(2)

$d_1 = 150mm = 0.15m$

$A_1 = \frac{\pi \times 0.15^2}{4}$; $A_1 = 0.0177\ m^2$

$d_2 = 75mm = 0.075m$

$A_2 = \frac{\pi \times 0.075^2}{4} = 0.0044 m^2$

~~From Continuity equation~~

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

$$(\sqrt{2gh} =)^2 \left\{ \frac{Q(\sqrt{A_1^2 - A_2^2})}{Cd \cdot A_1 \cdot A_2} \right\}^2$$

$$h = \left(\frac{Q(\sqrt{A_1^2 - A_2^2})}{Cd \cdot A_1 \cdot A_2} \right)^2 \div 2g$$

where $Q = 40 lit/sec = 0.04\ m^3/sec$

$Cd = 0.96$

$$h = \left\{ \frac{0.04(\sqrt{0.0177^2 - 0.0044^2})}{0.96 \times 0.0177 \times 0.0044} \right\}^2 \div (2 \times 9.81)$$

$$h = \frac{84.134}{2 \times 9.81}$$

$h = 4.29$

but $h = \frac{P_1 - P_2}{\omega}$

$h = \frac{P_1 - P_2}{\rho g}$

Relative density of given liquid = $\frac{\text{Density of given liquid}}{\text{Density of water}} \times$

$\therefore$ Density of the given liquid $= 1000 \times 0.8$

$= 800$

$\therefore P_1 - P_2 = h \times \rho g$

$P_1 - P_2 = 4.29 \times 800 \times 9.81$

$P_1 - P_2 = 3.37 \times 10^4\ Nm^{-2}$

Ukadike Joseph 18/ENG07/063 Mechatronics
ENG 214

(i) $h = \frac{(13.6 - s)}{s} \times$ Head of mercury

where s = sp of oil

$h = \frac{13.6 - 0.9}{0.9} \times 250\,mm$

$h = \frac{13.6 - 0.9}{0.9} \times 0.25\,m$

$h = 3.53$

$Cd = 0.98$

$d_1 = 300mm = 03m \quad \therefore A_1 = \pi d_1^2/4 = 0.0707\,m^2$

$d_2 = 150\,mm = 0.15m \quad \therefore A_2 = \pi d_2^2/4 = 0.0177\,m^2$

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

$Q = \frac{0.98 \times 0.0707 \times 0.0177 \sqrt{2 \times 981 \times 3.53}}{\sqrt{0.0707^2 - 0.0177^2}}$

$Q = \frac{0.0102}{0.0684}$

$Q = 0.149\,m^3/sec$

(ii) $h = \frac{P_1 - P_2}{\omega}$

$h \times \omega = P_1 - P_2$

$P_1 - P_2 = 3.53 \times 900 \times 9.81$

$P_1 - P_2 = 3.116 \times 10^3\,Pa$