TARIBARACATE DAVID I.
COMPUTER ENGINEERING
18/ENG02/091 [redacted]

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

Pitot smaller end = 2.5m

$h_1 = \frac{10.35(V-V^2)^2}{2g}$ L = 2.0m

Phat lower end =

$L = Z_1 - Z_2 = Z_a$

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

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

$= 2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + 2 - \frac{10.35(5-2)^2}{2 \times 9.81}$

$= 2.5 + 1.07 + 2 - 0.16055$

$P_2 = 5.409$ bar

pressure at lower end = 5.409 bar

2) Inlet diameter = 200m

inlet diameter = 100m

$P_1 = 17.658$

J = 300 m of mercury

Cd = 0.98

$A_1 = \frac{\pi d^2}{4} = \frac{(20/100)^2 \times 3.14}{4}$

$= 0.0314$

$A_2 = \frac{\pi d^2}{4} = \frac{(10/100)^2 \times 3.14}{4}$

$= 7.853 \times 10^{-3}$

J = 30cm (0.3m of mercury)

$P_1 = 12.658$

$= \frac{12.658}{1000} = 1.7658 \times 10^{-3}$ N/cm

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

$\frac{P_2}{\omega} = 0.3 \times 13.6 = 4.08$ of H_2O

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

$h = 4.0801$ (m)

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

$Q = \frac{0.98 \times 0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.853 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times -1.08018}$

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

$Q = 0.070\ cm^3/s$

3) $D_1 = 15cm$ $D_2 = 30cm$

500m of mercury = 0.5m   a = ?

S.G = 0.9   Cd = 0.64

$A_1 = \frac{\pi d^2}{4} = \frac{(18/100)^2 \times 3.14}{4} = 0.0146\ m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{(30/100)^2 \times 3.14}{4} = 0.0706\ m^2$

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

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

= 7.05 m of oil

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

$$q = \frac{0.0420 \times 0.0176 \times 0.0706 \sqrt{2 \times 9.81 \times 708}}{\sqrt{(0.0706)^2 - (0.0170)^2}}$$

$$q = \frac{9.35 \times 10^{-3}}{400.12}$$

$$q = 2.32 \times 10^{-3} m^3/s$$

4) A x'y = 15m

170mm of mercury (0.17m)

SG of mercury (13.6)

SG of sea water = 1.026 v = 1

$$h = y\left(\frac{S_{Hg}}{d_1} - 1\right)$$

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

$$h = 2.083 m$$

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

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

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

5) Volumetric efficiency = $\frac{\text{actual flowrate}}{\text{ideal flowrate}} \times 100$

$$= \frac{8.33 \times 10^{-3}}{2.83 \times 10^{-4}} \times 100$$

$$= 29.45\%$$

b) fluid power, $P_F = Q \times \Delta P$

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

$$= 124.95 \text{ Watts}$$

c) shaft power = T x 10

$\omega = 2 \times \pi \times$ speed of rotation

$$\omega = 2 \times \pi \times 28.3$$

$$\omega = 177.81 \text{ rad/sec}$$

$\therefore$ shaft power $= 15 \times 177.81$

$$= 2667.2 \text{ watts}$$

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

$$= \frac{124.95}{2667.2} \times 100$$

$$= 4.68\%$$