OBE CORNELIUS MBA
18/ENG06/049
MECHANICAL ENGINEERING
FLUID MECHANICS (ENG 214)

1) $V_1 = 5ms^{-1}$
$V_2 = 2ms^{-1}$
P_H at Smaller end = 2.5m
$h_f = \frac{(0.35(V'-V^2)^2}{2g}$
$L = 2.0m$
P_H at lower end =
$L = Z_1 - Z_2 = 2m$

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

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

$= 2.5 + 1.07 + 2 - 0.16055$
$P_2 = 5.4096 bar$
∴ Pressure at lower end is 5.4096 bar

2) Inlet diameter = 20cm
Throat diameter = 10cm
Pressure at Inlet = 17.658N/cm
Vacuum pressure at Throat = 30cm of Mercury
$C_d = 0.98$

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

$A_1 = 0.0314m$

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

$A_2 = 7.853 \times 10^{-3} m^4$

$y = 30cm$ (0.3m of Mercury)
Pressure at Inlet $P_1 = 17.658$

$$= \frac{17.658}{10000} = 1.7658 \times 10^{-3} K/m$$

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

$$\frac{P_2}{w} = -0.3 \times 13.6 = -4.08 \text{ of } H_2O$$

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

$h = 4.08018 m$

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

$$Q = 0.98 \times \frac{0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.853 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 4.0818}$$

$$Q = \frac{0.000241}{0.0304} \times 8.947$$

$= 0.0709 m^3/s$

3) $D_1 = 15cm$
$D_2 = 30cm$, 50cm of Mercury
$Q = ?$, $S.G = 0.9$, $C_d = 0.64$

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

$A_1 = 0.0176m$

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

$A_2 = 0.0706m$

$$h = y\left[\frac{13.6}{0.9} - 1\right]$$

$$h = 0.5\left[\frac{13.6}{0.9} - 1\right]$$

$= 7.05$ of Oil

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

$$Q = \frac{0.64 \times 0.0176 \times 0.0706 \times \sqrt{2 \times 9.81 \times 9.05}}{\sqrt{(0.0706)^2 - (0.0176)^2}}$$

$$Q = \frac{9.35 \times 10^{-3}}{4.0112}$$

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

f) Axis = 15m

170mm Of Mercury (0.17m)

S.G Of Mercury = 13.6

S.G Of Sea Water = 1.026

V = ?

$$h = y\left(\frac{S_{b_1}}{S_L} - 1\right)$$

$$h = 0.17\left(\frac{13.6}{1.026} - 1\right)$$

$$h = 2.083m$$

$$V = \sqrt{2gh}$$

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

$$V = 6.39 ms^{-1}$$