PHYS 4310, Homework 9 due on November 11$^{\text{th}}$, 2015

Griffiths (2$^{\text{nd}}$ edition): 4.9 (15 points), 4.11 (20 points) , 4.12 (20 points), and 4.13 (15 points)

Partial answer for 4.9: Remember that for a bound state, $E < 0$, so for $r > a$, we will have solutions of the form: $rR(r) = u(r) = Ce^{\alpha r} + De^{-\alpha r}$, where α is defined in terms of m, E, and $\hbar$. Can we rule out one of these terms?

After solving the wavefunction by using continuity at $r = a$, you should obtain $-\cot z = \sqrt{\left(\frac{z_0}{z}\right)^2 - 1}$, where $z \equiv ka$, $k = \frac{\sqrt{2m(E+V_0)}}{\hbar}$, and $z_0 \equiv \frac{\sqrt{2mV_0}}{\hbar}a$. From there, you can find the condition for having no bound state. It is important to graphically show your reasoning, since you are dealing with a transcendental equation intersecting a polynomial.