac{\pi}{4}(0.3)^2 = 0.702m^2$

$z_1 = 10m$

$v_1 = ?$

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

At section 2

$D_2 = 0.15m$

$Area = \frac{\pi \times (0.15)^2}{4} = 0.1767\ m^2$

$v_2 = ?$

$P_2 = ?$

$A_1 v_1 = A_2 v_2 = 40\ C\cdot N/sec = 40 \times 10^{-3}\ m/sec$

$v_1 = \frac{40 \times 10^{-3}}{0.707}$

$= 0.366\ m/s$

$v_2 = \frac{40 \times 10^{-3}}{0.01767}$

$= 2.264\ m/s$

Apply Bernoulli method

$$\frac{400\times10^3}{9800} + \frac{(0.536)^2}{2\times9.8} + 10 = \frac{P_2}{N} + \frac{(1.274)^2}{2\times9.8} + 6$$

$P_2 = 436.8\ kN/m^2$

(c) Reading of manometer = 170 mm
Specific gravity of mercury $S_h = 13.6$
Specific gravity of water $S_1 = 1.026$

$$h = y\left(\frac{S_h}{S_1} - 1\right]$$

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

$h = 2.083$

velocity of submarin

$V = \sqrt{2gh}$

$= \sqrt{2\times9.81\times2.083}$

$= 6.39\ m/s$