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1 $V_1 = 5ms^{-1}$, $V_2 = 2ms^{-1}$
$P_{T_1} = 2.5m$, $P_{T_2} = ?$
$P_{T_1} = P_{T_2} = 0.35(V_1 - V_2)^2 = \frac{0.35 \times 3^2}{2 \times 9.81} = 0.161$
$\therefore P_{T_1} - P_{T_2} = 0.161$
$2.5 - P_{T_2} = 0.161$
$P_{T_2} = 2.5 - 0.161$
$P_{T_2} = 2.67m$

2 200
$= 0.2m$
$A = \pi d^2 = P_T = \frac{\pi(0.20)^2}{4} = 0.0314\ m^2$
$P_1 = 17.658 N/cm^2 = \frac{17.658}{10^{-6}} = 176580000$
Specific gravity of mecury $= 13.6$
$\frac{P_1}{w} = \frac{P_1}{\rho g} = \frac{17.658 \times 10^{-6}}{1000 \times 9.81} = 1.8 \times 10^{-7}$

Vacuum pressure $= \frac{P_2}{w} = 300mmHg$

$d_2 = 100mm = 0.1$
$= 0.30 \times 13.6$ $A_2 = \frac{Ad^2}{4} = \frac{A(0.16)^2}{4} = 7.85 \times 10^{-3}$
$P_1 = -4.08$
$h = 1.8 \times 10^{-4} \times 4.08 = 4.08000000m$
$h = \frac{P_1}{w} - \frac{P_2}{w}$

$Q_{actual} = C_d \frac{P_1 P_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2gh}$
$= \frac{0.98 \times 0.0314 \times 7.815 \times 10^{-3} \sqrt{2 \times 9.81 \times 4.08}}{(0.0314)^2 - (7.85 \times 10^{-3})^2}$
$= 0.0710869 / 663$

3 $d_0 = 15 \times 10^{-2} m$ $d_1 = 30 \times 10^{-2} m$ $C_d = 0.64$
$A_0 = \frac{\pi \times (15 \times 10)^2}{4} = 0.01767 m^2$ $y = 50 \times 10^{-3} mHg$ $Q = ?$
S_g of oil $= 0.9$ $S_{n_1} = 13.6$
$S_0 = 0.9$
$A_1 = \frac{\pi \times (30 \times 10^{-2})^2}{4} = 0.0707 m^2$ $H = y\left[\frac{S_{n_1}}{S_0} - 1\right]$
$H = 50 \times 10^{-2}\left[\frac{13.6}{0.9} - 1\right]$
$H = 7.055m$
$Q = \frac{C_d A_0 A_1 \sqrt{2gh}}{\sqrt{A_1^2 - A_0^2}} = \frac{0.64 \times 0.0176 \times 0.0707 \times \sqrt{2 \times 9.81}}{0.0707^2 - 0.0176}$
$Q = 0.137 m^3/s$

4 $y = 170mmHg = 170 \times 10^{-3} mhg$ $H = y \times \frac{S_{n_1}}{S_0} - 1$
5g of mecury $= 13.6kg$
5g of sea water $= 1.026$ $H = 120 \times 10^{-3} \times \left(\frac{13.6}{1.026} - 1\right)$
$V = \sqrt{2gH}$
$V = \sqrt{2 \times 9.81 \times 2.08}$
$V = 6.39 m/s$ $H = 2.08m$

5 Actual flowrate $Q = 5dm^3/min = 8.33 \times 10^{-5} m^3/s$
$P = 15 bar = 15 \times 10^5 N/m^2$
$V = 1700 rev/min = 28.33 m/sec$
$T = 5N/m$ Normal displacement $= 100cm^2$ to
$= 1 \times 10^{-5} m^3/rev$

Volumetric Efficiency.

Actual flow rate x 100% Ideal flow rate = displacement x speed

Ideal flow rate

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

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

Volumetric Efficiency $= \frac{8.033 \times 10^{-5}}{2.833 \times 10^{-4}} \times 100$

$= 29.4\%$

Fluid power $(Q \times \Delta P)$

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

Shaft power $= T \times \omega$

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

$= T \times \omega$

$= 15 \times 178 = 2670$ watts

overall Efficiency

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

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

$= 4.68\%$