



Date: 20 October 2014; 8:00 a.m.

Department of Chemistry

CH101

Tutorial 3; Physical Chemistry

1. Find the mean radius of an electron in the 1s orbital of H-atom. The

wavefunction, $\Psi = \frac{1}{(\pi a_0^3)^{1/2}} e^{-r/a_0}$ and $\int_0^\infty r^3 e^{-2r/a_0} dr = \frac{3a_0^4}{8}$ and

$$4\pi = \int_0^\pi \int_0^{2\pi} \sin \theta d\theta d\varphi$$

2. Find the most probable radius of an electron in the 1s orbital of H-atom. The

wavefunction, $\Psi = \frac{1}{(\pi a_0^3)^{1/2}} e^{-r/a_0}$. Here a_0 is Bohr radius of H-atom.

3. For a two-electron atom, in the same energy state, write the possible spin-incorporated wavefunctions. Discuss possible valid wavefunctions corresponding to the ones with paired and unpaired spins.

4. In $\text{H}_2\text{C}=\text{CH}_2$, the carbon atoms are sp^2 hybridized. The central carbon atoms have electronic configuration $1s^2 2s^2 2p^2$. Find out the other two hybridized orbitals if one of them is $h_1 = (1/3)^{1/2} \{s + 2^{1/2} p_y\}$. Also, schematically draw the skeleton of one of the carbon atom hybrid orbitals and then show that these orbitals generate a bond angle of 120° .