A particle of mass \( m \) moves in a three-dimensional box with sides \( L \). The particle is in the third excited level, corresponding to \( n^2 = n_x^2 + n_y^2 + n_z^2 = 11 \).

(a) What is the energy of the particle?

\[
E = \frac{n_x^2k^2}{2ml^2} = \frac{n_y^2k^2}{2ml^2} = \frac{n_z^2k^2}{2ml^2} = \frac{11k^2}{2ml^2} = \frac{11h^2}{8ml^2}
\]

(b) What are the combinations of \( n_x \), \( n_y \) and \( n_z \) that would give this energy? And what is the degeneracy of this state?

The values that give \( n_x^2+n_y^2+n_z^2=11 \) are:  

\[
\begin{array}{ccc}
n_x & n_y & n_z \\
1 & 1 & 3 \\
1 & 3 & 1 \\
3 & 1 & 1 \\
\end{array}
\]

And has degeneracy of 3.

(c) Write down the full wavefunctions for these different states.

\[
\psi_{n_xn_yn_z} = \sqrt{\frac{8}{L^3}} \sin \frac{n_x \pi x}{L} \sin \frac{n_y \pi y}{L} \sin \frac{n_z \pi z}{L}
\]

\[
\psi_{113} = \sqrt{\frac{8}{L^3}} \sin \frac{\pi x}{L} \sin \frac{\pi y}{L} \sin \frac{3\pi z}{L}
\]

\[
\psi_{131} = \sqrt{\frac{8}{L^3}} \sin \frac{\pi x}{L} \sin \frac{3\pi y}{L} \sin \frac{\pi z}{L}
\]

\[
\psi_{311} = \sqrt{\frac{8}{L^3}} \sin \frac{3\pi x}{L} \sin \frac{\pi y}{L} \sin \frac{\pi z}{L}
\]