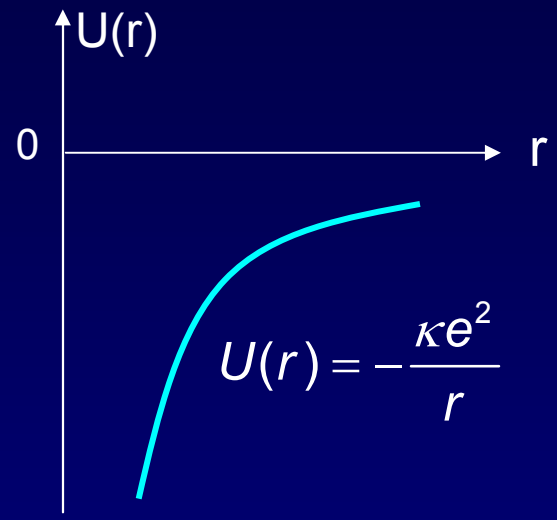
Potential Energy in the Hydrogen Atom

To solve this problem, we must specify the potential energy of the electron. In an atom, the Coulomb force binds the electron to the nucleus.

This problem does not separate in Cartesian coordinates, because we cannot write $U(x,y,z) = U_x(x)+U_y(y)+U_z(z)$. However, we can separate the potential in spherical coordinates (r,θ,ϕ), because:

$$U(r,\theta,\phi) = U_r(r) + U_\theta(\theta) + U_\phi(\phi)$$

$$-\frac{\kappa e^2}{r} \qquad 0 \qquad 0$$



$$\kappa = \frac{1}{4\pi\varepsilon_0} = 9\times10^9 \ \text{Nm}^2/\text{C}^2$$

Therefore, we will be able to write:

$$\psi(r,\theta,\phi) = R(r)\Theta(\theta)\Phi(\phi)$$

Question:
How many quantum numbers will be needed to describe the hydrogen wave function?