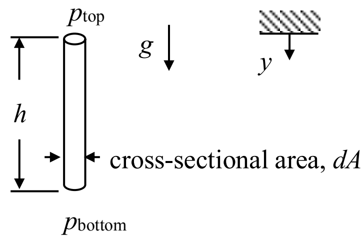
Assuming that air is incompressible, determine the height of a column of air required to give a pressure difference of 0.1 psi. Assume that the density of air is $2.38*10^{-3}$ slug/ft^3.

SOLUTION:

Assuming air as being incompressible:

$$p_{\text{bottom}} = p_{\text{top}} + \rho_{\text{air}} g h$$

$$\boxed{h = \frac{p_{\text{bottom}} - p_{\text{top}}}{\rho_{\text{air}} g}}$$



For:

$p_{\text{bottom}} - p_{\text{top}}$ = 0.1 psi = 14.4 $\text{lb}_\text{f}/\text{ft}^2$
ρ_{air} = 2.38×10^{-3} slug/ft^3
g = 32.2 ft/s^2

gives:

$\boxed{h = 188\text{ ft}}$

Hence, very large elevation differences must occur to give appreciable differences in pressure when dealing with atmospheric air (or gases in general).

Another way to determine the height, *h*, is to perform a vertical force balance on the column.

$$\sum F_y = 0 = -p_{\text{bottom}} dA + p_{\text{top}} dA + \rho_{\text{air}} g h dA$$

$$h = \frac{p_{\text{bottom}} - p_{\text{top}}}{\rho_{\text{air}} g} \quad \text{(Same answer as above!)}$$