

So

$$E = \frac{\pi^2 \hbar^2}{2mL^2} (n_1^2 + n_2^2 + n_3^2)$$

and

$$\psi(x, y, z) = \left(\frac{2}{L}\right)^{3/2} \sin\left(\frac{n_1 \pi x}{L}\right) \sin\left(\frac{n_2 \pi y}{L}\right) \sin\left(\frac{n_3 \pi z}{L}\right)$$

with $n_1 = 1, 2, \dots$

$n_2 = 1, 2, \dots$

$n_3 = 1, 2, \dots$

Degeneracy appears when different states have the same energy!

Example

n_1	n_2	n_3	
1	1	2	$\rightarrow \psi_{112} = \left(\frac{2}{L}\right)^{3/2} \sin\left(\frac{\pi x}{L}\right) \sin\left(\frac{\pi y}{L}\right) \sin\left(\frac{2\pi z}{L}\right)$
1	2	1	$\rightarrow \psi_{121} = \left(\frac{2}{L}\right)^{3/2} \sin\left(\frac{\pi x}{L}\right) \sin\left(\frac{2\pi y}{L}\right) \sin\left(\frac{\pi z}{L}\right)$
2	1	1	$\rightarrow \psi_{211} = \left(\frac{2}{L}\right)^{3/2} \sin\left(\frac{2\pi x}{L}\right) \sin\left(\frac{\pi y}{L}\right) \sin\left(\frac{\pi z}{L}\right)$

Three different state having the

same energy

$$E_{112} = E_{121} = E_{211} = \frac{6 \pi^2 \hbar^2}{2mL^2}$$