

## 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  $[2(1 - \alpha^2 Z^2)^{1/2}]!$ , 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  $\alpha^2 Z^2$ .