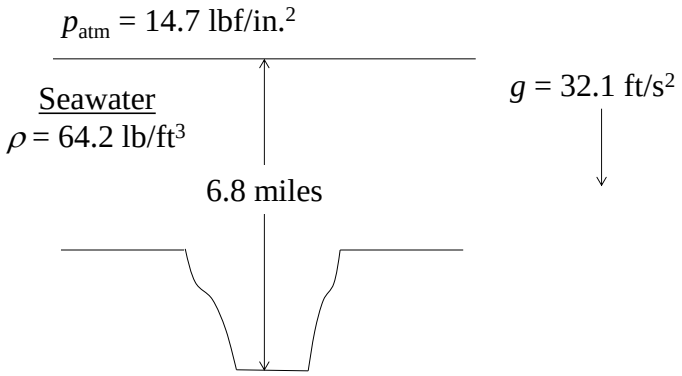
1.31 The Mariana Trench in the western Pacific Ocean includes the greatest known ocean depth at approximately 6.8 miles. The atmosphere exerts a pressure of 14.7 lbf/in.^{2} at the ocean surface. Modeling the ocean seawater as static and assuming constant local acceleration of gravity of 32.1 ft/s^2 and constant seawater density of 64.2 lb/ft^3, determine the absolute pressure, in lbf/in.^{2}, at this depth.

KNOWN: The Mariana Trench in the western Pacific Ocean includes the greatest known ocean depth.

FIND: The absolute pressure at the greatest depth in the Mariana Trench.

SCHEMATIC AND GIVEN DATA:



ENGINEERING MODEL:
1. Local gravitational acceleration is 32.1 ft/s^2.
2. Seawater density is constant at 62.4 lb/ft^3.
3. The ocean seawater is modeled as static.

ANALYSIS: The pressure acting at the bottom of the Mariana Trench at a depth of 6.8 miles is

$$p = p_{atm} + \rho g L$$

Substituting values and applying unit conversions yield

$$p = 14.7 \frac{\text{lbf}}{\text{in.}^2} + \left(64.2 \frac{\text{lb}}{\text{ft}^3}\right)\left(32.1 \frac{\text{ft}}{\text{s}^2}\right)(6.8 \text{ mi})\left|\frac{5280 \text{ ft}}{\text{mi}}\right|\left|\frac{1 \text{ ft}^2}{144 \text{ in.}^2}\right|\left|\frac{1 \text{ lbf}}{32.174 \frac{\text{lb} \cdot \text{ft}}{\text{s}^2}}\right| = \underline{\mathbf{15{,}985 \text{ lbf/in.}^2}}$$