

April 9, 2002

CH 342 S02, Homework 8

due Monday, April 15, 2002

This assignment will be covered in class. No late assignments will be accepted.

Those questions marked with a * must be done using a computational package.

Gas Dynamics

1. Calculate the collision frequency and mean free path for H_2 and N_2 at $25\text{ }^\circ\text{C}$. Use 1 mole of the gases at 1 bar pressure.
2. Calculate the collision flux for H_2 and N_2 at $25\text{ }^\circ\text{C}$. Use 1 mole of the gases at 1 bar pressure.
Extra Credit: Determine how many H_2 molecules strike a 1 cm^2 surface area in 1 second at pressures of 1 bar, 1 Pa, and 10^{-6} Pa.
3. Calculate values of diffusion coefficient, thermal conductivity, and viscosity for N_2 at $25\text{ }^\circ\text{C}$ using simple kinetic theory. Use 1 mole of the gas at 1 bar pressure.
4. A soda straw that is 15 cm long and 3 mm in diameter is used to pull air into a person's lungs. The measured flowrate of air at $25\text{ }^\circ\text{C}$ and 1 bar into the straw is 0.25 L/s. The pressure at the inlet of the straw remains constant at 1 bar. Determine the pressure at the end of the straw in the person's mouth. Use the viscosity of an ideal gas at 1 bar and $25\text{ }^\circ\text{C}$. *Lifelong Learning Lesson:* This question should give you an idea of how measurements can be made to determine how strong a person's lungs are (how well they can draw in air). A person with asthma has a reduced lung capacity (volume) and a reduced ability to draw in air (reduced inlet pressure).
Extra Credit: * Plot the Maxwell distribution of speeds for H_2 and N_2 at $25\text{ }^\circ\text{C}$. Put curves for both gases on one plot.