

① Pressure difference between extreme of flow of section

$$h = \left(\frac{P_1}{\rho g} + z_1 \right) - \left(\frac{P_2}{\rho g} + z_2 \right) = 3.53$$

$$\left(\frac{P_1}{\rho g} - \frac{P_2}{\rho g} \right) + (z_1 - z_2) = 3.53$$

$$(2.8 - z_1) = 0.8m$$

$$P_1 - P_2 = 3.88$$

$$\frac{P_1 - P_2}{\rho g} = (9.81 \times 0.1) \times 3.83$$

$$= 33.9 \text{ kN/m}^2$$

Question 2

Pressure difference ($P_1 - P_2$)

$$A_1 = \frac{\pi}{4} D_1^2 = \frac{\pi}{4} \times 0.15^2 = 0.01767 \text{ m}^2$$

$$A_2 = \frac{\pi}{4} D_2^2 = \frac{\pi}{4} \times (0.075)^2 = 0.00442 \text{ m}^2$$

$$Q_{\text{act}} = cd \times \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \times \sqrt{2gh}$$

$$0.04 = 0.96 \times 0.01767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h}$$

$$\therefore h = \left(\frac{0.04}{0.96 \times 0.00442 \times 4.429} \right)^2 = 4.247 \text{ m}$$

$$4.247 = \left(\frac{P_1}{\rho g} - \frac{P_2}{\rho g} \right) + (z_1 - z_2)$$

$$= \left(\frac{P_1 - P_2}{\rho g} \right) - 0.15$$

$$\begin{aligned} (P_1 - P_2) &= \rho g (4.247 + 0.15) \\ &= 10.8 \times 1000 \times 9.81 (4.247 + 0.15) \text{ N/m}^2 \\ &= 34.51 \text{ kN/m}^2 \end{aligned}$$

ORPDU JESSICA

18/EN 607/010 — PETROLEUM ENGR

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Question 1

Diameter at inlet, $D_1 = 300\text{mm} = 0.3\text{m}$

Area of inlet $A_1 = \frac{\pi}{4} \times 0.3^2 = 0.07\text{m}^2$

Diameter of throat, $D_2 = 150\text{mm} = 0.15\text{m}$

Area of throat, $A_2 = \frac{\pi}{4} \times 0.15^2 = 0.01767\text{m}^2$

S.g of Mercury = 13.6 S.W

S.g of oil = 0.9 S.P

$$\therefore h = \left(\frac{P_1}{\rho g} + z_1 \right) - \left(\frac{P_2}{\rho g} + z_2 \right)$$

$$= \frac{\gamma}{\rho g} \left(\frac{13.6}{0.9} - 1 \right) = 0.25 \left(\frac{13.6}{0.9} - 1 \right)$$
$$= 3.53\text{m of oil}$$

① Discharge of oil (Q)

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

$$Q = 0.98 \times \frac{0.07 \times 0.01767}{\sqrt{0.07^2 - 0.01767^2}} \times \sqrt{2 \times 9.81 \times 3.53}$$

$$= \frac{0.001212}{0.0677} \times 8.32$$

$$= 0.1489\text{m}^3/\text{s}$$