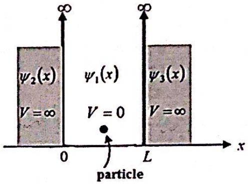
Exercise 1:

We consider a particle trapped in an infinite one-dimensional square well represented by the following potential:

$$V(x)=\begin{cases}+\infty & x<0\\ 0 & 0\le x\le L\\ +\infty & x>L\end{cases}$$



1- Explain why outside the well (in areas x <0 and x> L) the particle function is zero $(\Psi_3(x)=\Psi_2(x)=0)$.

2- Find the particle function $\psi_1(x)$: General solution to Schrodinger's time-dependent equation in Region 1: $0\le x\le L$. We take $k^2=\dfrac{2mE}{\hbar^2}$.

3- By applying the boundary conditions show that $k=\dfrac{n\pi}{L}$ where $n=1,2,3....$, then deduce the particle energy in terms of n ، m ، $\hbar$ و L. Are the particle energy levels connected or discrete (quantized).

4- Normalize the function $\psi_1(x)$.

5- If the particle began the movement from the following initial state:

$$\psi(x,0)=\frac{1}{6}\left[5\psi_1(x)+3\psi_2(x)+\sqrt{2}\psi_3(x)\right]$$

Where $\psi_1(x)$ ، $\psi_2(x)$ and $\psi_3(x)$ the particle functions in the ground state, the first and second excitations respectively of the particle trapped in the well.

5-1 Write the function $\psi(x,t)$.

5-2 If you measure the energy of a particle, what are the energies you can get? And what is the probability of each of them?