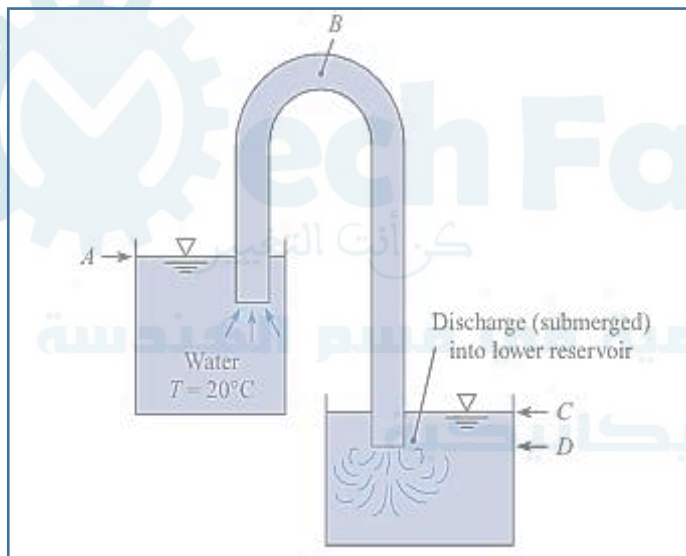


The elevations of points A,B,C and D respectively are 32 m , 34 m , 29 m , 28 m. And the pipe diameter is 20 cm
 the head losses between point A and point B is half the velocity head.
 And the head losses between point B and point D is half of the velocity head
 calculate:-

- A) Discharge B) pressure at point B C) pressure at point D
- D) the force on the bend E) Draw EL and HGL lines



The solution:-

Head losses between A and B

$$h_L = \frac{1}{2} \left(\frac{v^2}{2g} \right)$$

Head losses between B and D

$$h_L = \frac{1}{2} \left(\frac{v^2}{2g} \right)$$

1) Energy equation between A and C ($P_A = 0$ $P_C = 0$) ($v_A = 0$ $v_C = 0$)

$$\frac{P_A}{\gamma} + z_A + \frac{v_A^2}{2g} \equiv \frac{P_C}{\gamma} + z_C + \frac{v_C^2}{2g} + \sum h_L$$

$$0 + 32 + 0 = 0 + 29 + 0 + \frac{v^2}{2g}$$

$$\frac{v^2}{2g} = 3 \quad \text{---->} \quad v = \sqrt{6g}$$

$$v = 7.67 \frac{m}{s}$$

$$Q = vA = 7.67 \left(\frac{\pi}{4} \right) (0.2)^2 = 0.24 \text{ m}^3/\text{s}$$

2) Energy equation between A and B

$$\frac{P_A}{\gamma} + z_A + \frac{v_A^2}{2g} = \frac{P_B}{\gamma} + z_B + \frac{v^2}{2g} + \frac{1}{2} \left(\frac{v^2}{2g} \right)$$

$$0 + 32 + 0 = \frac{P_B}{\gamma} + 34 + \frac{3}{4} \frac{v^2}{g}$$

$$\frac{P_B}{\gamma} = -2 - \frac{3}{4} \left(\frac{7.67^2}{9.81} \right)$$

$$P_B = (9810)(-6.5) = -63741.67 \text{ Pa}$$

$$3) P_D = \gamma(z_C - z_D) = (9810)(29 - 28) = 9810 \text{ Pa}$$

$$4) F_y = \rho Q(v_0 - v_i) = 1000(0.24)(-7.67 - 7.67)$$

$$F_y = -3681.6 \text{ N}$$

But force on bend is opposite in direction with force on fluid so:

$$F_y = 3681.6 \text{ N (upward)}$$

