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1) Sp of gravity = 0.8

$D_1 = 0.15m$ $D_2 = 0.75m$ $Z_2 - Z_1 = 0.15m$ $Q = 0.04m^3/s$ $Cd = 0.96$

Pressure difference $(P_1 - P_2)$

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

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

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

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

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

$$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429}\right)^2 = 4.247m$$

$$h = \left(\frac{P_1}{\omega} + Z_1\right) - \left(\frac{P_2}{\omega} + Z_2\right)$$

$$h = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega}\right) + (Z_1 - Z_2)$$

$$4.247 = \left(\frac{P_1 - P_2}{P_g}\right) - 0.15$$

$$4.247 + 0.15 = \frac{P_1 - P_2}{P_g}$$

$$(4.247 + 0.15) P_g = P_1 - P_2$$

$$P_1 - P_2 = (0.8 \times 1000 \times 9.81)(4.247 + 0.15)$$

$$P_1 - P_2 = 34.5 kN/m^2$$

2) $D_1 = 0.3m$

Area of inlet $A_1 = \frac{\pi D_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

Diameter of throat $D_2 = \cancel{150}\ 0.15m$

Area of throat $= \frac{\pi D_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.01767m^2$

$Sh_e = 13.6$ (of mercury)

$S_p = 0.9$) (of liquid)

$y = 0.25m$

The differential h is then given by:

$$h = \left(\frac{P_1}{\omega} + Z_1\right) - \left(\frac{P_2}{\omega} + Z_2\right)$$

$$= y\left(\frac{Sh_e}{sp} - 1\right) = 0.25\left(\frac{13.6}{0.9} - 1\right) = 3.53m \text{ of Oil}$$

a) Discharge of oil (Q)

Applying the formula

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

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

$Q = 0.1489m^3/s$

b) Pressure difference

$$h = \left(\frac{P_1}{\omega} + Z_1\right) - \left(\frac{P_2}{\omega} + Z_2\right) = 3.53$$

$$h = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega}\right) - (Z_1 - Z_2) = 3.53$$

$Z_2 - Z_1 = 300mm$

$Z_2 - Z_1 = 0.3m$

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

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

$\left(\frac{P_1 - P_2}{\omega}\right.$

$P_1 - P_2$

$P_1 - P_2$

$$\left(\frac{P_1 - P_0}{\omega}\right) = 3 \cdot 83$$

$P_1 - P_2 = 3 \cdot 83 \times 10$

$P_1 - P_2 = 3 \cdot 82 \times 9 \cdot 81 \times 0 \cdot 9$

$= 33 \cdot 8 \text{ KN/m}^2$