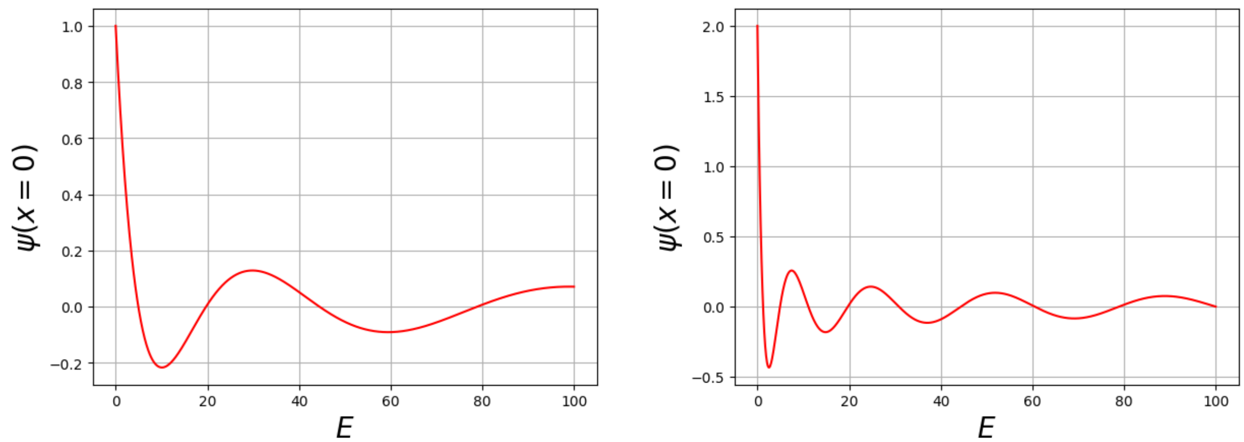
Q1.



Left, the plot of psi(x=0) vs Energy when a = 1, and right, the same plot where a = 2. You can notice that the number of solutions (zeroes) doubled for the same width of E when the width doubled.

Q2.
ODD SOLUTIONS:

```
Numerical:  4.934802265006132 | Exact:  4.934802200544679 | Decimal Error:  6.446145306426843e-08
Numerical:  19.73920936922748 | Exact:  19.739208802178716 | Decimal Error:  5.670487652764677e-07
Numerical:  44.413217322210315 | Exact:  44.41321980490211 | Decimal Error:  -2.482691797922598e-06
Numerical:  78.95683034410844 | Exact:  78.95683520871486 | Decimal Error:  -4.864606424348494e-06
Good to about 6 decimal places, which is a good estimate for our purposes.
```

Or in nicer table form:

Numerical Value	**Exact Value**	**Decimal Error**
4.934802265006132	4.934802200544679	6.446145306426843e-08
19.73920936922748	19.739208802178716	5.670487652764677e-07
44.413217322210315	44.41321980490211	-2.482691797922598e-06
78.95683034410844	78.95683520871486	-4.864606424348494e-06

They are good to about 6 decimals, nothing to frown about.

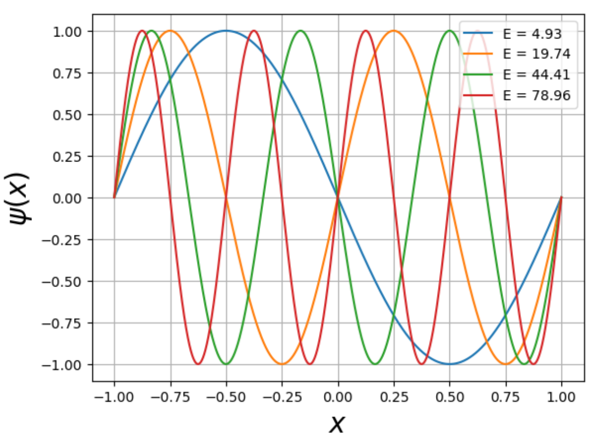
Q3.

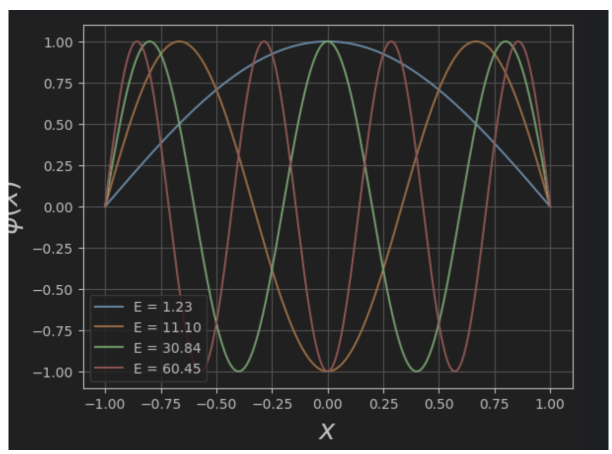
EVEN SOLUTIONS

```
Numerical:  1.2337005628768591 | Exact:  1.2337005501361697 | Decimal Error:  1.2740689392387594e-08
Numerical:  11.103305201598065 | Exact:  11.103304951225528 | Decimal Error:  2.503725369251697e-07
Numerical:  30.842513607492194 | Exact:  30.842513753404244 | Decimal Error:  -1.4591205044212074e-07
Numerical:  60.451320002485836 | Exact:  60.45132695667232 | Decimal Error:  -6.954186481777924e-06
Numerical:  99.9297439845624 | Exact:  99.92974456102975 | Decimal Error:  -5.764673431940537e-07
```

Numerical Value	**Exact Value**	**Decimal Err.**
1.2337005628768591	1.2337005501361697	1.2740689392387594e-08
11.103305201598065	11.103304951225528	2.503725369251697e-07
30.842513607492194	30.842513753404244	-1.4591205044212074e-07
60.451320002485836	60.45132695667232	-6.954186481777924e-06

Good to about e-6 as well.





Graphs of the wavefunction solutions found using the shooting method. Odd on the left, even on the right.

Q4.

If width is 7nm, a = 3.5nm.

```
Numerical:  0.030696342338940037 | Exact:  0.030696338888877827 | Decimal Error:  3.4501617673932117e-09
Numerical:  0.12278535890443718 | Exact:  0.12278535555511308 | Decimal Error:  3.349324095847095e-09
Numerical:  0.2762670459736101 | Exact:  0.27626704999900437 | Decimal Error:  -4.02539424015913e-09
Numerical:  0.4911413993020986 | Exact:  0.4911414222204523 | Decimal Error:  -2.2918353714818096e-08
Numerical:  0.7674084264628279 | Exact:  0.7674084722194568 | Decimal Error:  -4.575662893024912e-08
```

The odd solutions to the chip, in eV.

```
Numerical:  0.007674094374980535 | Exact:  0.030696338888877827 | Decimal Error:  9.652785967241562e-09
Numerical:  0.06906676724704415 | Exact:  0.12278535555511308 | Decimal Error:  4.7472930586600626e-09
Numerical:  0.19185211840399088 | Exact:  0.27626704999900437 | Decimal Error:  3.4912667201680847e-10
Numerical:  0.3760301411050366 | Exact:  0.4911414222204523 | Decimal Error:  -1.0282497187041884e-08
Numerical:  0.6216008299368013 | Exact:  0.7674084722194568 | Decimal Error:  -3.256095859605068e-08
```

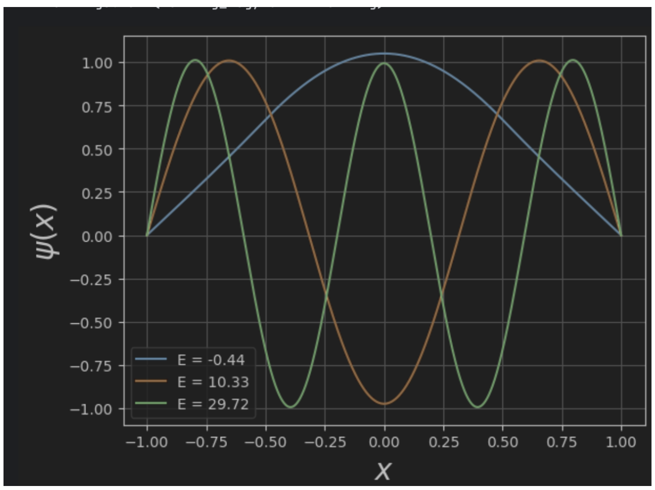
The even solutions to the chip, in eV.

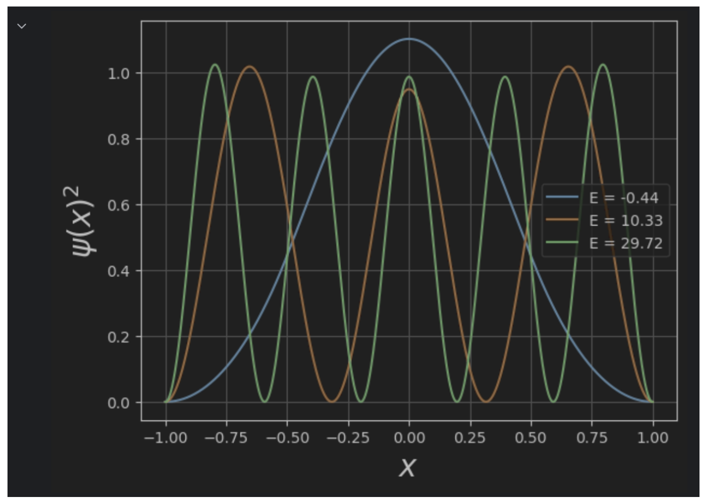
Solutions include the error from the exact solution using the En equation.

Q5.

```
Energies for the bound states are:
 -0.4426658
 10.3301867
 29.7239682
 59.5459219
 98.8616452
```

The “first two” energies for the even states are -0.44 and 10.33. Negative energy doesn’t really make any physical sense, so we throw it out. So the first two real physical energies are 10.33 and 29.72 respectively.





I included the negative energy just to see what the probability would be.

The most probable location for a particle for the first acceptable energy state, 10.33, is on either side of 0 at about x = $\frac{5}{8}$.

The most probable x for the second energy state, 29.72, is on either side of 0 at about x = 0.8.

If the energy was allowed to be negative, the probable location would be in the center at x=0.