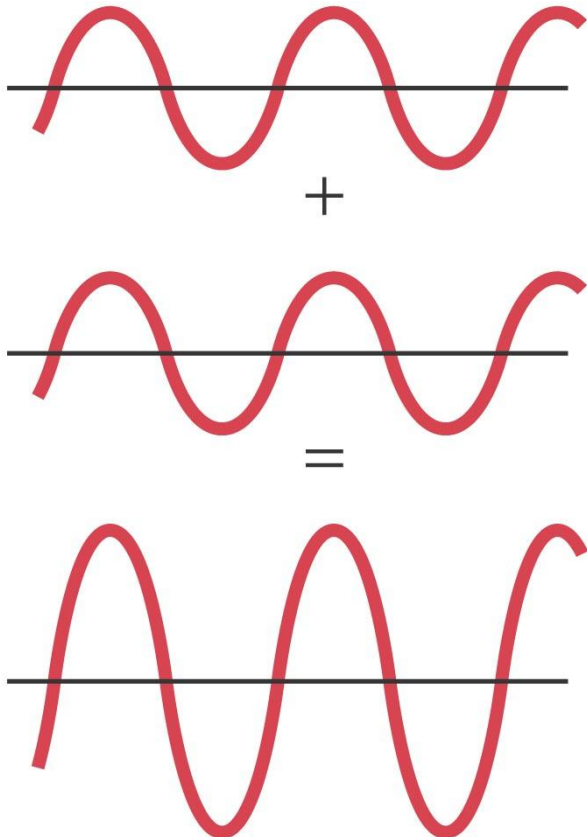


Interference

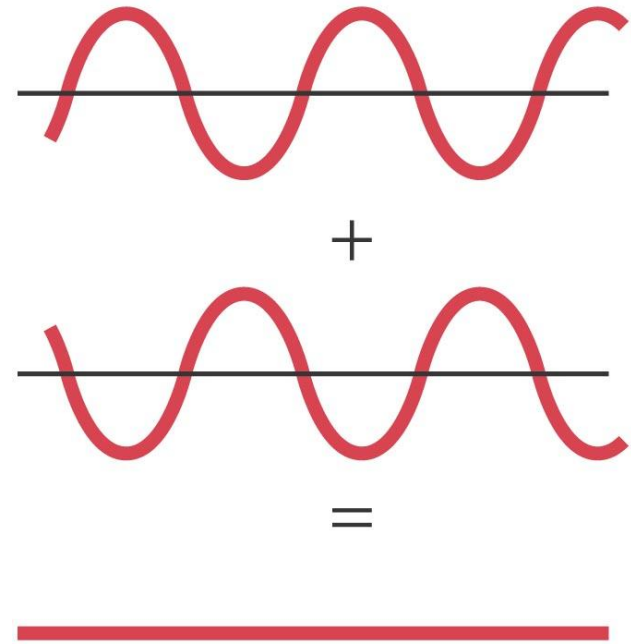
When two waves meet at some point in space, the waves at each instant of time simply add (principle of superposition).

Constructive Interference
(Waves "in phase")



(a)

Completely Destructive Interference
(Waves "out of phase")



(b)

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Figure 34.8a

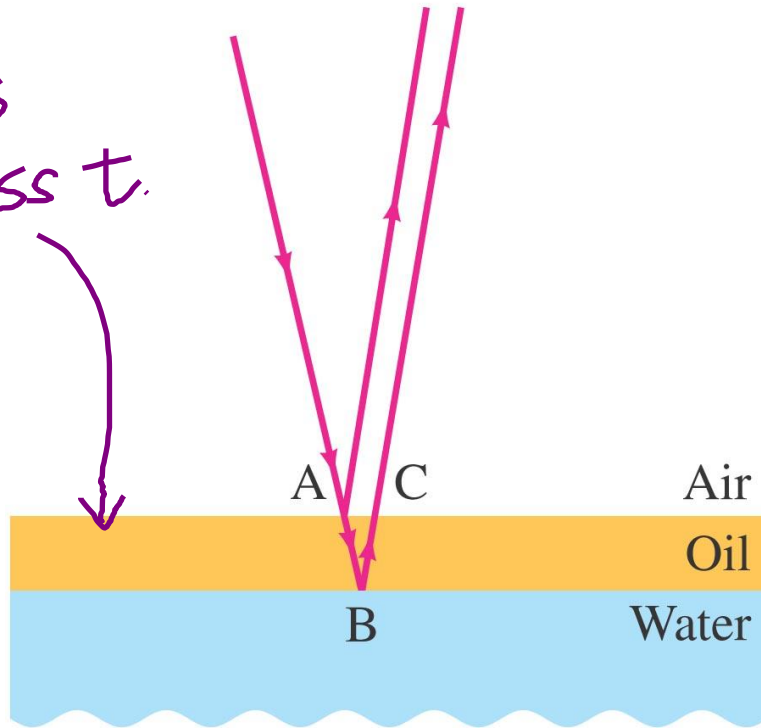
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Thin-film interference

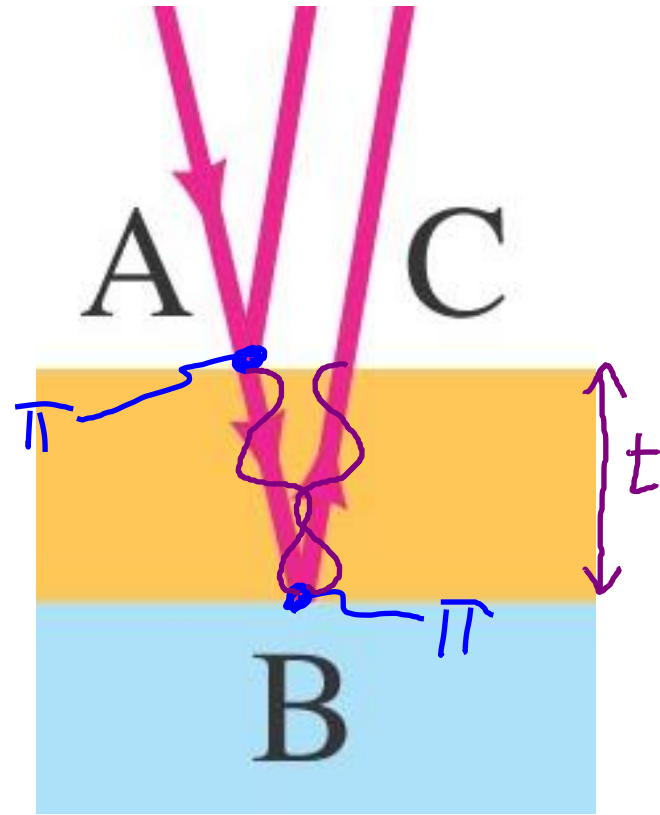


Film has thickness t .

$$\frac{\lambda_2}{\lambda_1} = \frac{n_1}{n_2}$$



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$$\Delta x = 2t$$

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta x}{\lambda_2} = \frac{2t}{\lambda_2}$$

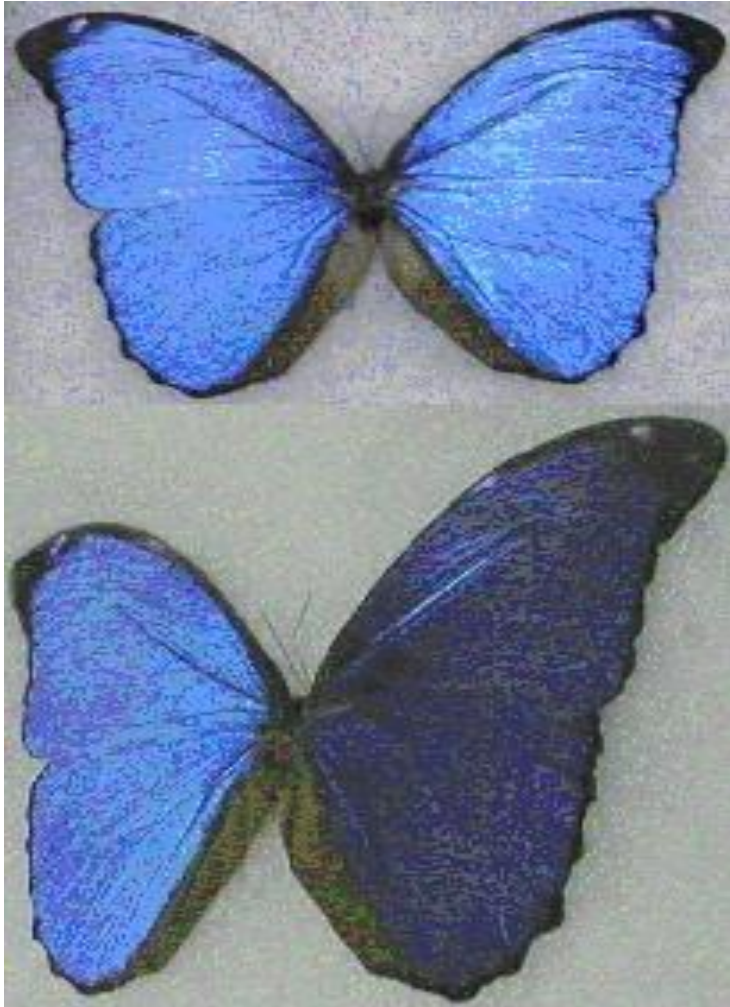
for constructive

$$= 0, 1, 2, 3, \dots$$

$$\frac{2tn_2}{n_1\lambda_1} = 0, 1, 2, \dots$$

Figure 34.17

Blue Morpho Iridescent Butterfly



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Color generation in butterfly wings and fabrication of such structures

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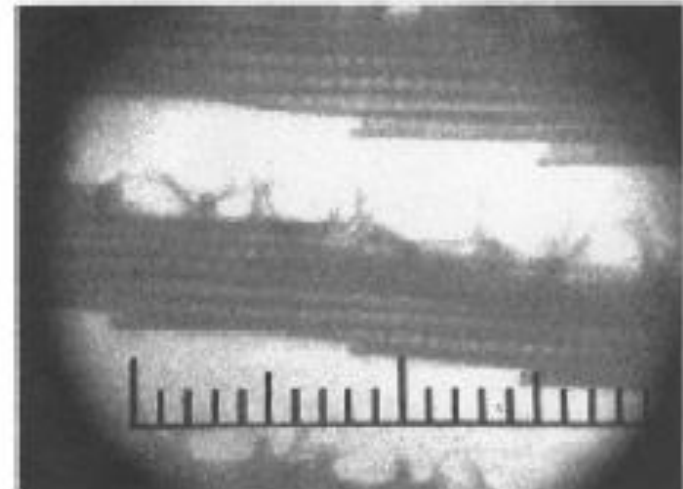


Fig. 1. TEM image of the ridges and layer structures for a morpho butterfly wing.

Iridescent Beetles



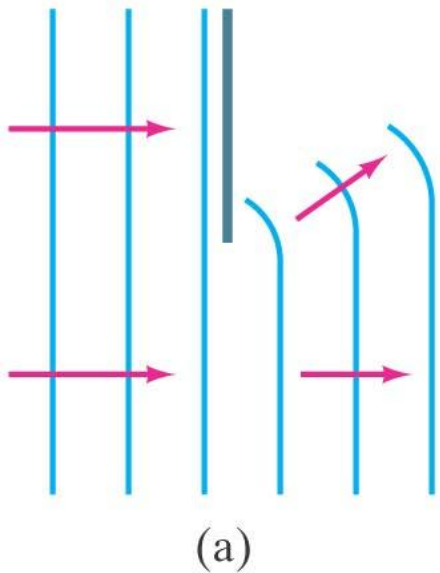
Birds



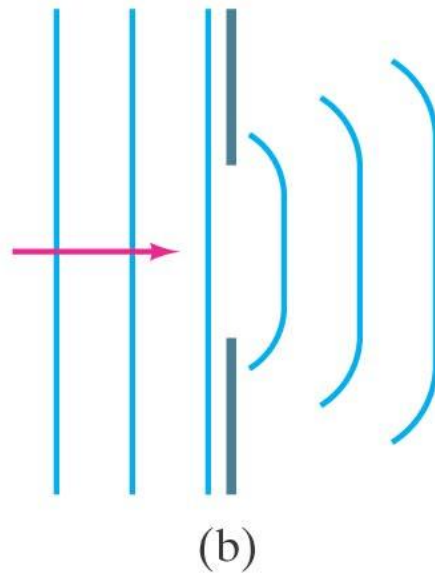


Diffraction – the bending of waves at an edge or opening

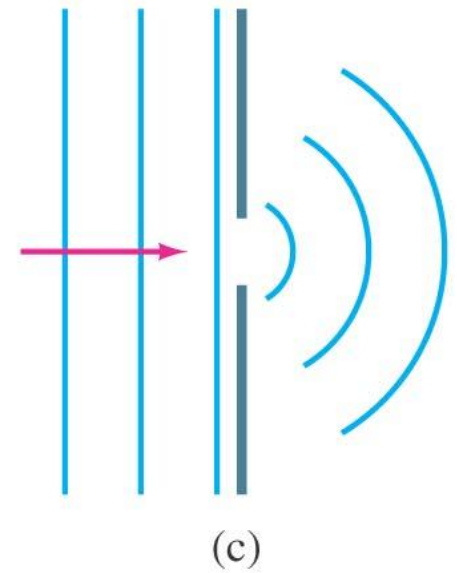
Edge diffraction



Slit width $> \lambda$



Slit width $< \lambda$



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Figure 34.2

Double-slit Interference

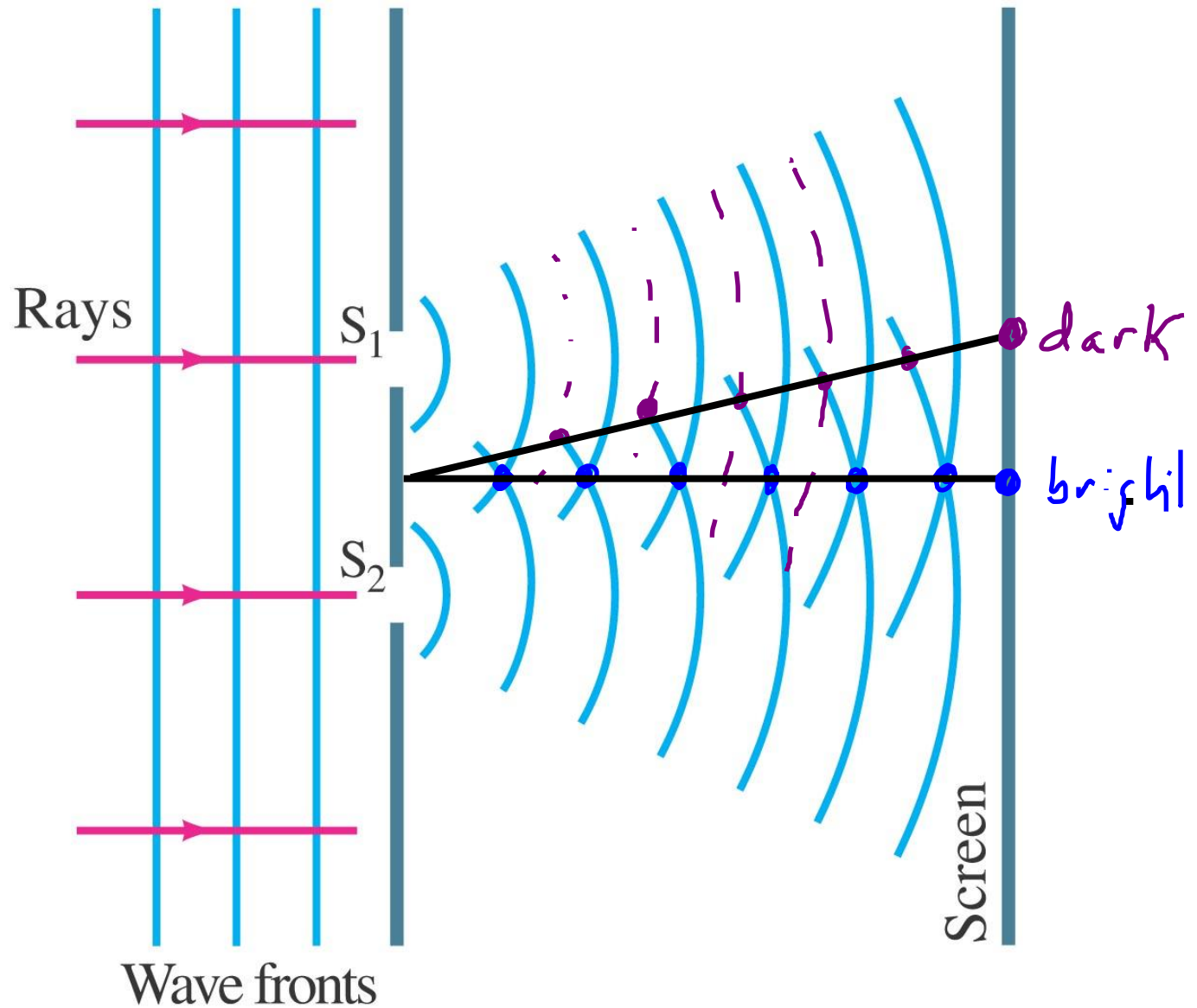
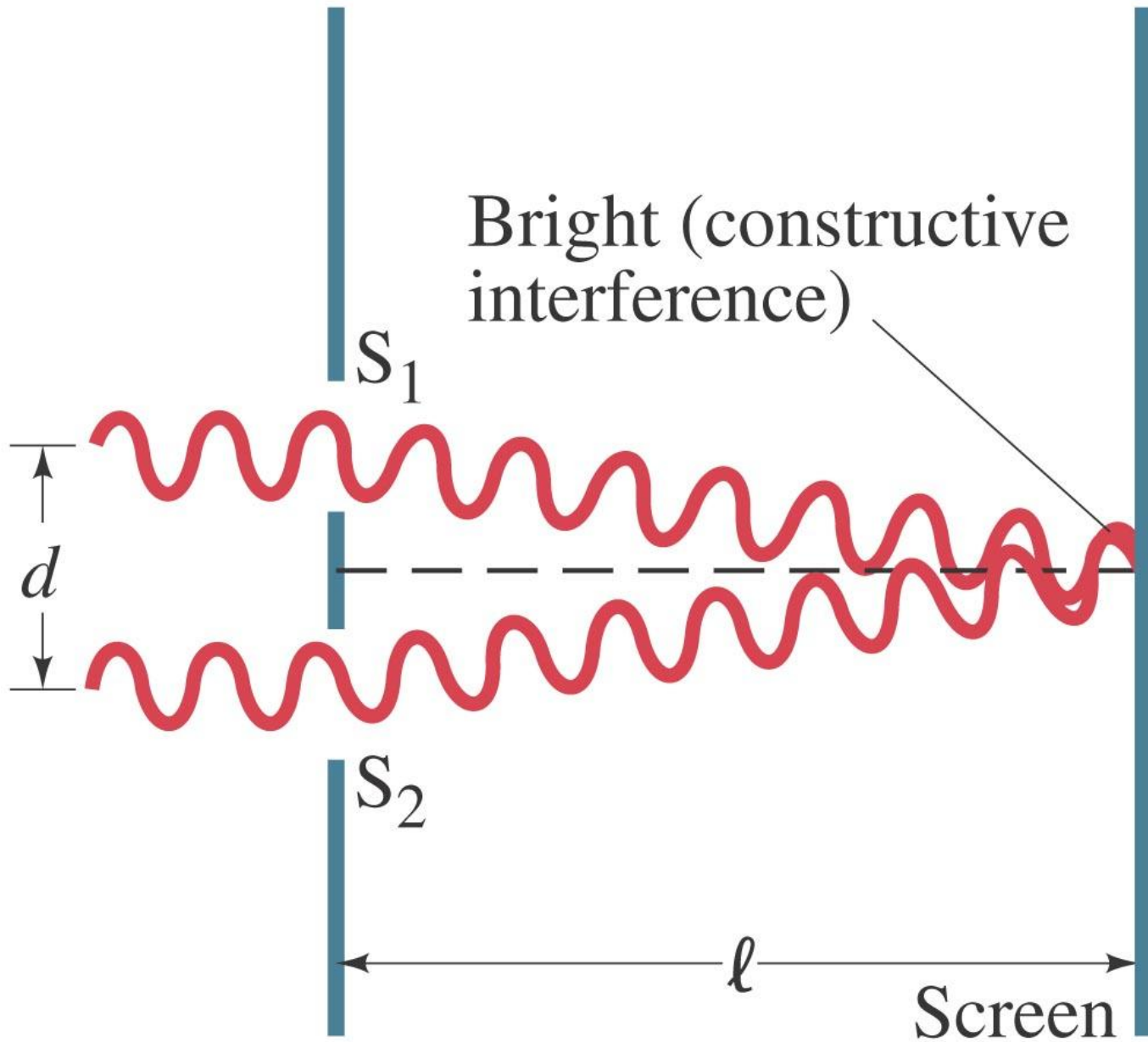
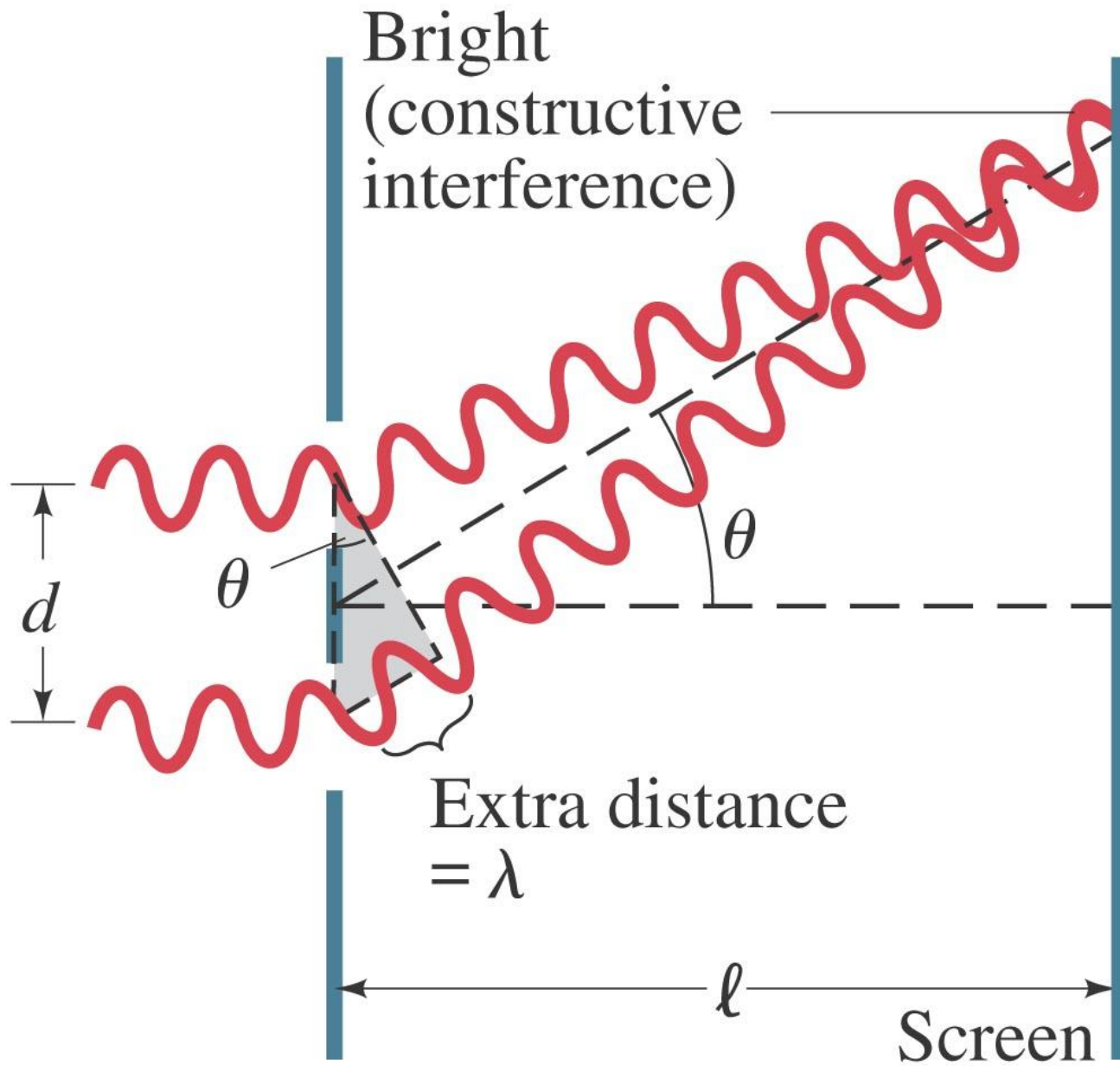


Figure 34.6



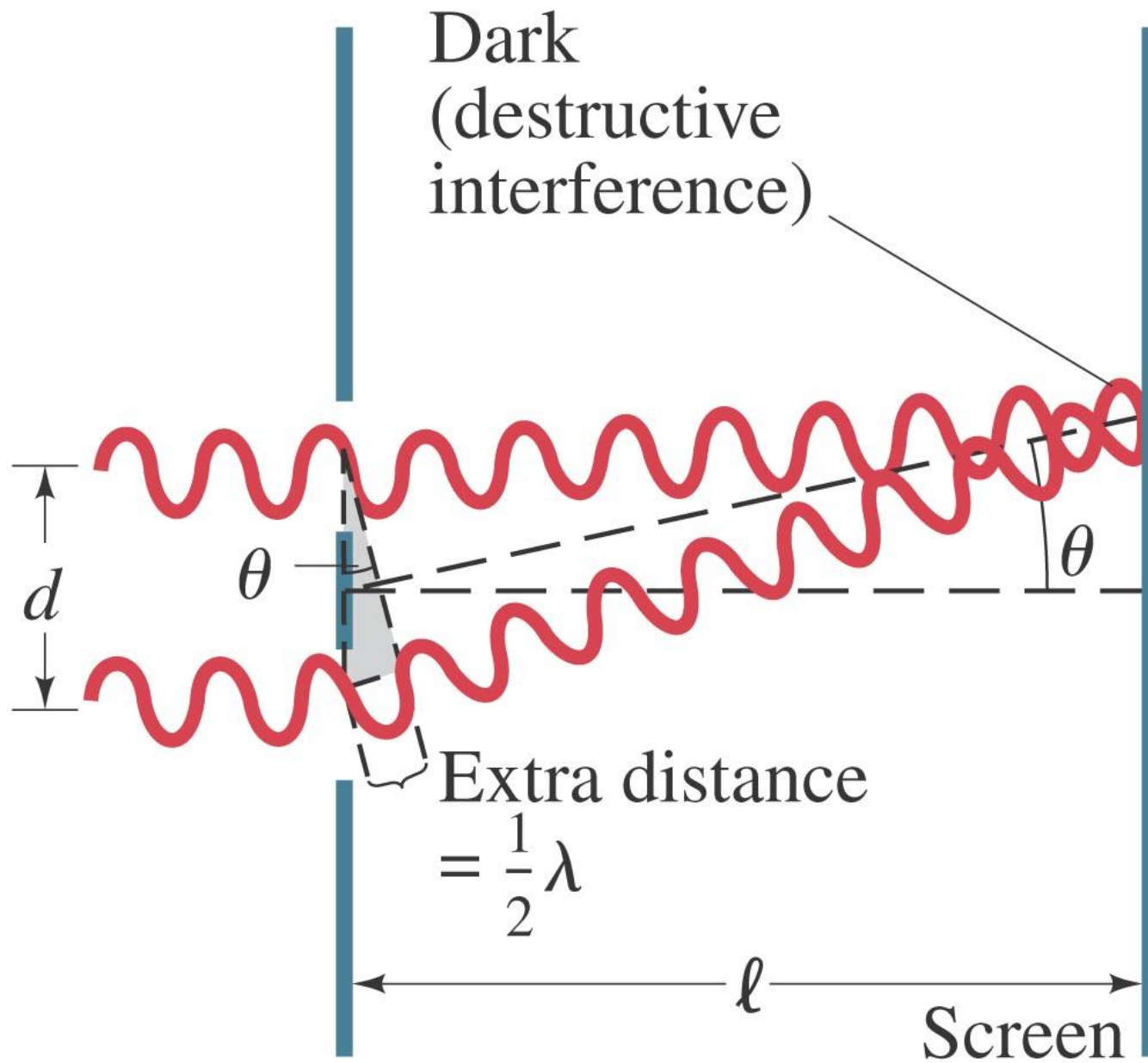
(a) $\theta = 0^\circ$

Figure 34.7b

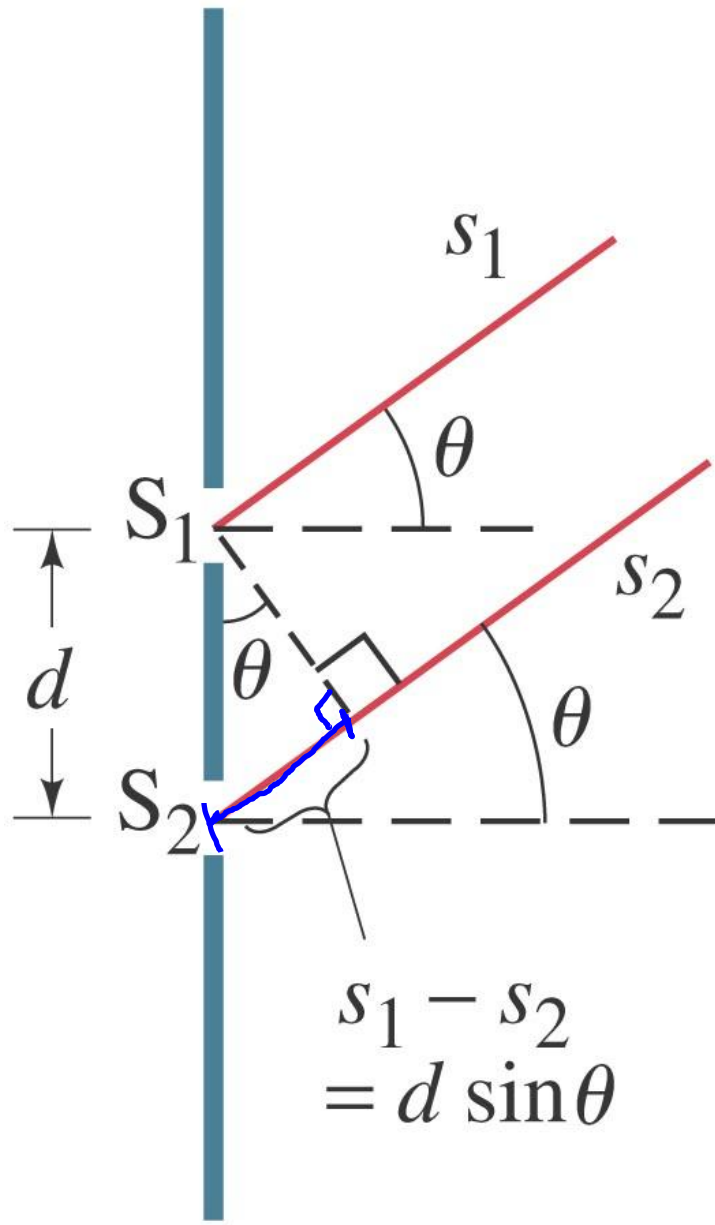


(b)

Figure 34.7c



(c)



(d)

constructive

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

$$m = 0, 1, 2, \dots$$

destructive

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

The distance between the slits in a double-slit experiment is increased by a factor of 4. If the distance between the fringes is small compared with the distance from the slits to the screen, the distance between adjacent fringes near the center of the interference pattern

1) increases by a factor of 2.

2) increases by a factor of 4.

3) depends on the width of the slits.

4) decreases by a factor of 2.

5) decreases by a factor of 4.

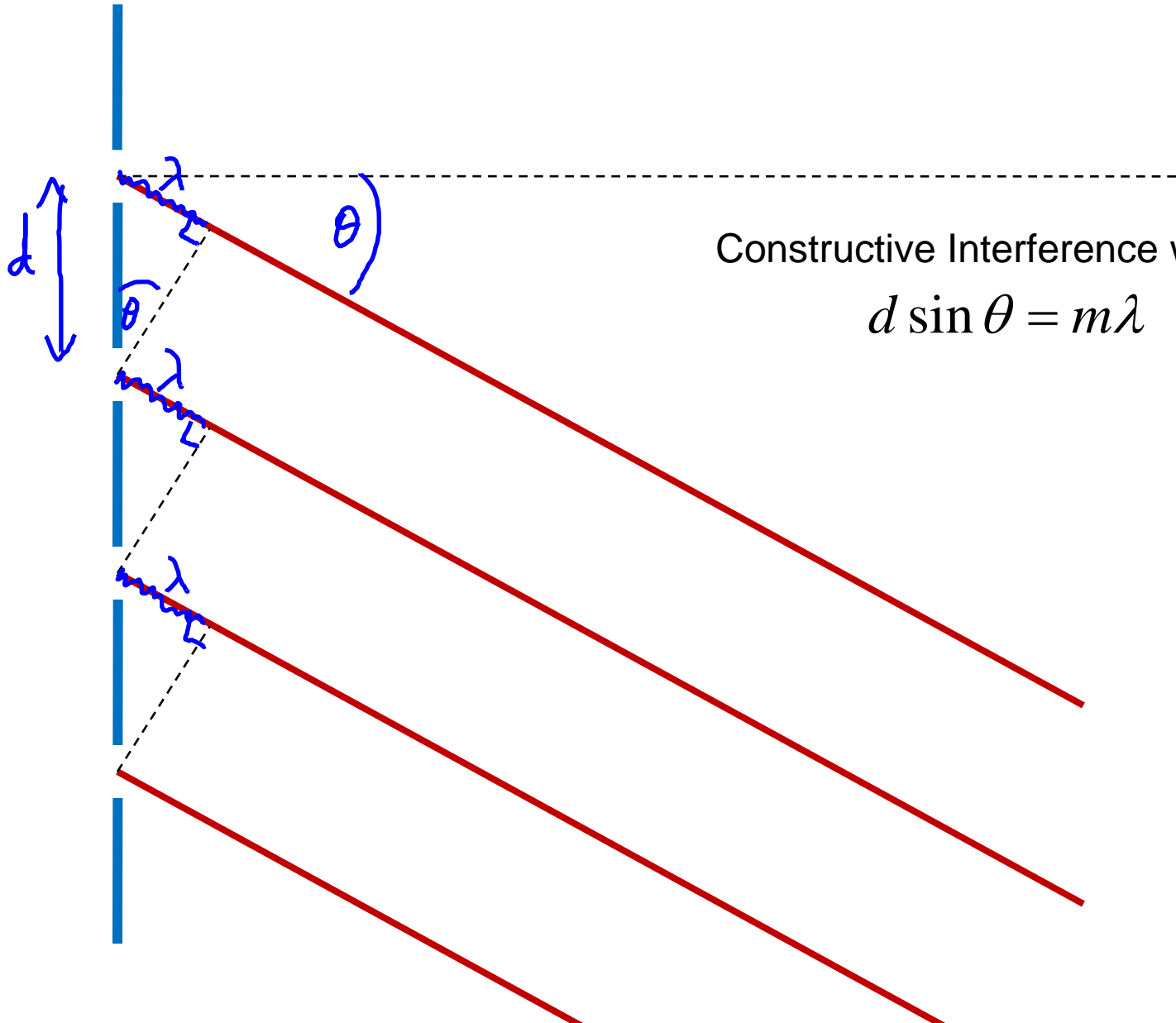
$$d \sin \theta = m \lambda$$

1st bright

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

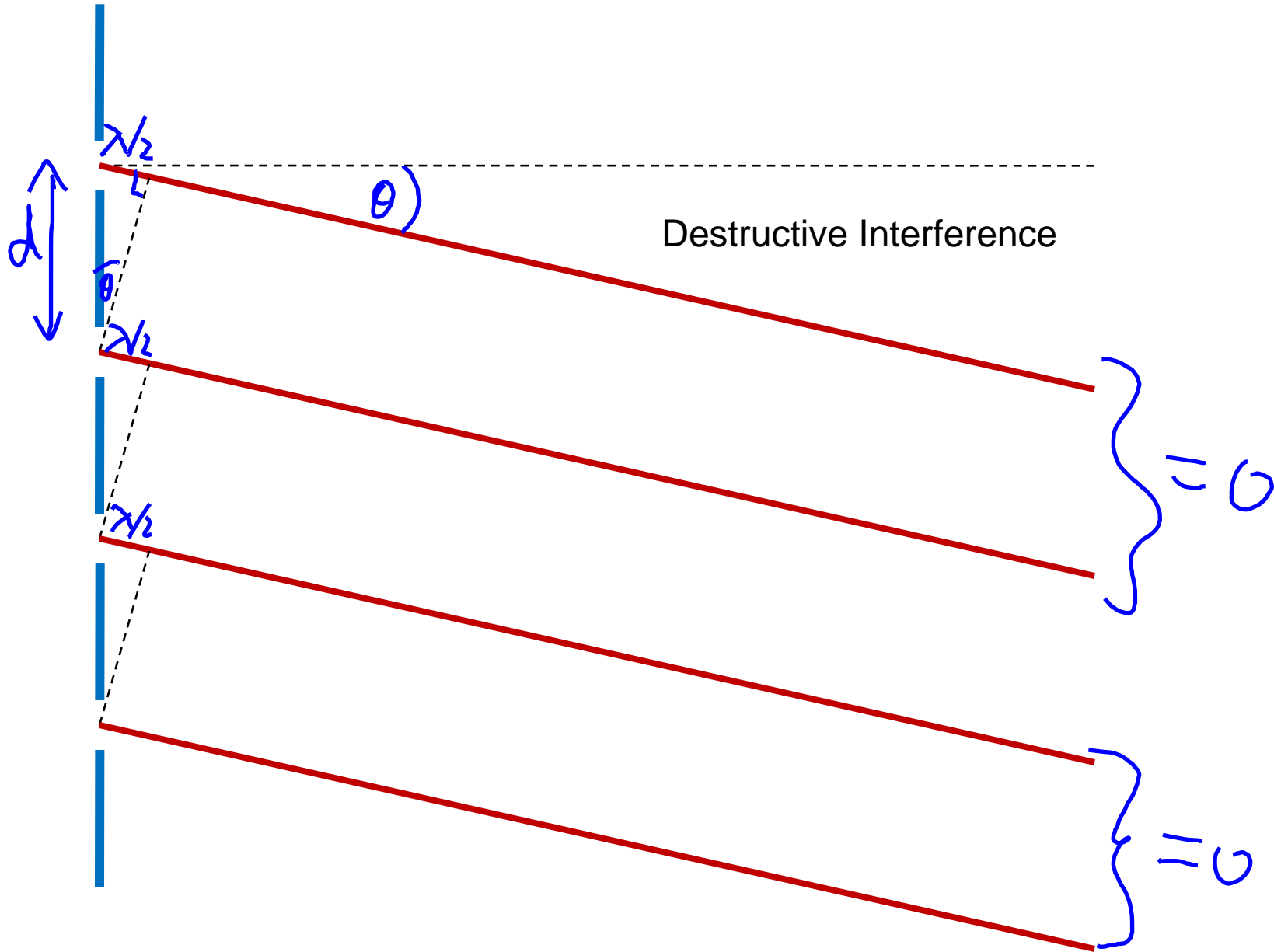
$$d \theta \approx \lambda$$

4 slits



Constructive Interference when
 $d \sin \theta = m\lambda$

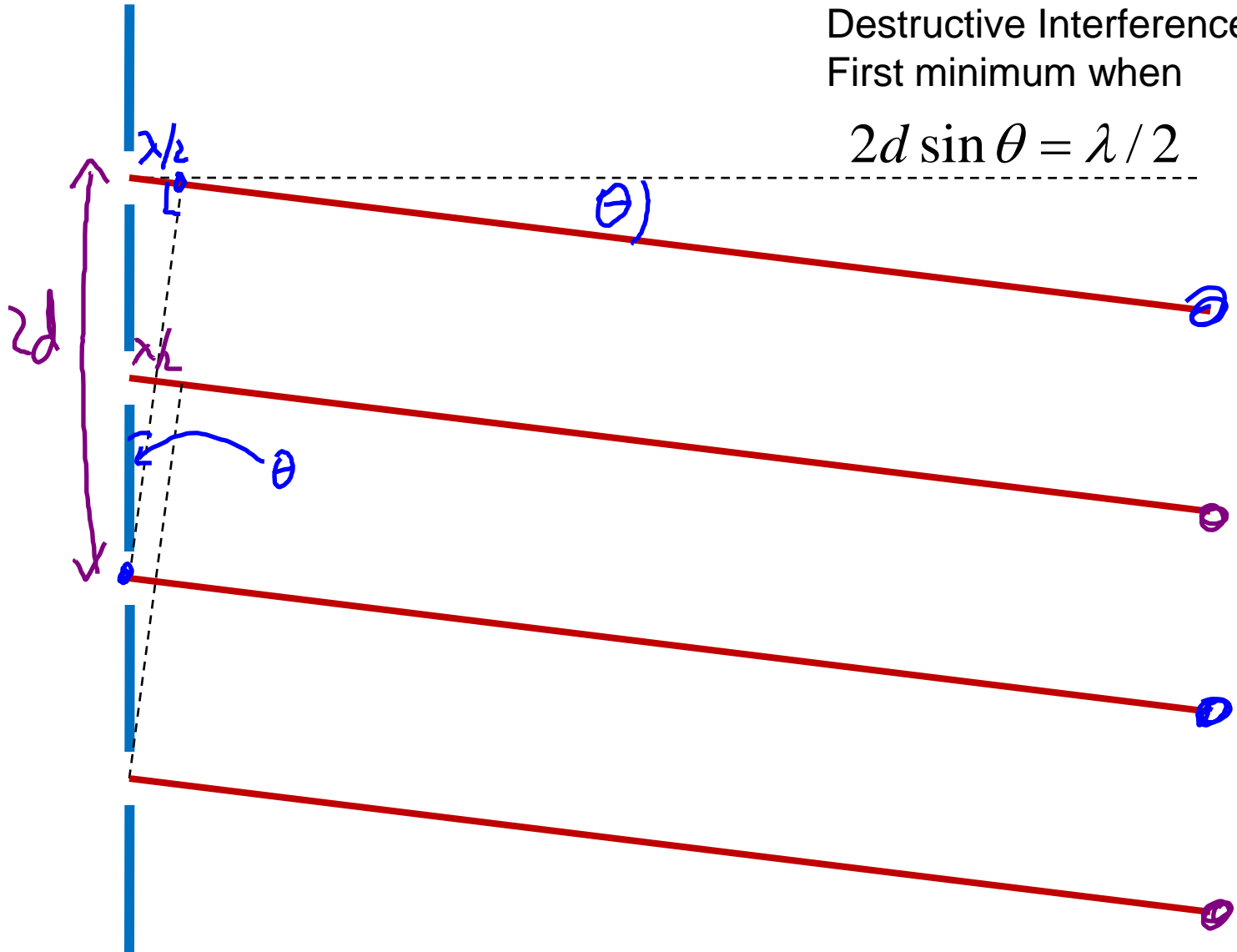
4 slits

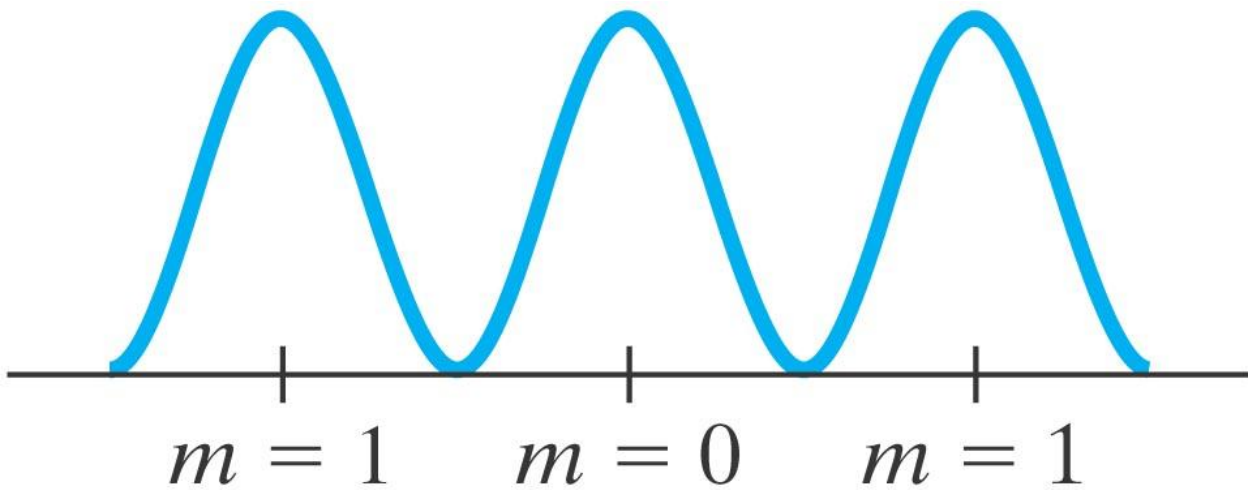


4 slits

Destructive Interference
First minimum when

$$2d \sin \theta = \lambda / 2$$



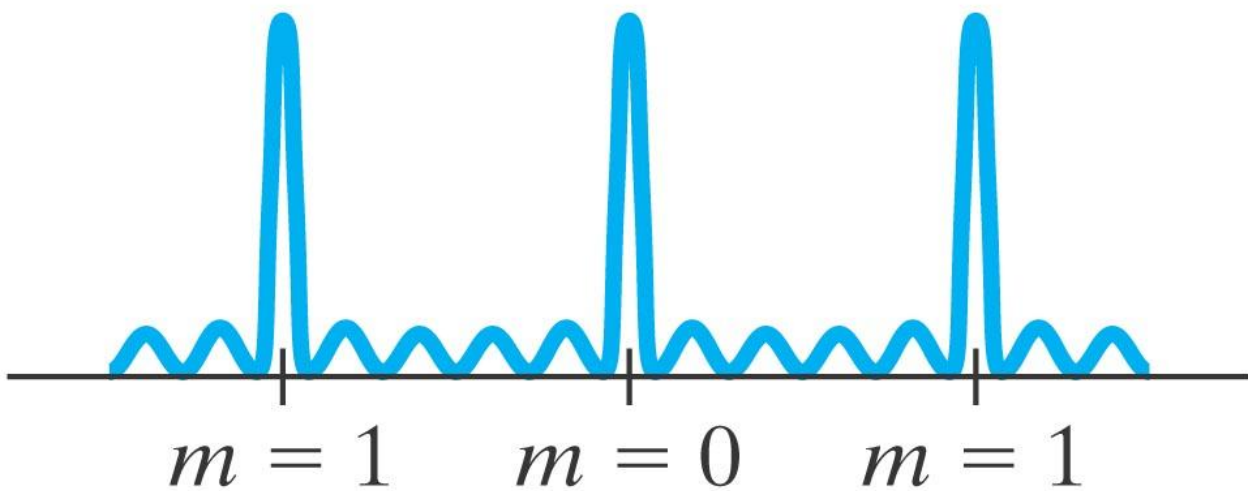


(a) 2 slits

N slits

First minimum when

$$\frac{N}{2} d \sin \theta = \lambda / 2$$



(b) 6 slits