Physics 7502: Homework Set No. 1

Due date: Tuesday, Jan. 19, 2016, 5:00pm
in PRB M2039 (Bowen Shi's office)

Total point value of set: 100 points

Problem 1 (5 pts.): Exercise 11.2.2 (Shankar, p. 283)

Problem 2 (5 pts.): Exercise 11.4.1 (Shankar, p. 300)

Problem 3 (20 pts.): Exercise 11.4.2 (Shankar, p. 300).
Answering the problem as stated is worth 10 points. To receive the second 10 points, derive in closed form the explicit expression for $[\hat{P}, \hat{H}]$.

Problem 4 (10 pts.): Exercise 11.4.3 (Shankar, p. 300)

Problem 5 (10 pts.): Exercise 11.4.4 (Shankar, p. 300)

Problem 6 (10 pts.):
Using cylinder coordinates $\rho = \sqrt{x^2+y^2}$, ϕ, and z, a particle is described by a wave function

$$\psi(\rho, \phi, z) = A\, e^{-\rho^2/(2\Delta^2)}\, e^{-z^2/(2\delta^2)} \left(\frac{\rho}{\Delta} \cos\phi + \sin\phi \right).$$

Reminding yourself of the eigenfunctions of $\hat{L}_z$, show that a measurement of this observable in the given state will yield the eigenvalues $\hbar$ and $-\hbar$ with equal probabilities. What other outcomes of the measurement are possible (i.e. will happen with non-zero probabilities)?

Problem 7 (10 pts.): Exercise 12.3.5 (Shankar, p. 316)

Problem 8 (10 pts.): Exercise 12.3.6 (Shankar, p. 316)

Problem 9 (20 pts.): Exercise 12.3.8 (Shankar, p. 317)