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Computer Engineering Fluid Mechanics

Question 1.

(1) Length tube

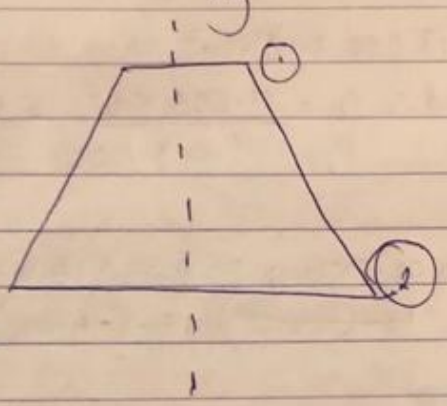
$L = 2.0m$

$V_1 = 5m/s$

$P_1 (Pg) = 2.5m$ of liquid

$V_2 = 2m/s$

Loss head $= h_L = \frac{0.35(V_1 - V_2)^2}{2g}$



$= \frac{0.35(0-2)^2}{2g} = \frac{0.35 \times 9}{2 \times 9.81} = 0.16$

Pressure head $\frac{P_2}{Pg} = ?$

Applying Bernoulli's equation at section (1) and (2), we get

$$\frac{P_1}{Pg} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{Pg} + \frac{V_2^2}{2g} + z_2 + h_L$$

Let the datum line passes through section (2). Then $z_2 = 0$, $z_1 = 2.0$

$$\frac{2.5 + 5^2}{2 \times 9.81} + 2.0 = \frac{P_2}{Pg} + \frac{2^2}{2 \times 9.81} + 0 + 0.16$$

$$2.5 + 1.27 + 2.0 = \frac{P_2}{Pg} + 0.203 + 16$$

$$\frac{P_2}{Pg} = (2.5 + 1.27 + 2.0) - (0.203 + 16)$$

$= 5.77 - 3.634 = 5.407$ m of fluid.

Question 2

Solution

Dia at inlet

$d_1 = 20Cm$

$a_1 = \frac{\pi}{4} \times (20)^2 = 314.16 Cm^2$

$d_2 = 10Cm$

$a_2 = \frac{\pi}{4} \times 10^2 = 78.7HCm^2$

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

$= 1000 \frac{kg}{m^3}$ and $\therefore \frac{P_1}{Pg} = \frac{17.658 \times 10^4}{9.81 \times 1000} = 18m$ of water

$\frac{P_2}{Pg} = -30Cm$ of mercury

$= -0.30m$ of mercury $= -0.30 \times 13.6 = -4.08m$ of water

$\therefore = h = \frac{P_1}{Pg} - \frac{P_2}{Pg} = 18 - (-4.08)$

$= 18 + 4.08 = 22.08m$ of water $= 2208Cm$ of water

The discharg Q is given by equation (6.8)

$$Q = \frac{Cd\, a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$$

$$= 0.98 \times \frac{314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.7H)^2}} \times \sqrt{2 \times 981 \times 2208}$$

$= \frac{50328837.21}{304} \times 165555 Cm^3/s = 165.555 lit/s.$

Question 3

soln

$A_O = \frac{\pi}{4}(15)^2 = 176.714\ Cm^2$ (A_o area of orifice)

$A_p = D_A (30)^2 = 706.858\ Cm^2$ (A_p area of the pipe)

$h = \left[\frac{13.6}{0.9} - 1\right] \times 50\ Cm\ of\ oil$

$= 705.555\ Cm\ of\ oil$

$Q = Cd \frac{A_O A_P}{\sqrt{A_P^2 - A_P^2}} \sqrt{2gh}$

$Q = \left(0.64 \times \frac{176.714 \times 706.858}{\sqrt{706.858^2 - 176.714^2}} \times \sqrt{2 \times 9.81 \times 705.55 \times 100}\right) cm^3/s$

$Q = 137414.25\ Cm^3/sec$

$Q = 137.414125\ Lts/sec$

Question 4

Diff of mercury level $x = 170mm = 0.17m$

sp gr of mercury $S_g = 13.6$

sp gr of sea water $S_0 = 1.026$

$h = x\left[\frac{S_g}{S_0} - 1\right] = 0.17\left[\frac{13.6}{1.026} - 1\right] = 2.0834m$

$V = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.0834} = 6.393 m/s$

$= \frac{6.393 \times 60 \times 60}{1000}\ km/hr = 23.015 km/hr$