**Department of Physics, University of Maryland, College Park, MD 20742-4111**

***Physics 404*** **HOMEWORK ASSIGNMENT #5** **Spring 2009**

**Due date:** Tuesday, March 24 **Deadline:** Thursday, March 26

B means a problem in Blundell & Blundell's text; GT means a problem in Gould & Tobochnik.

Based on how far we get in class on March 12, problem 9 is deferred to Assignment #6.

1. B 16.2

2. B 16.4 Hints: Part a) is rather trivial but gets you set up for part b), where you seek $(\partial U/\partial V)_T$; you must then use a Maxwell relation. To finish the problem, use the standard calculus formula for d [f(x)/g(x)]/dx to find $(\partial(p/T)/\partial T)_V$ and compare with the equation you have after invoking the Maxwell relation.

3. B 16.6 & 16.7, counts as one problem. Start with Eq. 16.82 and use the relation between $C_P$ and $C_V$ for an ideal gas. Note the similarity to GT Problem 2.22a (GT, p. 72). In 16.7, it is easier to take ρ as the number density rather than the mass density. [Taking ρ as the mass density changes the constant by $C_V \ln (m^\gamma)$, where m is the mass per gas molecule, so eqn. 16.93 is correct with either definition of ρ.]

4. B 17.2

5. B 17.3 When expanding, use $\ln(1 \pm x) \approx \pm x - x^2/2$; omitting the second term gives an answer that is off by a factor of 2.

6. B 5.2

7. B 5.4

8. B 6.5

Clarifications:

a) Use cos θ sin θ as the probability or weighting function. So in the numerator is this function times cos θ while in the denominator is just integral of the function (to normalize). Be careful to use only the range of angles corresponding to atoms that hit the surface.

b) For all the molecules the weighting function $\propto v^2\exp(-\beta m v^2/2)$, so in the denominator is the integral of this while in the numerator is the integral of the kinetic energy (or just $v^2$, adding m/2 afterwards); or you can just use the normalized Maxwell-Boltzmann f(v). For the second part, you want to do the same sort of average but with the modified weighting function given in the problem rather than simply f(v). Since there is no q dependence in $v^2$, the angular integration is the same in numerator and denominator and so cancels out.

~~9. B 7.1 Assume that the residual gas is $N_2$ and that you are at room temperature. Express your answer in Pa, mbar, and Torr.~~

Regarding the idea of availability, you might find the last part of §2.21 of GT to be enlightening. Also take a look at GT, p. 77, Problem 2.25 (not assigned). (Translations of GT's notation to B^2's: $E \rightarrow U$, $_{\text{bath}} \rightarrow\ _0$