losses 100000 cm³
a = 10 cm²

1) $l = 2.0_m$

$v_1 = 5 m/s$

$\frac{P_1}{W} = 2.5_m$

$v_2 = 2 m/s$

$h = \frac{0.35(v_1 - v_2)^2}{2g}$

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

$= 0.1 \cdot 61_m$

from Bernoulli's equation

$\frac{P_1}{W} + \frac{v_1^2}{2g} + Z_1 = \frac{P_2}{W} + \frac{v_2^2}{2g} + Z_2 + h$

where $Z_1 = 2_m$ and $Z_2 = 0_m$

$2.5_m + \frac{5^2}{2 \times 9.81} + 2 = \frac{P_2}{w} + \frac{2^2}{2 \times 9.81} + 0 + 0.161$

$4.5 + \frac{25}{1962} = \frac{P_2}{w} + \frac{4}{1982} + 0.161$

$\frac{P_2}{W} = \frac{25-4}{19.62} + 4.5 - 0.161$

$\frac{P_2}{W} = \frac{21}{19.62} + 4.339$

$= 1.07 + 4.339$

$\frac{P_2}{W} = 5.409_m$ of liquid

2) $d_1 = 20_{cm} = 0.2_m$

$A_1 = \frac{\pi \times 0.2^2}{4} = 0.0314 m^2$

$d_2 = 10_{cm} = 0.1_m$

$A_2 = \frac{\pi \times 0.1^2}{4} = 0.0079 m^2$

$P_1 = 17.658 N/cm^2 = 17.658 \times 10^4 N/m^2$

density of water = 1000 kg/m³

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

$= 18_m$

$\frac{P_2}{\rho g} = -30$ cm mercury

$= -0.3_m$ mercury

$= -0.3 \times 13.6 = -4.08_m$ of water

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

$= 1.8 - (-4.08)$

~~= 5.88 22.88~~

$= 22.88_m$ of water

$Q_a = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$

~~$Q_a = 0.0314 \times 0.0079$~~

$= \frac{0.0314 \times 0.0079 \times \sqrt{2 \times 9.81 \times 22.88}}{\sqrt{0.0314^2 - 0.0079^2}}$

$= \frac{0.0235 \times 21.187 \times 0.98}{\sqrt{0.00098596 - 0.00006241}}$

$= \frac{0.4979 \times 0.98}{0.0304}$

$= 16.051 m^3/s$

3) $d_0 = 15 cm = 0.15_m$

$a_0 = \frac{\pi \times 15^2}{4} = 0.0177 m^2$

$d_1 = 30_{cm} = 0.3_m$

$d_1 = \frac{\pi \times 0.3^2}{4} = 0.0707 m^2$

S.g of 1 =
Manometer

h =

4) x =
s.g ...
s.g ...

h =

v =
V =

5) Volume
...
Spec...
s.g = 1...
Manom...

$Sg_{oil} = 0.9$

Manometer reading of 50.5cm mercury

50.5cm mercury

$h = x\left(\frac{Sg_{water}}{Sg_{oil}} - 1\right) = 0.5\left(\frac{13.6}{0.9} - 1\right)$

$= 0.5 \times 14.11 = 7.055m$ oil

$Q_a = C_d \frac{A_0 A_1}{\sqrt{A_1^2 - A_0^2}} \times \sqrt{2gh}$

$C_d = 0.64$

$Q_a = 0.64 \times \frac{0.0177 \times 0.0707 \times \sqrt{2 \times 9.81 \times 7.055}}{\sqrt{0.0707^2 - 0.0177^2}}$

$= \frac{0.0872256 \times 11.765}{0.06845} = 0.138 m^3/s$

ii) $x = 170mm = 0.17m$

$sg_{mercury} = 13.6$

$Sg_{sea\ water} = 1.026$

$h = x\left[\frac{Sg_{mer}}{Sg_{sw}} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right]$

$= 2.0834m$

$v = \sqrt{2gh}$

$v = \sqrt{2 \times 9.81 \times 2.0834}$

$= 6.393m/s \times \frac{3600}{1000} = 23Km/hr$

5a) Volumetric flow rate $= 0.05m^3/min \times \frac{1}{60}$

~~$5\,dm^3 = 0.005m^3$~~ $= 8.33 \times 10^{-4} m^3/s$

Speed $= 1700rpm \times \frac{1}{60} = 28.33rps$

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

Nominal displacement $= 10cm^3/rev \times 10^{-6}$

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

Ideal flowrate = Nominal displacement × speed

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

$= 2.833 \times 10^{-4}$

Volume efficiency = $\frac{\text{Actual flowrate}}{\text{Ideal flowrate}}$

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

$= 2.94\%$

b) Fluid power $= Q \cdot \Delta p$

$= 8.33 \times 10^{-4} \times 15 \times 10^5$

$= 1250 Nm/s$

c) Shaft power $= T \cdot \omega$

$T = 15Nm$

$\omega = 2 \times \pi \times 28.33$

$= 178.02 rad/sec$

$T\omega = 178.02 \times 15$

$= 2670.35W$

Overall efficiency $= \frac{\text{Fluid power}}{\text{Shaft power}} \times 100$

$= \frac{1250 \times 100}{2670}$

$= 46.8\%$