Quiz 5 Your Name:

15 minutes; Gey-Hong Sam Gweon, Phys 139A, UC Santa Cruz, Spring 2008

1. [15 points] Below is a picture of a potential $V(x)$ in one dimension, and three wave functions $\Psi_1(x)$, $\Psi_2(x)$, and $\Psi_3(x)$, at time $t = 0$. $\Psi_1(x)$ is even: $\Psi_1(-x) = \Psi_1(x)$. $\Psi_2(x)$ is odd: $\Psi_2(-x) = -\Psi_2(x)$. And $\Psi_3(x) = \sqrt{\frac{1}{2}}\,(\Psi_1(x) + \Psi_2(x))$. For Ψ_1 and Ψ_2, a close up view near the origin is also shown.

   (a) Only one of the three wave functions corresponds to the ground state wave function. Which one is it? Why?

   (b) Only one of the three wave functions corresponds to the probability density $\rho(x,t) = |\Psi(x,t)|^2$ that oscillates in time. Which wave function is it? Why? Express the angular frequency of the oscillation in terms of the energy values of the other two states.

   (c) The two wells are separated from each other by making $b \to \infty$. Does the angular frequency in part (b) increase, decrease or stay constant as $b \to \infty$? Explain briefly why.