This problem is part of your written homework for chapter 18.

The diameter of an atom is about 1 angstrom (\(10^{-10}\) m). In order to develop some intuition for the molecular scale of a gas, assume that you are considering 1 liter of air (mostly \(\text{N}_2\) and \(\text{O}_2\), with molar masses of 28 g/mol and 32 g/mol respectively) at room temperature and atmospheric pressure (about \(10^5\) Pa). As always, be sure to show your work and explain your reasoning.

a) Calculate the number of molecules in this sample of air.

b) Estimate the average spacing between the molecules.

c) Estimate the average speed of a molecule based on the Maxwell-Boltzmann distribution. Convert your answer to miles per hour.

d) Suppose that we scale up the gas so that each atom is the size of a tennis ball. We also scale up the spaces between the atoms proportionally. Now what would be the average spacing between molecules? What would be the mass of a single molecule (assuming that the density of a molecule remains the same)?