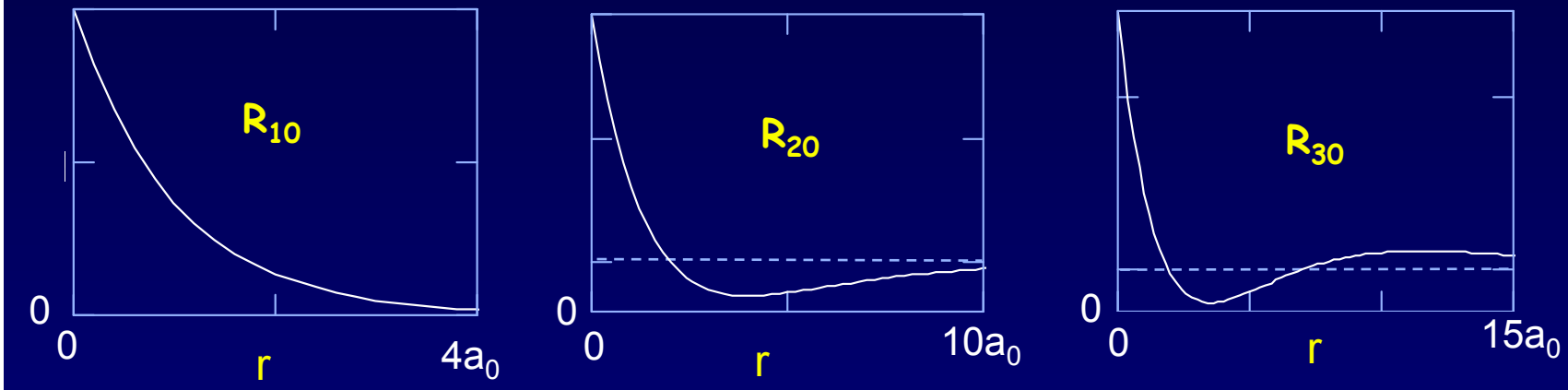
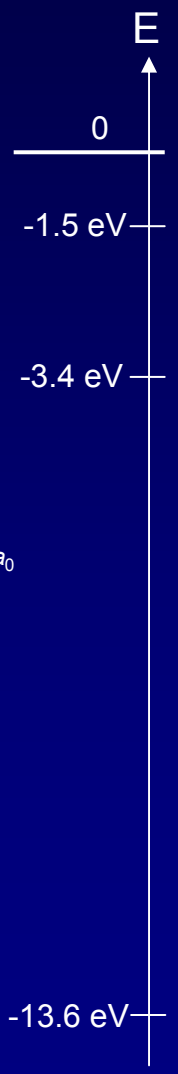
Radial Eigenstates of Hydrogen

Here are graphs of the s-state wave functions, $R_{no}(r)$, for the electron in the Coulomb potential of the proton. The zeros in the subscripts are a reminder that these are states with $l = 0$ (zero angular momentum!).





$$R_{1,0}(r) \propto e^{-r/a_0}$$

$$R_{2,0}(r) \propto \left(1 - \frac{r}{2a_0}\right) e^{-r/2a_0}$$

$$R_{3,0}(r) \propto \left(3 - \frac{2r}{a_0} + 2\left(\frac{r}{3a_0}\right)^2\right) e^{-r/3a_0}$$

$$r \approx \frac{\hbar^2}{m\kappa e^2} \equiv a_0 = 0.053 \text{ nm}$$

The "Bohr radius" of the H atom.

$$E \approx -\frac{m\kappa^2 e^4}{2\hbar^2} = -13.6 \text{ eV}$$

The ground state energy of the hydrogen atom.

One factor of e or e^2 comes from the proton charge, and one from the electron.