

2)  $d_1 = 300\text{mm} = 30\text{cm}$   
 $a_1 = \frac{\pi}{4} (30)^2 = 706.85\text{cm}^2$

$d_2 = 150\text{mm} = 15\text{cm}$   
 $a_2 = \frac{\pi}{4} (15)^2 = 176.7\text{cm}^2$

$Z_2 - Z_1 = 300\text{mm} = 30\text{cm}$

Sp. gr. of oil ( $S_o$ ) = 0.9

h in  $\text{H}_2\text{O}$  ( $S_g$ ) = 13.6

$x = 250\text{mm} = 25\text{cm}$

$h = x \left[ \frac{S_g}{S_o} - 1 \right] = 25 \left[ \frac{13.6}{0.9} - 1 \right] = 352.77\text{cm}$

1) discharge  $Q = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$   
 $= \frac{0.98 \times 706.85 \times 176.7}{\sqrt{(706.85)^2 - (176.7)^2}} \times \sqrt{2 \times 9.81 \times 352.77}$   
 $= \frac{101832219.9}{684.4} = 148790.5\text{cm}^3/\text{s}$   
 $= 148.79\text{L/s}$

Pressure difference  $h = \left[ \frac{P_1}{\rho g} + Z_1 \right] - \left[ \frac{P_2}{\rho g} + Z_2 \right]$

$352.77 = \left[ \frac{P_1}{\rho g} - \frac{P_2}{\rho g} \right] + Z_1 - Z_2$

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$$\frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 382.77 + 30$$

$$P_1 - P_2 = 382.77 \times \rho g \quad (\text{cm})$$

$$\text{NB: } \rho \text{ of oil} = 900 \times 1000 = 0.9 \times 1000 = 900 \text{ kg/cm}^3$$

$$\begin{aligned} P_1 - P_2 &= 382.77 \times 900 \times 9.81 \\ &= \cancel{33795} \quad 33794.76 \text{ N/m}^2 \\ &= \underline{3.3795 \text{ N/cm}^2} \end{aligned}$$

1)  $Rd = 0.8 = \sigma$   
 $\rho = \sigma \times 1000$   
 $= 0.8 \times 1000$   
 $= 800 \text{ kg/m}^3$

$d_1 = 150 \text{ mm} = 0.15 \text{ m}$   
 $d_2 = 75 \text{ mm} = 0.075 \text{ m}$   
 $Z_2 - Z_1 = 150 \text{ mm} = 0.15 \text{ m}$

$Q_a = 40 \text{ L/s} = 0.04 \text{ m}^3/\text{s}$

$C_d = 0.96$

$P_1 - P_2 = ?$

$a_1 = \frac{\pi}{4} (0.15)^2 = 0.018 \text{ m}^2$

$a_2 = \frac{\pi}{4} (0.075)^2 = 4.42 \times 10^{-3}$

$Q_A = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$

$= \frac{0.96 \times 0.018 \times 4.42 \times 10^{-3}}{\sqrt{0.018^2 - (4.42 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 0.15}$

$= 0.96 \times 0.26 \times 1.72$   
 $= 0.43$

$Q_A = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \times \sqrt{2gh}$

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$$0.004 = \frac{0.96 \times 0.018 \times 4.42 \times 10^{-3}}{\sqrt{0.018^2 + (4.42 \times 10^{-3})^2}} \times \sqrt{2gh}$$

$$= 0.96 \times 0.26 \times \sqrt{2gh}$$

$$\sqrt{2gh} = \frac{0.004}{0.2496} = 0.016$$

$$\sqrt{2gh} = 0.016^2$$

$$h = \frac{2.56 \times 10^{-4}}{2 \times 9.81}$$

$$h = 1.305 \times 10^{-5} \text{ m}$$

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