Name: ____

Discussion Session 6
KMTG and Real Gases

Useful equations:

$$\left[P_{obs} + a\left(\frac{n}{V}\right)^2\right](V - nb) = nRT$$

$$\frac{\text{Rate of effusion of gas 1}}{\text{Rate of effusion of gas 2}} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$$

$$Z = 4\frac{N}{V}d^2\sqrt{\frac{\pi RT}{M}}$$

$$\lambda = \frac{1}{\sqrt{2}\left(N/V\right)\left(\pi d^2\right)}$$

1. Before they were banned to protect the ozone layer, Freon-11 and Freon-12 were used as refrigerants in central home air conditioners. The rate of effusion of Freon-12 to Freon-11 (molar mass = 137.4 g/mol) is 1.07:1. The formula of Freon-12 is one of the following: CF_4, CF_3Cl, CF_2Cl_2, $CFCl_3$, or CCl_4. Which is the correct formula for Freon-12?

2. Two different samples of xenon gas, each containing a different number of particles, are held in 1.00 L containers at 300. K. Sample 1 contains 5.00 moles of gas and Sample 2 contains 0.0100 moles of gas. Calculate the pressures of the two samples using (a) the Ideal Gas Law and (b) the Van der Waals equation for real gases (the Van der Waals constants for Xe are: a = 4.19 atm L^2 mol^{-2} and b = 0.0511 L/mol). Which of the two samples behaves more ideally?

3. A sample of helium gas with a pressure of 3.0 atm occupies a volume of 5.0 L at 27 ˚C. A second sample at the same temperature and volume has a pressure of only 3.0×10^{-6} atm. Calculate the intermolecular collision frequency and the mean free path for each sample. Are the results consistent with what you would expect? Explain.

   (Use d = 50 pm, where 1 pm = 10^{-12} m.)