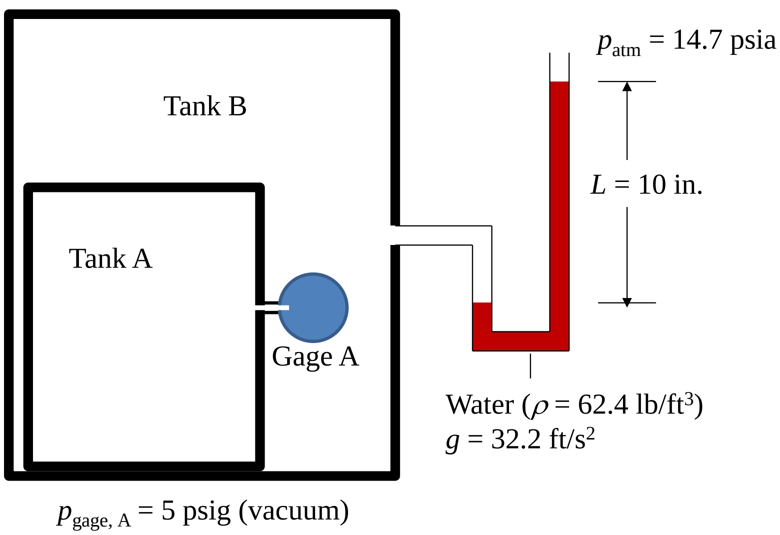
1.37 Figure P1.37 shows a tank within a tank, each containing air. Pressure gage A, which indicates pressure inside tank A, is located inside tank B and reads 5 psig (vacuum). The U-tube manometer connected to tank B contains water with a column length of 10 in. Using data on the diagram, determine the absolute pressure of the air inside tank B and inside tank A, both in psia. The atmospheric pressure surrounding tank B is 14.7 psia. The acceleration of gravity is g = 32.2 ft/s^2.

KNOWN: A tank within a tank, each containing air.

FIND: Absolute pressure of air in tank B and in tank A, both in psia.

SCHEMATIC AND GIVEN DATA:



ENGINEERING MODEL:
1. The gas is a closed system.
2. Atmospheric pressure is exerted at the open end of the manometer.
3. The manometer fluid is water with a density of 62.4 lb/ft^3.

ANALYSIS:
(a) Applying Eq. 1.11

$$p_{gas,B} = p_{atm} + \rho g L$$

where p_{atm} is the local atmospheric pressure to tank B, ρ is the density of the manometer fluid (water), g is the acceleration due to gravity, and L is the column length of the manometer fluid. Substituting values

$$p_{gas,B} = 14.7\frac{\text{lbf}}{\text{in.}^2} + \left(62.4\frac{\text{lb}}{\text{ft}^3}\right)\left(32.2\frac{\text{ft}}{\text{s}^2}\right)(10\text{ in.})\left|\frac{1\text{ lbf}}{32.2\frac{\text{lbm}\cdot\text{ft}}{\text{s}^2}}\right|\left|\frac{1\text{ ft}^3}{1728\text{ in.}^3}\right| = \underline{\mathbf{15.1\ lbf/in.^2}}$$

Since the gage pressure of the air in tank A is a vacuum, Eq. 1.15 applies.

$$p(\text{vacuum}) = p_{atm}(\text{absolute}) - p(\text{absolute})$$

The pressure of the gas in tank B is the local atmospheric pressure to tank A. Solving for p (absolute) and substituting values yield

$$p(\text{absolute}) = p_{atm}(\text{absolute}) - p(\text{vacuum}) = 15.1 \text{ psia} - 5 \text{ psig} = \underline{\mathbf{10.1 \text{ psia}}}$$