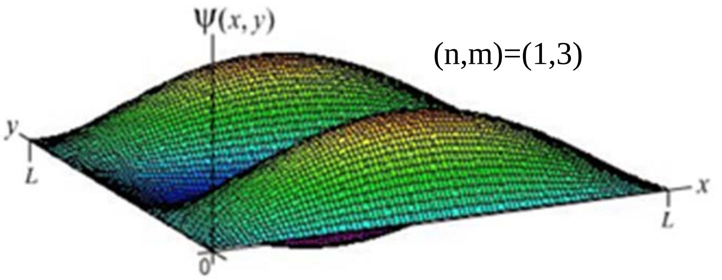
For these questions, use the simulation "Energy eigenstates of the two-dimensional triangular infinite well" and work through the simulation, including the step-by-step exploration (click on the "Step-by-step Exploration" tab).

1) Explain why ψ_{nm} and ψ_{mn} (as defined in the simulation) are not two independent eigenfunctions for the triangular well shown in the simulation. Interpret your answer using the graphs shown in the simulation.

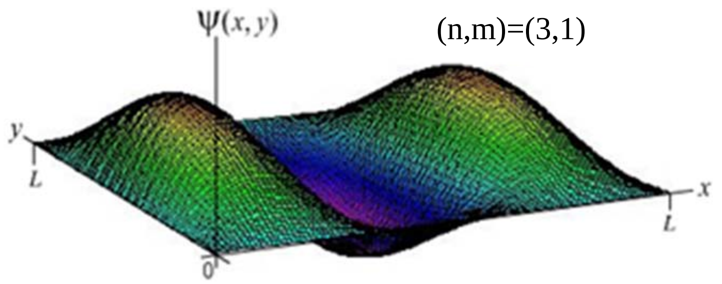
2) The graphs below show the infinite *square* well energy eigenfunctions

$u_{13} = \frac{2}{L}\sin\left(\frac{\pi}{L}x\right)\sin\left(\frac{3\pi}{L}y\right)$ and $u_{31} = \frac{2}{L}\sin\left(\frac{3\pi}{L}x\right)\sin\left(\frac{\pi}{L}y\right)$

for quantum numbers $(n, m) = (1,3)$ and $(n, m) = (3,1)$. Explain qualitatively using the graphs why the eigenfunction $\psi_{13}(x, y) = u_{13} - u_{31}$ will fulfill the boundary conditions, namely that ψ_{13} will be zero on all three sides of the triangular well. Write down an expression for the eigenfunction ψ_{13}. Show using this expression that ψ_{13} fulfills the boundary conditions, namely that ψ_{13} is zero for all three sides of the triangular well.



(n,m)=(1,3)



(n,m)=(3,1)

3) For the two-dimensional infinite *square* well, for $n \neq m$ there are two different eigenfunctions with the same eigenenergy, i.e., the energy levels with $n \neq m$ are two-fold degenerate. For example, u_{13} and u_{31} (the two wavefunctions shown in the figure above) both have energy $10\frac{\pi^2\hbar^2}{2mL^2}$ and are thus degenerate. Is this energy level also doubly degenerate for the triangular infinite well?

4) Show explicitly that ψ_{nn} is not a possible eigenfunction for the triangular well shown in the simulation.