Indian Institute of Technology Guwahati

Tutorial-5 PH1410H: Introductory Quantum Mechanics Due on : 21 April 2026

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1. A particle in an infinite square well of wdith L has the wave function

$$\Psi(x,0) = A\sin^3\frac{\pi x}{L}$$

Find A, $\Psi(x,t)$ and $\langle x\rangle$ as a function of time. Use $\sin 3x = 3\sin x - 4\sin^3 x$ and $\langle x\rangle$ for eigen states 1 and 3.

2. A particle is in a cubic box with infinitely hard walls whose edges are L long. The wave functions of the particle are given by the stationary states of an infinite square well potential whose nth state is given as

$$A\sin\left(\frac{n_x\pi x}{L}\right)\sin\left(\frac{n_y\pi y}{L}\right)\sin\left(\frac{n_z\pi z}{L}\right)$$

where $n_x = 1,2,3\cdots$, $n_y = 1,2,3\cdots$ and $n_z = 1,2,3\cdots$ Find the value of the normalization constant A.

3. (a) Find the possible energies of the particle in the cubic box by substituting its wave function in Schodinger's equation and solving for E.
(b) Compare the ground-state energy of a particle in a one dimensional box of length L with that of a particle in the three dimensional box.

4. Consider the nth stationary state of an infinite square well potential and calculate $\langle x\rangle$, $\langle x^2\rangle$, $\langle p\rangle$, $\langle p^2\rangle$, σ_x and σ_p. Check that the uncertainty principle is satisfied. Which state comes closest to the uncertainty limit?
