Fluid Mechanics

(1) $V_1 = 5 ms^{-1}$ $V_2 = 2 ms^{-1}$

PH at smaller end = 1.5m

$h_f = \frac{(0.35)(V_1 - V_2)^2}{2g}$ $L = 2.0m$

Pressure lower end:

$Z_1 = Z_2 = Z_3$

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

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

$= 2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + 2(0.35)\frac{(5-2)^2}{2 \times 9.81}$

$= 2.5 + 1.0742 - 0.1605$

$P_2 = 5.4137 mH_2O$

Pressure at lower end = 5.4137mH2O

(2) inlet diameter = 200m

throat diameter = 100m

Pressure at inlet =

$P_1 = 17.658 kN$

$y = 300mm$ of mercury

$C_d = 0.98$

$A_1 = \frac{\pi d^2}{4} = \frac{(20)^2}{4} \times 3.14$

$= 0.0314 m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{(10)^2}{4} \times 3.14 = 2.857 \times 10^{-3}$

$y = 30cm (0.3m$ of Mercury$)$

$P_1 = 17.658$

$= \frac{17.658}{100} = 1.7658 \times 10^{-3} N/m$

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

$\frac{P_2}{W} = 0.5 \times 13.6 = 4.08 mH_2O$

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

$h = 4.08218 M$

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

$Q = 0.98 \times \frac{0.0314 \times 2.857 \times 10^{-3}}{\sqrt{(0.0314)^2 - (2.857 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 4.0818}$

$Q = \frac{0.000274}{0.0304} \times 8.947$

$Q = 0.0807 m^3/s$

(3) $D_1 = 15m$ $D_2 = 30m$

$500mm$ of mercury $= 0.5m$ $Q = ?$

$S.G_{Hg} = 13.6$ $C_d = 0.64$

$A_1 = \frac{\pi d^2}{4} = \frac{(15)^2}{4} \times 3.14 = 0.0706 m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{(30)^2}{4} \times 3.14 = 0.0706 m^2$

$h = y\left[\frac{S_{Hg}}{S_w} - 1\right]$

$h = 0.5\left[\frac{13.6}{0.7} - 1\right]$

$= 2.05 mol$ of H_2O

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

$Q = \frac{0.64 \times 0.0706 \times 0.0706}{\sqrt{(0.0706)^2 - (0.0706)^2}} \sqrt{2 \times 9.81 \times 2.05}$

$Q = \frac{4.25 \times 10^{-3}}{0.0012}$

$Q = 2.33 \times 10^{-3} m^3/s$

(4) $A_2 = 15m$

170mm of Mercury $(0.17m)$

S.G of Mercury $= 13.6$

S.G of Sea water $= 1.026$ $V = ?$

$h = y\left(\frac{S_{Hg}}{S_w} - 1\right)$

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

$h = 2.08m$

$V = \sqrt{2gh}$

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

$V = 6.39 ms^{-1}$

(5) $0.05 m^3/min$

15 bar

1700 RPM

$10 Bm^2$ PCV

15 NMA