PHYSICS 204

Light as a Wave - Lab

In this lab you are using the PhET Wave Interference simulation:

https://phet.colorado.edu/sims/html/wave-interference/latest/wave-interference_en.html

Procedure

Open the link above and click on 'Waves', then click on the green button at the side of tap to turn on liquid dropping into container half filled with liquid. Use 'Top View' and continuous wave from lower left side of screen.

1. (a) What does the dropping liquid create?
   (b) Describe what you see as the liquid continue to drop.
   (c) On the right side, increase and decrease amplitude setting. To get a better understanding of amplitude, use side view of liquid filled tank. Describe what happens to drops of liquid and liquid in tank as amplitude is increased and then decreased.
   (d) Now after observing at (c) above, state what is amplitude.
   (e) Increase and decrease frequency setting. What happens to actual drops of liquid as you increase and decrease frequency setting?
   (f) What is frequency?

2. Select the 'Wave meter' on the top right side by dragging it next to the tank. Place the two floating bulbs in the tank. Now resume droplet flow into tank and observe wave meter.

(a) What is displayed on the wave meter? Make a sketch of this display.

(b) Vary amplitude and frequency and observe what happens on the wave meter screen.

(c) Can you calculate the periodic time, T, frequency, f, wavelength, λ and amplitude from your screen? Record these values for your lab report.

PHYSICS 204

Light as a Wave - Lab

3. Pause simulation and select light source from right side of screen and check boxes for 'Graph' and 'Screen'.

(a) Start simulation by pressing on green button and observe what happens as you vary frequency and amplitude. Describe what you observe.

(b) Why does the screen change color as you vary frequency selection?

4. Select 'Slits' at the base of screen.

On right side of screen select light source (icon to the right of speaker icon) and check boxes for 'Graph', 'Screen' and 'Intensity'.

Choose 'One Slit' and turn light generator on by pushing on green button.

(a) What do you observe on your screen and intensity profile?
(b) Vary amplitude, frequency, and slit width to see how it affects your on-screen display. Determine and record which combination of settings give you the sharpest display.
(c) Select 'Light Meter' (this is the graph display of Electric Field vs time) and place only one sensor in the path of light coming from light source. Place the other sensor away from the light so it does not measure anything. Press play to resume experiment.
(d) Observe reading of Electric Field on light meter. Pause experiment and record reading from light meter for the time it take one wavelength to display on screen (of light meter). This is the periodic time, T
(e) Determine frequency of this light coming from light source.
(f) Calculate wavelength of light coming from light source.

PHYSICS 204

Light as a Wave - Lab

4. Pause experiment and select 'Two Slits'. Resume experiment and observe screen. What do you see displayed on-screen and on intensity profile?

(a) Vary slit width and slit separation and observe the effects they have on the interference pattern. Determine and select the combination which gives you the sharpest display of interference on screen.

(b) For interference of light, an important equation is:

$d \times \sin\theta = n\lambda$,

here d – is distance between slits. Theta, θ is the angle whose trig sine measure is calculated using the distance y, a fringe is from the center bright fringe divided by the distance L, slits are from the screen. n is the order of fringe seen on screen with bright spot at center screen being zero and the next bright fringe is one. Lambda, λ is wavelength of light.

$\sin\theta = y/L$

From the information available on your screen and the wavelength you calculated at 4(f), determine a value for $\sin\theta$ and θ *[For angles of small measure, sine of the angle is approximately the same as the angle measure itself.]*

5. Select 'Diffraction' at base of screen. Explore diffraction simulation.

After exploring this simulation, explain clearly why as you observe different frequencies or colors of light in the simulation, the size of the diffraction pattern seen on-screen changes.