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**Computer Engineering**

1. $D_1$ = 150mm = 0.15m

   $D_2$ = 75mm = 0.075m

   $Z_2$ - $Z_1$ = 150mm = 0.15m

   $Q_{act}$ = 40 litres/sec = 0.04$m^3$/s

   $C_d$ = 0.96

   ***To find the difference in pressure:***

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

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

   $Q_{act} = C_d \times \frac{A1A2}{\sqrt{A1^2 - A2^2}} \times \sqrt{2gh}$

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

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

   Also,

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

   $4.247 = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) + (z_1 - z_2) = \left(\frac{P_1 - P_2}{\rho g}\right) - 0.15$

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

   $= 34\ 507.656\ N/m^2$

   $\approx$ **34.51 kN/$m^2$**

2. $D_1$ = 300 mm = 0.3m

   $D_2$ = 150 mm = 0.15m

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

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

   $S_{hl}$ = 13.6

   $S_p$ = 0.9

   $y$ = 250 mm = 0.25m

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

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

   = 3.53 m of oil

   ***To find the discharge of oil (Q):***

   Using the formula,

   $Q = C_d \times \frac{A1A2}{\sqrt{A1^2 - A2^2}} \times \sqrt{2gh}$

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

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

   $= 0.1489488922$

   $\approx$ **0.149 $m^3$/s**

   ***To find the pressure difference between the throat and entrance sections ($P_1 - P_2$):***

   Recall that,

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

And,

$Z_2 - Z_1 = 300\ mm = 0.3\ m$

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

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

$3.83 = \left(\frac{P_1 - P_2}{w}\right)$

$P_1 - P_2 = 3.83 \times (9.81 \times 0.9 \times 1000) = 33\ 815.07 \approx$ **$33.8\ kN/m^2$**