1. The poor student Iwana Pass comes to you and says “For the potential shown below I have drawn an approximate ground state wave function next to it. Is it OK?”

![Potential Diagram]

(a) Explain to the student briefly but nicely why it is wrong.

Alas, Iwana, the ground state wave function has no nodes.

(b) Draw your best guess for the ground state wave function and identify clearly in which regions the wave function decays exponentially. Does it decay faster in one region than the other? If so explain clearly where and why; do it quantitatively.

The wave function decays exponentially in the regions with $V(x) = V_1$ and $V(x) = V_2$. Since $E < V_1$, the kinetic energy is negative; the region is classically forbidden.

$\Psi(x) \sim \exp\left( -\frac{x^2}{\lambda^2} \right)$ where $\frac{\hbar^2 x^2}{2m} = V_1 - E$ or $V_2 - E$ respectively.

It decays more rapidly larger $x$ is or where the kinetic energy is more negative, i.e. where $V(x) = V_2$ ($x > a$).

![Wave Function Decay Diagram]

Note that the peak position will be closer to 0 than to a.