Help
Wave Function Sketcher
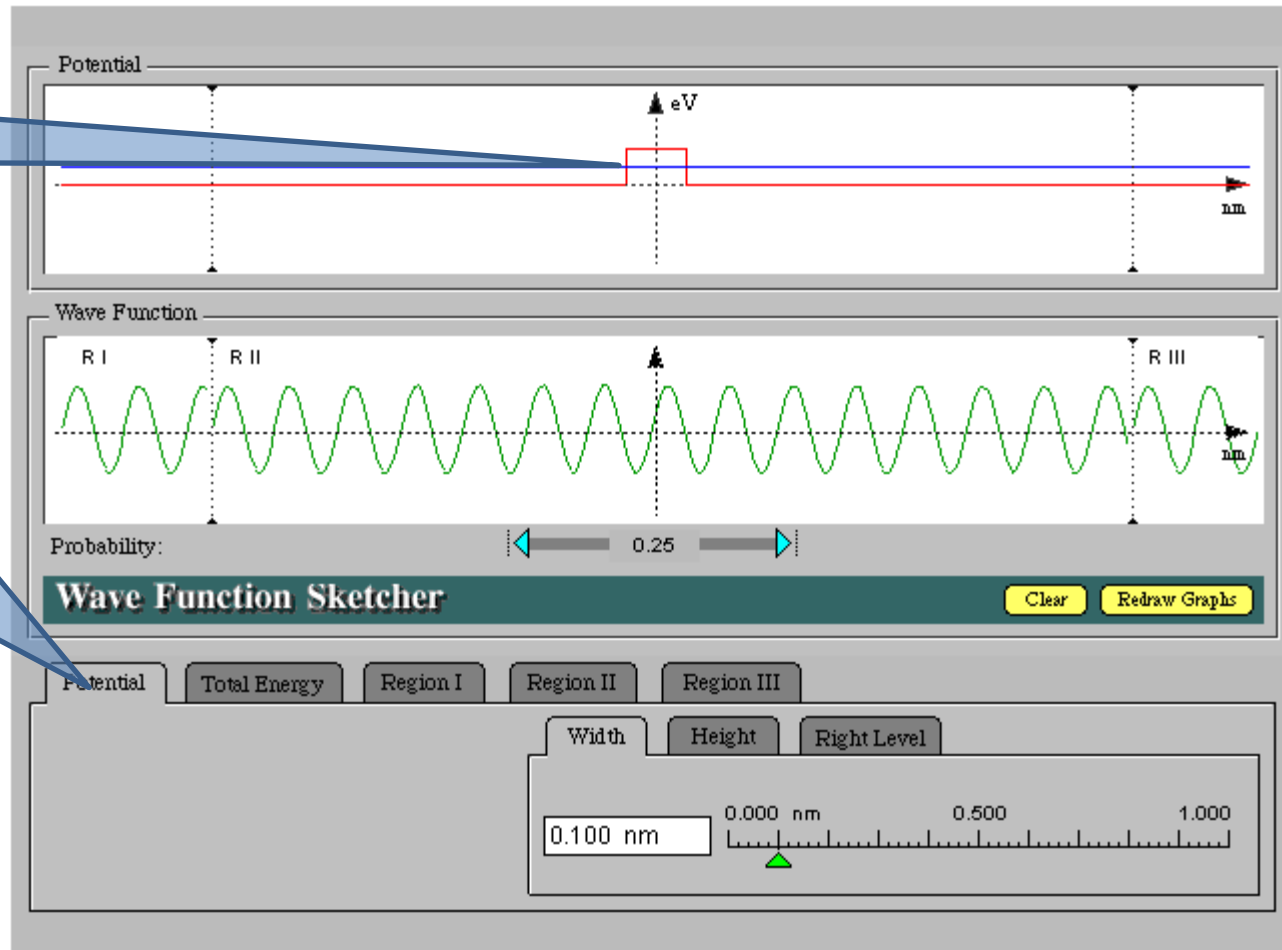
Visual Quantum Mechanics

Next Step

STEP 1: Changing the Potential

The program uses a square potential barrier/well

Begin by changing the depth and width of the potential barrier/well. Click on the "Potential" tab at the bottom of the screen.
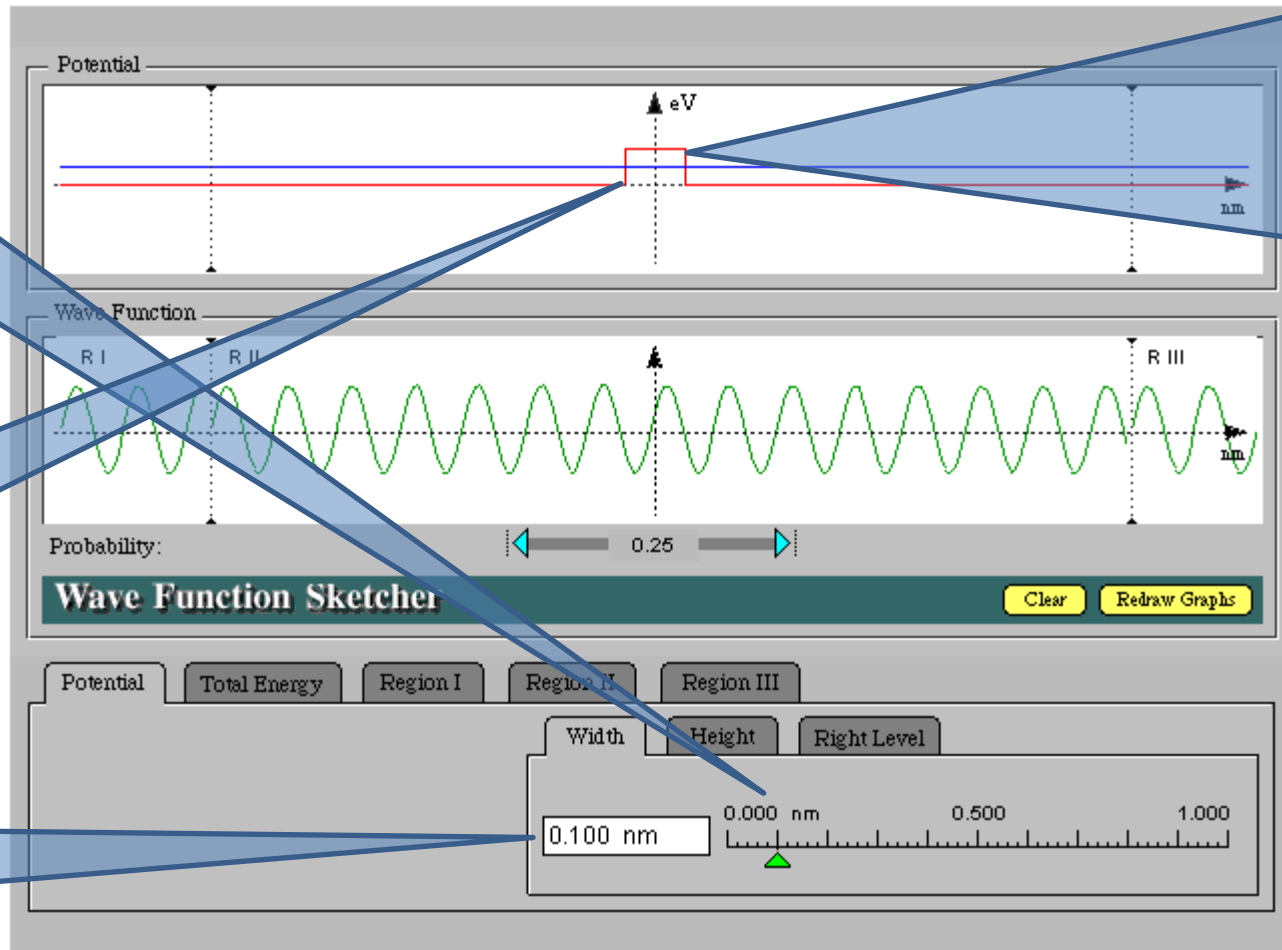

Next Step

STEP 1a: Changing the Width of the Potential

Use the slider in the "Width" tab inside the "Potential" tab. The default width is 0.1nm, but it can be varied from 0 to 1nm. screen.

Observe the width of the potential energy diagram change at the top of the screen.

The value of the width is displayed in the text box adjacent to the slider.

You can also change the width by clicking one of the walls of the potential barrier, at the top of the screen and dragging it left or right. The other wall of the potential barrier mirrors the change.

Potential

Wave Function

R I   R II   R III

Probability: ◀ 0.25 ▶

Wave Function Sketcher   Clear   Redraw Graphs

Potential   Total Energy   Region I   Region II   Region III

Width   Height   Right Level

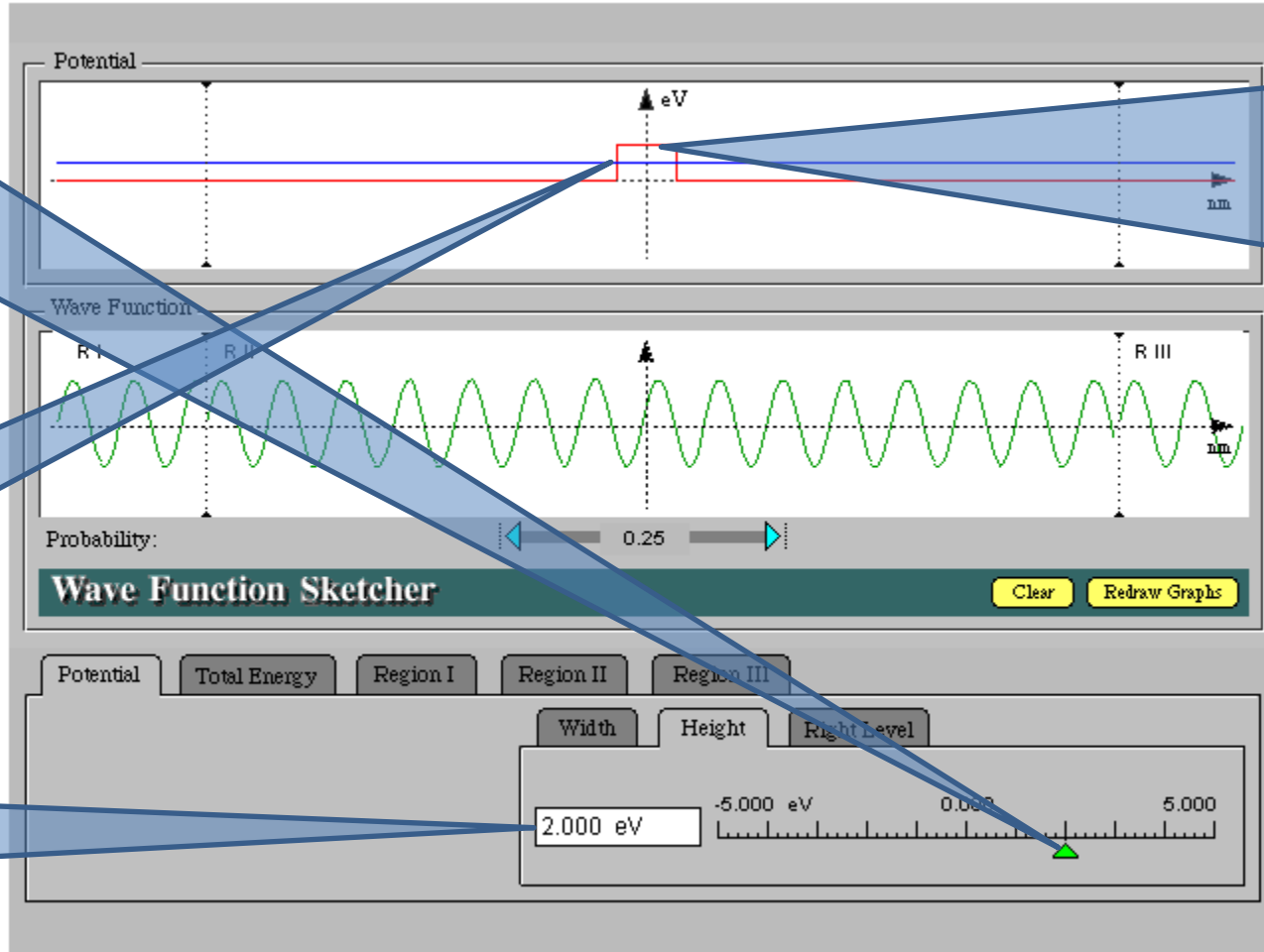0.100 nm   0.000 nm   0.500   1.000

Next Step

STEP 1b: Changing the Height of the Potential

Use the slider in the "Height" tab inside the "Potential" tab. It can be varied from -5.0eV to 5.0eV. Positive values of height correspond to a repulsion, while negative values correspond to attraction.

You can also change the depth by clicking on the top of the potential barrier at the top of the screen and moving it up or down.

Observe the height of the potential energy diagram change at the top of the screen.

The value of the width is displayed in the text box adjacent to the slider.

Next Step

STEP 1c: Changing the Height of the Right Side of the Potential

This step is frequently not needed.

Use the slider in the "Right Level" tab inside the "Potential" tab. It can be varied from -5.0eV to 5.0eV. Positive values of the right level correspond to a repulsion, while negative values correspond to attraction.

You can also change the right side by clicking on it at the top of the screen and moving it up or down.

Observe the height of the right side of the potential energy diagram change at the top of the screen.

The value of the right side is displayed in the text box adjacent to the slider.


Next Step
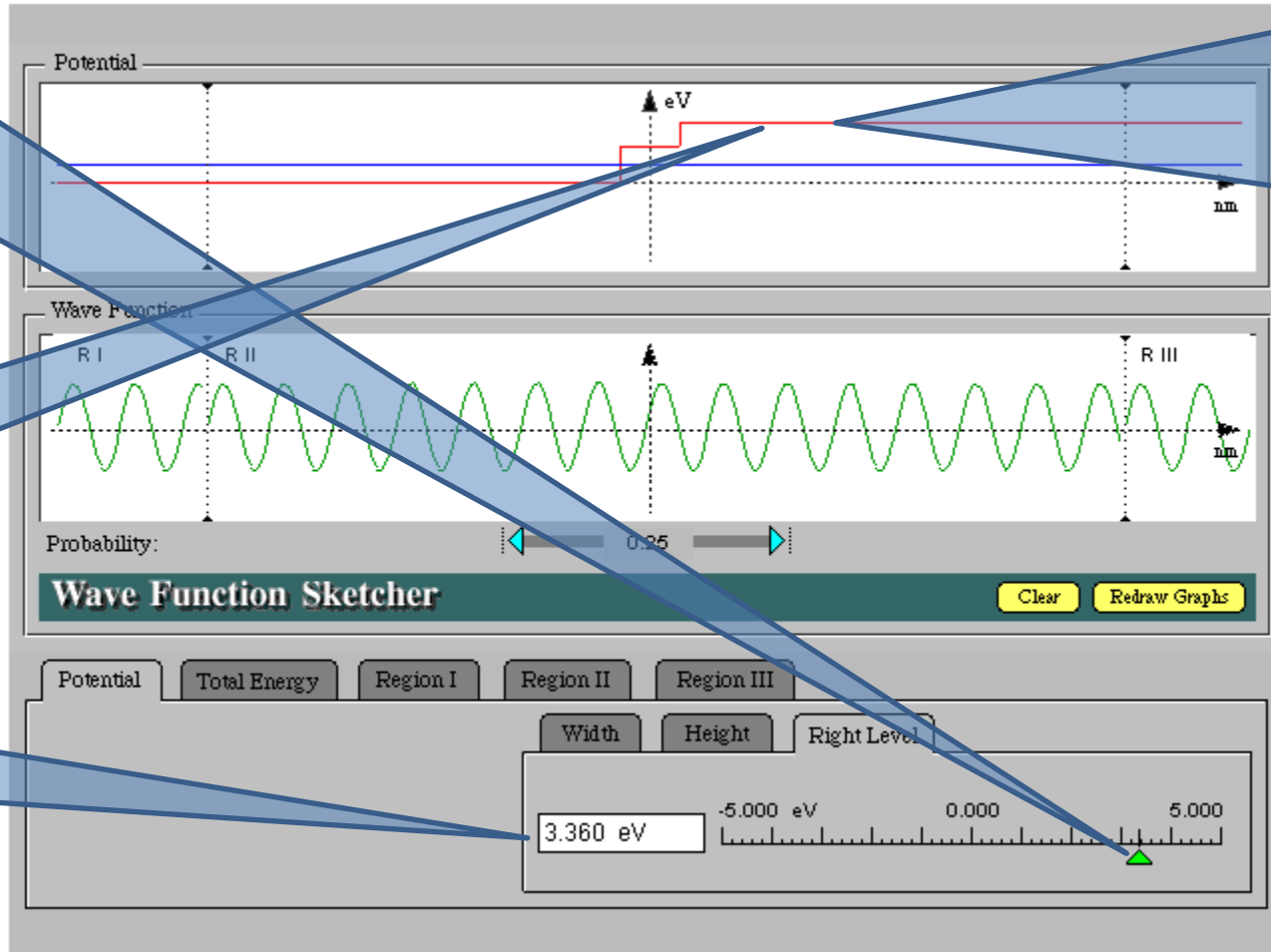
STEP 2: Changing the Total Energy

Click the "Total Energy" tab at the bottom of the screen, and adjust the slider in it to change the total energy of the electron. The default value of the total energy is 1eV, but it can be changed from -5eV to 5eV.

Observe the horizontal blue total energy line in the potential energy diagram above change.

The value of the total energy is displayed in the text box adjacent to the slider.
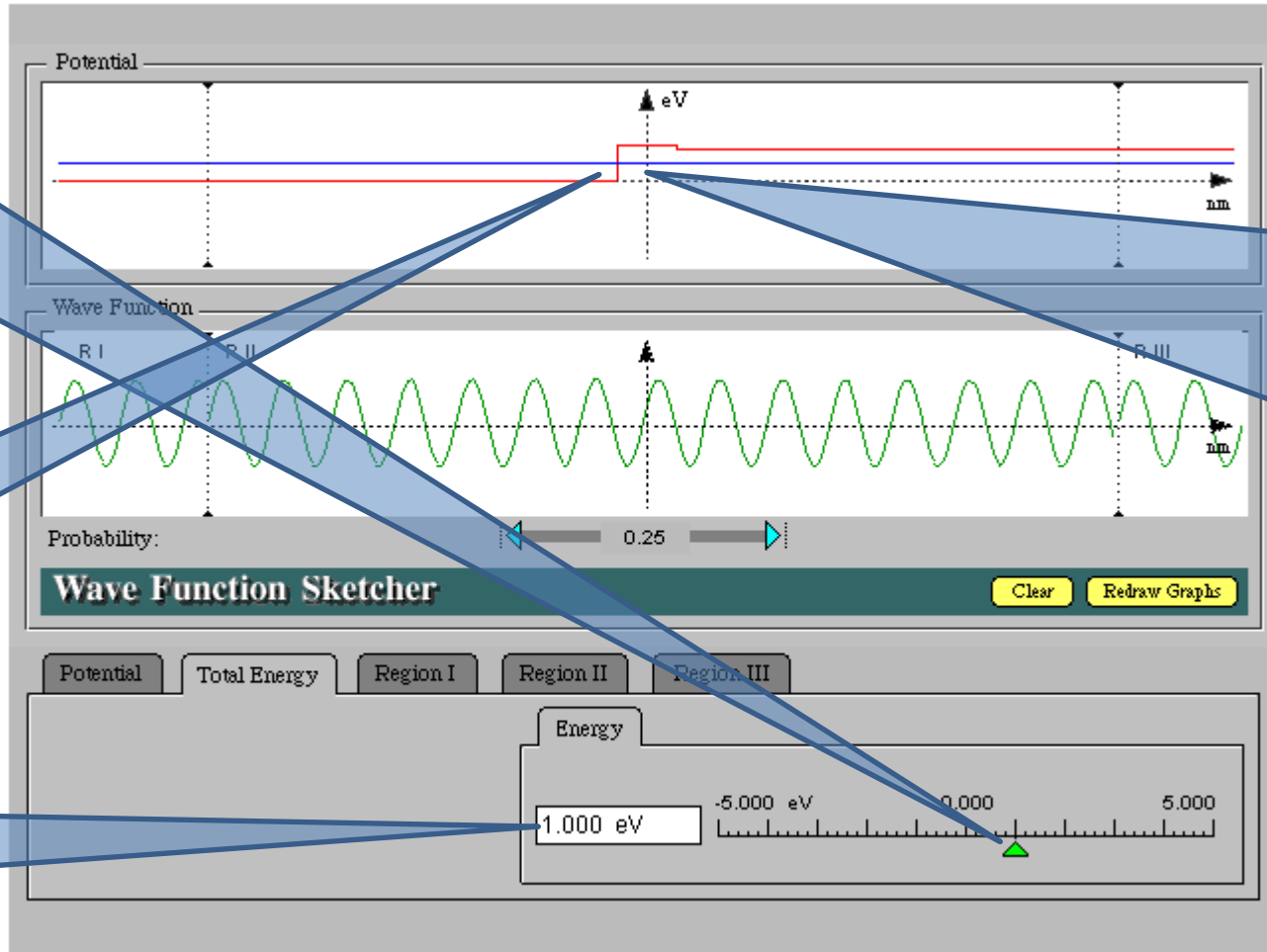
You can also change the total energy using by clicking on the horizontal blue total energy line in the potential energy graph and dragging it up or down.

Potential

eV

nm

Wave Function

R I   R II   R III

nm

Probability: 0.25

Wave Function Sketcher   Clear   Redraw Graphs

| Potential | Total Energy | Region I | Region II | Region III |

Energy

1.000 eV   -5.000 eV   0.000   5.000
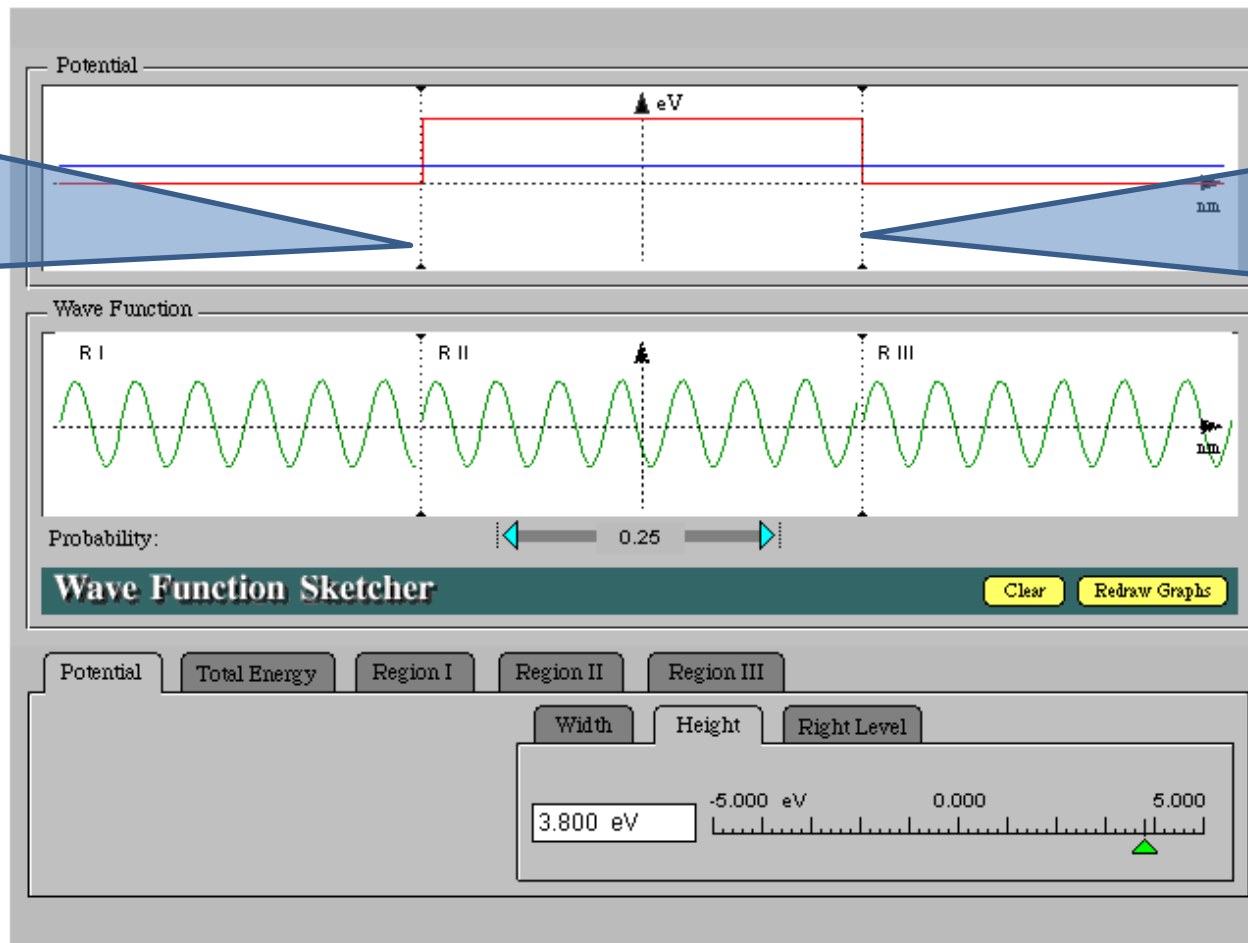
Next Step

STEP 3: Defining the Region Boundaries

The boundary between regions is located where the potential energy changes. In this program we can have at most three different values of the potential energy and thus two boundaries. The boundaries are represented by the thin dashed vertical lines that run across both the potential energy and wave function graphs.

Region I - Region II Boundary: Click on the left line and drag it to the appropriate positions. This line defines the boundary between Region I and Region II.

Region II - Region III Boundary: Click on the right line and drag it to the appropriate positions. This line defines the boundary between Region II and Region III.

Potential

eV

Wave Function

R I   R II   R III

nm

Probability: 0.25

Wave Function Sketcher   Clear   Redraw Graphs

Potential | Total Energy | Region I | Region II | Region III

Width | Height | Right Level

3.800 eV

-5.000 eV   0.000   5.000

Next Step

STEP 4: Sketching the Wave Function in Any Region

Choose the desired Region I, II, or III; using the appropriate tab at the bottom of the screen.

Depending upon the total energy and potential energy in the chosen Region, decide whether the wave functions will be oscillating or decreasing. Click on the appropriate radio button in the Region tab.
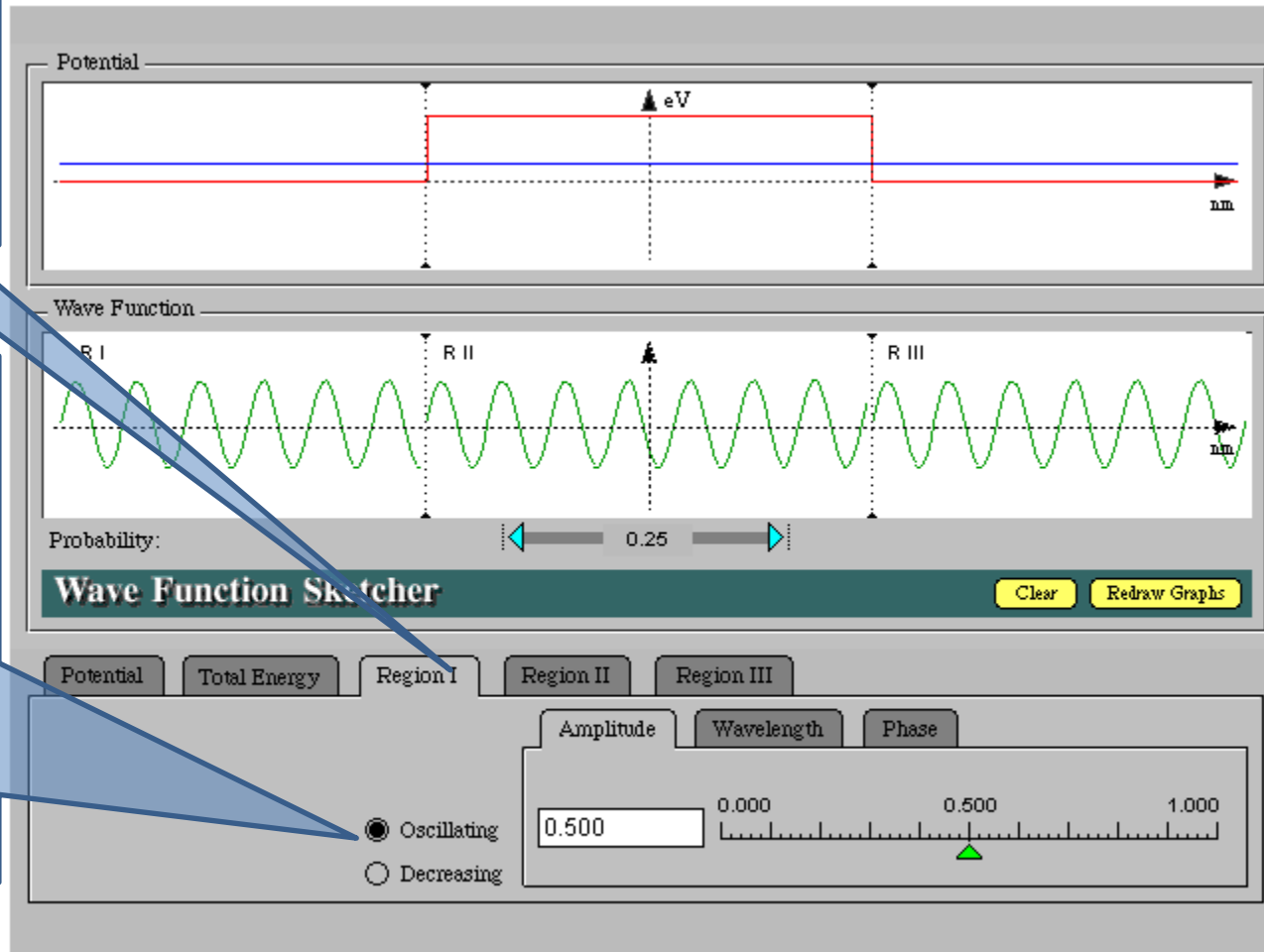

After choosing the type of wave function (Oscillating or Decreasing) change the parameters of the wave function using the appropriate tab. **See the next two slides.**

Next Step

STEP 4a: Sketching an Oscillating Wave Function in Any Region

The wave functions must match at the boundaries of the regions. (This one is not correct.) To make them match you must adjust the parameters of the wave function.
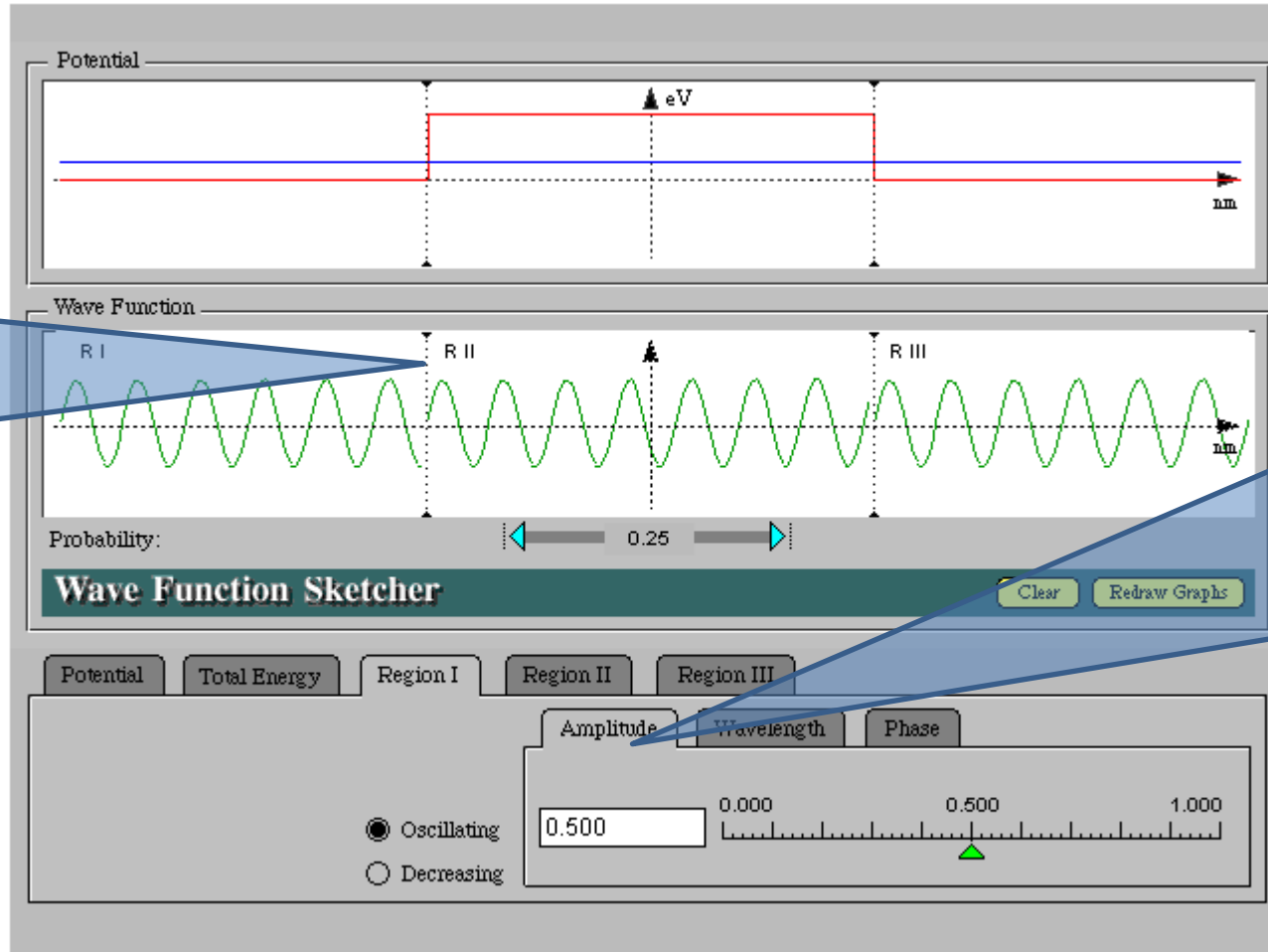
Change the "Amplitude", "Wavelength", and "Phase" by clicking on the appropriate tab and using the slider. The wavelength depends on the Total and Potential Energies, so the computer will check to see if you have it correct.

Next Step

STEP 4b: Sketching a Decreasing Wave Function in Any Region

Select the "Shape " first. Then calculate the Decrease length which is dependent on the Total and Potential Energies . The computer sometimes makes a error when checking your result. Then adjust the amplitude to make the wave functions match at t he boundaries. it correct.
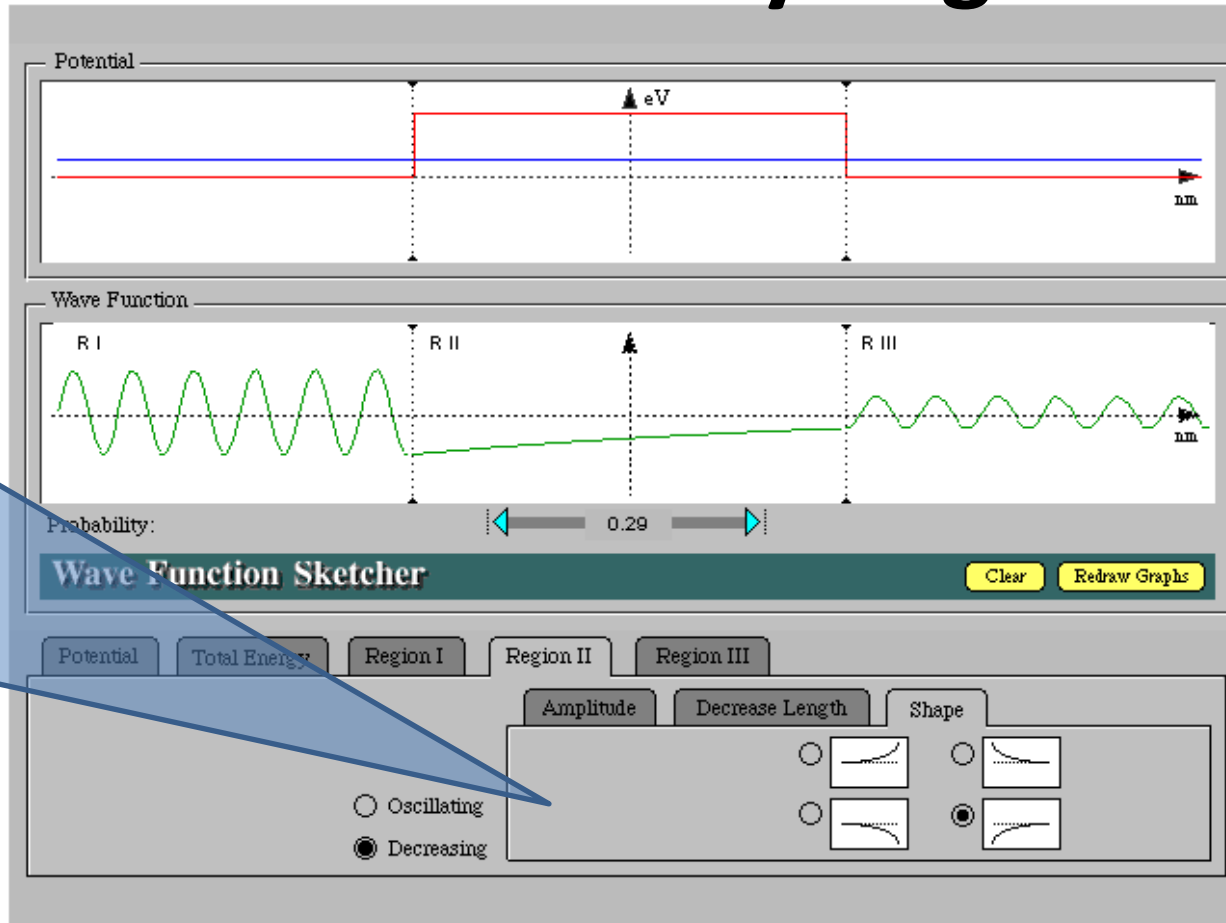
In most cases making the wave functions match at the boundaries will take more than one try. You will probably need to go back and adjust wave function parameters a few times to get the best fit. While mathematically only one correct fit is possible, with this methods more than one possibility is OK.