

## 2002S Homework #01

Due 03/12/2002

1. Assume that the wave function of an electron is described by

$$\psi = \frac{1}{\sqrt{4\pi}} (e^{i\phi} \sin \theta + \cos \theta) \cdot g(r); \text{ here } \int_0^{\infty} |g(r)|^2 r^2 dr = 1.$$

- (a) Find out the possible measured values of  $\hat{L}_z$ .
- (b) What is the possibility of each possible value?
- (c) What is the expectation value of  $\hat{L}_z$ ?
- (*Hint: you have to decompose the wave function to see its combination.*)
2. The wave function of a particle subjected to a spherically symmetrical potential  $V(r)$  is given by  $\psi(\mathbf{r}) = (x+y+3z) f(r)$ . Is  $\psi$  an eigenfunction of  $L^2$ ? If so, what is the  $l$ -value? If not, what are the expectation value of  $L^2$ ?
- (*Hint: Rewrite  $\psi$  in the spherical coordinate and calculate  $\langle r, \theta, \phi | L^2 | \psi \rangle$ )*