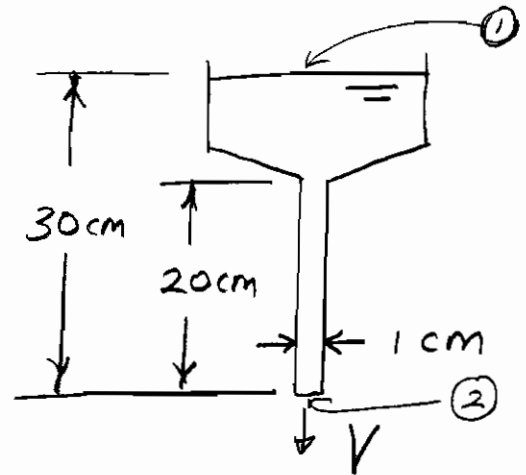


10,16 (1)

GIVEN: GLYCERINE FLOWING
THROUGH A FUNNEL
($T = 20^\circ\text{C}$)

FIND: V



SOLUTION: WRITE EXTENDED BERNOULLI EQUATION
FROM SURFACE OF GLYCERINE TO EXIT OF FUNNEL.

$$\frac{p_1}{\gamma} + z_1 + \alpha_1 \frac{V_1^2}{2g} = \frac{p_2}{\gamma} + z_2 + \alpha_2 \frac{V_2^2}{2g} + h_L$$

ASSUME LAMINAR FLOW: $\Rightarrow \alpha_2 = 2$, $h_L = \frac{32\mu L V}{\gamma D^2}$
(CHECK LATER)

$$\frac{V^2}{g} + \frac{32\mu L}{\gamma D^2} V + z_2 - z_1 = 0 \quad \gamma = \rho g$$

$$V^2 + \frac{32\mu L}{D^2} V - gH = 0 \quad \gamma = \frac{\mu}{\rho}$$

$$H = 0.3 \text{ m} \quad L = 0.2 \text{ m} \quad \mu = 1.12 \times 10^{-3} \frac{\text{m}^2}{\text{s}}$$

$$D = 0.01 \text{ m}$$

USE QUADRATIC FORMULA

$$V = \frac{1}{2} \left\{ -\frac{32\mu L}{D^2} + \sqrt{\left(\frac{32\mu L}{D^2}\right)^2 + 4gH} \right\}$$

10.16 (2)

$$V = \frac{1}{2} \left\{ -\frac{32 (.00112)(.2)}{(.01)^2} \pm \sqrt{\left(\quad \right)^2 + 4(9.8)(0.3)} \right\}$$

$$V = \frac{1}{2} \left\{ -71.68 \quad \pm \quad 71.76 \right\}$$

↑
USE + ROOT

$$V = 0.041 \text{ m/s} \quad = \quad \underline{4.1 \text{ cm/s}}$$

10.23

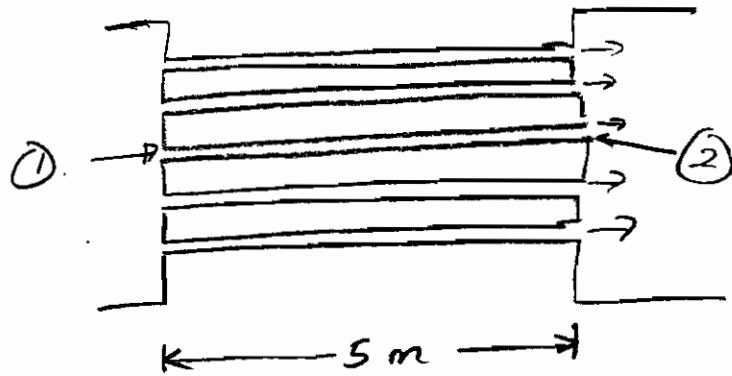
GIVEN: WATER IS PUMPED THROUGH A HEAT EXCHANGER AS SHOWN.

$$D = 5 \text{ mm}$$

$$V = 12 \text{ cm/s}$$

TEMPERATURE AT ENTRANCE IS 20°C ,
 " " " EXIT " 30°C ,

FIND: PRESSURE DIFFERENCE ACROSS THE HEAT EXCHANGER.



SOLUTION: APPLY EXTENDED BERNOULLI FROM ENTRANCE TO EXIT

$$\frac{p_1}{\gamma} + \cancel{z_1} + \cancel{\alpha_1} \frac{V_1^2}{2g} = \frac{p_2}{\gamma} + \cancel{z_2} + \cancel{\alpha_2} \frac{V_2^2}{2g} + h_L$$

$$p_1 - p_2 = \gamma h_L$$

CHECK Re TO SEE IF FLOW IS LAM. OR TURB.

$$Re = \frac{DV}{\nu} \quad \text{at } 25^\circ\text{C} \rightarrow \nu = 8.94 \times 10^{-7} \frac{\text{m}^2}{\text{s}}$$

$$Re = \frac{(0.005)(.12)}{8.94 \times 10^{-7}} = 671 \Rightarrow \text{FLOW IS LAMINAR}$$

$$\Rightarrow h_L = \frac{32 \mu L V}{\gamma D^2}$$

$$p_1 - p_2 = \frac{32 \mu L V}{D^2} = \frac{32 (8.91 \times 10^{-4}) (5) (.12)}{(0.005)^2}$$

$$p_1 - p_2 = 684 \text{ Pa}$$