PROBLEM SET 2

CHM 3400, Dr. Chatfield, Fall 2011
Due Thursday, Sept 15

Note: One is to use the perfect gas equation for problems in Atkins unless otherwise specified.

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1. One mole of N_2, initially at a pressure of 10 bar and a temperature of 10^oC, is expanded isothermally against a piston exerting a constant external pressure of 0.4 bar until the pressure of the gas is also equal to 0.4 bar. Determine the work done during expansion. Treat the gas as a perfect gas.

2. One mole of N_2, initially at a pressure of 10 bar and a temperature of 10^oC, is again expanded isothermally against a piston. This time, however, the external pressure is varied so that at all times it is equal to the internal pressure, i.e. the pressure of the N_2. Expansion is continued until the pressure is 0.4 bar. Compute the work, treating the N_2 as a perfect gas, and compare to the result in question 1.

3. Atkins, exercise 2.23 (2.32 in 4^{th} ed)

4. Atkins, exercise 2.24 (2.33 in 4^{th} ed)

5. Atkins, exercise 3.5

6. Atkins, exercise 3.6 (3.10 in 4^{th} ed)

7. Atkins, exercise 3.22 (3.26 in 4^{th} ed)

8. Atkins, exercise 2.30 (2.37 in 4^{th} ed; theoretical question, more challenging).

9. Return to the situation described in question 2. Compute the work again, but this time treat N_2 as a van der Waals gas. The parameters *a* and *b* are given in Chapter 1. (Hint: You cannot now use the equation $w = -nRT \ln V_f/V_i$. You will need to derive a new equation.) Compare with the result in part a. [Hint: Calculating the work with the equation you derive can be tricky because you need to know the initial and final volumes, but you are given the pressures instead. One way to get V with the van der Waals equation, given p and T, is to start with a good *guess* for V (e.g. from the perfect gas equation). Plug that into the van der Waals equation and solve for p. If the p is incorrect, increase or decrease V a little and recalculate. Do this a few times until you get very close to the actual p; then you have a good value for V. This can be done very quickly using Excel.]