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Question 1

Tries remaining: 2

Points out of 1.00

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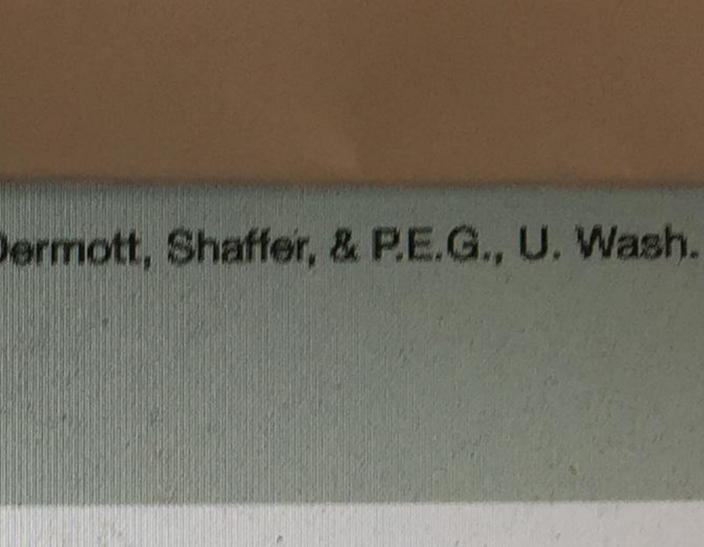
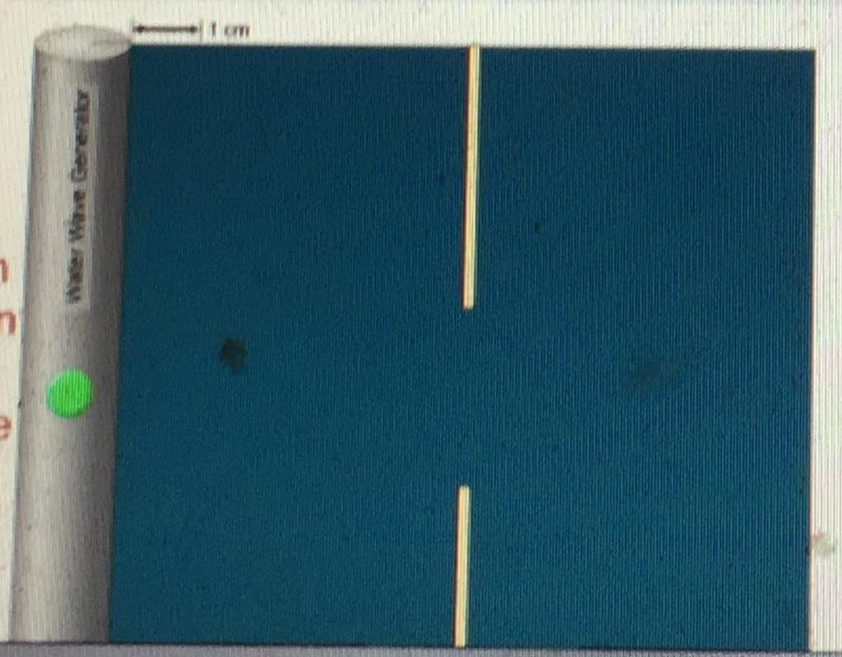
The sketch shows a ripple tank seen from above. A long flat dowel is used to tap the surface of the water and create long parallel wavefronts. Partway across the tank there is barrier with a central opening. The wave passes through the opening from region 1 into region 2.

Use the link below to open a simulation of this setup. Choose 'Slits'. Set the slit width (opening) as wide as it will go (2.5 cm). Turn on the water wave generator and watch what happens to the wave as it crosses the barrier.

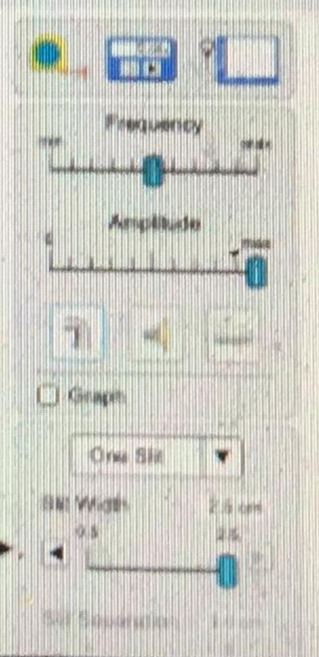
Simulation of ripple tank with slit





The green button turns on the wave gene-rator.

Adjust the width here.



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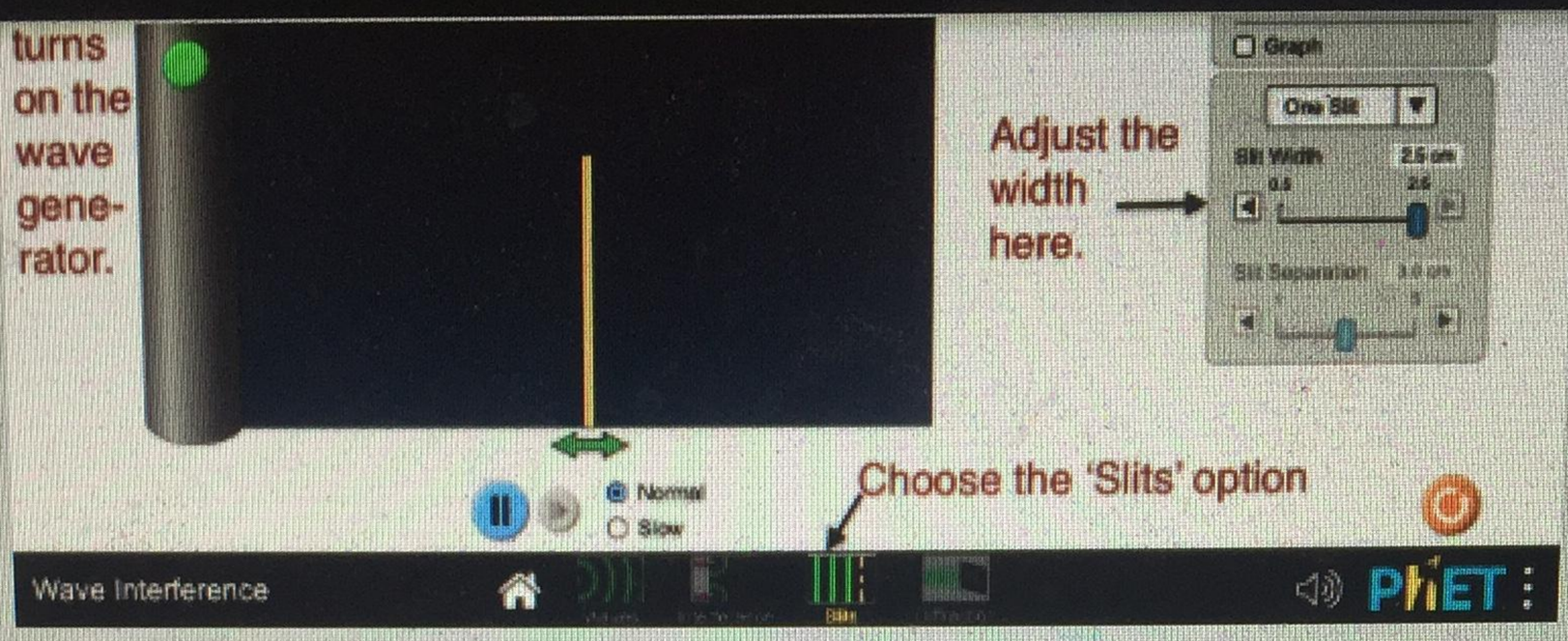

Which two statements correctly describe the shape of the wave after crossing the barrier?

Select one or more:

- a. The waves have the same shape as before the barrier but don't stretch all the way from top to bottom anymore.
- b. The wave continues to be just as wide as the opening in the barrier as it travels through region 2.
- c. It is flat across the center and rounded near the edges of the slit.
- d. The waves a perfect half-circles on the far side of the barrier.
- e. The wave spreads out as it crosses the opening so that it cover the whole of region 2.

Check

Question 2

Not yet answered

Points out of 1.00

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Now, while the wave generator is running, gradually reduce the width of the slit down to its narrowest setting. Describe how the shape of the waves in region 2 change as the slit width decreases.

Question 3

Tries remaining: 2

Points out of 1.00

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Which is the correct description of the path of the wave after passing through the slit in the barrier?

Select one:

a. The wave spreads out to travel in all available directions on the other side of the barrier.

b. The wave continues in exactly the same direction that it was traveling before the slit.

Check

Question 4

Not yet answered

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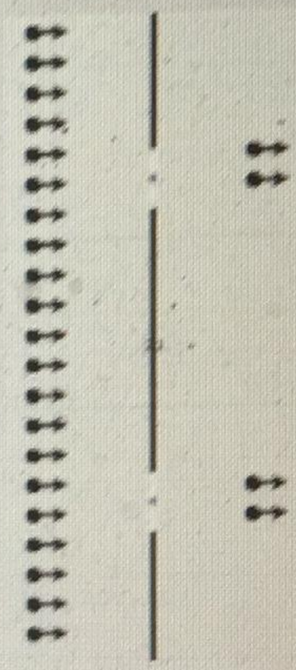
Imagine that light traveled through the openings in straight lines without diffraction.

How would the pattern in region 2 be different than what you see in the simulation?



A ▾ Fi ▾ B I U S x_2 x^2

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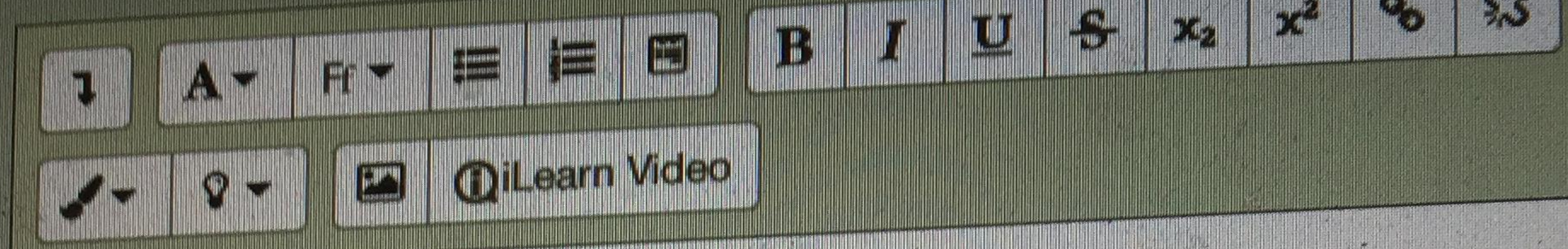

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Switch between the different types of waves in the simulation. Just under the amplitude slide
you have the choice of water waves (the faucet), sound waves (the speaker) and light waves
(the laser).

Watch each of the different sources pass through the slit and notice the similarities in behavio
between the three different types of waves.

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Question 5

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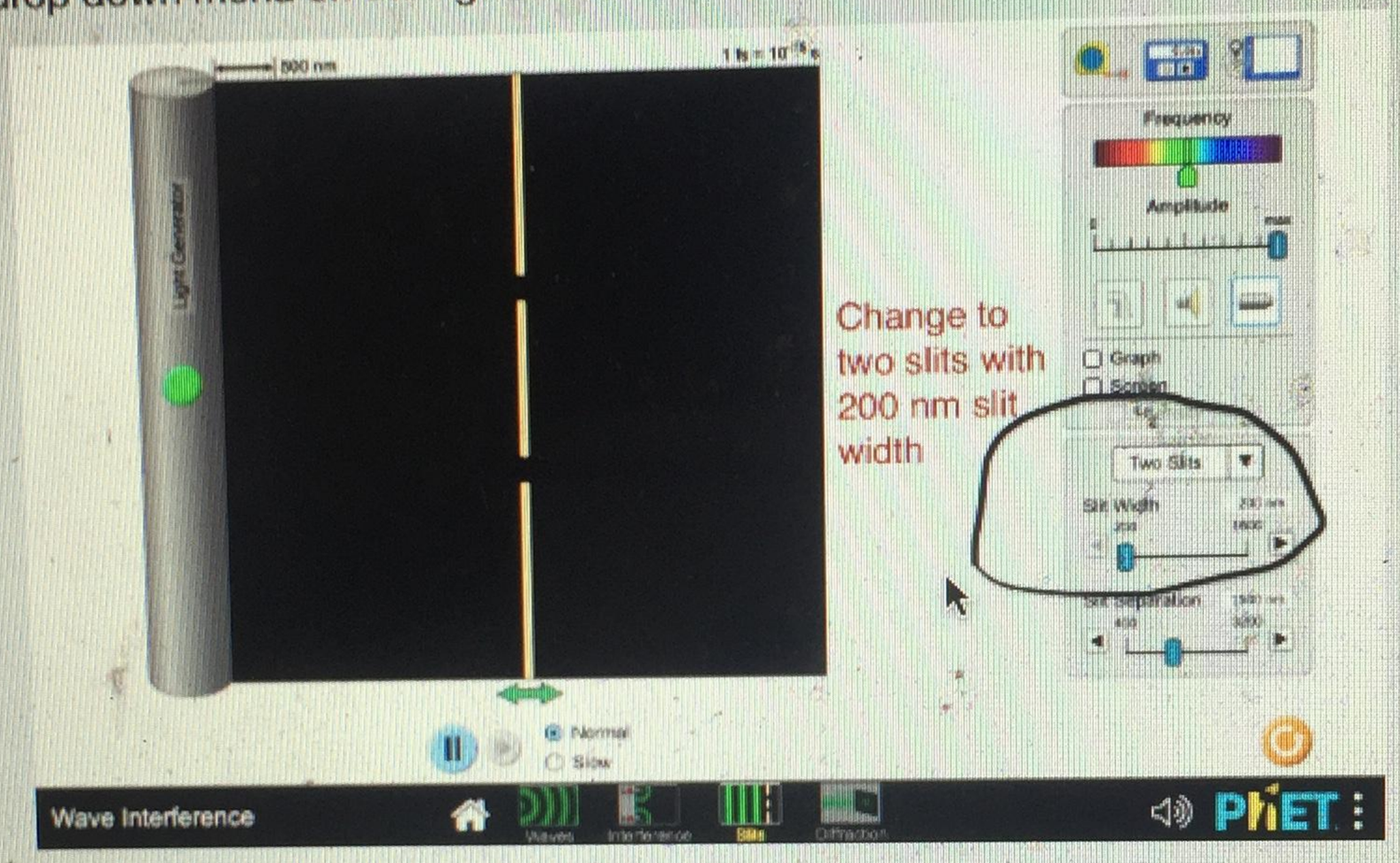
Sticking with the case of light waves, adjust the simulation so that there are two slits using the drop down menu on the right and then adjust the slits to their narrowest setting (200 nm).



Run the simulation and watch the pattern of the light waves in region 2 past the barrier. Compare and contrast this pattern with the pattern that we produced last week with overlapping light from different sources.

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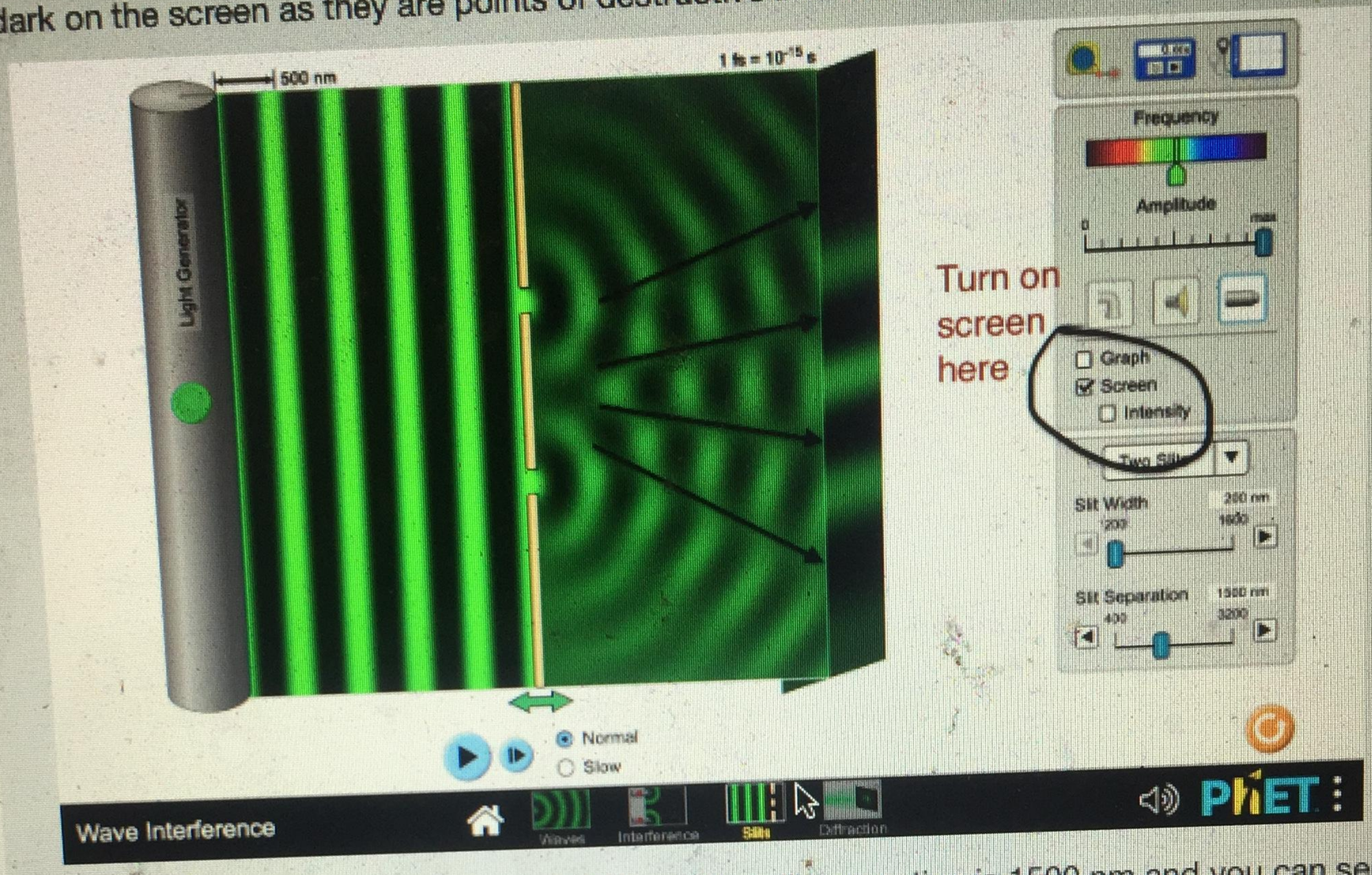
In the right menu there is a click box to turn on the screen. The screen shows the light intensity at different points and will make it easier to track the lines of nodes, which show up dark on the screen as they are points of destructive interference.



In this first image the slit width is still 200 nm, the slit separation is 1500 nm and you can see that there are 4 lines of nodes.

Adjust the slit separation down to 800 nm and count the number of lines of nodes. There are [ ].

Adjust the slit separation up to 2000 nm. Now there are [ ] lines of nodes.

Go all the way up to a slit separation of 3200 nm. Now how many lines of nodes are there?

[ ].

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Question 7

Tries remaining: 3

Points out of 2.00

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Staying with a slit with of 200 nm and a slit separation of 3200 nm, try adjusting the color/frequency of the light.

Pick a nice bright red shade and count the number of lines of nodes [ ].

Then switch to violet. At the extreme edges of red and violet the light is dim and hard to see. Stop far enough from the most extreme violet color that you can still see the light in region 2.

Now how many lines of nodes are there? [ ]

Which has a shorter wavelength [ ]

- the violet light
- the red light
- the color of the light is not related to the wavelength

So as the wavelength of light ge [ ]

Check

Question 8

Tries remaining: 4

Points out of 2.00

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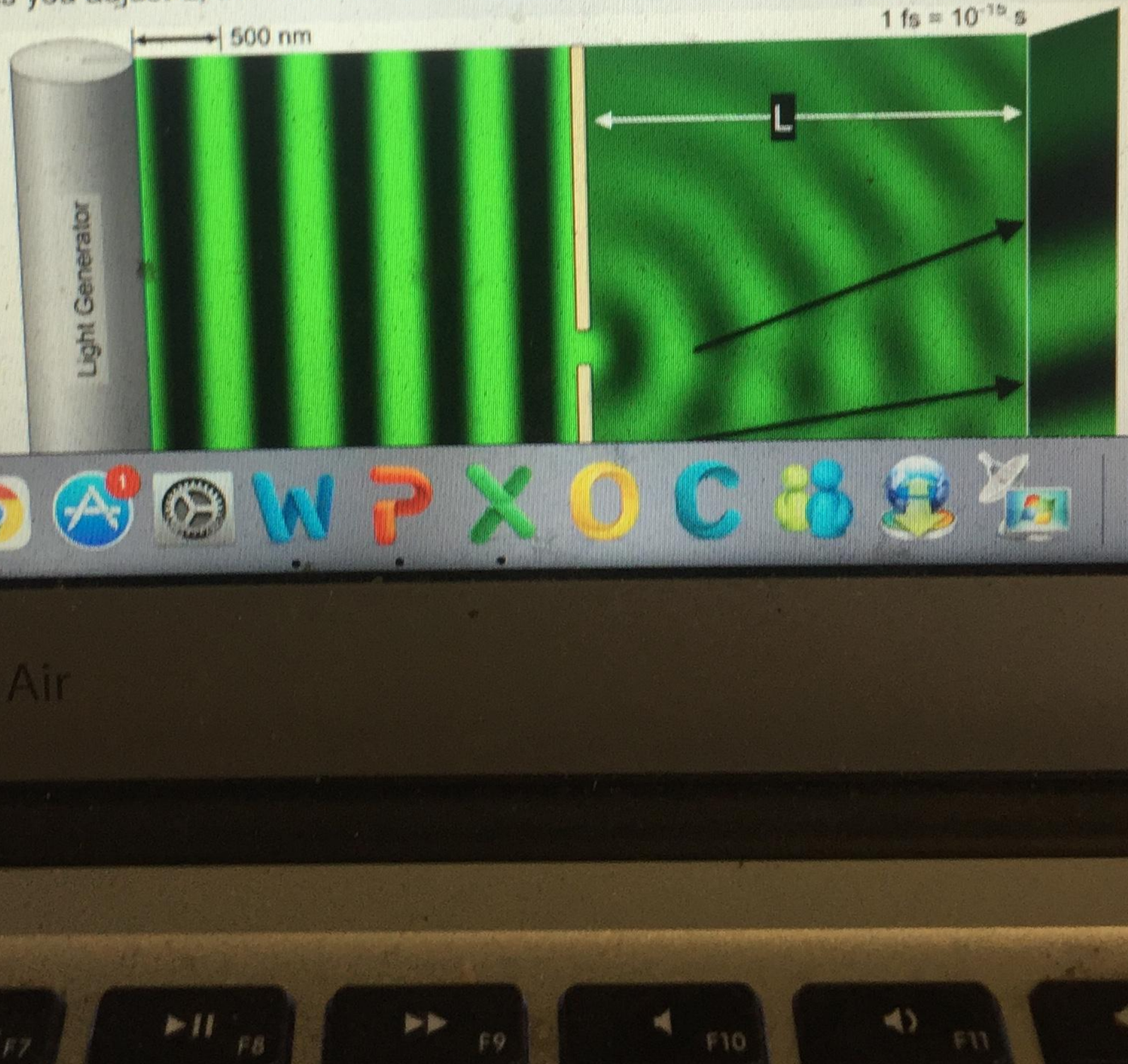
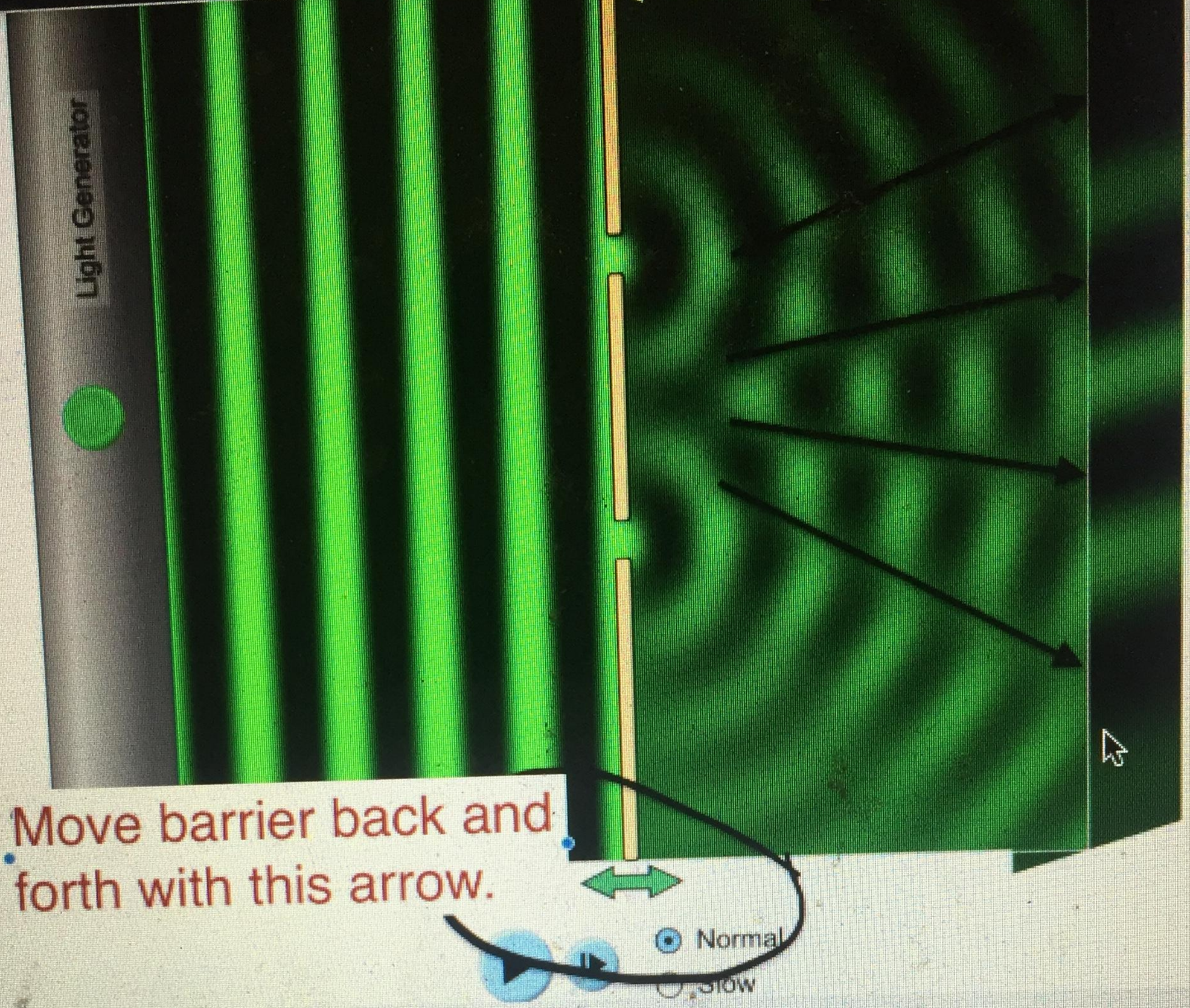
Go back to green light and a slit separation of 1500 nm where we were able to produce a patter with 4 lines of nodes. At the base of the barrier that contains the slits there is a double-sided arrow. Grab the arrow and use it to slide the barrier back and forth, towards and away from the screen. Watch what happens to the waves in region 2 and to the pattern on the screen as you adjust L, the distance from the barrier to the screen.





Does/How does changing the distance L change the number of lines of nodes?

How does changing L change the spacing of the fringes (light and dark bands on the screen)?

Check

9 Put the barrier back in the middle somewhere and try adjusting the slit width. We have done

Check

Question 9

Not yet answered

Points out of 1.00

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Put the barrier back in the middle somewhere and try adjusting the slit width. We have done all our work so far with the slit width at its narrowest setting of 200 nm. Gradually increase the width of the slits and see how the wave pattern in region 2 and the appearance of light on the screen change as the slit width is increased.

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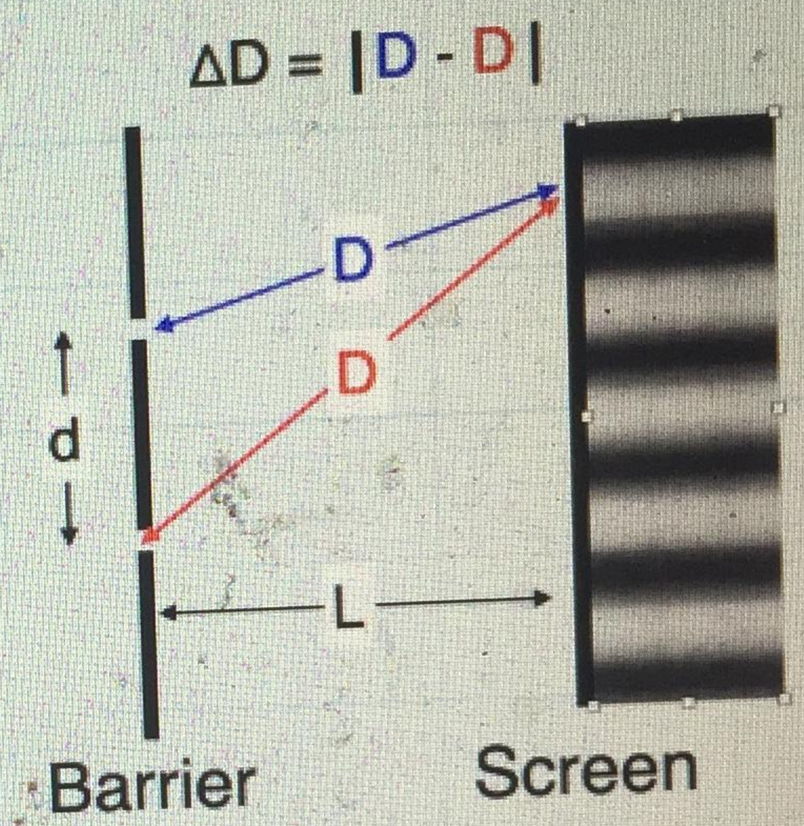
The light and dark patterns that show up on the screen come from light having traveled different distances ΔD to that point from each of the two slit and arriving in or out of phase.



Question 10

Tries remaining: 3

Points out of 2.00

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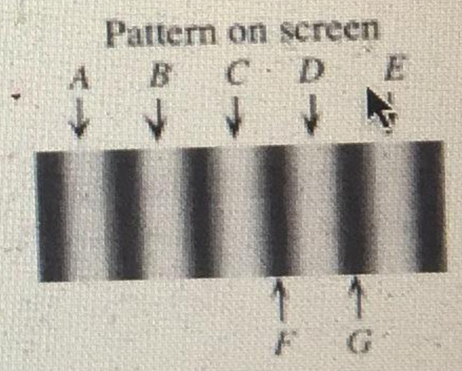
Consider the following experiment where a student uses a laser and two slits in a mask to produce a pattern on the screen as shown in the figure.

For each of the lettered points, determine ΔD (in terms of λ).



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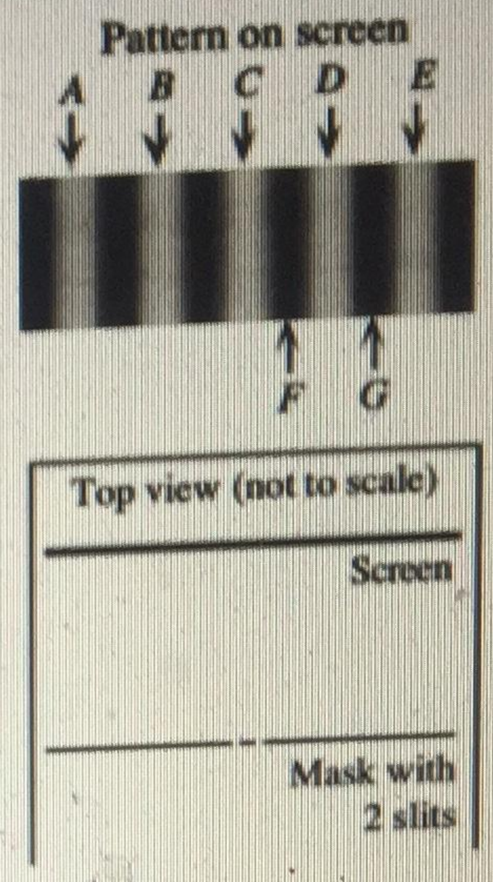

For each of the lettered points, determine ΔD (in terms of λ).

Note: Point *C* is at the center of the screen. All numbers will be positive. Where appropriate use 0.5 rather than 1/2

ΔD for each fringe

	A	B	C	D	E	F	G
ΔD	λ	λ	λ	λ	λ	λ	λ

Check

Question 11

Not yet answered

Points out of
2.00

Which points correspond to:

Constructive interference? Explain.

Destructive interference (nodal lines)? Explain.

(make sure to answer both in the box below)

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Question 11

Not yet answered

Points out of 2.00

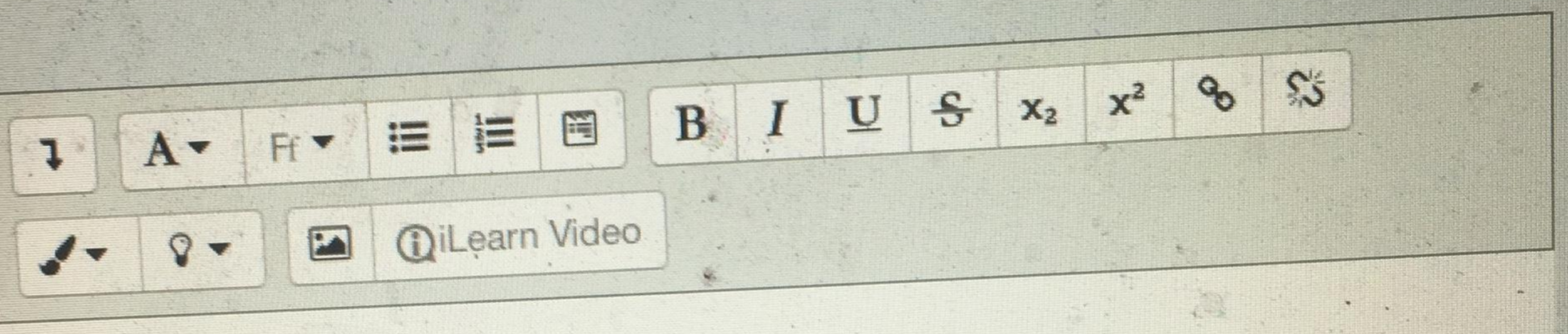
Flag question

Which points correspond to:

Constructive interference? Explain.

Destructive interference (nodal lines)? Explain.

(make sure to answer both in the box below)



Question 12

Tries remaining: 3

Points out of 3.00

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In each part below, suppose that a *single* change were made to the original apparatus. For each case, determine how, if at all, that change would affect the pattern spacing on the screen.

If the distance between the slits is decreased (without changing the width of the slits) the lines would [ ] .

Check

Question 13

Tries remaining: 1

Points out of 1.00

Flag question

Consider point *B*, the first maximum to the left of the center of the screen.

Suppose that the two slits are separated by d = 0.2 mm, that the screen is L = 1.2 m away from the slits, and that the distance from the center of the pattern (point *C*) to point *B* is y = 3.6 mm.

Use this information to determine the wavelength of the light.

hint: Remember the formula from the introductory powerpoints:

$y = m\lambda L/d$.

- y = distance from center of pattern to fringe of interest
- d = slit separation
- L = distance from slits to screen
- λ = wavelength of light
- m = 0, ½, 1, 1.5, 2, 2.5, ...

Answer:

✓ Choose...
nm
mm
m

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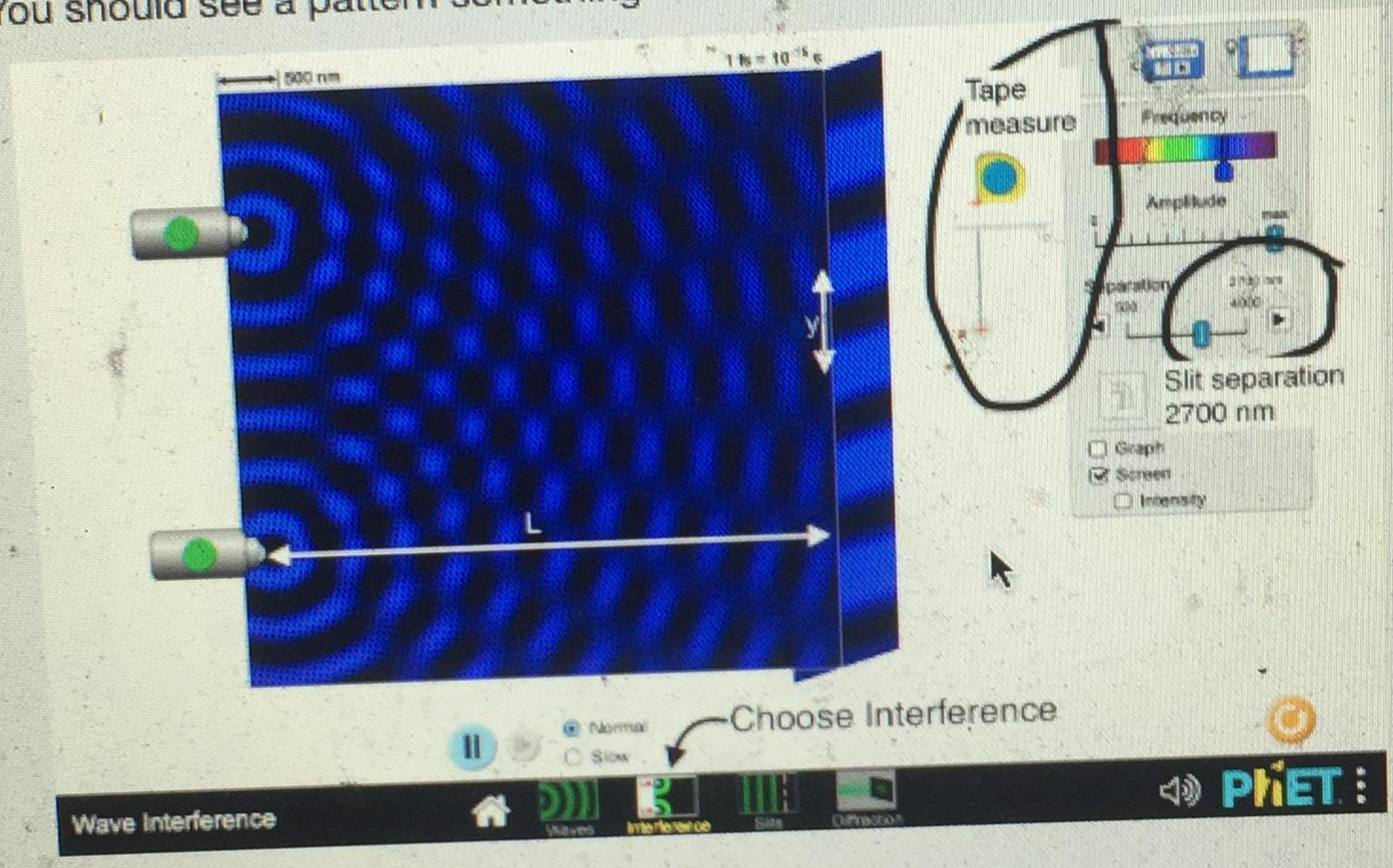
Now we will use the simulation to measure and make a similar calculation.

Click on the "Interference" tab of the simulation.

Using light waves, adjust the frequency until the waves are a medium blue color. Click "screen."

Set the separation of the sources to d = 2700 nm.

You should see a pattern something like this:



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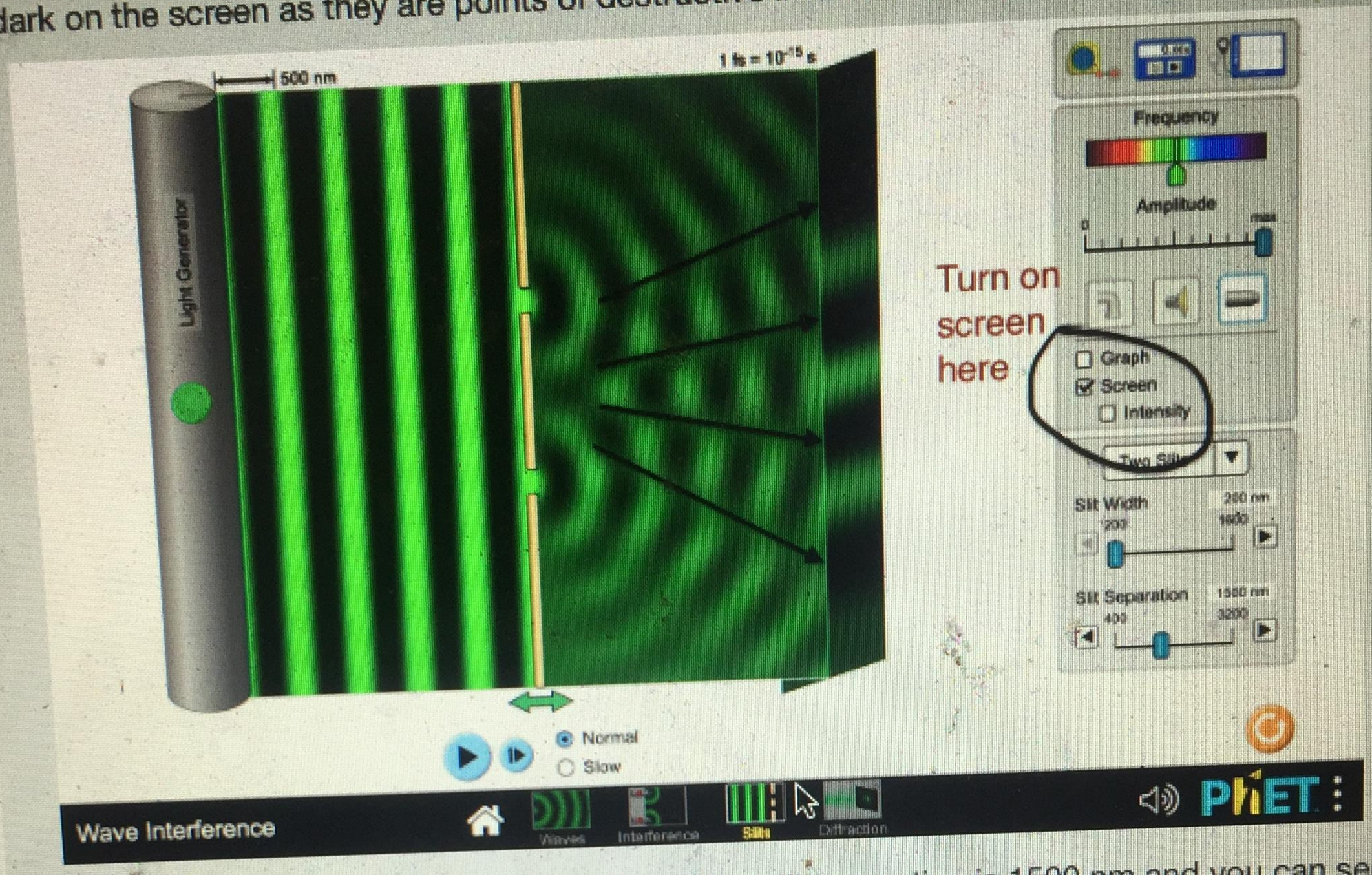

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Adjust the slit separation up to 2000 nm. Now there are [ ] lines of nodes.

Go all the way up to a slit separation of 3200 nm. Now how many lines of nodes are there?

[ ].

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Question **16**

Not yet answered

Points out of 1.00

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Using your measured values for L and y and the fact that d is set to 2700 nm calculate the wavelength of blue light in nm.

No automatic grading here because everyone probably has a different shade of blue, but enter your result in the textbox below.

Compare your result with the values in the table. Is your wavelength result reasonable? Is your blue really blue or did you maybe get indigo by mistake? They are hard to tell apart.

Color vs Wavelength

Color	Wavelength (nm)
red	630-750
orange	590-630
yellow	570-590
green	490-570
blue	450-490
indigo	420-450
violet	380-420

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Leaving the color the same, set the source separation to d = 3400 nm.

Again use the measuring tool to determine the distance (y) from the center of the pattern on the screen to the center of the first bright spot.

Calculate the wavelength of the light.

Are your results for the wavelength of blue light consistent with each other? Enter your new result below and explain any differences.

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Repeat for your favorite color (other than blue).

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Finish attempt ...

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