

Physics 330, Spring 2009
HW#4 25 points

Problems from Tipler and Llewellyn:

1. **5.5 (5 points)** According to statistical mechanics, the average kinetic energy of a particle at temperature T is $3kT/2$, where k is the Boltzmann constant. What is the average de Broglie wavelength of nitrogen molecules at room temperature?
2. **5.14 (5 points)** Show that in Davisson and Germer's experiment with 54-eV electrons using the $D = 0.215$ nm planes, diffraction peaks with $n=2$ and higher are not possible.
3. **5.21 (5 points)** If a phone line is capable of transmitting a range of frequencies $\Delta f = 5000$ Hz, what is the shortest duration pulse that can be transmitted over the phone line?
4. **5.41 (5 points)** Using the relativistic expression $E^2 = p^2c^2 + m^2c^4$, (a) show that the phase velocity of an electron wave is greater than c . (b) Show that the group velocity of an electron equals the particle velocity of the electron.
5. **5.47 (5 points)** A proton and a 10-g bullet each move with a speed of 500 m/s, measured with an uncertainty of 0.01 percent. If measurements of their respective positions are made simultaneously with the speed measurements, what is the minimum uncertainty possible in the position measurements?