1) Idealflow rate = normal displacement × 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 = ΔPQ

$\Delta p = 1.2 \times 10^5 = 1200.000$

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

$= \Delta PQ = 200.4$ watts

iii. Shaft power = $\frac{2\pi NT}{60} = 2 \times \pi \times 1500 \times 12.5$

$= 1964.3\,Nm$

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 = ΔPQ

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

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

$= 5833.3$ watts

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

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

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

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3) Ideal flow rate = normal displacement x speed

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

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

$= 0.82 = 82\%$

Fluid power $= \Delta P Q$

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

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

$\Delta p Q = 8300$

Shaft = 15 Kwatts = 15000

Overall efficiency $= \frac{\text{Fluid power}}{\text{Shaft power}}$

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

$= 55.3\%$

4) $Z = 24000 cm \times 10^{-2}$ -

$= 240 m$

Vol flow rate = 13 l/s Jet velocity = 66 m/sec

$Q = \frac{13}{1000} = 13 \times 10^{-3} \; m^3/sec$

when $P = Z = 0$

$P = \frac{\rho Q \cdot v^2}{2} = \frac{1000 \times 13 \times 10^{-3} \times 66^2}{2} = 28314$ watts

i). $P = V$, $V = 0$

$P = \rho g Q z = 1000 \times 9.81 \times 13 \times 10^{-3} \times 240$

$= 30607.2$ watts

ii) $P = 30.6072$ kWatts

Power lost in transmission

Power of reservoir - Power of jet

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$= 30607.2 - 28314$

$= 2293.2$ watts

iii). $h = \frac{\text{Power lost in transmission}}{\rho g Q}$

$h = \frac{2293.2}{1000 \times 9.81 \times 13 \times 10^{-3}} = 17.982 m$

iv) Efficiency $= \frac{\text{Power of Jet}}{\text{Power of reservoir}} \times 1000$

$= \frac{28314}{30607.2} \times 100 = 92.5 \simeq 93\%$

5.) $T = 890$ $h = 300m$, $v = 7m/s$ $Q = 2206 m/s = 0.22 m^3/s$

Power of jet $P = \frac{1}{2} \times \rho a v^3 = \frac{1}{2} \times 890 \times 0.22 \times r^2$

$P = 4797.1$ watts

Power of reservoir $P = \omega Q A = 890 \times 9.81 \times 0.22 \times 300$

$= 576239.4 W$

Power from reservoir $= r Q_A = 890 \times 0.22 \times 300 = 58740 kgm/s$

Supply jet $= \frac{1}{2} \rho v^2 Q = \frac{1}{2} \times \frac{890}{9.81} \times r^2 \times 0.22$

$= 489 kgfm/s$

Power lost in transmission $= r Q h = 58740 - 489$

$= 5825 kg m/s$

$h = \frac{58251}{890 \times 0.22} = 297.5 m$

Efficiency $= \frac{\text{Power of jet}}{\text{Supply}} = \frac{489}{58740} = 0.0083 \times 100$

$= 0.83\%$

6.) $E = mgh$ $P = \frac{mgh}{t}$

$t = \sqrt{\frac{20 \times 2}{g}} \times 4.07s$

$P = \frac{\pi \times 0.05^2 \times 20 \times 1000 \times 9.81 \times 20}{4.07} = 7558.4 W$

7) $P_{ig} = 19.62 N/m^3$

$C_d = 0.96$

$d_1 = 0.3m \quad d_2 = 0.2m$

$u_1 = Q, 0.0707 \quad u_2 = Q_2 \, 0.0314$

$P_1 + P_g Q z = P_2 + P_{fg}(z_2 - 19.62) + P_0 g R$

$P - P_2 = 19.62(z_2 - z_1) + 587.423$ --- Q_1

For the venturimeter

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

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

combine Q and Q_2

$0.803 V_2^2 = 587.423$

$v^2_{ideal} = 27.47 m/s$

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

$= 0.85 m^3/s$

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

8) $d_1 = 0.152m$

$d_2 = 0.076m \qquad A_1 = 0.01814m$

$P = 300 kg/m^3 \qquad A_2 = 0.00454m$

$C_d = 0.97$

Apply Bernoullis method

$$\frac{P_1}{Pg} + \frac{V_1^2}{2g} + z_1 = \frac{p^2}{Pg} + \frac{U_2^2}{2g} + z_2$$

9) $P_1 = P_2 \qquad \frac{V_1^2}{2g} + z_1 = \frac{U_2^2}{2g} + z_2$

$Q = V_1 A_1 = V_2 A_2$

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

$V = \sqrt{\frac{0.914 \times 2 \times 9.81}{15}} = 1.0934 m/s$

$Q = CdA_1V_1$

$Q = 0.76 \times 0.01814 \times 1.0934$

$0.019 m^3/s$

$A_1V_1 = A_2V_2 = 40$ litre/sec $= 40\times10^{-3} m/sec$

$V_1 = \frac{40\times10^{-3}}{0.707}$

$= 0.566 m/s$

$V_2 = \frac{40\times10^{-3}}{0.01767}$

$= 2.264 m/s$

Apply Bernoullis method

$\frac{400\times10^{3}}{9800} + \frac{(0.566)^2}{2\times9.8} + 10 = \frac{P_2}{w} + \frac{(1.274)^2}{2\times9.8} + 6$

$P_2 = 436.8 kN/m^2$

10.) Reading of the manometer $= 170mm$

Specific gravity of mecury $Sh_1 = 13.6$

Specific gravity of water $S_1 = 1.026$

Specific gravity

$h = y\left[\frac{Sh_1}{S_1} - 1\right]$

$h = 0.17\left[\frac{13.6}{1.026} - 1\right]$ $h = 2.083$

Velocity of submarine

$V = \sqrt{2gh}$

$= \sqrt{2\times9.81\times 2.083}$

$= 6.39 m/s$