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Assignment

1) $z_1 = 0$, $z_2 = 2.0\text{m}$, $V_1 = 5\text{m/s}$, $V_2 = 2\text{m/s}$

The pressure, h , $\frac{P_1}{w} = 2.5\text{m}$

$$\frac{P_2}{w} = ??$$

$$h_f = 0.35 \frac{(V_1 - V_2)^2}{2g}$$
$$= \frac{0.35(5-2)^2}{2 \times 9.81} = \frac{0.35 \times 9}{2 \times 9.81}$$
$$= 0.1606\text{m}$$

Applying Bernoulli's Equation

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

$$\frac{P_2}{w} = \frac{P_1}{w} + \frac{V_1^2}{2g} + z_1 - \frac{V_2^2}{2g} - z_2 - h_f$$

$$= 2.5 + \frac{5^2}{2 \times 9.81} + 0 - \frac{2^2}{2 \times 9.81} - 2.0 - 0.1606$$

$$= 2.5 + 1.274 - 0.204 - 0.1606 - 2.0$$

$$= \cancel{1.4094\text{m}} \quad 1.4094\text{m}$$

$$= 1.41\text{m}$$

$$h_2, \frac{P_2}{w} = 1.41\text{m}$$

$$2) \quad \lambda_1 A_1 = 20 \text{ cm} = \frac{20}{100} = 0.2 \text{ m}$$

$$\lambda_2 A_2 = 10 \text{ cm} = \frac{10}{100} = 0.1 \text{ m}$$

$$A_1 = \frac{\pi d^2}{4} = \frac{\pi (0.2)^2}{4} = 0.0314 \text{ m}^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{\pi (0.1)^2}{4} = \frac{0.0094}{4} = 0.00235$$

$$P_1 = 17.658 \text{ kg/cm}^2 = 17.658 \times 10^4 = 176580 \text{ N/m}^2$$

$$P_2 = 0.30 \text{ cm of mercury} = 0.5 \text{ m of Hg} = -0.5 \text{ m Hg} \times 13.6$$

$$h_2 = -4.08 \text{ m}$$

$$h_1 = \frac{P_1}{w} = \frac{176580}{1000 \times 9.81} = 18 \text{ m}$$

$$h = h_1 - h_2$$

$$h = 18 - (-4.08)$$

$$= 18 + 4.08$$

$$= 22.08$$

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

$$= \frac{0.95 \times 0.0314 \times 0.00785 \times \sqrt{2 \times 9.81 \times 7.06}}{(0.0514)^2 - (0.00786)^2}$$

$$Q = \frac{0.00503}{0.0304}$$

$$Q = \frac{0.1058 \text{ m}^3/\text{s}}{0.1653 \text{ m}^2/\text{s}}$$

3) Orifice diameter, $d_o = 15 \text{ cm}$
 $= 0.15 \text{ m}$

Pipe diameter, $d_i = 30 \text{ cm}$
 $= 0.3 \text{ m}$

$$A_o = \frac{\pi d_o^2}{4} = \frac{\pi (0.15)^2}{4} = 0.01767 \text{ m}^2$$

$$A_i = \frac{\pi d_i^2}{4} = \frac{\pi (0.30)^2}{4} = 0.070686 \text{ m}^2$$

Pitot static head.

$$y = 50 \text{ cm} = 0.5 \text{ m}$$

$$h = \frac{P}{w} = y \left(\frac{\text{S.G. of mercury} - 1}{\text{S.G. of oil}} \right) = 0.5 \left(\frac{13.6 - 1}{0.9} \right)$$

$$h = 7.06 \text{ m} = 7.06$$

$$Q = \frac{C_d \times A_i A_o \sqrt{2gh}}{\sqrt{A_i^2 - A_o^2}}$$

$$= \frac{0.64 \times 0.01767 \times 0.070686 \times \sqrt{2 \times 9.81 \times 7.06}}{\sqrt{(0.070686)^2 - (0.01767)^2}}$$

$$= \frac{0.009907}{0.06844}$$

$$Q = 0.1374 \text{ m}^2/\text{s}$$

$$Q = 0.137 \text{ m}^2/\text{s}$$

4) Difference of Hg (y)

$$y = 170 \text{ mm}$$
$$= \frac{170}{1000}$$

$$y = 0.17 \text{ m}$$

$$\text{S.G of mercury} = 13.6$$

$$\text{S.G of sea water} = 1.026$$

$$h = y \left(\frac{\text{S.G of Hg}}{\text{S.G of sea water}} - 1 \right)$$

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

$$= 0.17 (12.255)$$

$$h = 2.08 \text{ m}$$

$$\text{Velocity} = \sqrt{2g\Delta h}$$

$$= \sqrt{2gh}$$

$$= \sqrt{2 \times 9.81 \times 2.08}$$

$$V = 6.39 \text{ m/s.}$$