Physics 829: Problem Set 4

Due Wednesday, April 23, 2008 at 11:59 PM

Each problem is worth 10 points, unless otherwise stated.

1. Shankar, problem 20.1.1.

2. (20pts.) Shankar, 20.2.2.

3. Consider an electron of momentum p traveling in the positive x direction and incident on a potential barrier of height V located at x = 0.

   (a). Calculate the reflection and transmission coefficient of the barrier by solving the Dirac equation, under the assumption that $V < E+mc^2$, where E is the incident energy.

   (b). What strange prediction emerges from this calculation if $V > E + mc^2$? Interpret in terms of the Dirac hole theory. [This is known as the "Klein paradox" (Klein, 1929)].