Quantum Mechanics and Atomic Physics 750:361

Prof. Sean Oh, Fall 2011

HW #4

Due date: Monday, Oct. 3, 2011, at the beginning of class

1. Consider the semi-infinite potential well illustrated in Figure P3.11 of Reed Problem 3-11: Each of the following parts is worth one full HW problem for grading.

(a) Set up and solve the SE for this system; assume E < $V_{0.}$ Apply the appropriate boundary conditions at x=0 and x=L, show that $\tan(\xi) = -\frac{\xi}{\sqrt{K^2-\xi^2}}$, where $K^2 \equiv \frac{2mV_0L^2}{\hbar^2}$ and $\xi = k_2 L$ with $k_2 \equiv \sqrt{\frac{2mE}{\hbar^2}}$.

(b) As we did in class, sketch $f(\xi) = \tan(\xi)$ and $g(\xi) = -\frac{\xi}{\sqrt{K^2-\xi^2}}$, and find how many bound states exist for K^2=100.

(c) With K^2=100, find all real and positive roots of ξ in the equation [$\tan(\xi) = -\frac{\xi}{\sqrt{K^2-\xi^2}}$] using a numerical root-finder (such as FindRoot[] in Mathematica).

2. Reed, Prob. 3-17

3. Reed, Prob. 3-18

4. Reed, Prob. 3-21. Please sketch V(x).

5. Reed, Prob. 3-22. Please sketch V(x).

6. Reed, Prob. 3-23.