```
First set the separation between the wells equal to $0$ by setting $a=-1$,
$b=c=0$ and $d=1$ with $V_0=-10$. Do the values you observe for the first 2
eigenvalues correspond to what you obtained studying the finite well?
```

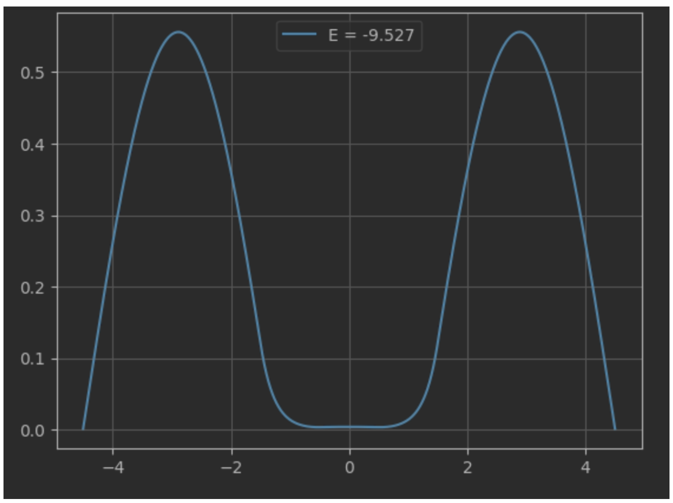
```
-9.0075020
-9.0073461
-6.0807113
-6.0784638
-1.5400045
-1.4684289
 1.2074156
 3.3151988
 5.0331533
 7.1273844
```

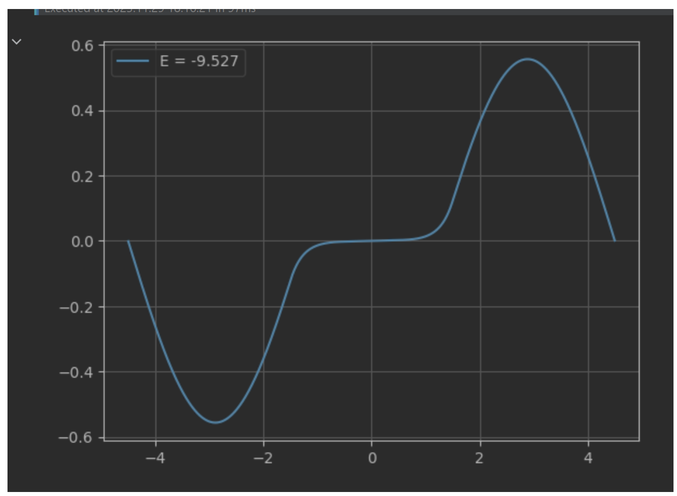
Referring to the Jupyter notebook from Assignment 2, the first two energies are -9.1802599 and -6.7790593, which agree roughly with the first two energies here (-9.0075020 and -6.0807113).

The energy levels are calculated using different methods, so it's not surprising that they are slightly different

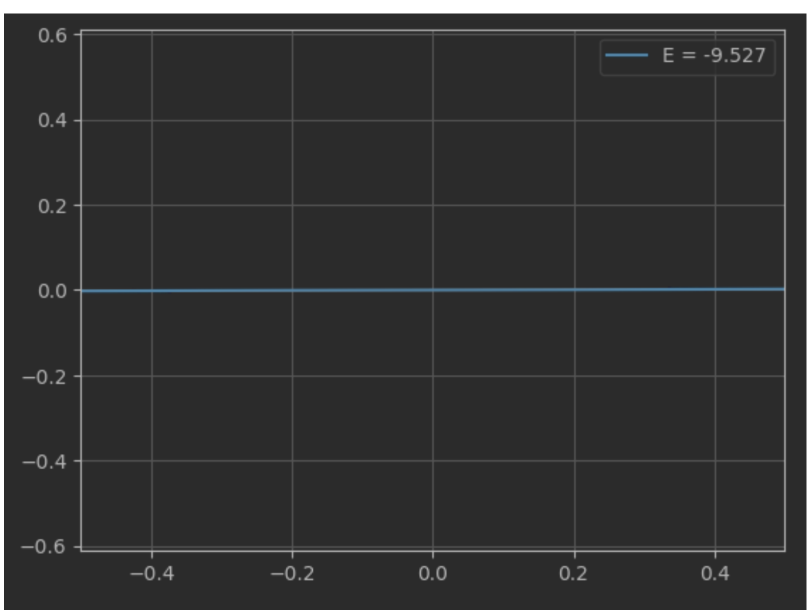
Next consider the intermediate case where the width of the two wells is comparable to their separation. Set $a=-1.5$, $b=-0.5$, $c=0.5$ and $d=1.5$ with $V_0=-10$. What is the functional form of the wavefunction in the interval -0.5 to 0.5 for the ground state and the first excited state?

The ground state and first excited state:



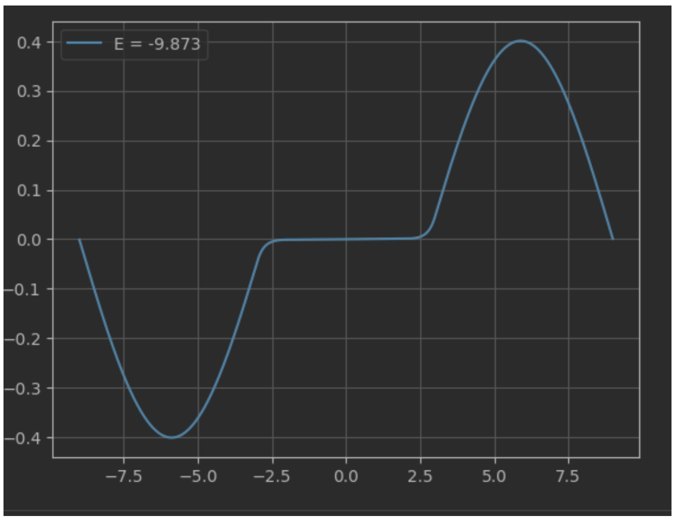


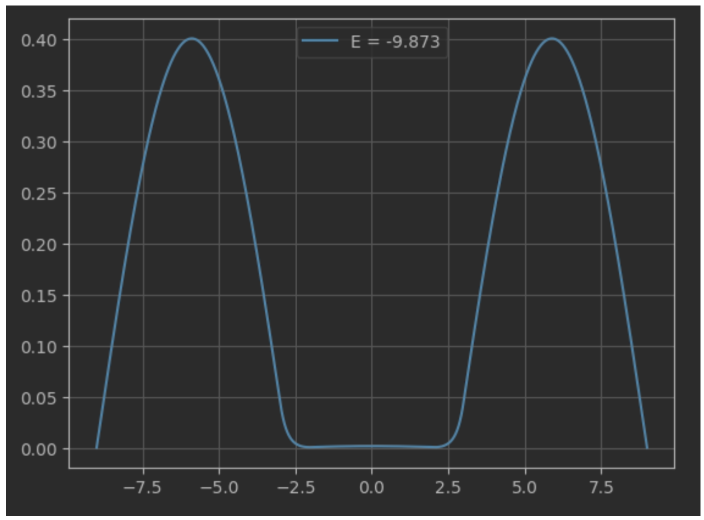
The maximum values occur for the ground state at x = +-2.888597149287322. For the first excited state, they occur at x = +-2.888597149287321. **In the region -½ < x < ½, the wavefunction is the zero function:**



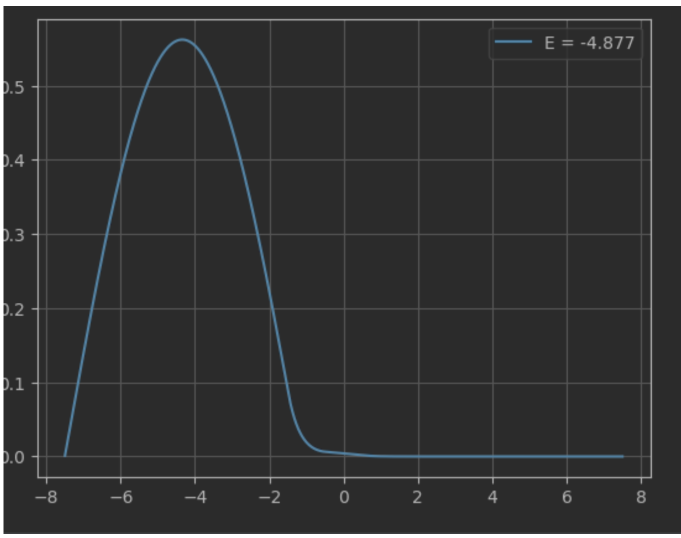
```
Next let us analyze the case where there is a significant distance between the
two wells by setting $a=-3$, $b=-2$, $c=2$ and $d=3$ with $V_0=-10$. What do
you observe when you plot the first 2 wave-functions? Explain.
```

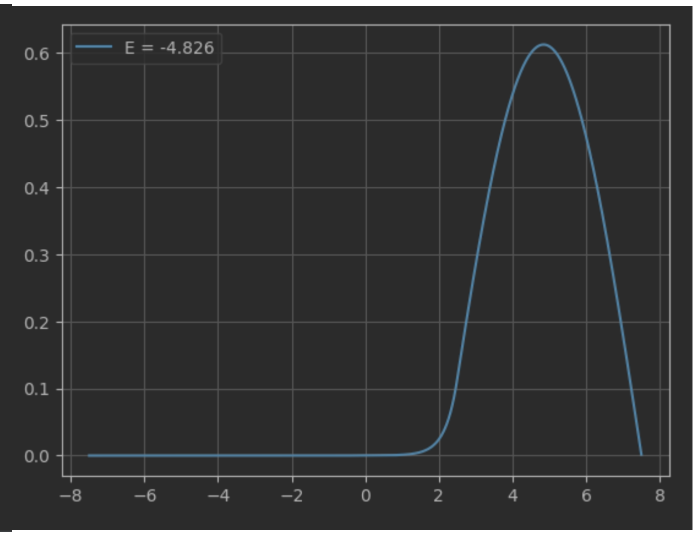
It is observed that the chances of actually finding the particle in either of the wells gets considerably smaller. In fact, it seems there is a larger chance of finding the particle OUTSIDE of the wells than inside. And in half of each well (the half closer to the middle), the wave function is ~0.





```
Now let's try something new! Modify the potential so that the two wells have
different widths. Choose $a=-1.5$, $b=-0.5$, $c=0.5$ and $d=2.5$ but this time
with $V_0=-5$. Where is the wave-function mostly likely to be located for the
ground state and the first excited state?
Explain.
```





The ground state (left) wavefunction implies that the most probable place for the particle to be found is at around x = -4.341710427606902. For the first excited state, this occurs at about x=4.840585146286571. When the wave function is primarily located in the right well, the most probably x value is further away from the origin than the ground state because the well's rightmost wall is further away.

When the particle is in the lowest energy state, it prefers to stay in the smaller well because it is smaller; when the particle moves up an energy level, it moves to the larger well to accommodate its energy.

The next energy level sees the addition of another node, and follows the same trend (left well, then right well) as the energy level increases.