

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

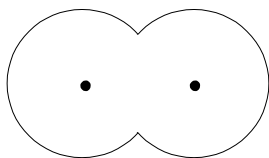
Some general data for $O_2(g)$: $a = 1.38 \text{ bar L}^2 \text{ mol}^{-2}$, $b = 0.0317 \text{ L mol}^{-1}$; $P_c = 50.8 \text{ bar}$,
 $T_c = 154.8 \text{ K}$; O=O bond length = 121.1 pm; $M = 32.00 \text{ g mol}^{-1}$

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 $b = 0.0408 \text{ L mol}^{-1}$ 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°C . 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 $3 \times 10^{-20} \text{ g}$ at 15°C 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 $1 \text{ N} = 1 \text{ kg m s}^{-2}$)

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.

