$dp = 15\,bar = 15 \times 10^5\ N\,m^{-2}$

Norminal displacement $= 100m^3/rev$

Note that $100^3\,cm^3 = 1m^3$

$10cm^3 = x$

$x = \frac{10}{100^3} = 1 \times 10^{-5}\ m^3/rev$

$\therefore$ ideal flow rate $= 28.33 \times 1 \times 10^{-5}$

$= 28.33 \times 10^{-4}$

a) Volumetric efficiency $= \frac{\text{Actual flow rate}}{\text{ideal flow rate}} \times 100\%$

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

$= 29.4\%$

b) fluid power $= Q.dp$

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

$= 124.95\,Nm/sec.$

c) shaft power $= \tau\omega$

$\tau = 15Nm$

$\omega = 2 \times \frac{22}{7} \times 28.33 = 178.07\,rad/sec$

$\therefore \tau\omega = 2671.05$ watts

d) overall efficiency $= \frac{\text{fluid power}}{\text{shaft power}} \times 100\%$

$= \frac{124.95}{2671.05} \times 100$

$= 4.66\%$ //

$$Q = \frac{C_d \times A_o A_p}{\sqrt{A_p^2 - A_o^2}} \times \sqrt{2gh}$$

$$= \frac{0.64 \times 176.714 \times 706.858}{\sqrt{(706.858)^2 - (176.714)^2}} \times \sqrt{2 \times 9.81 \times 705.556}$$

$$= 13742.96 \, cm^3/sec.$$

4) $h = x\left[\frac{S_g}{S_{gm}} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right] = 2.0834\,m$

using $v = \sqrt{2gh}$

$v = \sqrt{2 \times 9.81 \times 2.0834} = 6.393\,ms^{-1}$

Converting to km/hr

$= 23\,km/hr.$

5) Volumetric flow rate

$10\,dm = 1\,m$

$10^3\,dm^3 = 1\,m^3$

$1000\,dm^3 = 1\,m^3$

$5\,dm^3 = 0.005\,m^3$.

Volumetric flowrate $= 0.005\,m^3/min$

Actual flow rate $= \frac{0.005}{60} = 8.33 \times 10^{-5}\,m^3/sec$

Speed $= 1700\,rpm$

$\frac{1700}{60} = 28.33$ rev/sec.

$\rho_w = 1000\ Kg/m^3$

$P_1 = 17.658\ N/cm^2 = 17.658 \times 10^4\ Nm^{-2}$

$\therefore \frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{1000 \times 9.81} = 18m,$

$\frac{P_2}{\rho g} = -30cm$ of mecury $= -0.3m$

$= -0.3 \times 13.6 = 4.08\ m$

Differential head $(h) = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 18 + 4.08$

$= 22.08m$ of water.

using discharge equation,

$$Q = Cd \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

$$= 0.98 \times \frac{0.0314 \times 7.85 \times 10^{-3}}{\sqrt{(0.0314^2) - (7.85 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 22.08}$$

$$= 0.98 \times 8.107 \times 10^{-3} \times 20.81$$

$$= 0.1653 m^3/s$$

③ $A_{orifice} = \frac{\pi}{4} \times (15)^2 = 176.714 cm^2$

$A_{pipe} = \frac{\pi}{4} \times (30)^2 = 706.858\ cm^2$

$$h = \left(\frac{13.6}{0.9} - 1\right) \times 50cm \text{ of oil}$$

$= 705.556$ cm of oil.

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1) $L = 2.0m$

$V_1 = 5ms^{-1}$

$P_1/\rho g = 2.5m$ of liquid

$P_2/\rho g = ?$

$V_2 = 2ms^{-1}$

loss of head $(h_L) = \frac{0.35(V_1 - V_2)^2}{2g}$

$$= \frac{0.35(5-2)^2}{2 \times 9.81} = 0.16m$$

using bernoullis equation

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

$$2.5 \times \frac{5^2}{2 \times 9.81} + 2.0 = \frac{P_2}{\rho g} + \frac{2^2}{2 \times 9.81} + 0 + 0.16$$

$$2.5 \times 1.27 + 2.0 = \frac{P_2}{\rho g} + 0.204 + 0.16$$

$$5.77 = \frac{P_2}{\rho g} + 0.364$$

$$\therefore \frac{P_2}{\rho g} = 5.77 - 0.364 = 5.406m \text{ of liquid.}$$

2) $d_{inlet} = 0.2m$

$$A_{inlet} = \frac{\pi}{4}(0.2)^2 = 0.0314 m^2$$

~~d~~ $d_{throat} = \cancel{10cm}$ $0.1m$

$$A_{throat} = \frac{\pi}{4} \times (0.1)^2 = 7.85 \times 10^{-3} m^2$$