PHYS 314
Problem set # 1 *(due January 28)*
Each problem is 10 points.

Griffiths, Ch. 6: 6.5, 6.7 (this is a model of a one-dimensional crystal)

Q1 A particle with mass m moves in a potential given by

$$U(x) = \begin{cases} \infty & \text{if } |x| \geq a; \\ V_0 & \text{if } |x| < b; \\ 0 & \text{if } b \leq |x| < a, \end{cases}$$

where V_0 is small. Treat this problem as a perturbation on the case of a particle in an infinite-sided square well potential of width $2a$ and calculate the changes in the energies of the three lowest energy states to the first order in V_0. Explain qualitatively why odd-numbered states are affected by the perturbation more than even-numbered states.

Q2 Consider the case of a particle of mass m subject to a one-dimentional potential $U(x)$ where $U(x) = m\omega^2 x^2/2 + \gamma x^4$. Calculate the energy of the ground state to the first order in γ.

Q3 A particle with mass m moves in a two-dimensional potential

$$U(x,y) = \begin{cases} V_0 xy/a^2 & \text{if } |x| < a \text{ and } |y| < a; \\ \infty & \text{otherwise}, \end{cases}$$

where V_0 is a constant, small enough for the term in xy to be treated as perturbation. Obtain expressions for the energies of the ground and first excited states of this system to first order in V_0.