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① $V = 5ms^{-1}, V_2 = 2ms^{-1}$

$P_1 = 2.5m, \; P_{T2} = 1$

$P_{T1} = P_{T2} - 0.35 \frac{(u_1 - u_2)^2}{2g} = \frac{0.35 \times 3^2}{2 \times 9.81} = 0.161$

$\therefore P_{T1} = P_{T2} - 0.161$

$2.5 = P_T = 0.161$

$P_{T2} = 2.5 - 0.161$

$P_{T2} = 2.67m$

② $200 = 0.20m$

$A = \frac{\pi d^2}{4}, P_1 - \pi (0.20)^2 = 0.0315m^-$

$P_1 = 17.658 \, N/cm^2 = \frac{17.658}{10^{-6}} = 17658000.$

Specific gravity of mercury $= 13.6$

$\frac{P.1}{10} = \frac{P_1}{\rho g} = \frac{17.658 \times 10^{-6}}{1000 \times 9.81} = 1.8 \times 10^{-7}$

Vaccum pressure $= \frac{P_2}{10} = 300mmHg$

$d_2 = 100mm - 0.1$

-0.30×13.6 $\quad \pi_2 = \frac{\pi d^2}{4} = \frac{\pi (0.1)^2}{4} = 7.85 \times 10^{-3}$

$P_1 = -4.08$

$h = 1.8 \times 10^{-4} \times 4.08 = 4.08000000mm$

$h = \frac{P_1}{\omega} - \frac{P_2}{\omega}$

$\text{actual} = \frac{C_d P_1 P_2 \sqrt{2gh}}{\sqrt{P_1^2 - P_2^2}}$

$= \frac{0.98 \times 0.0314 \times 7.815 \times 10^{-3} \sqrt{2 \times 9.81 \times 4.080000002}}{(0.0314)^2 - (7.85 \times 10^{-3})}$

$= 0.07108691665$

③ $d_1 = 150mm = 0.15m$

Pipe diameter $d_2 = 300mm = 0.30m$

$A_1 = \frac{\pi d^2}{4} = \frac{3.142 \times 0.15^2}{4} = 0.0177m$

$A_2 = \frac{\pi (0.30)^2}{4} = 0.0707m^2$

$y = 500mm\ Hg = 0.50m\ lts$

$Cd = 0.64$

$h = \frac{Sg\ of\ hg - Sg\ of\ 0.1}{Sg\ of\ 0.1} \times y = \frac{13.6 - 0.9}{0.9} \times 0.5$

$= 7.00m$

Rate of flow, $Q_{actual} = \frac{Cd A_2 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$

$= \frac{0.64 \times 0.0707 \times 0.0177 \sqrt{2 \times 9.81 \times 7.06}}{\sqrt{(0.0708)^2 - (0.0177)^2}}$

$= 0.1377$

④ $V = \sqrt{2gh}$

$H = y\left(\frac{Sg\ of\ mercury - Sg\ of\ water}{Sg\ of\ water}\right)$

$H = 0.17\left(\frac{136 - 1.026}{1026}\right) = 2.0842m$

$V = \sqrt{2 \times 9.81 \times 2.0842}$

$= 6.39ms^{-1}$

∴ Speed of submarine $= 6.39ms^{-1}$

$H = \frac{y \times Sm}{SW} - 1$

$H = 100 \times 10^{-3} \times \left(\frac{136 - 1}{1026}\right)$

$H = 2.08m$

(3) Actual flowrate $Q = 5 dm^3/min = 8.33 \times 10^{-5} m^3/sec$

$P = 15 bar = 15 \times 10^5 N/m^2$

$V = 1700 \cdot 8 v/min = 28.33 m/se$

$T = 15 N/m$ Normal displacement $= 100 cm^3/rev$

$= 1 \times 10^{-5} m^3/rev$

Volumetric efficiency

$\frac{\text{Actual flowrate}}{} \times 100\%$ Ideal flowrate = displacement × speed

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

$= 2.833 \times 10^{-4} m^3/sec$

Volumetric Efficiency $= \frac{8.33 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100$

$= 29.4\%$

fluid power = $(Q \times \Delta P)$

$= 8.33 \times 10^{-5} \times 15 \times 10^5 = 124.95$ watts

Shaft power = $T \times \omega$

$\omega = 2 \times \pi \times N = 2 \times \pi \times 28.33 = 178 rad/sec$

$= T \times \omega$

$= 15 \times 178 = 2670$ watts

Overall efficiency

$\frac{\text{fluid power}}{\text{Shaft power}} \times 100\%$

$= \frac{124.95 \times 100}{2670}$

$= 4.68\%$