Toby Andrew .A. 18/ENG07/013 Petroleum Eng 200 Level

1) $V_1 = 5\ m/s$ $V_2 = 2\ m/s$

Smaller end = 2.5m

L = 20

$h_1 = 0.35\frac{(V_1 - V_2)^2}{2g}$

$L = t_1 - t_2 = 2m$

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

$\frac{P_2}{\omega} = \frac{P_1}{\omega} + \frac{1}{2g}(V_1^2 + V_2^2) + (Z_1 - Z_2)h$

$= 2.6 + \frac{(5^2 - 2^2)}{2 \times 9.81} + 2 = \frac{(0.35(5-2)^2)}{2 \times 9.81}$

$= 2.5 + 1.07 + 2 - 0.16055$

$P_2 = 5.409\ bar$

2) Inlet diameter = 20cm

Throat diameter = 10cm

$C_d = 0.98$

Initial, $P_1 = 17.658\ N/cm^2$

$A_1 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{20}{100}\right)^2 \times \pi$

$= 0.0314\ m^3$

$A_2 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{10}{100}\right) \times \pi$

$= 7.85 \times 10^{-3}\ m^2$

If $y = 30cm$ (0.3m of mercury

$P_1 = \frac{17.658}{1000} = 1.7658 \times 10^{-3}\ N/m$

$\frac{P_1}{\omega} = \frac{1.7658 \times 10^{-3}}{9.81} = 1.8 \times 10^{-4} m$

$\frac{P_2}{\omega} = 0.3 \times 13.6 = 4.08$

$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = 1.8 \times 10^{-4} - (-4.08)$

$= 4.080018\ m$

$Q = C_d \times \frac{A_1 A_2}{\sqrt{A_1 A_2}} \times \sqrt{2gh}$

$Q = 0.98 \times 0.0314 \times 7.85 \times 10^{-3} \times \sqrt{2 \times 9.81 \times 4.08}$

$\sqrt{0.0314 \times 7.85 \times 10^{-3}}$

$Q = 0.98 \times \frac{0.0314 \times 7.85 \times 10^{-3}}{\sqrt{0.0314 \times 7.85 \times 10^{-3}}} \times \sqrt{2 \times 9.81 \times 4.08}$

$= 0.070 m^3/s$

③ $D_1 = 15cm$

$D_2 = 30cm$

50 cm = 0.5m of mercury

S.G = 0.9

$Cd = 0.6$

$A_1 = \frac{\pi d^2}{4} = \frac{1}{4} \times \left(\frac{15}{100}\right)^2 \times \Omega$

$= 0.0176\,m$

$A_2 = \frac{\Omega d^2}{4} = \frac{1}{4} \times \left(\frac{30}{100}\right)^2 \times \Omega$

$= 0.0706m$

$h = I\left(\frac{13.6}{0.9} - 1\right) = 7.055$

$q = Cd \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$

$= 0.64 \times \frac{(0.0176 \times 0.0706)}{\sqrt{(0.0176)^2 \times (0.0706)^2}} \times \sqrt{2 \times 9.81 \times 7.055}$

$= 2.83 \times 10^{-3} m$

④ orifice diameter = 15cm

Pipe diameter = ?

170mm of mercury = 0.17m

S.G of mercury = 18.6

S.G of sea water = 1.026

$h = I\left(\frac{S.G\ of\ mercury}{S.G\ of\ sea\ water} - 1\right)$

$h = 0.17\left(\frac{18.6}{1.026} - 1\right)$

$= 2.083$

$V = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.083}$

$= 6.39 m/s$

⑤ $Q = 0.05\,dm^3/min$

$= 8.33 \times 10^{-5} m^3/s$

Speed of rotation = 1700 rev/min

$= 28.3$ rev/s

Nominal displacement = $10cm^3$/rev

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

Torque input = 15 Nm

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

Ideal flowrate = Nominal displacement × speed rotation

$10^{-5} \times 28.3$

$= 2.83 \times 10^{-4} m^3/s$