HW 3 - P502 2018

Problem 1.

Use the WKB approximation to determine the bound state energies of

$$V(x) = \begin{cases} \dfrac{V_0}{a}|x|, & |x| \le a \\ V_0 = \dfrac{1}{m}\left(\dfrac{h}{a}\right)^2, & |x| \ge a. \end{cases}$$

Problem 2.

A neutron falling in a gravitational field and bouncing-off a horizontal mirror exhibits quantized energy levels. The potential of the problem is $V(z) = mgz$ for $z > 0$ and ∞ for $z < 0$. Applying the WKB method obtain the energy levels of the system.

Problem 3.

Estimate the ground state of the infinite-well (one-dimensional box) problem defined by

$$V = \begin{cases} 0, & \text{for } |x| < L \\ \infty, & \text{for } |x| > L, \end{cases}$$

using the trial eigenfunction $\phi = |L|^\alpha - |x|^\alpha$ with α the trial parameter and compare it with the exact energy value.

Problem 4.

Consider the triangular potential $V(x) = \begin{cases} Fx, & \text{if } x > 0 \\ \infty, & \text{if } x < 0. \end{cases}$ This is used as a model for an electron trapped on the surface of liquid helium by an electric field due to two capacitor plates bracketing the helium and vacuum above it or for the MOSFET. Applying the variational method calculate ground state energy. Use the trial eigenfunction as $\phi = x\mathrm{e}^{-ax}$.