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Physics 404 **HOMEWORK ASSIGNMENT #8** **Spring 2009**

Due date: Tuesday, April 21 **Deadline:** Thursday, April 23

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

1. B 21.4 Note that eq. 21.48 should read $Z = (Z_{atom})^N Z_N$.

2. B 22.2

3. B 22.6, parts a and b up to eq. 22.97. (You do NOT need to do the evaluation at 1000K.) Assume the H atom has single bound state with energy R. (Not my choice of notation for a characteristic energy!) You should also assume that the mass of H is essentially the same as that of a proton. (You do not then need to discuss assumptions.) Note that the result of B 22.5, which you need to use, is a 2-liner, once you fix the typo N1 to the correct N!. You plug into $F = k_B T \ln Z_N$, use Stirling's approximation, use eq. 22.6, and combine the ln's.
   This problem makes use of eq. 21.50 from problem 21.6 (as is stated in the problem). The solution to problem B 21.6 starts with eq. 21.19, then ignores excited states and sets the zero of energy at -R to get this result. I.e. the lowest energy state is at -R and kinetic energy adds to that in the same way it added to 0 to get 21.19. Note that $e^{\beta R}$ is in the argument of the logarithm: $\ln[(Z_1{}^H/N_H)e^{\beta R}]$.

4. For the chemical reaction $2H_2 + O_2 \rightarrow 2H_2O$ (in gas phase), find the equilibrium constant *K* in terms of partial pressures (cf. eq. 22.81) and in terms of the change in molar Gibbs free energies at STP, as in eq. 22.86. According to Schroeder the molar Gibbs free energies (to form a mole of the molecule from elementary atoms in their purest state) for H_2 , O_2 and H_2O are 0, 0, and –228.57 kJ, respectively.

5. GT 7.12 (p. 382; just qualitative reasoning!)