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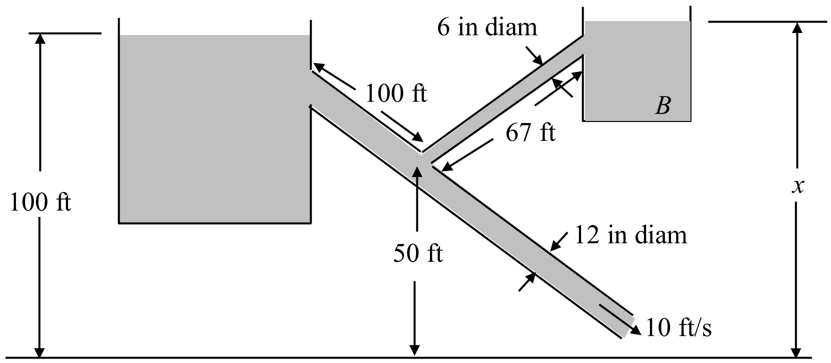

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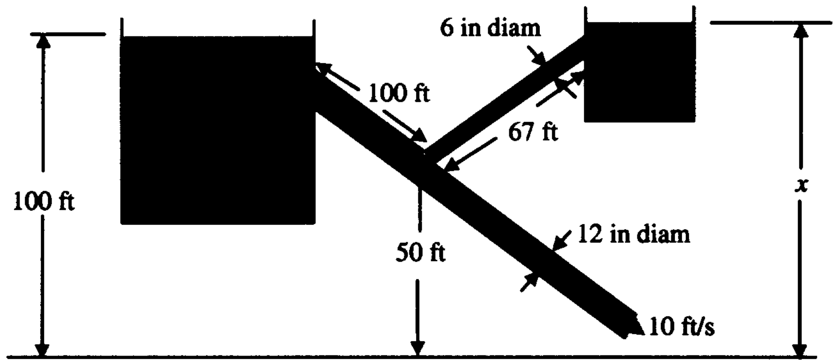
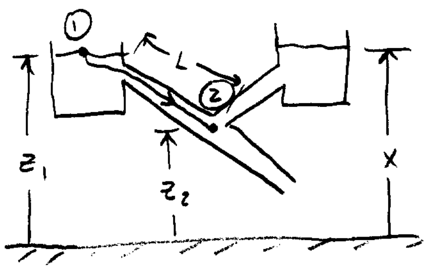


SOLUTION:

- Apply the Extended Bernoulli Eqn from 1 to 2:



$$\left(\frac{p}{\rho g}+\alpha\frac{\bar{V}^2}{2g}+z\right)_2=\left(\frac{p}{\rho g}+\alpha\frac{\bar{V}^2}{2g}+z\right)_1-H_{L_{1\to2}}+H_{S_{1\to2}}$$

where $p_1 = 0$ (gage)

$p_2 = \rho g(x-\cancel{z_2})$ 50ft (gage) (from hydrostatics)

$\bar{V}_2 = 10\,\mathrm{ft/s}$ (assume turbulent flow $\Rightarrow \alpha_2 \approx 1$)

$\bar{V}_1 \approx 0$

$z_1 = 100\,\mathrm{ft}$

$z_2 = 50\,\mathrm{ft}$

$H_{S_{1\to2}} = 0$

from tables $K_{\text{sharpedged entrance}} = 0.5$

$$H_{L_{1\to2}} = K_{\text{viscous}}\frac{\bar{V}_2^2}{2g} + K_{\text{entrance}}\frac{\bar{V}_2^2}{2g}$$

where $K_{\text{viscous}} = f\left(\frac{L}{D}\right)$

with $f = 0.0195$ (from Moody chart)

$Re_D = \frac{\bar{V}_2 D}{\nu} = \frac{(10\,\mathrm{ft/s})(1\,\mathrm{ft})}{(1.08\times10^{-5}\,\mathrm{ft^2/s})} = 924{,}000$ (turbulent flow!)

$\epsilon/D = \frac{0.00085\,\mathrm{ft}}{1\,\mathrm{ft}} = 0.00085$

$L = 100\,\mathrm{ft}$
$D = 1\,\mathrm{ft}$
$\Rightarrow K_{\text{viscous}} = 1.95$

SOLUTION...

- Substitute and simplify :

$$(x - z_2) + \frac{\bar{V}_2^2}{2g} + z_2 = z_1 - (K_{viscous} + K_{entrance}) \frac{\bar{V}_2^2}{2g}$$

$$\Rightarrow \quad x = z_1 - (K_{viscous} + K_{entrance} - 1) \frac{\bar{V}_2^2}{2g}$$

For $z_1 = 100\,ft$

$K_{viscous} = 1.95$

$K_{entrance} = 0.5$

$\bar{V}_2 = 10\,ft/s$

$g = 32.2\,ft/s^2$

$$\Rightarrow \boxed{x = 97.7\,ft}$$

NOTE:
Entrance loss is not negligible compared to viscous loss.