Physics 451: Homework #14

Due Tuesday, Nov. 4, 5:00PM, 2008

4.1

4.2 Try writing $\psi(x,y,z) = X(x)Y(y)Z(z)$. Then you can write the time-independent Schrödinger equation in the form $\frac{1}{X(x)}\frac{\partial^2 X(x)}{\partial x^2} + \frac{1}{Y(y)}\frac{\partial^2 Y(y)}{\partial y^2} + \frac{1}{Z(z)}\frac{\partial^2 Z(z)}{\partial z^2} = -\frac{2mE}{\hbar^2}$. Every term will have to be constant for this equation to be true. Then you will have $\frac{\partial^2 X(x)}{\partial x^2} = -k_x^2 X(x)$, $\frac{\partial^2 Y(y)}{\partial y^2} = -k_y^2 Y(y)$, and $\frac{\partial^2 Z(z)}{\partial z^2} = -k_z^2 Z(z)$, where $k_x^2 + k_y^2 + k_z^2 = \frac{2mE}{\hbar^2}$. The boundary conditions will help you decide that $k_x = \frac{\pi \ell}{a}$, $k_y = \frac{\pi m}{a}$, and $k_z = \frac{\pi n}{a}$, where ℓ, m, and n are integers. The 14th energy level comes from integers 3, 3, 3 and from 5, 1, 1 (in any order).

4.3

4.5