6.9.1: Interference- Ripple Tank Simulation

This simulation shows a top view of a source making waves on the surface of a tank of water (imagine tapping the surface of a pond with the end of a stick at regular intervals). The white circles coming from the spot represents the wave crests with troughs in between. Two sources can be seen at the same time and the separation between them and the wavelength of both can be adjusted. The simulation can also be imagined to represent two sound sources (for example two speakers), each producing exactly the same wave. The wavelength, λ, and distance between sources, d, are in the same arbitrary distance units (meters, cm, μm, etc.). Speed is a unitless parameter that controls the rate at which the simulation is refreshed.

Simulation Questions:

1. After looking at the left and right waves to verify they are the same, click on 'Both' to see them together. Waves from each source will cancel in some places (destructive interference) but add in other places (constructive interference). How many lines of constructive interference do you see?
2. With two sources change the wavelength of the sources. How does the number of destructive interference lines change with wavelength? Write a statement about the relationship between wavelength and the number of interference lines.
3. With two sources and a wavelength of 2.0, change the separation between the sources. How does the number of destructive interference lines change with separation? Write a statement about the relationship between source separation and the number of interference lines.
4. Reset the simulation to the original values and click 'Both'. Suppose instead of a ripple tank this simulation represented two light sources (which have the same wavelength and start off in phase- for example laser light from a single source shining through two small openings). The light starts at the middle of the simulation and reaches a screen at the top edge of the simulation. How many bright spots would be seen on the screen in the simulation for the this case?
5. If the simulation represented a double slit light source, changing the wavelength would be equivalent to changing the color. Describe the difference in the location of the bright spots for the color represented by wavelength equal to 1 compared to the location of the spots for the color represented by wavelength equal to 4. Do they occur in the same location on the screen (at the top edge of the simulation)?
6. What would be the result on the screen of shining light which was a mixture of two colors through a double slit?

Advanced Questions:

The formula for double slit interference is given by $d \sin\theta_{bright} = m\lambda$ where $m = 0, \pm1, \pm2, \pm3\ldots$ for the case of constructive interference. For destructive interference $d \sin\theta_{dark} = (m + 1/2)\lambda$ where $m = 0, \pm1, \pm2, \pm3\ldots$ In both cases d is the distance between the center of the openings (the separation of the sources), the angle θ is the angle from the central maximum out to a minimum or maximum and m numbers the maximums (or minimums) starting from the center ($m = 0$).

Note

In order to actually measure this effect for light the slits must be similar to the wavelength of light; in other words, very small and close together with the screen quite a distance away. The light must also be coherent (have the same phase as is the case for laser light).

1. For 600 nm light and a separation of 0.01 mm, what is the angle (in radians) to the first maximum? What is the color of this light?
2. For the previous question, how far away would the screen have to be in order to have a 2 mm separation between the first and second maximum?