Problems on kinetic theory of gases

1. A gas consists of a mixture of hydrogen molecules and helium atoms. Compute their average speeds, their rms speeds and their most probable speeds, for temperature T=300K.

2. Derive the formula for the most probable speed of a molecule in a gas.

3. In a gas of helium atoms at 300 K, there are 10,000 atoms that have velocity in the x direction between -1m/s and 1m/s. Approximately how many atoms have velocity in the y direction between 100m/s and 101m/s?

4. At what temperature is the average speed of a nitrogen molecule (M=28g/mole) 600 m/s?

5. For a gas at temperature T, the most probable speed of the molecules is v_0. For what temperature is the average speed v_0?

6 At what temperature do oxygen molecules have the same rms speed as helium atoms have at 300K?

7. Compute the average value of $|v_x|$ for an ideal gas. How does it compare to the average speed?

8. Assume there is a very small hole in the wall of a container that contains an ideal gas. Show that the mean kinetic energy of the molecules that escape is larger than 3/2 kT. What is it?