Inclass 23. 1. Determine the most probable r in the ground state H-atom.

$$P(r) = r^2 R_{1,0}{}^* R_{1,0} = r^2 \left[2\left(\frac{1}{a_0}\right)^{\frac{3}{2}} e^{-\frac{r}{a_0}}\right] [2\left(\frac{1}{a_0}\right)^{\frac{3}{2}} e^{-\frac{r}{a_0}}]$$

Inclass 23-2. What is the expectation value <*r*> for the ground state of H-atom? $R_{1,0}(r) = 2(\frac{1}{a_0})^{\frac{3}{2}} e^{-r/a_0}$

$$Integral: \int x^3 e^{bx} dx = \frac{1}{b} x^3 e^{bx} - \frac{3}{b} e^{bx} \left( \frac{x^2}{b} - \frac{2x}{b^2} + \frac{2}{b^3} \right) + C$$

Inclass 23-3. At t=0 a hydrogen atom is in a mixed state given by

$\Psi(r,\theta,\phi,t=0)=\frac{1}{\sqrt{2}}\psi_{(1,0,0)}+\frac{1}{\sqrt{2}}\psi_{(2,1,1)}$. (a) Determine the wave function at $t$ later.
(b) Determine expectation value of energy $< E >$.

Recall: $\psi_{(1,0,0)}=R_{(1,0)}Y_{(0,0)};\ \ \psi_{(2,1,1)}=R_{(2,1)}Y_{(1,1)}$

Inclass 23-4. At t=0 a hydrogen atom is in a mixed state given by

$\Psi(r,\theta,\phi,t=0)=\frac{1}{\sqrt{2}}\psi_{(1,0,0)}+\frac{1}{\sqrt{2}}\psi_{(2,1,1)}$. Determine the expectation values: $<L^2>$ and $<L_z>$ at $t$ later.

Recall: $\psi_{(1,0,0)}=R_{(1,0)}Y_{(0,0)}$; $\psi_{(2,1,1)}=R_{(2,1)}Y_{(1,1)}$