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1) Ideal flow rate = nominal displacement x Speed
10 x 1500 = 15dm³/min

(i) Volumetric efficiency = $\frac{\text{Actual flow}}{\text{Idea flow}} = \frac{10}{15}$
= 0.67 = 67%

(ii) Fluid Power = ΔPQ
$\Delta P = 12 \times 10^5 = 1200000$
$Q = \frac{10 \times 10^{-3}}{60} = 1.67 \times 10^{-4}$

= ΔPQ = 200.4 watts

(iii) Shaft Power = $\frac{2\pi NT}{60} = 2 \times \pi \times 1500 \times 12.5$
= 1964.3Nm

(iv) Overall efficiency = $\frac{\text{Fluid Power}}{\text{Shaft Power}}$
$= \frac{200.4}{1964.3}$
= 0.102 = 10.2%

2) $87\% = \frac{F.P}{S.P}$

Fluid Power = ΔPQ
$P = 100 \times 10^5 \text{ Nm}^2$
$Q = 35 \times 10^{-3} = 5.83 \times 10^{-4}$
= 5833.3 Watts

$87\% = \frac{5833.3}{x}$
$0.87 = \frac{5833.3}{x}$

$x = \frac{5833.3}{0.87} = 6705 \text{ Nm}$

3) Idea flow rate = normal displacement x Speed
= 50 x 850 = 42.5dm³/mm

6 $h = 20m$

$d = 10cm = 0.1m$

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

$\omega = ?$

$V_2^2 = V_1^2 - 2gh$

$V_1 = \sqrt{V_2^2 + 2gh}$

$V_1 = \sqrt{0^2 + 2(9.81)(20)}$

$= 19.8 m/s$

The flow rate is equal to the speed through the area

$Q = VA = (19.8)(7854 \times 10^{-5})$

$= 0.155 m^3/s$

$W = \rho g Q h$

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

$= 30478 kgm^2/s^2$

$= 30 \times 10^3 W$

7 $P_1 g = 19.62 N/m^2$

$C_d = 0.96$

$d_1 = 0.3m$

$d_2 = 0.2m$

~~$U_1 = 0.0$~~ $U_1 = Q_1 0.0707$

$U_2 = Q_1 0.0314$

$P_1 + \rho_g g z = P_2 + P_1 g(Z_2 - R_f) + \rho_w g R_f$

$P_1 - P_2 = 19.62(Z_2 - Z_1) + 587.423 - Q_1$

For the Venturimeter

$\frac{P_1}{\rho_g g} + \frac{U_1^2}{2g} + Z_1 = \frac{P_2}{\rho_g g} + \frac{U_2^2}{2g} + Z_2$

$P_1 - P_2 = 1962(Z_2 - Z_1) + 0.808 U_2^2 \cdots Q_2$

Combine Q_1 and Q_2

$0.803 U_2^2 = 587.423$

$U^2_{ideal} = 27.047 m/s$

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

$= 0.85 m^3/s$

$Q = C_d \, Q_{ideal} = 0.96 \times 0.85 =$

$0.86 m^3/s$

8) $d_1 = 0.152m$ — $d_1 = 0.152m$, $d_2 = 0.06m$ (given) — $A_1 = 0.0184m$, $A_2 = 0.0028m$

$\rho = 800 kg/m^3$

$Q = 0.97$

Apply Bernoulli method

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

(a) $P_1 = P_2$

$\frac{V_1^2}{2g} + Z_1 = \frac{U_2^2}{2g} + Z_2$

$Q = V_1 A_1 = V_2 A_2$

$V_2 = \frac{V_1 A_1}{A_2} = 0.4$

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

$= 1.0934 m/s$

$Q = C_d A_1 V_1$

$Q = 0.96 \times 0.01814 \times 1.0934$

$= 0.019 m^3/s$

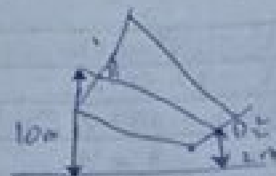
$P_1 - P_2 = 15170$

$\frac{P_1 - P_2}{\rho g} = \frac{U_2^2 - U_1^2}{2g} = 0.914$

$\frac{15170}{\rho g} = \frac{Q_2(220.43^2 - 55.11^2)}{2g} - 0.914$

$Q = 0.035 m^3/s$

(i) 9)



At Section 1

$D_1 = 0.3m$

$A = \frac{\pi}{0.4}(0.3)^2 = 0.707m^2$

$z_1 = 10m$

$V_1 = ?$

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

At Section 2

$D = 0.15m$

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

$Z_2 = 6m$

$V_2 = ?$

$P_2 = ?$

$A_1V_1 = A_2V_2 = 40 litre/sec = 40 \times 10^{-3} m^3/sec$

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

$= ~~0.56~~\ 0.566 m/s$

$V_2 = \frac{40 \times 10^{-3}}{0.0767} = 2.264 m/s$

Apply Bernoulli's method

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

$\frac{P_2}{W} + \frac{(1.274)^2}{2 \times 9.8} + 6$

$P_2 = 436.8 KN/m^2$

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Reading of the Manometer = 170mm

Specific gravity of mercury = 13.6

Specific gravity of sea water = 1.026

$h = 0.17\left[\frac{13.6}{1.026} - 2\right]$

$h = 2.085$

Velocity of Submarine

$V = \sqrt{2gh}$

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

$= 6.39 m/s$

V_2 (lower end) = 2m/s

$R = \frac{0.35\,(V_1 - V_2)}{2g}$

PL at smaller head = 2.5m

3) $D_1 = 0.15m$

S.6 = 0.

$A_1 = \frac{\pi d^2}{4} =$

6

Volumetric efficiency $= \frac{\text{Actual flow}}{\text{Idea flow}} = \frac{35}{42.5} = 0.82$

Fluid Power = $\Delta P Q$

$\Delta P = 100 \times 10^5$

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

$\Delta P Q = 8300$

Shaft = 15kwatts

Overall Efficiency $= \frac{\text{Fluid Power}}{\text{Shaft Power}} = \frac{8300}{15000} = 0.553 = 55.3\%$