EZENWATA VICTOR CHUKWUMA
17/ENG04/026
Electrical/Electronics

2i) Diameter of throat = 150mm = 0.15m
Diameter of entrance = 300mm = 0.3m
Difference in elevation of the throat section and entrance section $(z_1 - z_2)$ = 300mm = 0.3m
gauge deflection (x) = 250mm = 0.25m
coefficient of discharge (cd) = 0.98
Specific gravity of mercury (s_m) = 13.6
Specific gravity of oil (s) = 0.9

Area of throat section $(a_2) = \frac{\pi}{4} d_2^2$

$= \frac{\pi (0.10^2)}{4} = 0.0177 m^2$

Area of entrance section $(a_1) = \frac{\pi d_1^2}{4}$

$= \frac{\pi (0.5)^2}{4} = 0.077 m^2$

Difference between the pressure head at entrance section and throat section (h)

$$h = x\left(\frac{S_h}{S} - 1\right) = 0.25 \times \left(\frac{13.6}{0.9} - 1\right) = 3.52$$

i) Discharge of the oil (q_2)

$$= \frac{C_d q_1 q_2 \sqrt{2gh}}{\sqrt{q_1^2 - q_2^2}}$$

$$= \frac{0.98 \times 0.071 \times 0.0177 \times \sqrt{2 \times 9.81 \times 3.52}}{\sqrt{0.071^2 - 0.0177^2}}$$

$$= 0.149 \ m^3/s$$

ii) Pressure difference ($P_1 - P_2$)

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

$$P_1 - P_2 = (h + (z_1 - z_2))\rho g$$

$$= 3.52 - (1 - 0.3) \times (0.9 \times 9.81)$$

$$= 2842.38$$

2(i) a)

$Q = A_1 V_1 = A_2 V_2$

$V_1 = 2.27$ m/s

$V = 9.06$ m/s

using bernoulli's equation

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + z$$

$$\frac{P_1 - P_2}{\rho g} = \frac{V_2^2 - V_1^2}{2g} + 0.15$$

$$\frac{P_1 - P_2}{\rho g} = 4.27 + 0.15 = 4.42$$

$P_1 - P_2 = 4.42 \times 1000 \times 9.81 = 43701 \text{ N/m}^2$

b)

$$h = x\left(\frac{13.56}{0.8} - 1\right)$$

$4.42 = 15.875x$

$x = 278$ mm.