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## Problem 23.12 (RHK)

An open-closed pipe of length $L=25.0 \mathrm{~m}$ contains air at atmospheric pressure. It is thrust vertically into a fresh water lake until the water rises halfway up in the pipe. We have to find the depth $h$ of the lower end of the pipe. We may assume that the temperature is the same everywhere and does not change.


## Solution:

It is given that an open-closed pipe of length $L=25.0 \mathrm{~m}$ contains air at atmospheric pressure. It is thrust vertically into a freshwater lake until the water rises halfway up in the pipe.

As the air inside the pipe has been compressed to half of its initial value at constant temperature, the pressure
inside it would have become double of its initial value, that is, 2.0 atm .

Pressure at depth $h-L / 2$ will therefore be 2.0 atm . At that the depth the pressure will be

$$
\begin{aligned}
& 1.0 \mathrm{~atm}+\rho_{\text {water }} g(h-L / 2) \\
& =\left(1.01 \times 10^{5}+1.0 \times 10^{3} \times 9.8 \times(h-12.5)\right) \mathrm{Pa}
\end{aligned}
$$

We have the condition

$$
\begin{aligned}
& (h-12.5) \mathrm{m}=\frac{1.01 \times 10^{5}}{1.0 \times 10^{3} \times 9.8} \mathrm{~m} \\
& \text { and } \\
& h=22.8 \mathrm{~m} .
\end{aligned}
$$

