

1. The wave function, describing the state of 3D rotator, is

$$\psi = C(2 \sin \theta \sin \phi + 3i).$$

Find the normalization coefficient C , observed values of L_z and \mathbf{L}^2 , and the probabilities to observe these values. Present the results as a table.

Hint: You might use the table of spherical harmonics (p. 127 of Gaziorowicz's book). For negative m , keep in mind the relation (7-46) from the same book .

2. For the particle with the spin $S = 1/2$ find eigenvalues and eigenfunctions of operators \hat{S}_y and \hat{S}_z (in S_z -representation).
3. For the ground-state of hydrogen atom described by the wave function

$$\psi_{100}(r) = \frac{1}{\sqrt{\pi a_0^3}} \exp\left(-\frac{r}{a_0}\right)$$

find:

- a) the most probable distance between electron and nucleus;
- b) average value of modulus of Coulomb force, acting on electron;
- c) average potential energy of electron.