

Special Problem 6.1:(a) Use the variational method to estimate the ground-state energy of a hydrogen atom with hamiltonian

$$H = \frac{\mathbf{p}^2}{2\mu} - \frac{e^2}{r} \quad (1)$$

using as trial wave functions

$$\psi_1(r, \theta, \phi) = N_1(a)e^{-r/a} \quad (2)$$

where  $N(a)$  is a normalization constant. What is the best value of the parameter  $a$ ? and what energy does it give?

(b) Same problem but with trial wave functions

$$\psi_2(r, \theta, \phi) = N_2(a)e^{-r^2/a^2} \quad (3)$$

where  $N_2(a)$  is a normalization constant.

(c) Which trial functions worked better?