Quiz #4 **Name:** KEY

The normalized wavefunction a hydrogen atom in the "3s" state is:

$$\psi_{n,l,m} = \frac{1}{81\sqrt{3\pi}}\frac{1}{a_0^{3/2}}\{27 - 18(r/a_0) + 2(r/a_0)^2\}\exp(-r/3a_0)$$

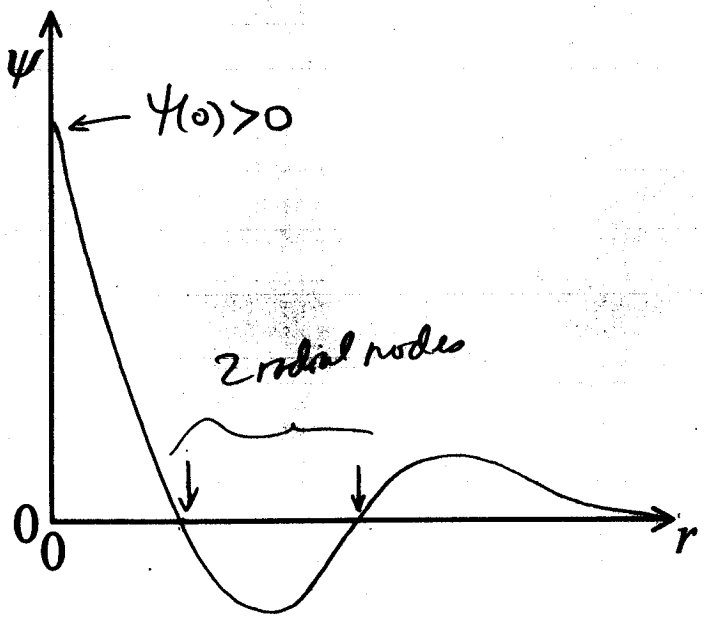
3 a) What are the values of the three quantum numbers n, l, and m_l associated with this state?

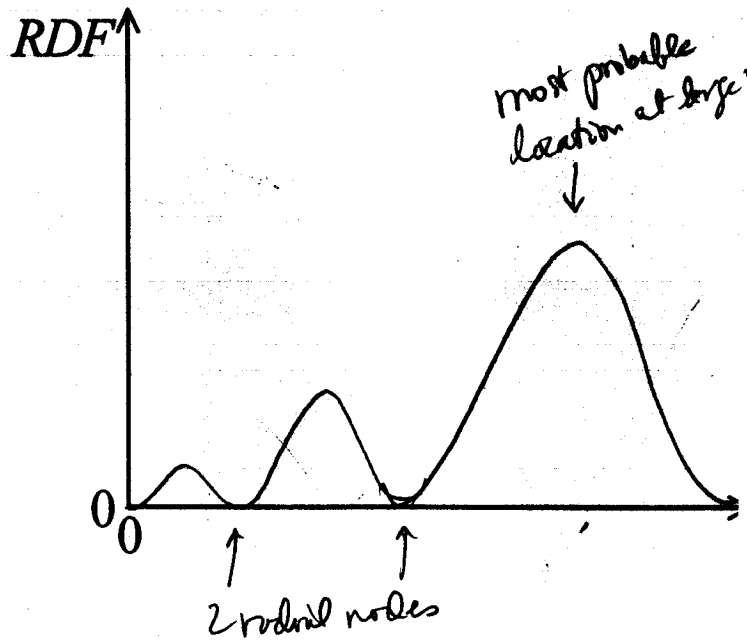
$n=3,\ l=0,\ m_l=0$

3 b) How does one know that this wavefunction corresponds to an "s" type state?

no θ, φ dependence

4 c) Sketch the wavefunction, ψ, and the radial distribution function ("RDF"), $4\pi r^2|\psi|^2$, for this state vs. r.





1 d) What is the energy of this state?

in general $E_n = -13.6\text{eV}\left(\frac{Z}{n}\right)^2$ here $E = -13.6\text{eV}\left(\frac{1}{3}\right)^2 = -\frac{13.6}{9}\text{eV}$

1 g) How many other states of the H atom have this same energy? (Explain.)

$n=3$ level is $n^2 = 9$-fold degenerate so 8 other states

$3p_{0,\pm1}$, $3d_{0,\pm1,\pm2}$

3 5