Physics 491: Recitation #3
September 4, 2015

1. Use the undertainty principle to estimate the ground state energy of hydrogen. The energy is

$$E = \frac{p^2}{2m} - \frac{\hbar c \alpha}{r}$$

Use the uncertainty principle to minimize $E(r)$ and evaluate $E(r_{min})$. Compare r_{min} to the Bohr radius. What do you get for the energy ($mc^2 = 511$keV)?

2. A polished silicon surface can act as an impenetrable barrier for neutrons. Imagine that a neutron is "placed" (negligible kinetic energy) above such a mirror with gravity acting down. Estimate the height (in microns) that the neutron would float above the mirror. (For this estimate, use $m_N c^2 = 1000$ MeV, $\hbar c = 200$ eV-nm, and $m_N g = 10^{-13}\text{eV}/\mu\text{m}$.)

Note that the exact solution is found in terms of the Airy function. See Landau Liftshitz, vol 3 Quantum Mechanics. In my copy (3rd edition) it is on page 74, section 24 Motion in a homogeneous field".