Exercise Sheet 4 due 15 November 2018

1. *Airy functions*

Consider a triangular well with infinite potential for $z \leq 0$ and $V(z) = e\mathcal{E}\,z$ for $z > 0$. Find the lowest three eigenstates when the electric field is $\mathcal{E}$=0.25 V/Å. What are the lowest three eigenstates when the field is doubled?

2. *infinite potential well in electric field*

Consider an infinite potential well $V(z) = e\mathcal{E}\,z$ for $-L/2 < z < L/2$ of width L=10 Å. Determine the eigenfunctions and energies for the three lowest states for (i) zero electric field $\mathcal{E} = 0$ and (ii) in the presence of an electric field of $\mathcal{E}$=500 V/μm.

3. *Numerov method*

Numerically calculate the solution of the Schrödinger equation with linear potential $e\mathcal{E}\,x$ with $\mathcal{E}$=1 V/Å, for some energy E.

i. Integrate the Schrödinger equation to the left, starting 15 Å to the right of the classical turning point. What are reasonable values φ_0 and φ_1 for starting the integration when you have no routine to calculate the Airy functions? How do the solutions depend on this choice? How do they depend on the energy E?

ii. Use the Airy functions to start the numerical integration, integrate from 15 Å to the right of the classical turning point and continue for 30 Å. Compare your numerical result to the exact solution.