

ECE/Mat 162 A, Fall 2009

Assignment #5

1. Chapter 6 Problem 2
2. Chapter 6 Problem 7
3. Chapter 6 Problem 8
4. Chapter 6 Problem 19
5. Consider the case of a spherical potential well – that is, a structure in which the potential energy is lower and constant for a radii $r < r_0$ and higher and constant for all $r > r_0$ - and a particle of mass m .
 - a. For the case of an infinite potential well (i.e on in which the potential is infinite for all $r > r_0$) find the energy of the lowest state if a particle in a well relative to the bottom of the well, (You may presume the lowest state had the lowest possible angular momentum).
 - b. Note: Remember that it can be shown that with a radial wave function $R(r) = \chi(r)/r, \chi(0) = 0$
6. Hydrogen Atom Calculations
 - a. Calculate the expectation value $\langle V \rangle$ of the potential energy in the ground state of the hydrogen atom
 - b. Show that in the ground state $E = \langle V \rangle / 2$ where E is the total energy
 - c. Use the relation $E = K + V$ to calculate the expectation value $\langle K \rangle$ of the kinetic energy in the ground state and show that $\langle K \rangle = -\langle V \rangle / 2$.

These relations are obtained for any state of motion of any quantum mechanical system with a potential in the form $V(r) \propto 1/r$. They are sometimes called the virial theorem.