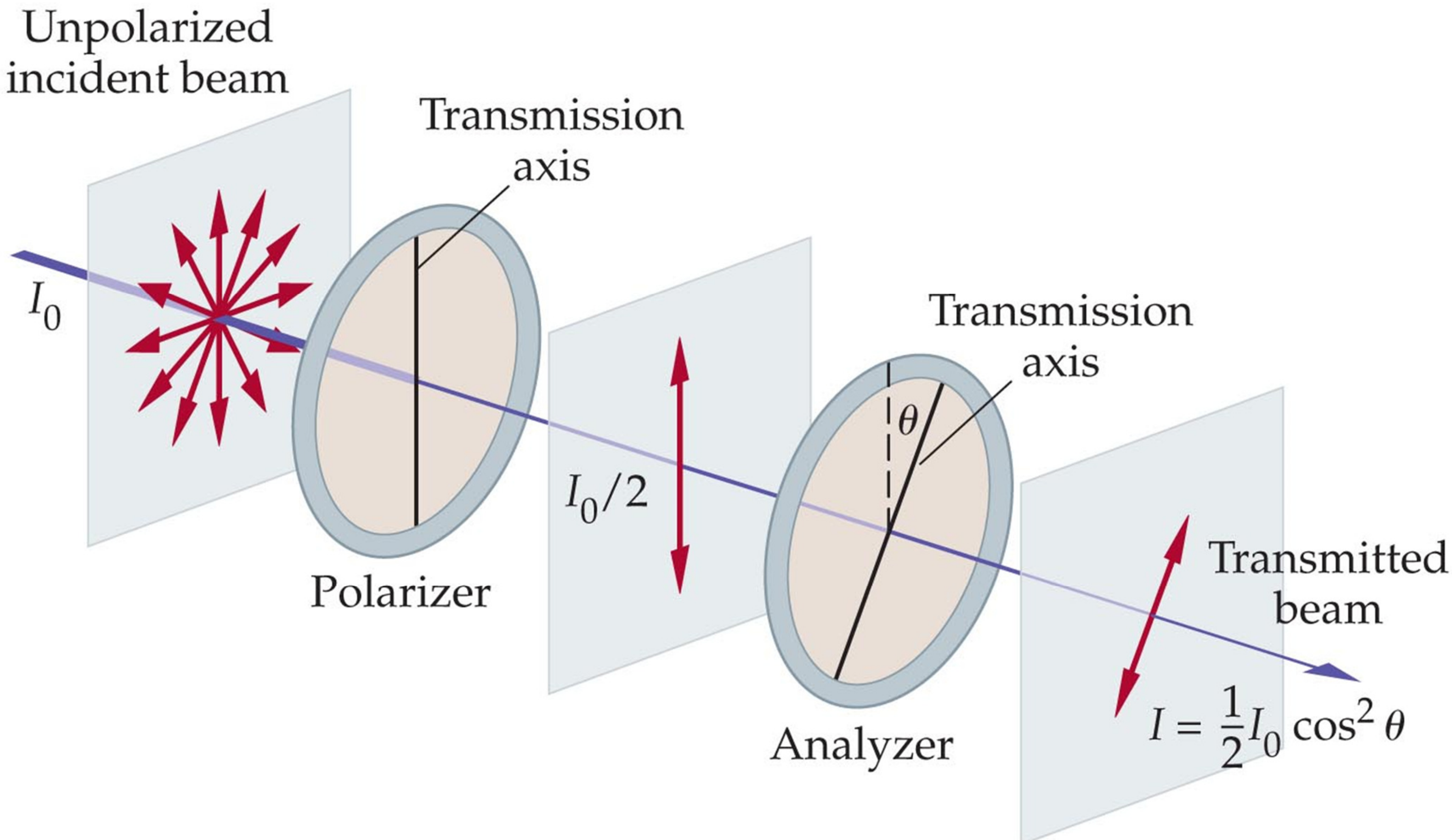
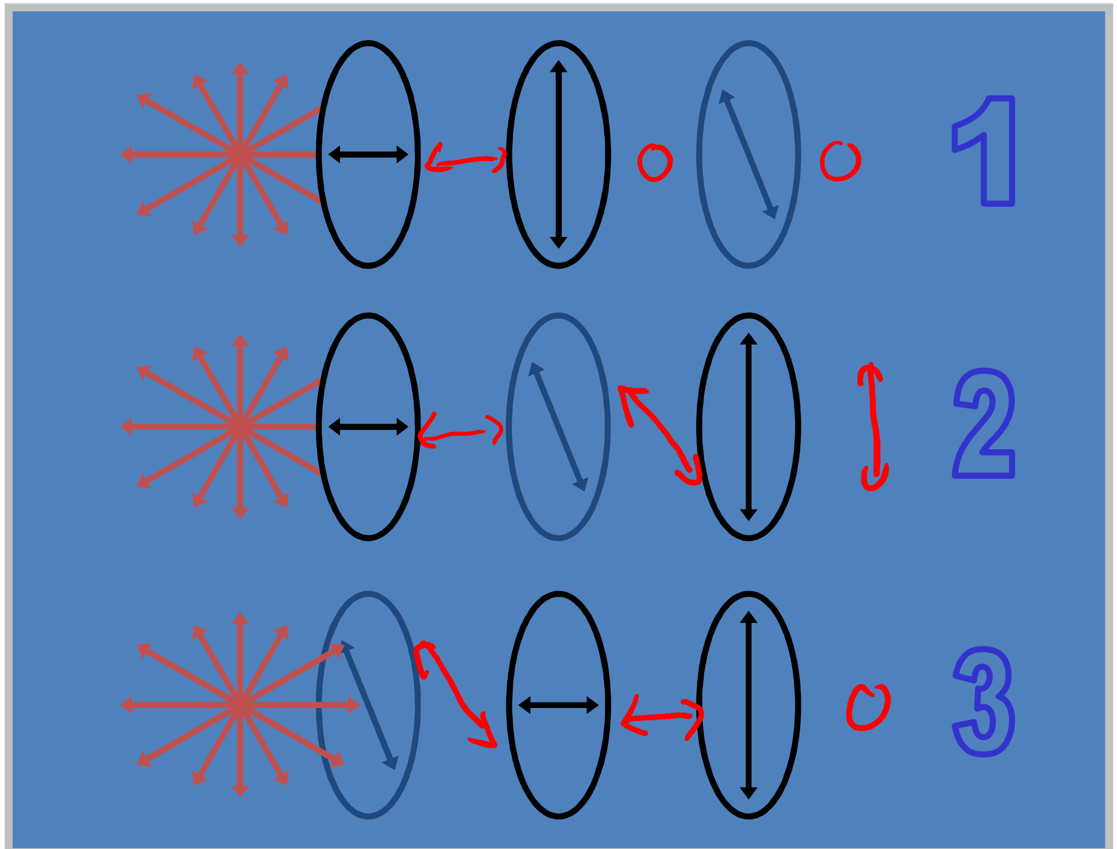
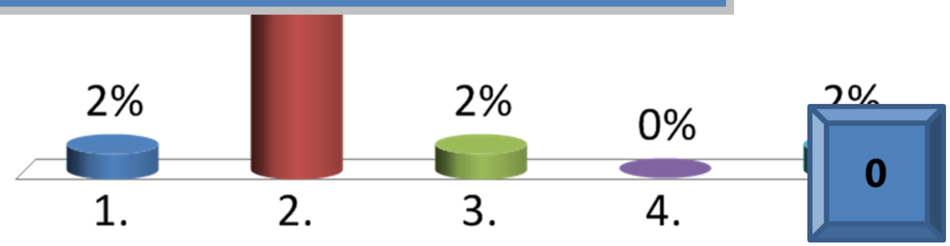

Unpolarized incident beam
Transmission axis
I_0
Polarizer
$I_0/2$
Transmission axis
θ
Analyzer
Transmitted beam
$I = \frac{1}{2} I_0 \cos^2 \theta$

If unpolarized light is incident from the left, in which case will some light get through?

1. Case 1
2. ✓ Case 2
3. Case 3
4. Cases 1 & 3
5. All three



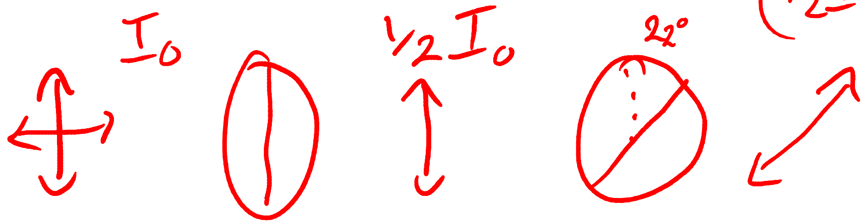
41 of 48



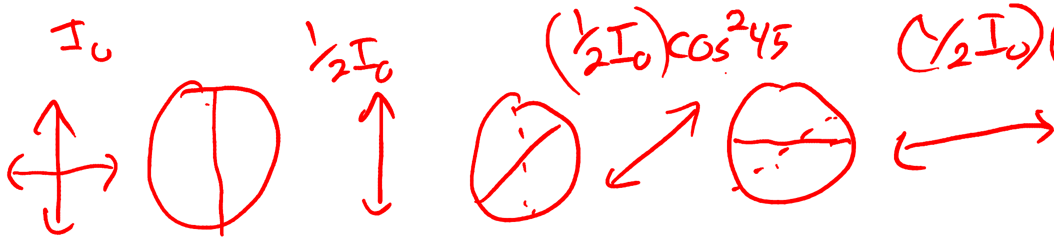
Polarization worksheet

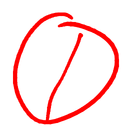
Polarization worksheet

$(\frac{1}{2}I_0)\cos^2 22° = 0.4298\, I_0$



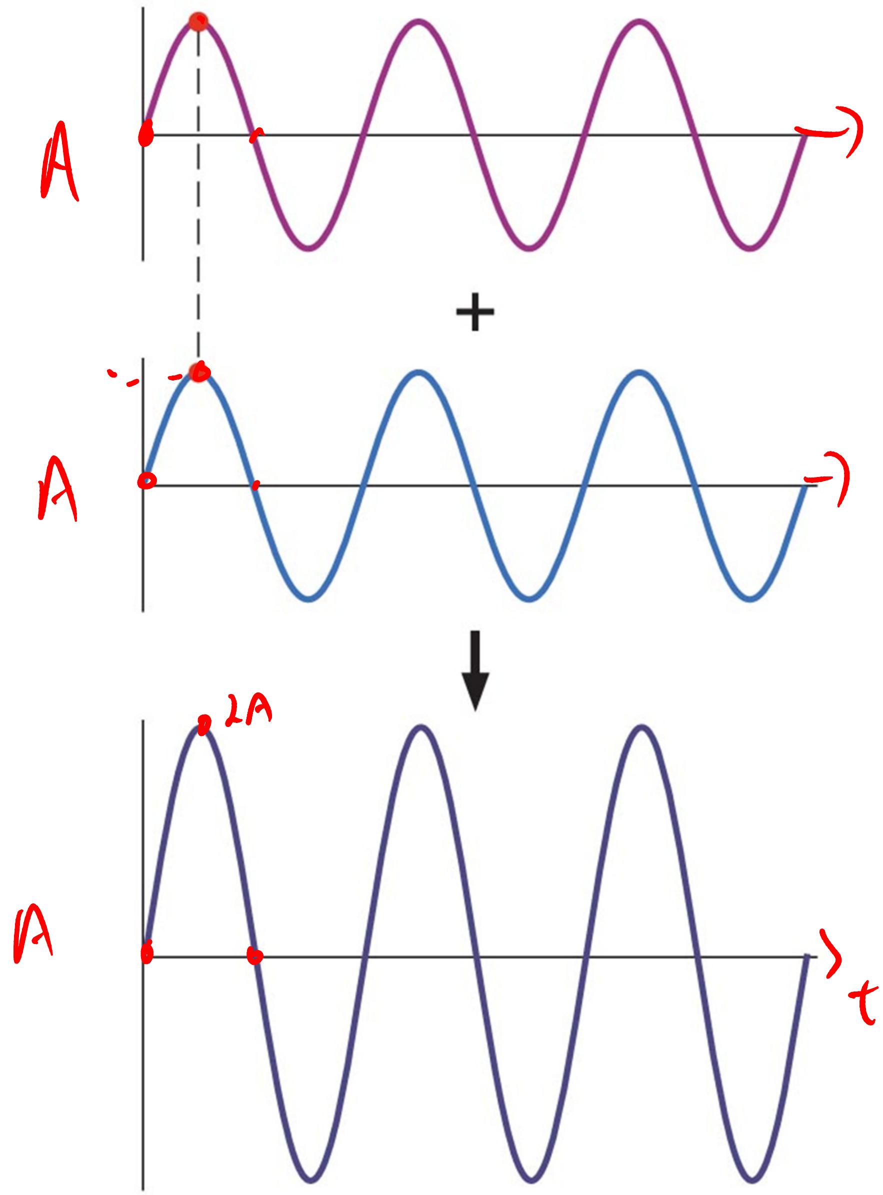
$(\frac{1}{2}I_0)(\cos^2 45)\cos^2(45) = 0.125\, I_0$



if middle one is  9°, it loses $\cos^2(9)$ =

$$\frac{1}{2}I_0\,(\cos^2(9))^{10} = 0.3903\, I_0$$

"Superposition"

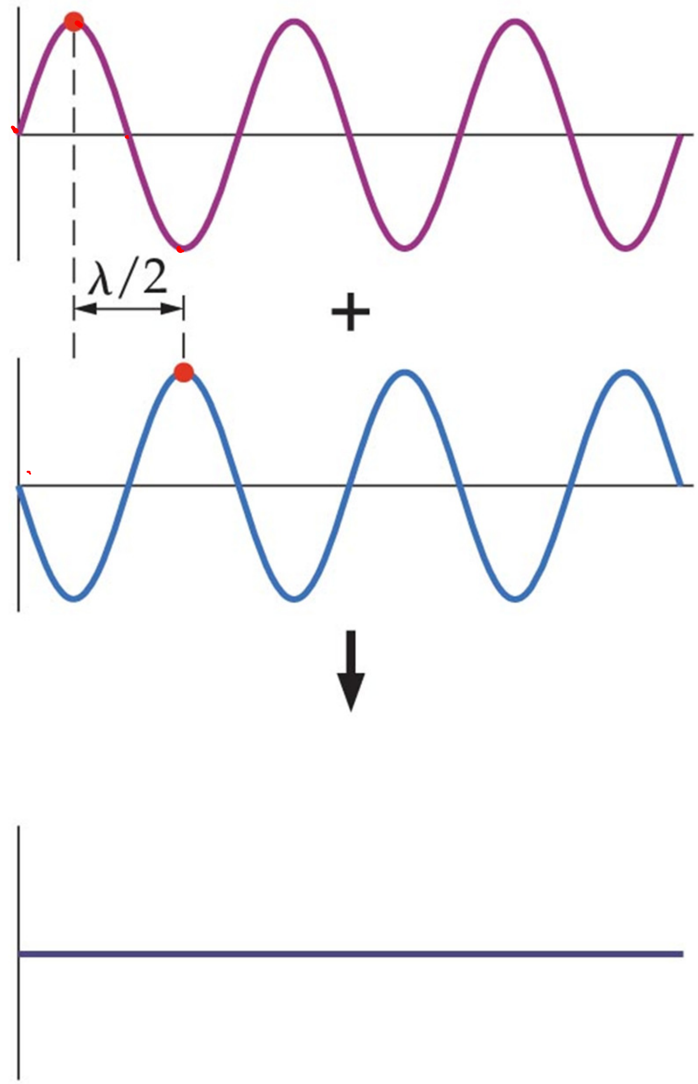


$A\sin(kx-\omega t)$

$A\sin(kx-\omega t)$

$2A\sin(kx-\omega t)$

(a) In phase



(b) Half wavelength out of phase

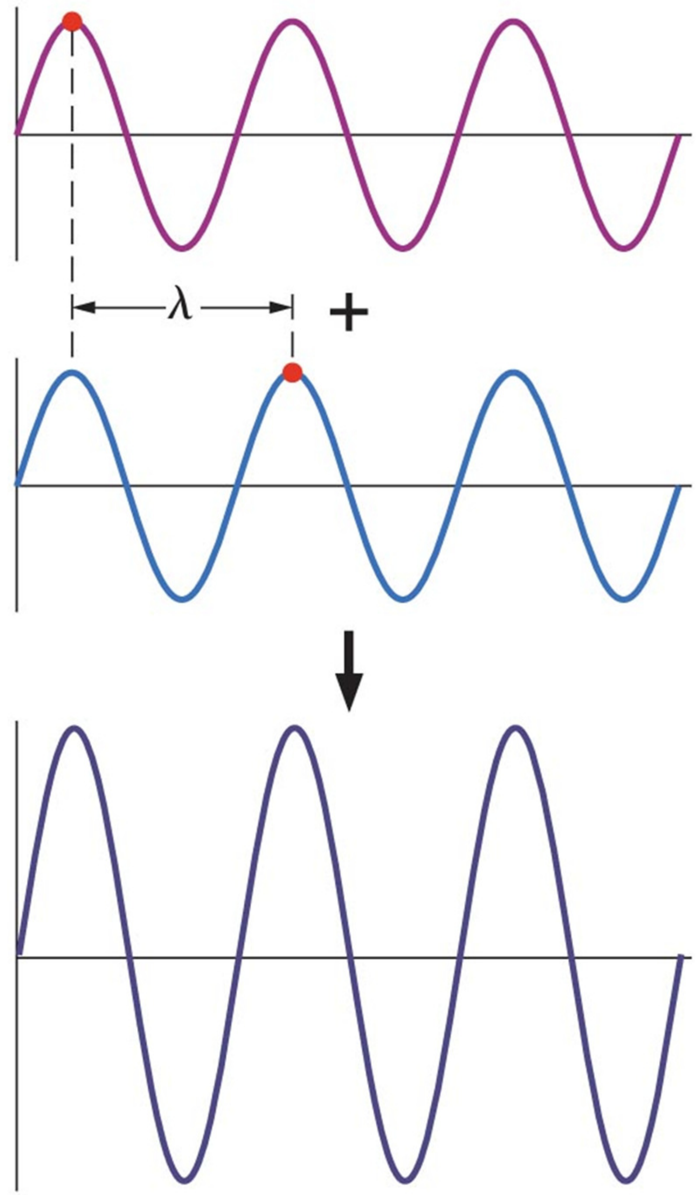
Sin (stuff)

↓

π

||

Ø phase

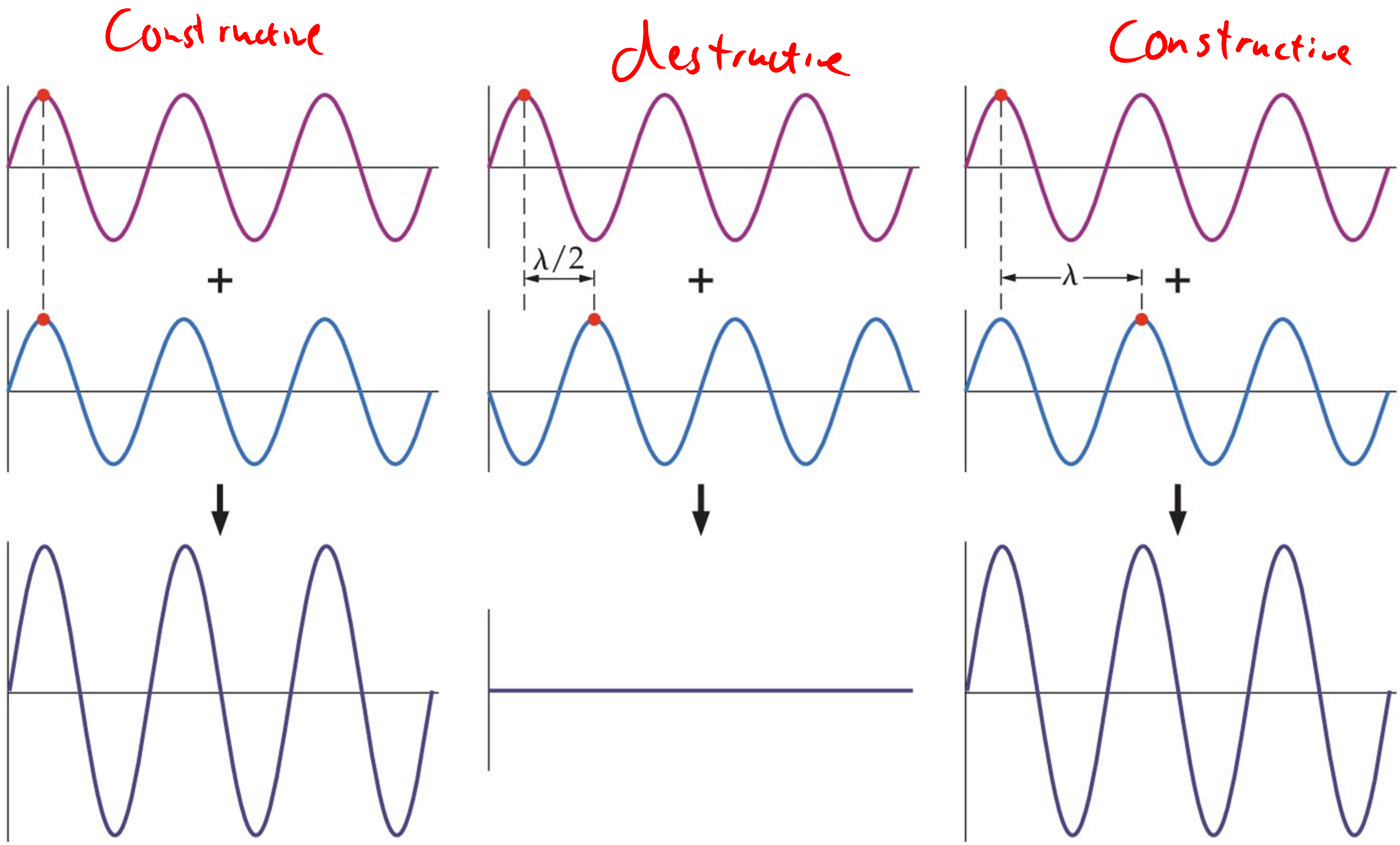


(c) Full wavelength out of phase

$\theta = 2\pi$

One λ

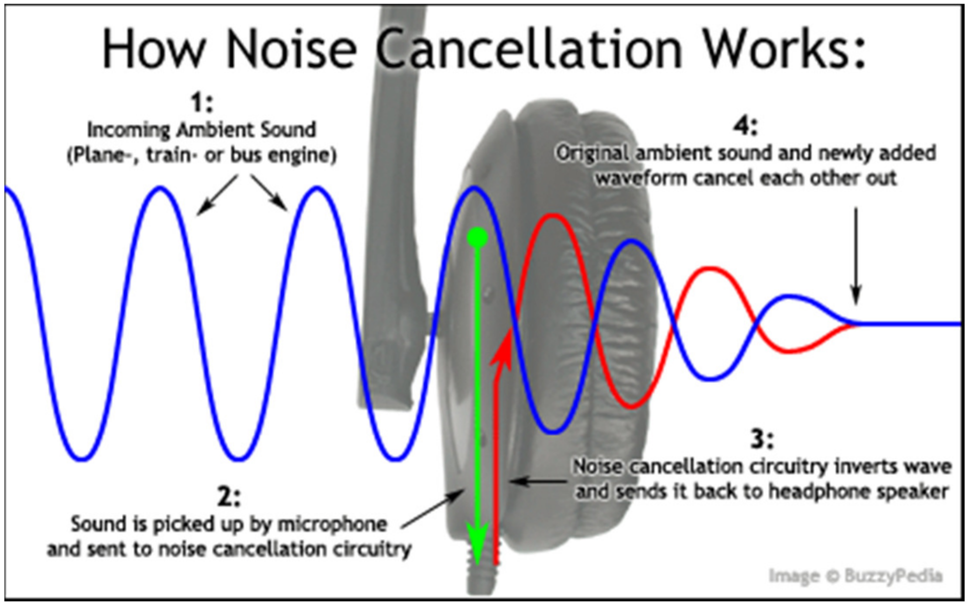
$\sin(kx - \omega t + \theta)$



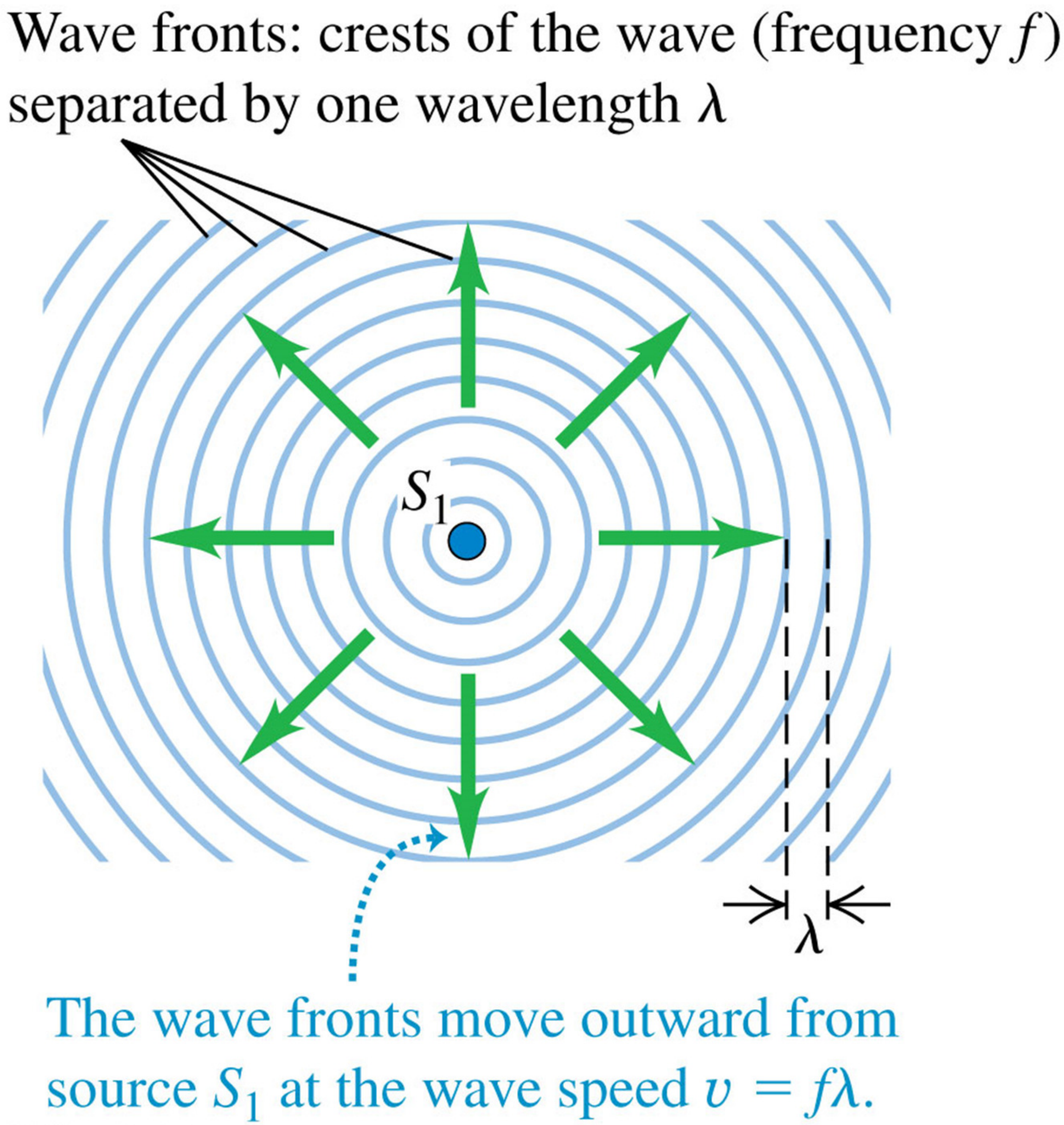
(a) In phase

(b) Half wavelength out of phase

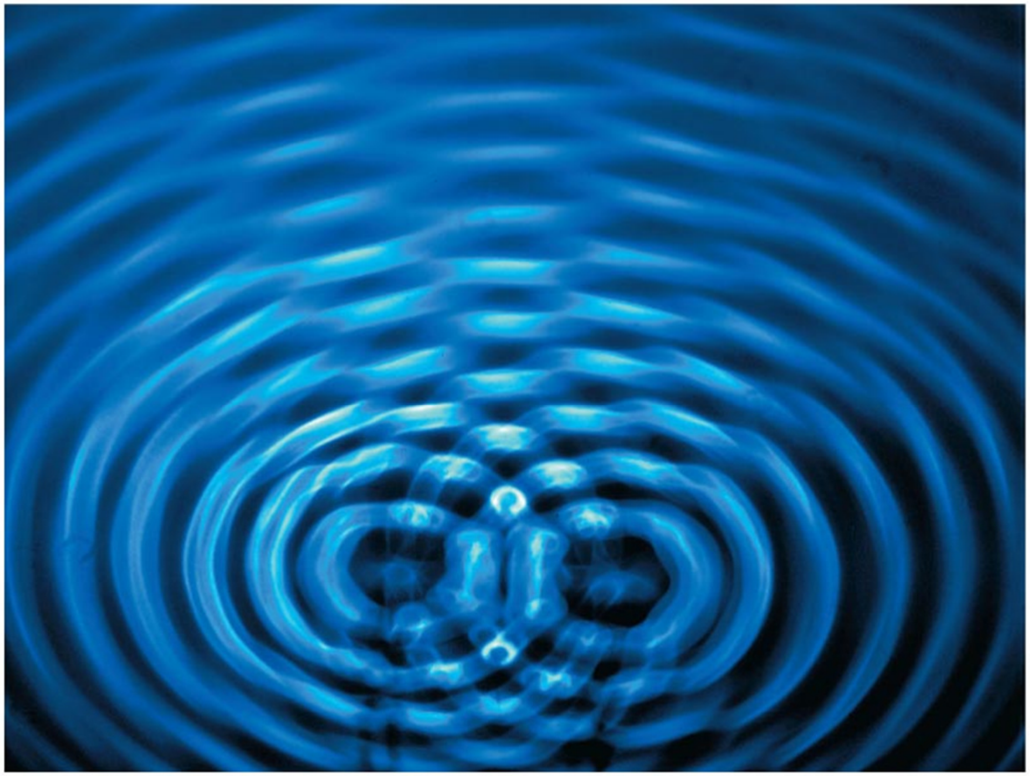
(c) Full wavelength out of phase


How Noise Cancellation Works:
1:
Incoming Ambient Sound
(Plane-, train- or bus engine)
4:
Original ambient sound and newly added
waveform cancel each other out
3:
Noise cancellation circuitry inverts wave
and sends it back to headphone speaker
2:
Sound is picked up by microphone
and sent to noise cancellation circuitry
Image © BuzzyPedia

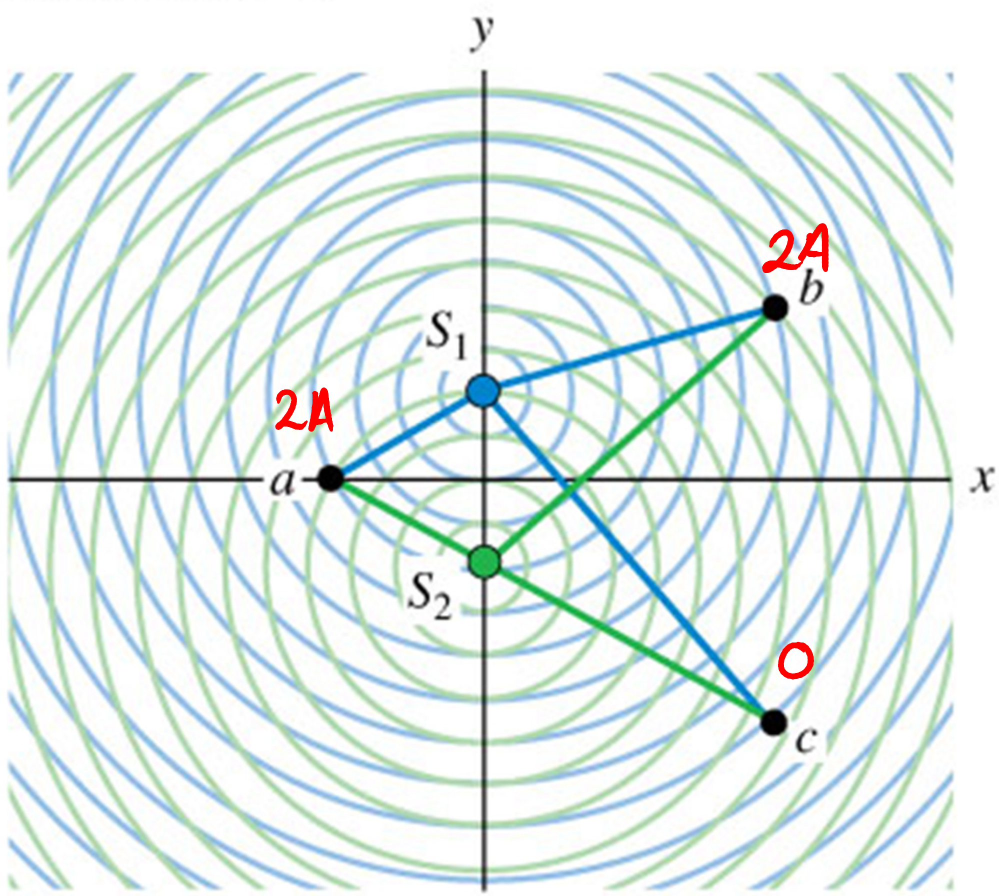

BOSE



Wave fronts: crests of the wave (frequency f) separated by one wavelength λ
S_1
λ
The wave fronts move outward from source S_1 at the wave speed $v = f\lambda$.

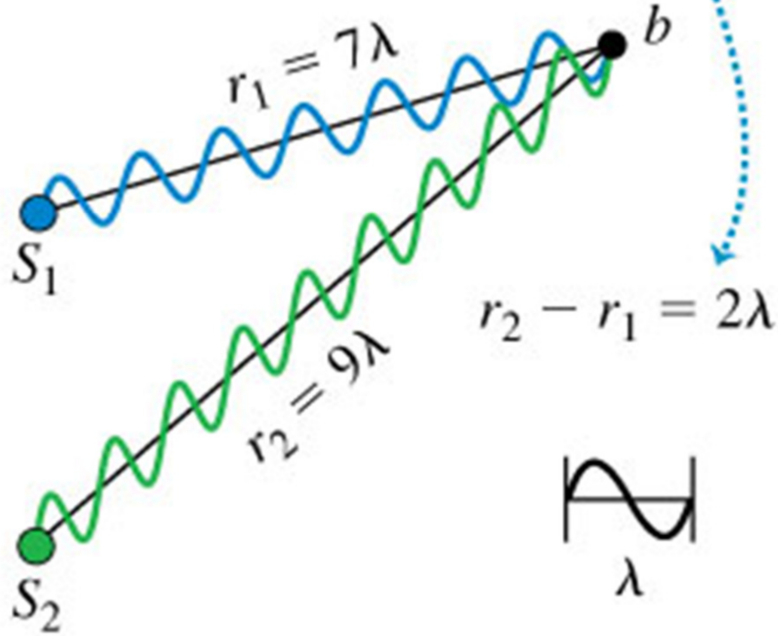


(a) Two coherent wave sources separated by a distance 4λ



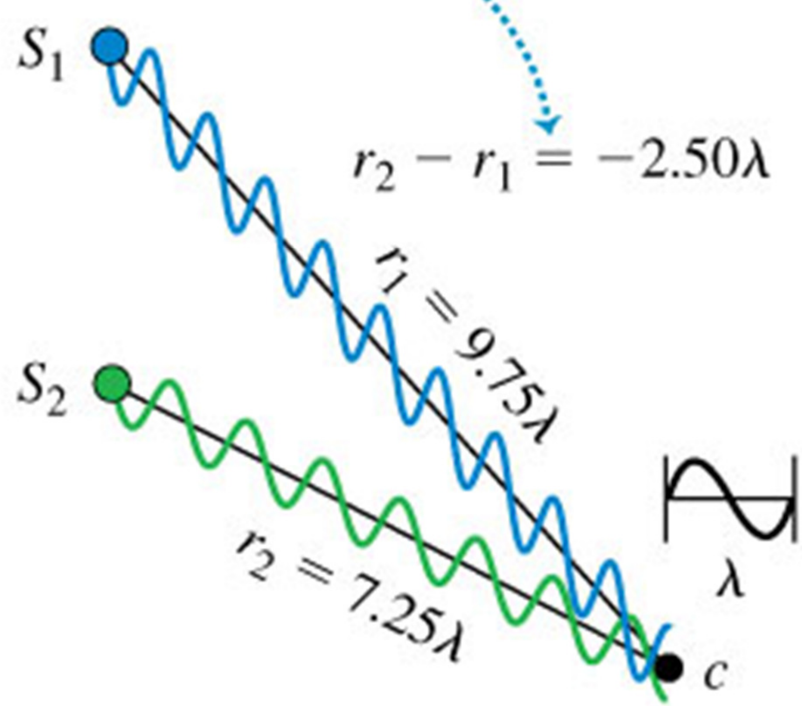
Coherent
- in phase
- Same λ

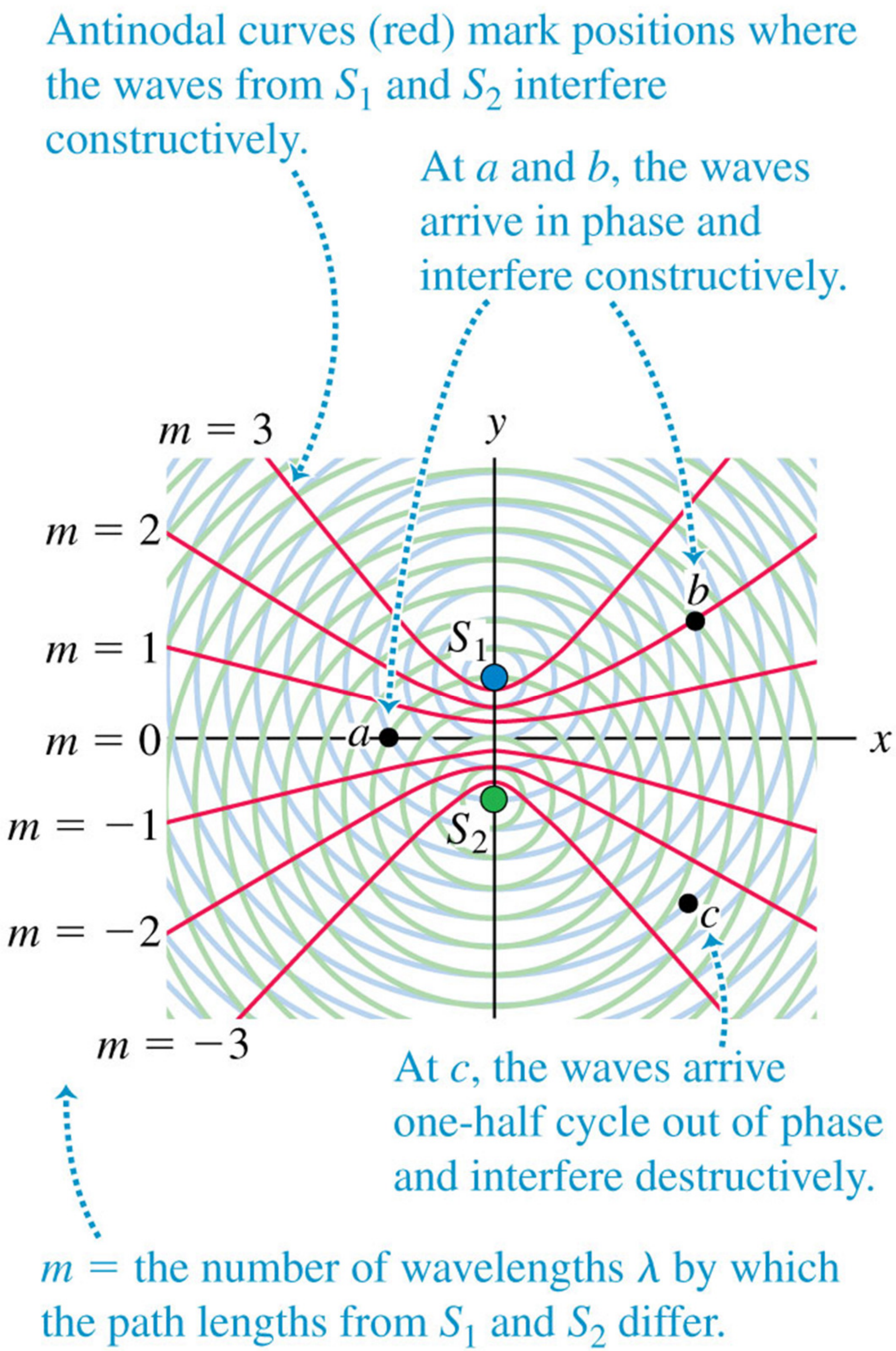
(b) Conditions for constructive interference:
Waves interfere constructively if their path lengths differ by an integral number of wavelengths: $r_2 - r_1 = m\lambda$.

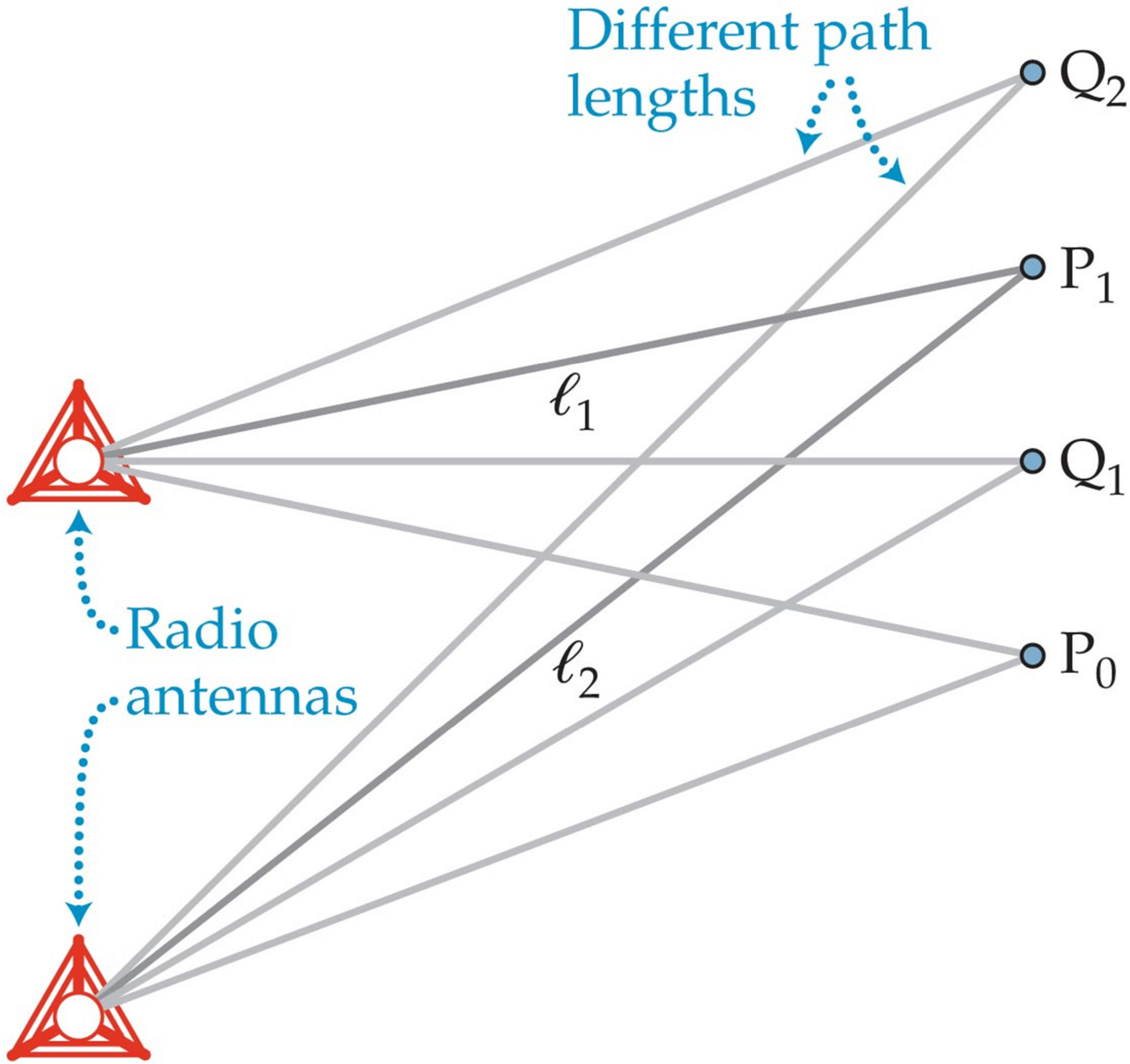


(c) Conditions for destructive interference:

Waves interfere destructively if their path lengths differ by a half-integral number of wavelengths: $r_2 - r_1 = (m + \frac{1}{2})\lambda$.




Antinodal curves (red) mark positions where the waves from S_1 and S_2 interfere constructively.
At a and b, the waves arrive in phase and interfere constructively.
$m = 3$
$m = 2$
$m = 1$
$m = 0$
$m = -1$
$m = -2$
$m = -3$
y
x
a
b
c
S_1
S_2
At c, the waves arrive one-half cycle out of phase and interfere destructively.
$m =$ the number of wavelengths λ by which the path lengths from S_1 and S_2 differ.

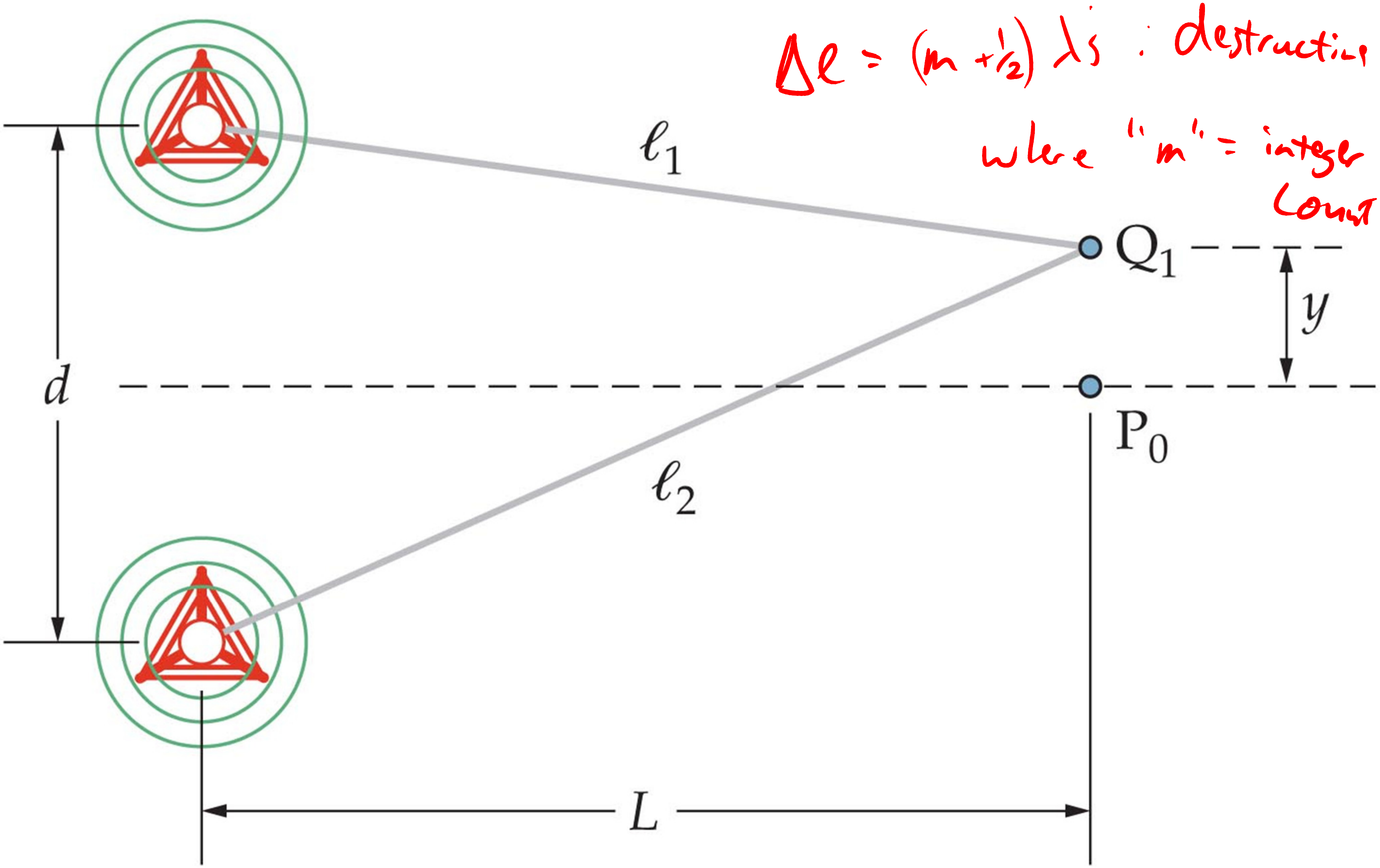


Different path lengths
Q_2
P_1
ℓ_1
Q_1
Radio antennas
ℓ_2
P_0

$\Delta \ell = m\lambda$'s : constructive

$\Delta \ell = (m + \frac{1}{2})\lambda$'s : destructive

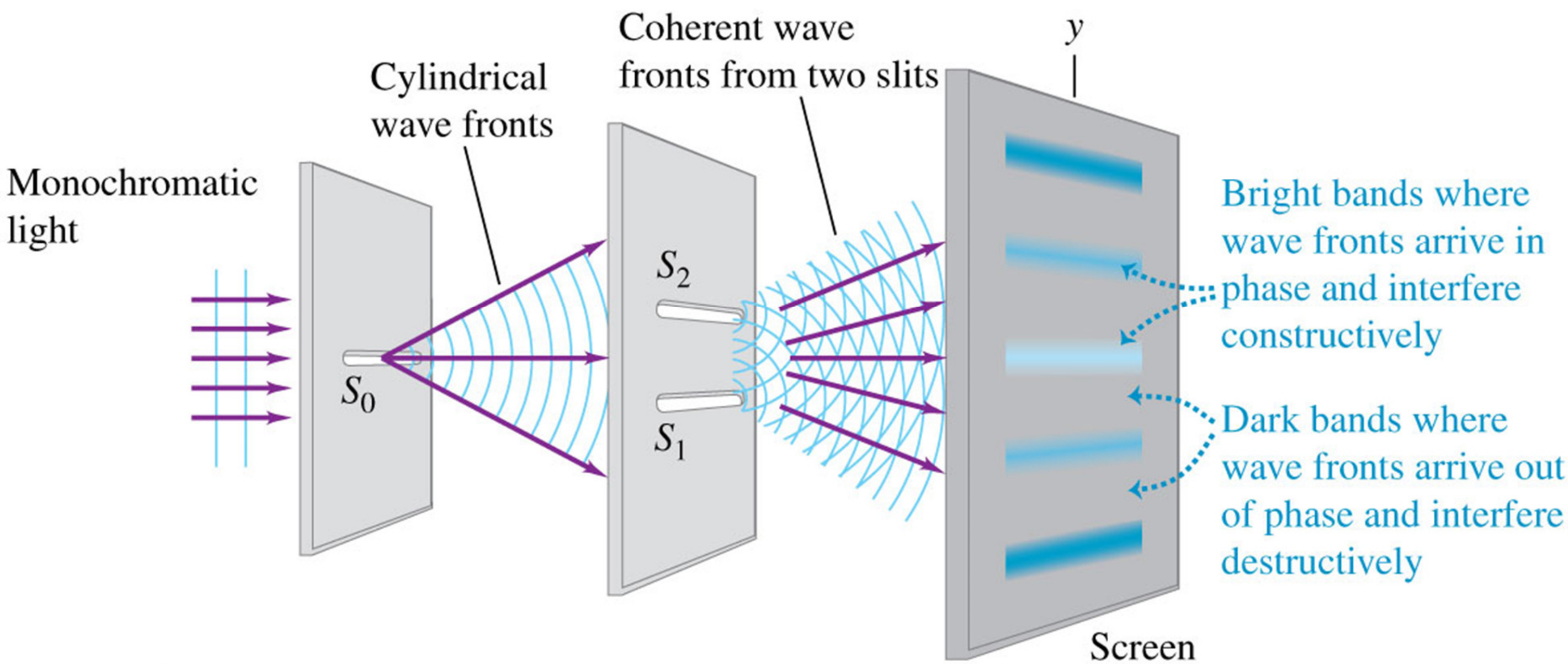
where "m" = integer count



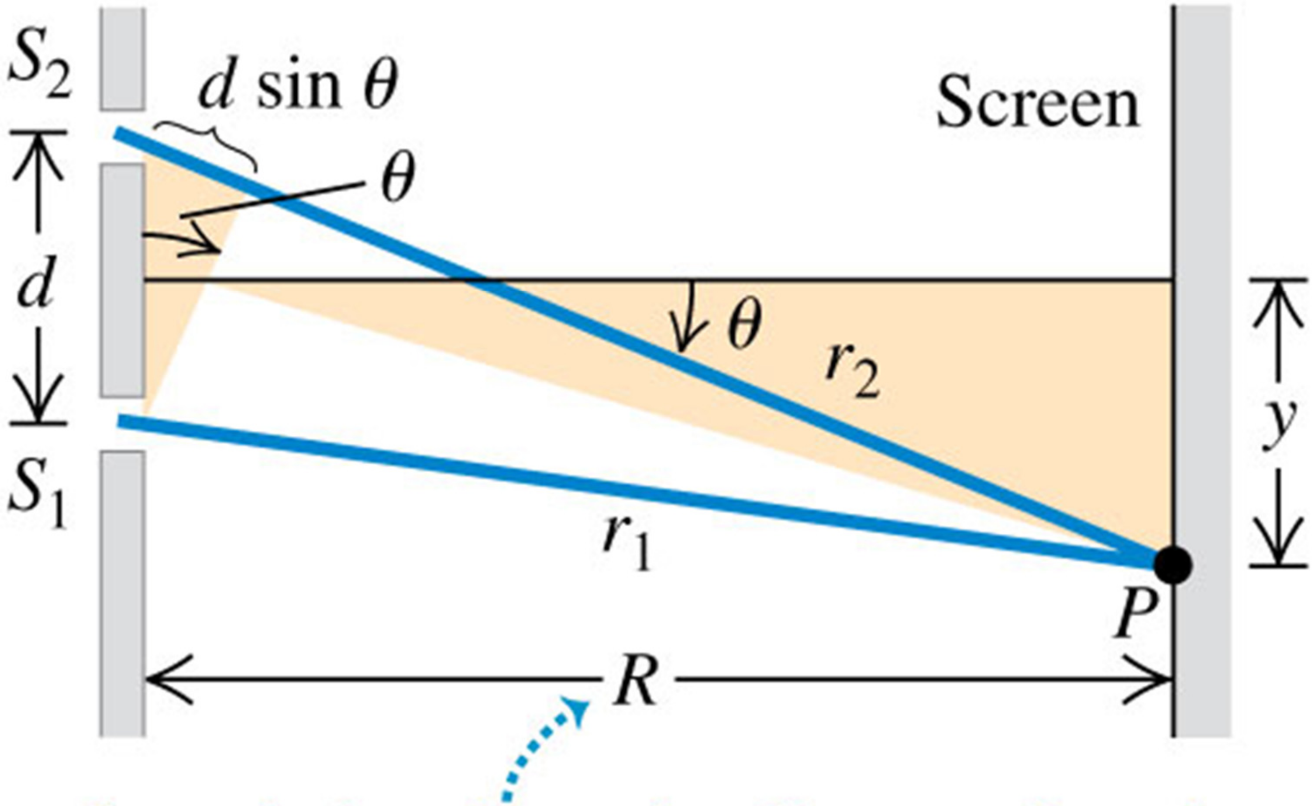
Try the “Interference Problems” worksheet: #1 & #2


λ

(a) Interference of light waves passing through two slits

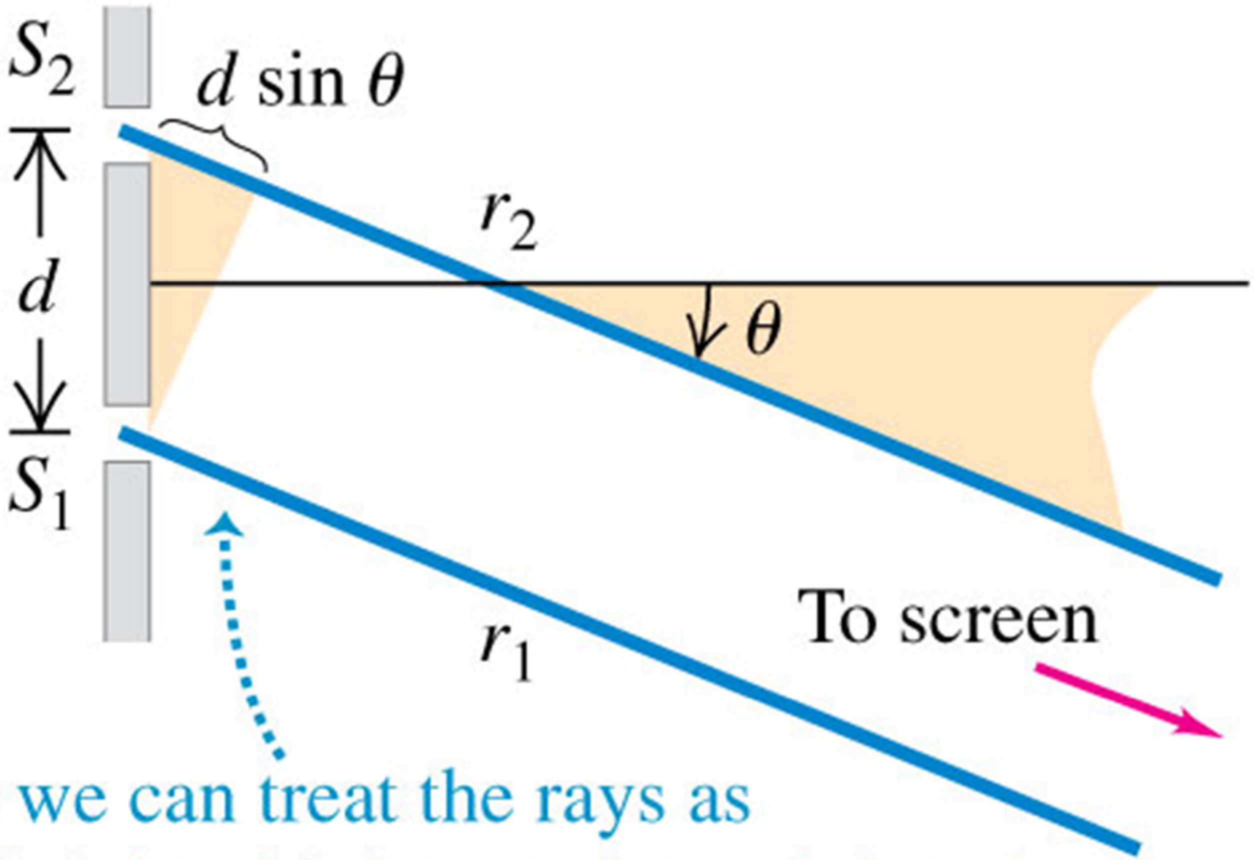


(b) Actual geometry (seen from the side)

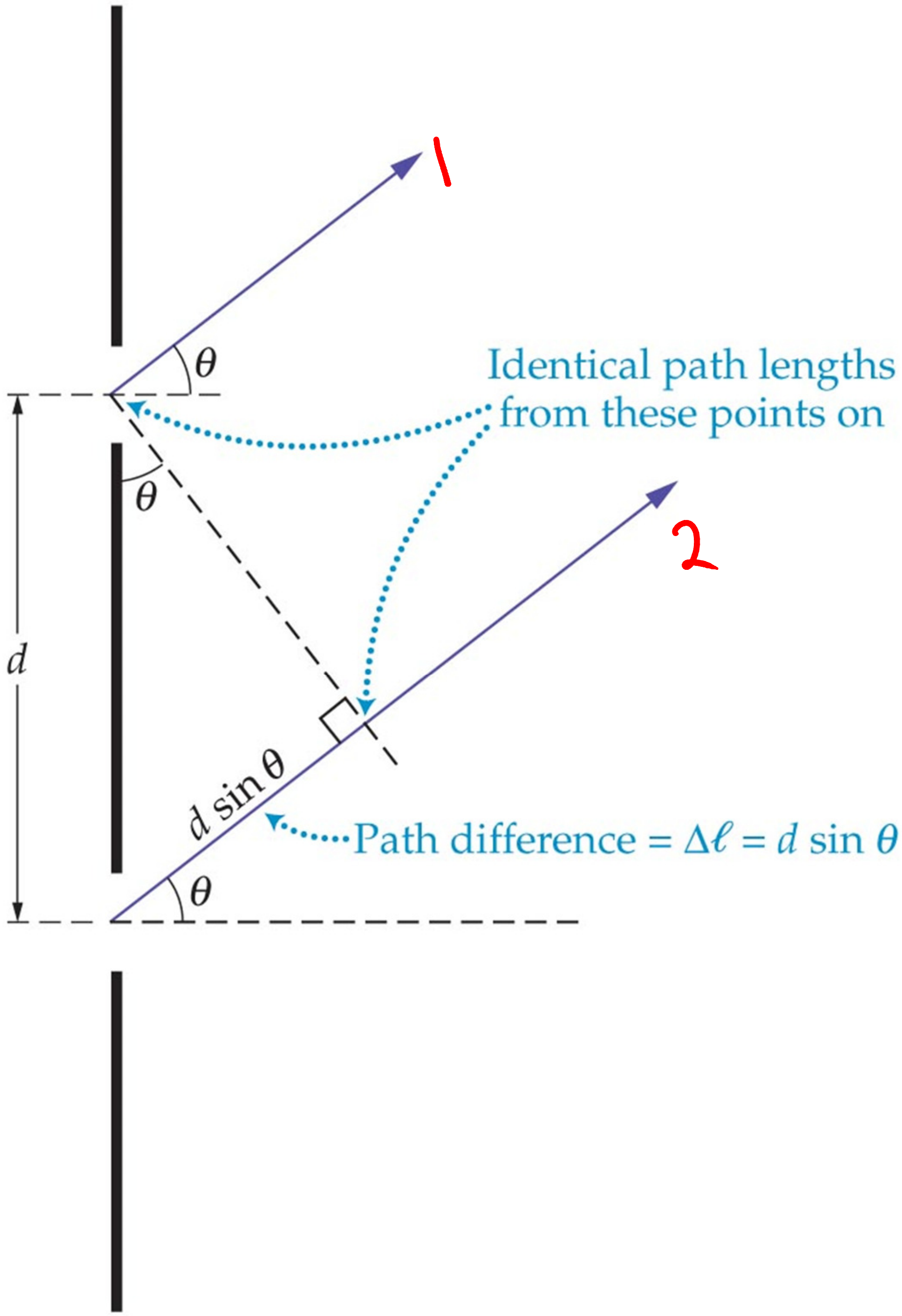


In real situations, the distance R to the screen is usually very much greater than the distance d between the slits ...

(c) Approximate geometry



... so we can treat the rays as parallel, in which case the path-length difference is simply $r_2 - r_1 = d \sin \theta$.



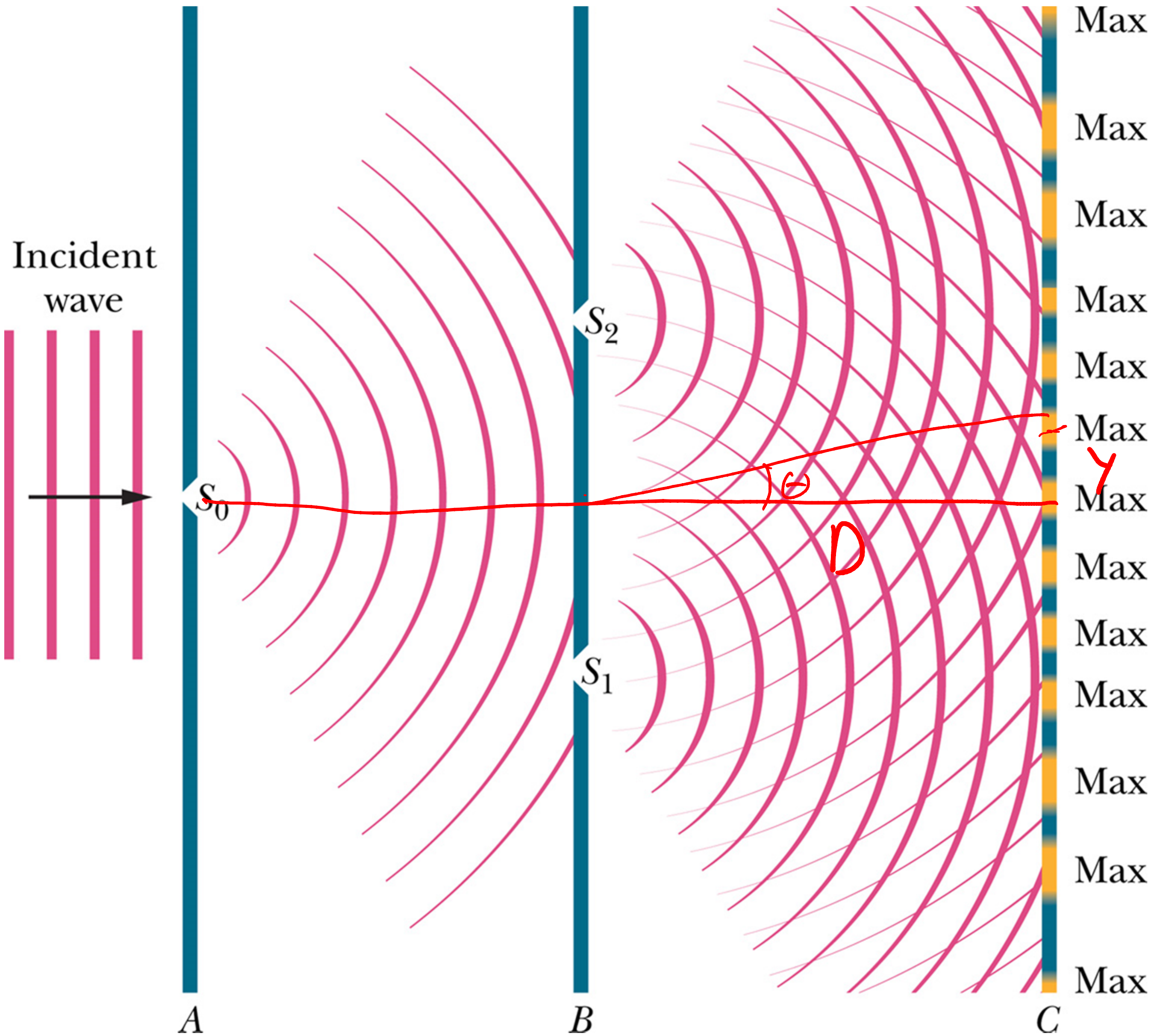
$\Delta \ell = d \sin\theta$

if $\Delta \ell = m\lambda$: bright

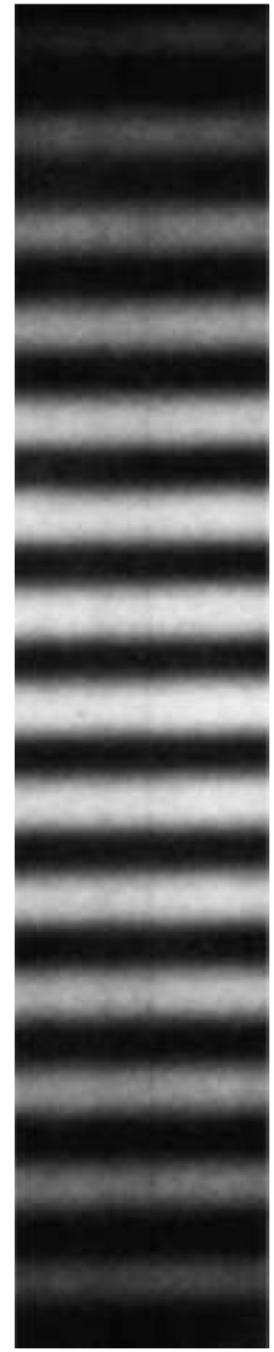
$\Delta \ell = (m + \frac{1}{2})$: dark

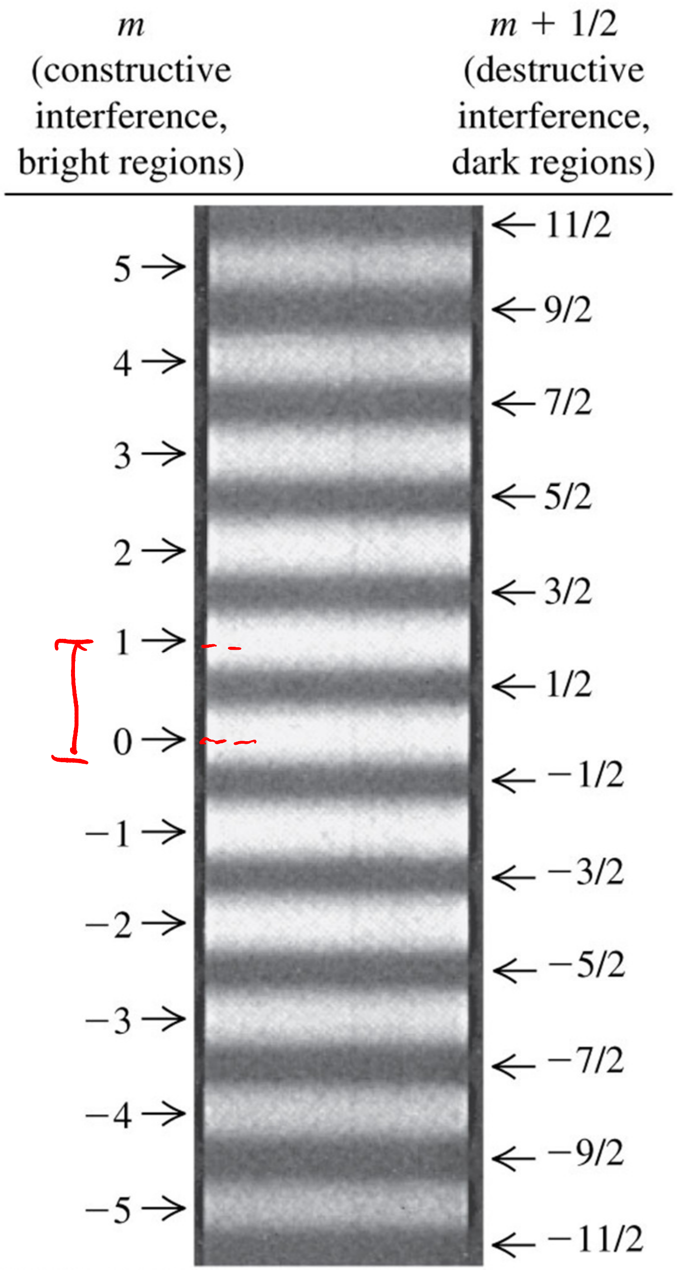
$m\lambda = d \sin\theta$

$(m + \frac{1}{2})\lambda = d \sin\theta$

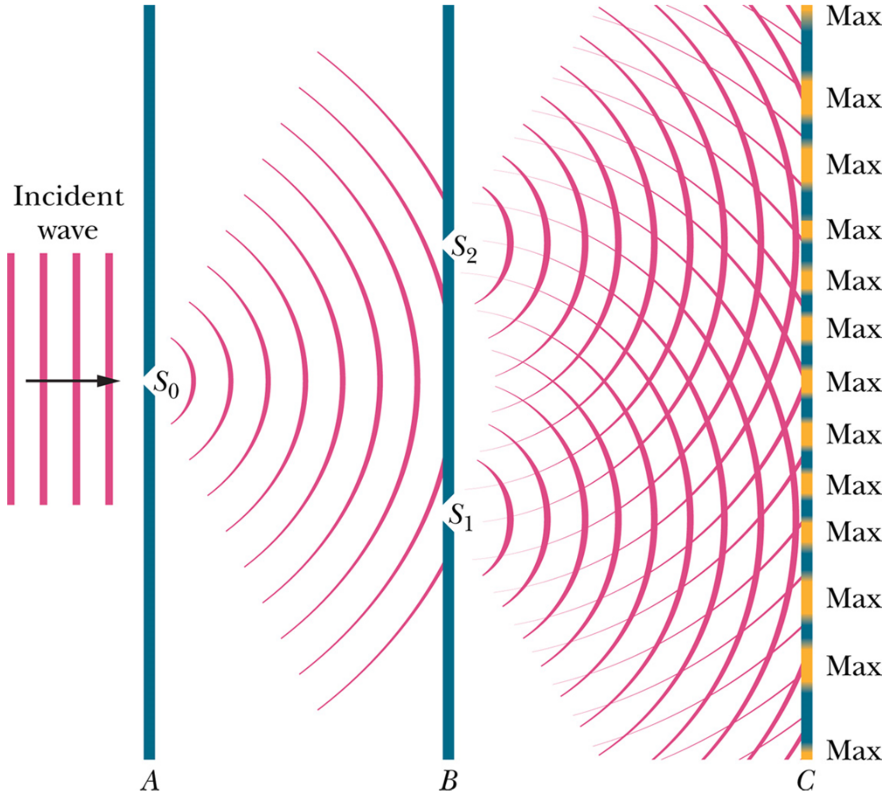


Incident wave
S_0
S_2
S_1
Max
Max
Max
Max
Max
Max
Max
Max
Max
Max
Max
Max
Max
θ
D
Y
A
B
C

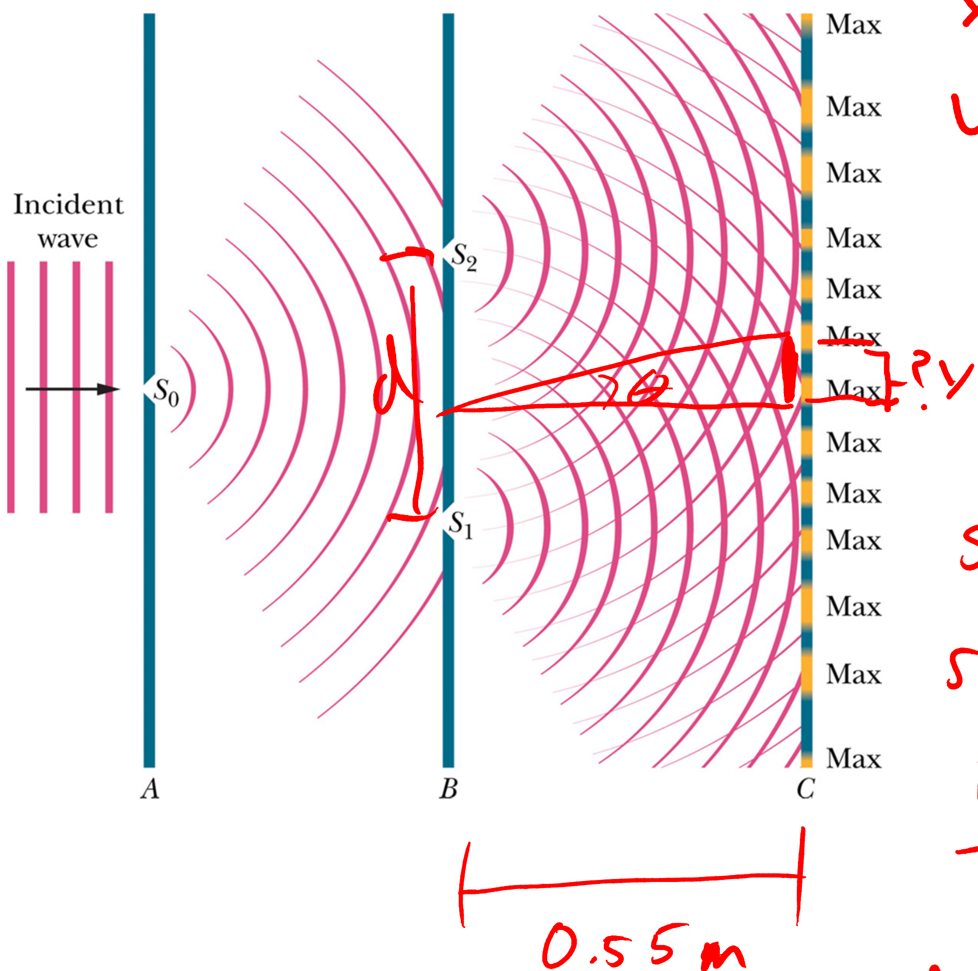




$m\lambda = d \sin\theta$



λ=546 nm light is sent through the setup above,
the distance *d* between S_1 & S_2 is 0.12 mm, and
a screen is *D* = 55 cm to the right of S_1 & S_2 .
How far apart are the bright fringes on the screen?



$\lambda = 546\ nm \quad d = 0.12\ mm \quad D = 55\ cm$

What are the distances between Bright fringes?

$$d \sin\theta = m\lambda$$

$$\tan\theta = \frac{y}{D}$$

Small angles $\sin\theta = \theta = \tan\theta$

$$\sin\theta = \frac{m\lambda}{d} = \tan\theta = \frac{y}{D}$$

$$\frac{m\lambda}{d} = \frac{y}{D}$$

$$y_m = \frac{m\lambda D}{d}$$

$$\Delta y = y_m - y_{m+1} = \frac{m\lambda D}{d} - \frac{(m+1)\lambda D}{d}$$

$$= \frac{\lambda D}{d}$$

$$\frac{(546 \times 10^{-9}\ m)(55 \times 10^{-2}\ m)}{0.12 \times 10^{-3}\ m} \quad D$$

$$= 2.5 \times 10^{-3}\ m$$

$$= 2.5\ mm$$