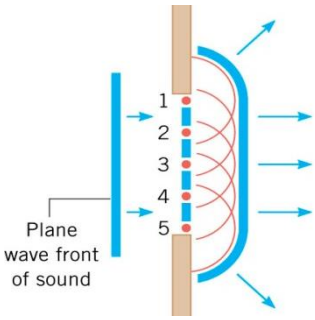
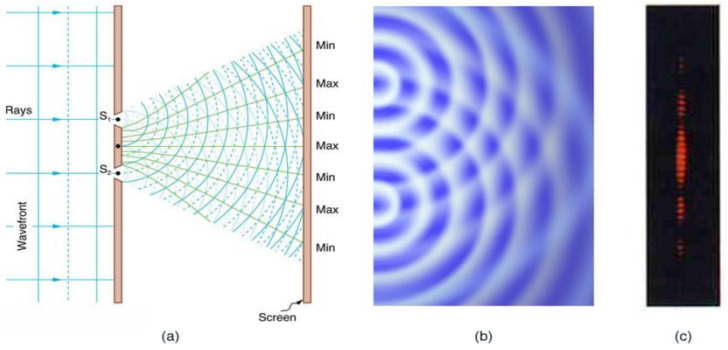
Wave Character of Light

- When _____ interacts with object several _____ it's _____, it acts like a _____
- When _____ interacts with _____ objects, it acts like a _____
- When light hits _____ from a _____, it _____ down
  - _____ stays the same
  - $c = f\lambda$
  - $v = \frac{c}{n} = f\frac{\lambda}{n}$
  - $\lambda_n = \frac{\lambda}{n}$
  - Where λ_n = wavelength in medium, n = index of refraction



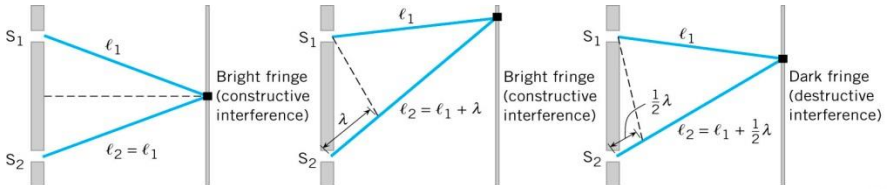
Huygens' Principle

- Every point on a _____ front acts as a _____ of tiny _____ that move forward with the same _____ as the _____; the wave _____ at a later instant is the _____ that is _____ to the wavelets.

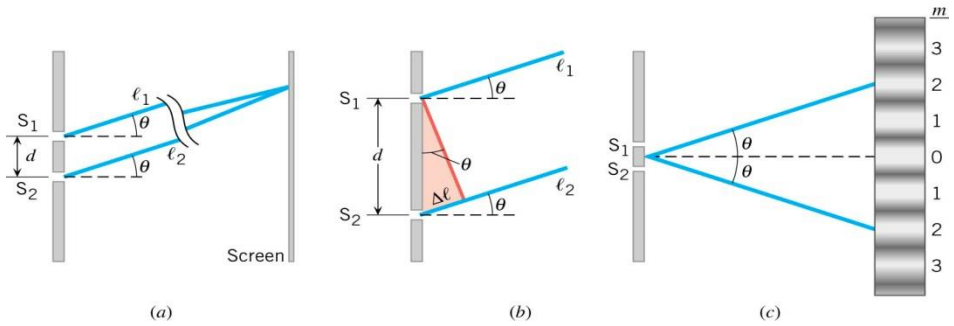


Young's Double Slit Experiment

- Thomas Young showed that two overlapping _____ waves _____ and was able to calculate _____.
- Bright fringe where $\ell_1 - \ell_2 = m\lambda$
- Dark fringe where $\ell_1 - \ell_2 = \left(m + \frac{1}{2}\right)\lambda$
- Brightness of fringes _____
  - Center fringe the _____ and _____ on either side



- (a) Rays from slits S_1 and S_2, which make approximately the same _____ θ with the horizontal, strike a distant _____ at the _____ spot.
- (b) The difference in the _____ lengths of the _____ rays is $\Delta\ell$ = d sin θ.
- (c) The angle θ is the angle at which a _____ fringe (m = 2, here) occurs on either side of the _____ bright fringe (m = 0)
- _____ fringe: $\sin\theta = m\frac{\lambda}{d}$
- _____ fringe: $\sin\theta = \left(m + \frac{1}{2}\right)\frac{\lambda}{d}$



A laser beam (λ = 630 nm) goes through a double slit with separation of 3 μm. If the interference pattern is projected on a screen 5 m away, what is the distance between the third order bright fringe and the central bright fringe?

Homework

1. What type of experimental evidence indicates that light is a wave?
2. Why does the wavelength of light decrease when it passes from vacuum into a medium? State which attributes change and which stay the same and, thus, require the wavelength to decrease.
3. Does Huygens's principle apply to all types of waves?
4. Young's double slit experiment breaks a single light beam into two sources. Would the same pattern be obtained for two independent sources of light, such as the headlights of a distant car? Explain.
5. Find the range of visible wavelengths of light in crown glass. (OpenStax 27.2) **250 nm to 500 nm**
6. What is the index of refraction of a material for which the wavelength of light is 0.671 times its value in a vacuum? Identify the likely substance. (OpenStax 27.3) **1.49, Polystyrene**
7. Analysis of an interference effect in a clear solid shows that the wavelength of light in the solid is 329 nm. Knowing this light comes from a He-Ne laser and has a wavelength of 633 nm in air, is the substance zircon or diamond? (OpenStax 27.4) **1.92, Zircon**
8. At what angle is the first-order maximum for 450-nm wavelength blue light falling on double slits separated by 0.0500 mm? (OpenStax 27.6) $\mathbf{0.516}°$
9. Calculate the angle for the third-order maximum of 580-nm wavelength yellow light falling on double slits separated by 0.100 mm. (OpenStax 27.7) $\mathbf{0.997}°$
10. What is the separation between two slits for which 610-nm orange light has its first maximum at an angle of 30.0°? (OpenStax 27.8) $\mathbf{1.22 \times 10^{-6}\ m}$
11. Find the distance between two slits that produces the first minimum for 410-nm violet light at an angle of 45.0°. (OpenStax 27.9) $\mathbf{0.290\ \mu m}$
12. Calculate the wavelength of light that has its third minimum at an angle of 30.0° when falling on double slits separated by 3.00 μm. (OpenStax 27.10) **600 nm**
13. What is the wavelength of light falling on double slits separated by 2.00 μm if the third-order maximum is at an angle of 60.0°? (OpenStax 27.11) **577 nm**