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$$D) \quad P_1 = 300\text{mm} = 0.3\text{m}$$

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

$$S_{hl} = 13.6$$

$$S_p = 0.9$$

$$y = 250\text{mm} = 0.25\text{m}$$

$$P_2 = 150\text{mm} = 0.15\text{m}$$

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

$$h = g \left[\frac{S_{hl}}{S_p} - 1 \right] = 0.25 \left[\frac{13.6}{0.9} - 1 \right]$$

$$= 3.53\text{m of oil}$$

(e) Discharge of oil

$$Q \Rightarrow C_d \times \frac{A_1 A_2}{\sqrt{A_1^2 + A_2^2}} \times \sqrt{2gh}$$

$$Q \Rightarrow \frac{0.98 \times 0.07 \times 0.01767 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{0.07^2 + 0.01767^2}}$$

$$\Rightarrow \frac{0.001212 \times 8.32}{0.0677} = 0.1489\text{m}^3/\text{s}$$

$$(ii) \quad \left(\frac{P_1}{w} - \frac{P_2}{w} \right) + z_1 - z_2 = 3.53$$

$$z_1 - z_2 \Rightarrow 300\text{mm} \Rightarrow 0.3\text{m}$$

$$\left(\frac{P_1}{w} - \frac{P_2}{w} \right) - 0.3 = 3.53$$

$$P_1 - P_2 = (3.83)(w)$$

$$P_1 - P_2 = (3.83)(0.9 \times 9.81) \times 1000$$

$$P_1 - P_2 = 33.81507\text{KN/m}^2$$

$$D_1 = 150 \text{ mm} = 0.15 \text{ m}$$

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

$$Q = 40 \text{ l/s} \Rightarrow 40 \times 10^{-3} \Rightarrow 0.04 \text{ m}^3/\text{s}$$

$$z_1 - z_2 = 150 \text{ mm} \Rightarrow 0.15 \text{ m}$$

$$(2) \quad A_1 = \frac{\pi D_1^2}{4} \Rightarrow \frac{3.142 \times 0.15^2}{4} = 0.01767 \text{ m}^2$$

$$A_2 = \frac{\pi D_2^2}{4} \Rightarrow \frac{3.142 \times 0.075^2}{4} = 0.00442 \text{ m}^2$$

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

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

$$0.04 = 0.96 \times 0.004565 \times 4.429 \times \sqrt{h}$$

$$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429} \right)^2 \Rightarrow \left(\frac{0.04}{0.0194} \right)^2$$

$$\Rightarrow 4.25 \text{ m}$$

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

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

$$(0.96 \times 9.81)(4.25 + 0.15) = P_1 - P_2$$

$$7848 \times 4.40 \Rightarrow 34531.2 \text{ N/m}^2$$

$$\Rightarrow 34.53 \text{ kN/m}^2$$