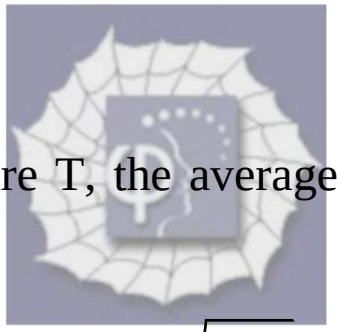
225.

Problem 20.57P (HRW)

Two containers are at the same temperature. The first contains gas with pressure p_1, *molecular mass* m_1, *and root mean square speed* v_{rms1}. *The second contains gas with pressure* $2p_1$, *molecular mass* m_2, *and average speed . We have to find the mass ratio* m_1/m_2.

Solution:



At temperature T, the average speed $\bar{v}$ is given by the relation

$$\bar{v} = \sqrt{\frac{8kT}{\pi m}},$$

where *m* is molecular mass. And the root-mean-square rms) speed v_{rms} is given by

$$v_{rms} = \sqrt{\frac{3kT}{m}}.$$

We have been given that

$$\bar{v}_2 = 2v_{rms1}.$$

This implies that

$$\sqrt{\frac{8kT}{\pi m_2}} = \sqrt{\frac{3kT}{m_1}},$$

or

$$\frac{8kT}{\pi m_2} = \frac{4 \times 3kT}{m_1},$$

or

$$\frac{m_1}{m_2} = \frac{3\pi}{2} = 4.71$$