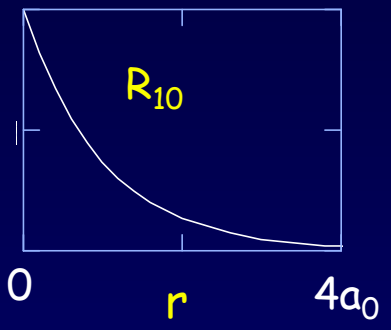
Solution

What is the normalization constant for the hydrogen atom ground state?



$$\psi_{100}(r,\theta,\phi) = NR_{10}(r) = Ne^{-r/a_o}$$

The probability density is $|\psi|^2 = N^2 \exp(-2r/a_o)$.
In 3D, this means "probability per unit volume".

We require that the total probability = 1: $\int|\psi|^2\, dV = 1$

$dV = r^2 \sin\theta\, dr\, d\theta\, d\phi$

With spherical symmetry, the angular integrals give 4π, so we are left with:

$$4\pi N^2 \int_0^\infty r^2 e^{-2r/a_0} dr = 1 \quad \Rightarrow \quad N^2 = \frac{1}{\pi a_o^3}$$

"You can look it up!"

$$\psi_{100}(r) = \sqrt{\frac{1}{\pi a_o^3}}\, e^{-r/a_o}$$

Normalized ground-state wave function of hydrogen