Physics 616, Fall 2009, Homework 3

Due: Tuesday, October 13, 5 pm

1. Stirling’s formula and an application

   (a) Go through the steps necessary to derive Eq. (8.52), the Stirling formula. Make sure to explain each step in your argument carefully.

   (b) Show that the constant of integration $C_2$ in Stirling’s formula is $\frac{1}{2}\ln(2\pi)$ by taking the logarithm of the doubling formula.

   (c) Use Stirling’s formula to estimate the number of possible rearrangements of a standard deck of playing cards.

2. The solution to the Dirac equation for hydrogenic atoms yields factors such as $[2(1 - \alpha^2Z^2)^{1/2}]!$, where $\alpha = 1/137$ is the fine-structure constant, and $Z$ is the atomic number. Expand this factor as a power series in the small quantity $\alpha^2Z^2$. 