1. Can you proof the next expression $\left[\hat{H},\vec{L}^2\right]=0$. What does it means from physical point of view?

2. Can you proof the next expression $\left[\hat{H},L_z\right]=0$. What does it means from physical point of view?

3. Obtain the equation for radial part of wave function $-\frac{\hbar^2}{2M}\left[\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{dR(r)}{dr}\right)\right]+\left[\frac{\hbar^2 l(l+1)}{2M\,r^2}+U(r)\right]R(r)=E\,R(r)$

from general Schrödinger equation for hydrogen atom $-\frac{\hbar^2}{2M}\left[\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial}{\partial r}\right)-\frac{1}{\hbar^2 r^2}\vec{L}^2_{\theta\,\phi}-\frac{2M}{\hbar^2}U(r)\right]\psi(\vec{r})=E\,\psi(\vec{r})$.

4. What does the equation for the radial wave function look like if we assume that the electron is an uncharged particle?

5. What does the equation for the radial wave function look like if we assume that the electron is an uncharged particle and moves around the nucleus in an orbit with a fixed radius (r=const)?

6. Write the radial part of wave function R_{nl} for quantum numbers n=3 and l=2.

7. How looks like the radial part of wave function for 3s , 2d and 1f states?

8. How can be calculate the ionization energy of an electron from the ground state?

9. How can be calculate the ionization energy of an electron from the states 3s and 4p?

10. The total energy of electron in hydrogen atom can be calculated as follows : $E_n=-R\hbar\frac{1}{n^2}$. But how can be calculate separately the kinetic and potential energy of an electron in hydrogen atom for principal quantum number n=3 ?
NB! The classical relation between the potential and kinetic energies for electron in hydrogen atom can be used.

11. Calculate the photon wavelength required to ionize a hydrogen atom from the ground state.

12. Calculate the possible maximum number of electrons in 1p and 3f orbitals for hydrogen atom.

13. Calculate the possible maximum number of electrons in 4p and 2d orbitals for hydrogen atom.

14. Calculate the number of electrons on N-shell. Description of calculation.

15. Calculate the number of electrons on O-shell. Description of calculation.

16. Calculate the number of electrons on p-level. Description of calculation.

17. Calculate the number of electrons on f-level. Description of calculation.

18. Electron configuration for B atom is looks like so: $1s^2 2s^2 2p^1$. What does it means? Describe all numbers in the configuration description.
https://www.chem.fsu.edu/chemlab/chm1045/e_config.html

19. How looks like the electron configuration for O, Al and Li atoms? Why?
https://www.chem.fsu.edu/chemlab/chm1045/e_config.html

20. How looks like the electron configuration for N ,Cl and K atoms? Why?
https://www.chem.fsu.edu/chemlab/chm1045/e_config.html

21. How looks like the electron configuration for Cu atom and Cu^{2-} ion? Why?
https://www.chem.fsu.edu/chemlab/chm1045/e_config.html

22. How looks like the electron configuration for Li,Na and K atoms? Why? What do all these materials have in common (in terms of physical properties)? How does this relate to the configuration of the electrons?
https://www.chem.fsu.edu/chemlab/chm1045/e_config.html

23. How looks like the electron configuration for Ne and Kr atoms? Why? What do all these materials have in common (in terms of physical properties)? How does this relate to the configuration of the electrons?
https://www.chem.fsu.edu/chemlab/chm1045/e_config.html

24. Why the vector of angular momentum and magnetic moment of electron are have an opposite directions?

25. What does the eigenvalue problem look like for the operator of square of the orbital magnetic moment $\hat{\mu}_l^2$ of an electron in a hydrogen atom? Present the wavefunction and eigenvalues of this operator.