Quantum Mechanics I - Module 4

1. Show from a qualitative argument that a one-dimensional finite square well potential always has one bound eigenvalue, no matter how shallow the binding region. What would the eigenfunction look like if the binding region were very shallow?

2. Why do the lowest eigenvalues and eigenfunctions of an infinite square well provide the best approximation to the corresponding eigenvalues and eigenfunctions of a finite square well?

3. If the eigenfunctions of a potential have definite parities, the one of lowest energy always has even parity. Explain why.

4. A particle of mass m in an infinite square well has a wavefunction at t =0 proportional to:

$$\psi(x,0) = \sin^3\left(\frac{\pi x}{2L}\right)\cos\left(\frac{\pi x}{2L}\right)$$

a) What is $\psi(x,t)$ for $t > 0$?

b) What are the expectation values of x and p, including their time dependence?