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181ENG04/060
Elect/Elect

1. $Q = 400 \text{ Litres/secs} = 0.4 \text{ m}^3/\text{secs}$

$Cd = 0.96$, Density (P) = 0.8

$D_1 = 150 \text{ mm} = ~~1.5~~ = 0.15$

$D_2 = 75 \text{ mm} = 0.075$

$P_1 = 150 \text{ mm} = 19788.3 \text{ N/m}^2$, $P_2 = ?$

$$A_1 = \frac{\pi (0.15)^2}{4} = 0.018$$

$$A_2 = \frac{\pi (0.075)^2}{4} = 0.0044$$

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

$$0.4 = \frac{0.96 \times 0.018 \times 0.0044 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.018^2 - 0.0044^2}}$$

$$0.4 = \frac{0.000069 \times 4.43 \times \sqrt{h}}{0.0175}$$

$$0.4 = \frac{0.00031 \sqrt{h}}{0.0175}$$

$$h = \frac{0.0175 \times 0.4}{\sqrt{0.00031}} = \sqrt{22.6} = 4.754$$

$$P_2 = Pgh$$

$$= 0.8 \times 9.81 \times 4.754$$

$$= 37.81 \text{ m}$$

$$\therefore P_2 = 4974.2 \text{ N/m}^2$$

$$\therefore P_1 - P_2 = 19788.3 - 4974.2$$

$$= 15014.1 \text{ N/m}^2 \text{ OR } 112.62 \text{ m}$$

$$\begin{aligned}
 \text{iv} \quad D_1 &= 300 \text{ mm} = 0.3 \text{ m} \\
 D_2 &= 150 \text{ mm} = 0.15 \text{ m} \\
 P_1 &= 300 \text{ mm} = 34996.6 \text{ N/m}^2 \\
 P_2 &= 280 \text{ mm} = 33330.5 \text{ N/m}^2 \\
 C_d &= 0.78 \\
 \text{S.g. of mercury} &= 13.6 \\
 Q &=?
 \end{aligned}$$

$$x_1 = \frac{\pi (0.3)^2}{4} = 0.0707$$

$$x_2 = \frac{\pi (0.15)^2}{4} = 0.0177$$

$$Q = c_d \frac{x_1 x_2}{\sqrt{x_1^2 - x_2^2}} \sqrt{2gh}$$

$$h = \frac{P_1 - P_2}{w} = \frac{8666.1}{8829} = 0.76$$

$$Q = \frac{0.98 \times 0.0707 \times 0.0177 \sqrt{2 \times 9.81 \times 0.76}}{\sqrt{0.0707^2 - 0.0177^2}}$$

$$Q = \frac{0.0048}{0.0685}$$

$$\therefore Q = 0.0707 \text{ m}^3/\text{s}$$

$$\text{ii) } \text{S.g.} = \frac{w}{1000 \times 9.81}$$

$$13.6 = \frac{w}{9810}$$

$$w = 133416$$

$$h = \frac{P_1 - P_2}{w}$$

$$\begin{aligned}
 P_1 - P_2 &= h w \\
 &= 0.76 \times 133416 \\
 &= 101396.16 \text{ N/m}^2
 \end{aligned}$$