Physics 324, Fall 2001 **Problem set #1** Due: Fri. 10/12/01

Assigned problems. *All are to be turned in; four of the problems (the last problem, plus three others chosen at random) will be graded, and will be worth 25 points each.*

1. Gasiorowicz, Ch. 1, #2
2. Gasiorowicz, Ch. 1, #5
3. Gasiorowicz, Ch. 1, #6
4. Gasiorowicz, Ch. 1, #12
5. Gasiorowicz, Ch. 1, #15
6. **This problem will definitely be graded**. A free, relativistic electron of mass m has energy E and momentum p satisfying

$$E = \sqrt{p^2c^2 + m^2c^4} \ .$$

Using the de Broglie relations $E = \hbar\omega$ and $p = \hbar|\vec{k}|$, come up with a second order differential equation satisfied by a plane wave $\psi = e^{i(\vec{k}\cdot\vec{r}-\omega t)}$ describing a relativistic electron. Can you find plane wave solutions to your equation which correspond to a different energy-momentum relation than $E = \sqrt{p^2c^2 + m^2c^4}$? These funny solutions were first interpreted by Dirac as evidence for an "anti-electron" (known as a positron).