Physics 215C
Take-home Midterm
Spring, 2000

[a.] Set up the equations for finding the eigenvalues and eigenfunctions of the following Hamiltonian.

$$H = c\vec{\alpha} \cdot \vec{p} + \beta mc^2 + \beta V(r) \ ,$$

where

$$V(r) = \begin{cases} 0 & \text{for } r < a \,, \\ V_0 & \text{for } r > a \,, \end{cases}$$

$V_0 > 0$. <u>There is a β in front of V_0.</u>

[b.] What are the boundary conditions at $r = a$? [Hint: Think about continuity of current.]

[c.] Find the lowest eigenvalue and its corresponding eigenvector in the case $V_0 = \infty$.