Ph 340 – Problem Set 10 – Spring 1997

1. Spontaneous symmetry breaking. The RLaB program *adwell_demo.r* solves the scaled Schrödinger equation for the eigenvalues and eigenvectors of the problem with two separated potential wells. The potential takes the form

$$U(x) = -6\{\exp[-(x - s/2)^2]/a + a\exp[-(x + s/2)^2]\}$$

   where s and a are constants. The parameter s defines the spacing of the two wells and a is an "asymmetry parameter" — if $a = 1$ the potential is symmetric in x and the solutions must be eigenfunctions of the parity operator. If $a \neq 1$, this restriction does not apply.

   (a) For $s = 2, 4, 6$ determine how different from unity a must be to result in significant asymmetry in the ground state and first excited state eigenfunctions.

   (b) Compare the energy difference between the ground state and first excited state in each of the above cases to the difference in depths between the two potential wells in this problem.

   (c) Qualitatively, how does $< x >$ change for the lowest two eigenstates as a is increased from unity?