Exam 3 Brandon Woods

1. The biggest difference between this problem and the other one’s we have done is that there is a barrier where the potential energy, and therefore the equation of the wave, changes. It is important to solve this from both sides because the two wave equations (inside the well and outside the well) must match at the point of the barrier, otherwise it would be disconnected. By solving from both sides allows us to find the eigenvalues for the Energy levels of the particle in the box that match the wave function on the outside. The biggest advantage to solving the problem this way is that, as stated, it allows you to find the eigenvalues for the wave function’s energy. The biggest, and most obvious, disadvantage is that it is more complicated, as far as the coding goes. I think if you have the eigenvalues, which we do for this particular problem, you could probably solve it with “one” equation, by changing the equations you are using at each barrier (e^kx🡪 sin(kx)🡪e^-kx). Otherwise, I think it is best to just use the two-way solver.
2. A and B). First off, I want to point out that I don’t think that the Euler method is the best way. I think that using an rk4, or at least rk2 method would be the best for this equation, because it has an E^2 within the equation. With that said, I could not get either the rk4 or rk2 method to work in my code for some reason, so I ended up just going with the simplest Euler method, and that worked. The code, with all relevant equations are in the folder with this.

C). When g~ = 0 (my other constants were: w=0.4, T=1, g=2) the energy stayed near zero for some time and then increased (or decreased into the negative, depending on exactly what E(0) was, but it was not 0), exponentially. Which I think that makes sense, as the stated definition of what g~ is would mean that the power of the laser would eventually begin increasing exponentially if there was no saturation value.

D). When g~>0, E evolves as a form of a sin/cos wave. It is a little wacky, but it oscillates on a constant (at least while my program ran) period. Changing the constants can make the wave change a bit, but it still has the same general look of a sine/cos wave. Sometimes it would be growing, but I found no way to make it shrink.

E). So I have found that this shows a limit cycle. Which is something I have never heard of before. By doing some research on it, it seems to be the boundary for stability. So anything outside of that(I assume) is no longer stable, and will begin to behave chaotically.