1.26 Referring to Fig. 1.7,
(a) if the pressure in the tank is 1.5 bar and atmospheric pressure is 1 bar, determine L, in m, for water with a density of 997 kg/m^3 as the manometer liquid. Let g = 9.81 m/s^2.
(b) determine L, in cm, if the manometer liquid is mercury with a density of 13.59 g/cm^3 and the gas pressure is 1.3 bar. A barometer indicates the local atmospheric pressure is 750 mmHg. Let g = 9.81 m/s^2.

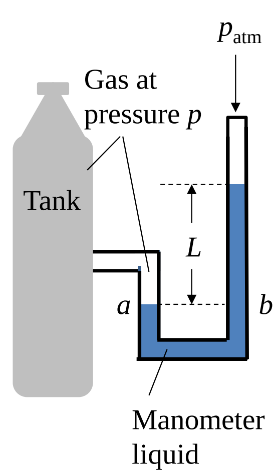
KNOWN: A manometer is attached to a tank containing a gas.

FIND: L considering two different manometer liquids with associated gas pressures.

SCHEMATIC AND GIVEN DATA:

(a) $p_{\text{gas}} = 1.5$ bar
$p_{\text{atm}} = 1$ bar
$\rho_{\text{water}} = 997$ kg/m^3

(b) $p_{\text{gas}} = 1.3$ bar
$p_{\text{atm}} = 750$ mmHg
$\rho_{\text{mercury}} = 13.59$ g/cm^3



ENGINEERING MODEL:
1. Local gravitational acceleration is 9.81 m/s^2.

ANALYSIS:
(a) We have $p_a = p_{\text{gas}}$ and $p_a = p_b$. p_b is evaluated using Eq. 1.11. Collecting results,

$$p_{\text{gas}} = p_{\text{atm}} + \rho_{\text{w}} g L$$

where $\rho_{\text{w}} = 997$ kg/m^3 and $g = 9.81$ m/s^2.

Solving for L

$$L = \frac{p_{\text{gas}} - p_{\text{atm}}}{\rho_{\text{w}} g} = \frac{(1.5-1)\text{ bar}}{\left(997\,\frac{\text{kg}}{\text{m}^3}\right)\left(9.81\,\frac{\text{m}}{\text{s}^2}\right)}\left|\frac{10^5\,\frac{\text{N}}{\text{m}^2}}{1\,\text{bar}}\right|\left|\frac{1\,\frac{\text{kg}\cdot\text{m}}{\text{s}^2}}{1\,\text{N}}\right| = \underline{\mathbf{5.11\ m}}$$

(b) First solve for p_{atm} with L = 750 mmHg and $\rho_{\text{mercury}} = 13.59$ g/cm^3.

$$p_{\text{atm}} = \rho_{\text{mercury}} g L$$

$$p_{\text{atm}} = \left(13.59\,\frac{\text{g}}{\text{cm}^3}\right)\left|\frac{1\,\text{kg}}{10^3\,\text{g}}\right|\left|\frac{10^2\,\text{cm}}{1\,\text{m}}\right|^3\left(9.81\,\frac{\text{m}}{\text{s}^2}\right)(750\,\text{mmHg})\left|\frac{1\,\text{m}}{10^3\,\text{mm}}\right|\left|\frac{1\,\text{N}}{1\,\frac{\text{kg}\cdot\text{m}}{\text{s}^2}}\right| = 10^5\ \text{N/m}^2$$

Following the approach of part (a) and solving for L

$$L = \frac{p_{\text{gas}} - p_{\text{atm}}}{\rho_{\text{w}} g} = \frac{(1.3-1)\,\text{bar}}{\left(13.59\,\frac{\text{g}}{\text{cm}^3}\right)\left(9.81\,\frac{\text{m}}{\text{s}^2}\right)}\left|\frac{10^3\,\text{g}}{1\,\text{kg}}\right|\left|\frac{1\,\text{m}}{10^2\,\text{cm}}\right|^3\left|\frac{10^5\,\frac{\text{N}}{\text{m}^2}}{1\,\text{bar}}\right|\left|\frac{1\,\frac{\text{kg}\cdot\text{m}}{\text{s}^2}}{1\,\text{N}}\right|\left|\frac{100\,\text{cm}}{1\,\text{m}}\right| = \underline{\mathbf{22.5\ cm}}$$