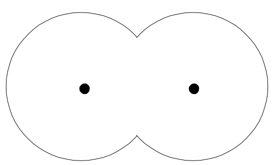
CHEM441-001/002
College of Charleston
Fall 1999
Exam II

Some general data for O_2(g): a = 1.38 bar L^2 mol^{-2}, b = 0.0317 L mol^{-1}; P_c = 50.8 bar,
T_c = 154.8 K; O=O bond length = 121.1 pm; M = 32.00 g mol^{-1}

1(10). A student looked up the van der Waals constants for HCl(g) and compared them to the values given above for O_2(g).
Is the value of a for HCl greater or less than that for O_2? Why?

Does the value of b = 0.0408 L mol^{-1} for HCl imply that HCl is a larger molecule than O_2?

2(15). Using the value of b given above, calculate the "collision radius" of O_2. Show that this value is greater than the bond length by correctly indicating both distances on the sketch.



3(15). The 1.25-dm^3 "bomb" in a calorimeter was filled with 40.4 g of O_2(g) at 25 ^oC. Calculate the pressure of the gas (expressed in bar) using the
A) ideal gas law

B) the law of corresponding states (Hougen-Watson-Ragatz plot attached)

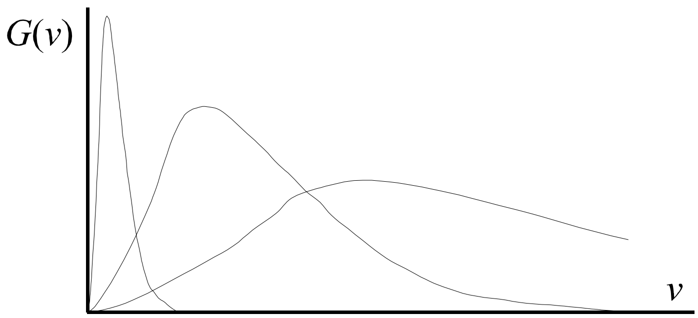
4(15). Calculate the v_{rms} for a fog particle of mass 3×10^{-20} g at 15 ^oC and 1 bar. Compare the value to a typical molecular speed.

What would be the v_{rms} of the particle at 0.1 bar?

5(15). A wall of a container is struck by 1.0×10^{23} O_2 molecules each second. What is the total force exerted on the wall if the speed of the molecules is 450 m s^{-1}? Calculate the pressure (expressed in Pa) if the area of the wall is 10.0 cm^2. (Note that 1 N = 1 kg m s^{-2})

6(10). The three curves shown in the diagram represent a gas at a very low temperature, the same gas at a moderate temperature, and a second, higher molar mass gas at the same moderate temperature. Match each curve to the appropriate gas/temperature information by drawing a line from each set of information to the respective curve.

Lower molar mass, very low temperature
Lower molar mass, moderate temperature
Higher molar mass, moderate temperature



7(20). To prepare for this examination a student decided to derive the expression for $\left(\overline{v^3}\right)^{1/3}$ for an ideal gas by finding $\overline{v^3}$ first and then taking the cube root. Carry out this derivation.