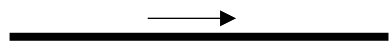
Water flows at 10 L/min through a horizontal 15 mm diameter tube. The pressure drop along a 20 m length of tube is 85 kPa. Calculate the head loss in meters.



SOLUTION:
Apply the Extended Bernoulli Equation from one end of the tube to the other,

$$\left(\frac{p}{\rho g}+\alpha\frac{\bar{V}^2}{2g}+z\right)_2=\left(\frac{p}{\rho g}+\alpha\frac{\bar{V}^2}{2g}+z\right)_1-H_{L,12}+H_{S,12} \quad (1)$$

where,

$\Delta p = p_2 - p_1 =$ -85 kPa,

$\left(\alpha\frac{\bar{V}^2}{2g}\right)_2=\left(\alpha\frac{\bar{V}^2}{2g}\right)_1$ (the mass flow rate and pipe diameter are constant)

The flow is turbulent at both locations: $\mathrm{Re}_D=\frac{\bar{V}D}{\nu}=\frac{4Q}{\pi D\nu}=$ 7860 so $\alpha_2 \approx \alpha_1 \approx 1$ ($\nu = 1.8*10^{-6}$ m^2/s).

$z_2 = z_1$,

$H_{S,12} = 0$.

Substitute and solve for the head loss,

$$\frac{\Delta p}{\rho g}=-H_{L,12} \Rightarrow H_{L,12}=-\frac{\Delta p}{\rho g}. \quad (2)$$

Using the given data,

$\Delta p =$ -85 kPa,

$\rho = 1000$ kg/m^3,

$g = 9.81$ m/s^2,

=> $\boxed{H_{L,12} = 8.66\text{ m}}$