Particle in a Box (3 Dimensions)-Team Project

The time independent Schrödinger equation for a particle equation moving in more than three dimensions is:

$$-\frac{\hbar^2}{2m}\nabla^2\Psi(\mathrm{x},\mathrm{y},\mathrm{z}) + V(x,y,z)\Psi(\mathrm{x},\mathrm{y},\mathrm{x}) = E\Psi(\mathrm{x},\mathrm{y},\mathrm{z})$$

Where:

Summary of Variables and Constants	
h	Plank's constant (describes size of quanta in quantum mechanics = $6.26068 \times 10^{-34}\,\frac{\mathrm{m^2kg}}{\mathrm{s}}$)
$\hbar$	$h/2\pi$ (reduced Plank's constant)
m	mass of particle
$\psi(x,y,z)$	time independent wave function
$\lvert\psi(\mathrm{x},\mathrm{y},\mathrm{z})\rvert^2$	probability density that contains information about where the particle is located
$V(x,y,z)$	potential energy of particle
E	total energy of particle (these are our eigenvalues in quantum mechanics)

1. Solve the equation for a particle in a three-dimensional box of length $x = L$, height $y = H$, and depth $z = K$ with a potential energy function:

$$V(x,y,z) = \begin{cases} 0 & 0 < x < L, 0 < y < H, \ \ 0 < z < K \\ \infty & \text{elsewhere} \end{cases}.$$

   Use $n, p,$ and q to designate the integers that govern the characteristic waves in $x, y,$ and z respectively.

2. Determine an expression for energy E in terms of $n, p, q, L, H, K, h,$ and m.

3. Assuming the $L = 1, H = 3,$ and $K = 2$:

   a. Write out an expression for the wave function ψ_{213} (i.e. $n = 2, p = 1, q = 3$).

   b. Write an expression for the energy E associated with ψ_{213}? If the particle drops to the ground state ψ_{111}, how much energy is liberated (don't worry about units)?

   c. What is the probability that a particle in the wave state ψ_{213} with be found at the location $.25 < x < .5, 1 < y < 2,$ and $1.75 < z < 2$?