

Central Forces Homework 4

Due 3/9/09

REQUIRED:

1. Consider the normalized state $|\Phi\rangle$ for a quantum mechanical particle of mass μ constrained to move on a circle of radius r_0 , given by:

$$|\Phi\rangle = \frac{\sqrt{3}}{2} |3\rangle + \frac{i}{2} |-2\rangle$$

- (a) What is the probability that a measurement of L_z will yield $2\hbar$? $3\hbar$?
 - (b) What is the probability that a measurement of energy will yield $E = \frac{2\hbar^2}{I} + U(r_0)$?
 - (c) What is the expectation value of L_z in this state?
 - (d) What is the expectation value of the energy in this state?
2. Consider the normalized state $|\Phi\rangle$ for a quantum mechanical particle of mass μ constrained to move on a circle of radius r_0 , given by:

$$|\Phi\rangle = \frac{N}{2 + \cos(3\phi)}$$

where N is the normalization constant.

- (a) Plot this wave function using Maple.
 - (b) Find N .
 - (c) What is the expectation value of L_z in this state?
3. Make a table, similar to the one passed out in class, for a particle confined to a ring. Include all of the following information.
 - Hamiltonian
 - Eigenvalues of Hamiltonian
 - Normalized eigenstates of Hamiltonian
 - Coefficient of the n th eigenstate
 - Probability of measuring E_n
 - Expectation value of Hamiltonian
 - Z-component of angular momentum
 - Eigenvalues of z-component of angular momentum
 - Eigenstates of z-component of angular momentum
 - Coefficient of m th state of z-component of angular momentum
 - Probability of measuring $m\hbar$ for z-component of angular momentum
 - Expectation value of z-component of angular momentum