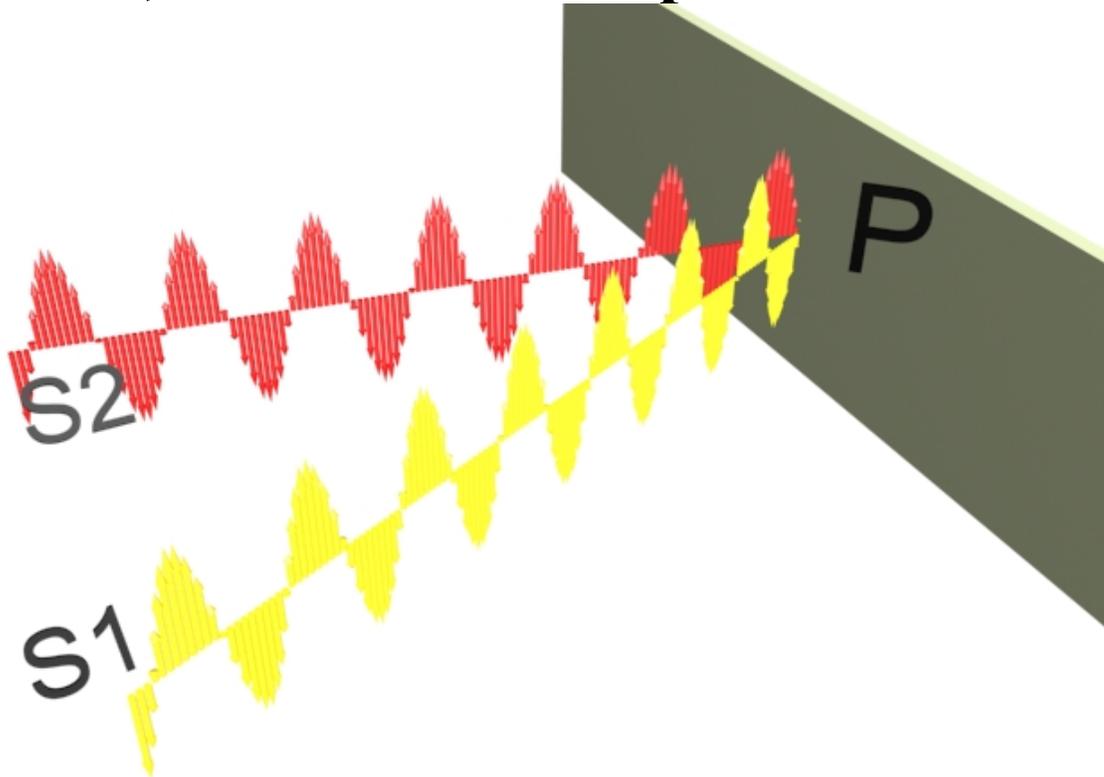
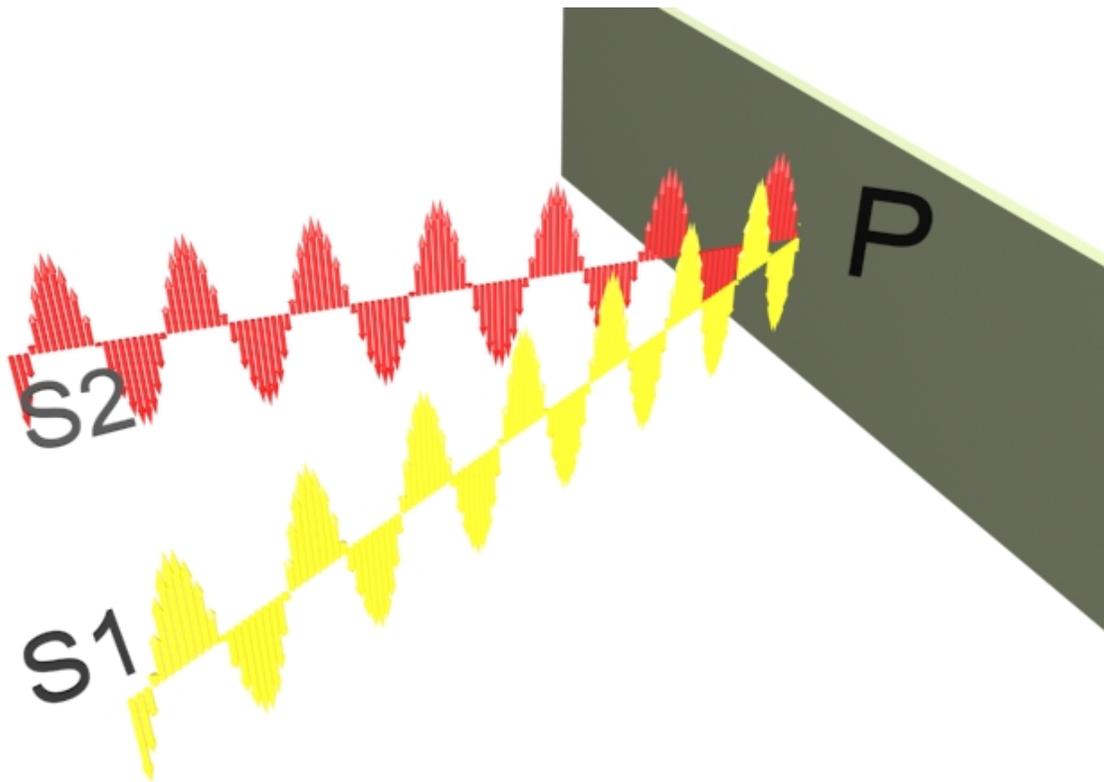


Coherent, monochromatic plane waves:



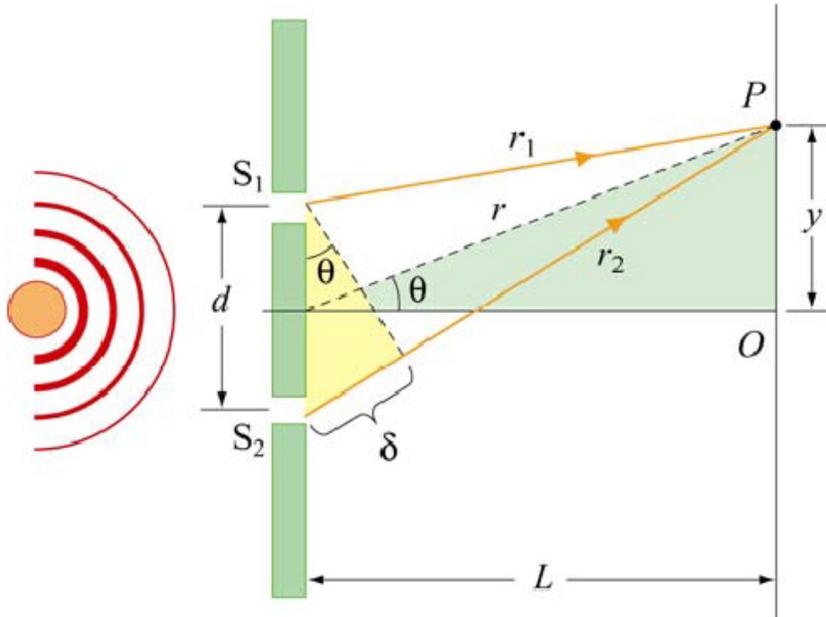
In the Figure above, the fringe at point P on the screen will be:

- 1. An interference maximum**
- 2. An interference minimum**
- 3. Don't have a clue**



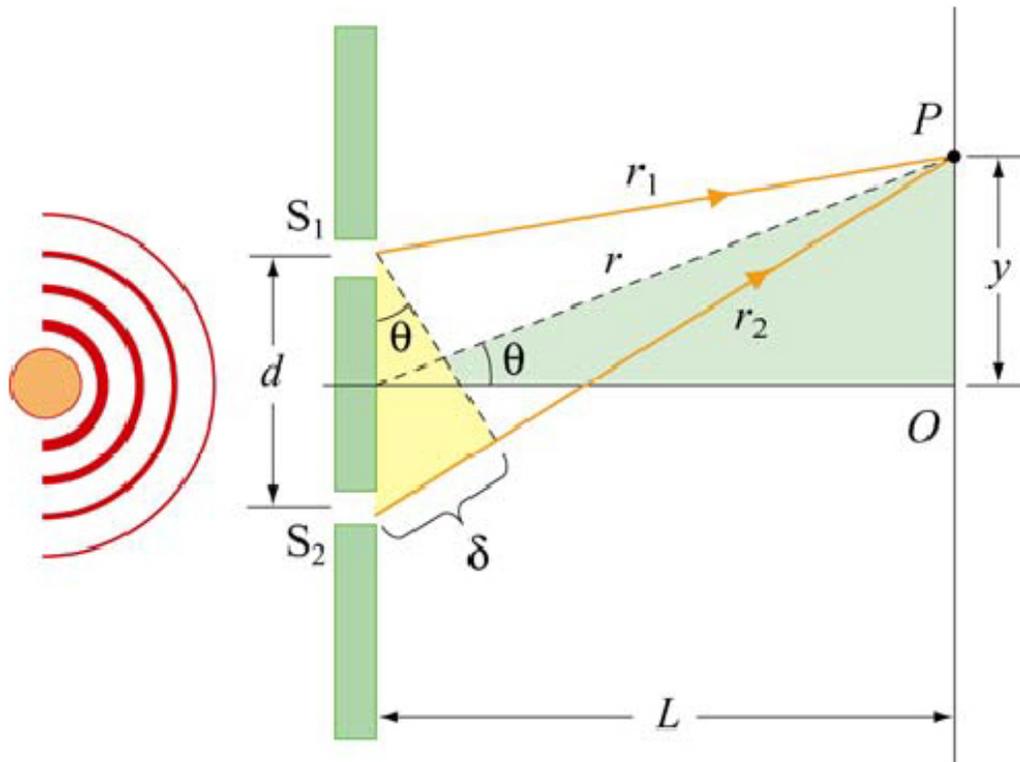
Answer: 2. Interference minimum.

The two waves arrive at point *P* exactly 180 degrees or half a wavelength out of phase.



Coherent monochromatic plane waves impinge on two apertures separated by a distance d . An approximate formula for the path length difference between the two rays shown is

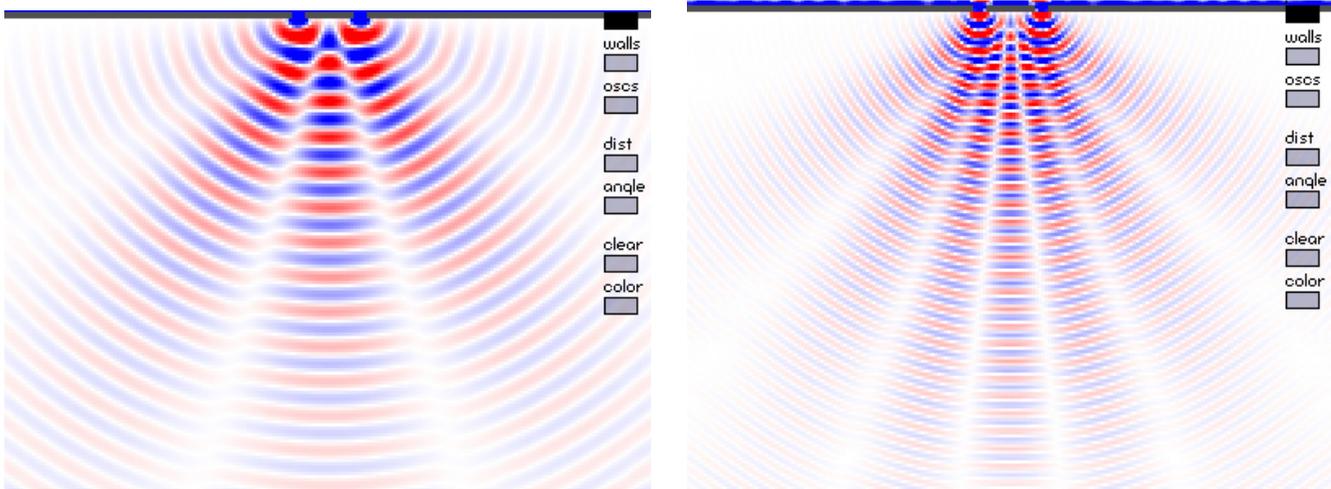
1. $d \sin \theta$
2. $L \sin \theta$
3. $d \cos \theta$
4. $L \cos \theta$
5. **Don't have a clue.**



Answer: 1. $\delta = d \sin \theta$

The difference between the two paths can be seen to have this value by geometrical construction (using the triangle show in yellow).

Two Slit Interference:



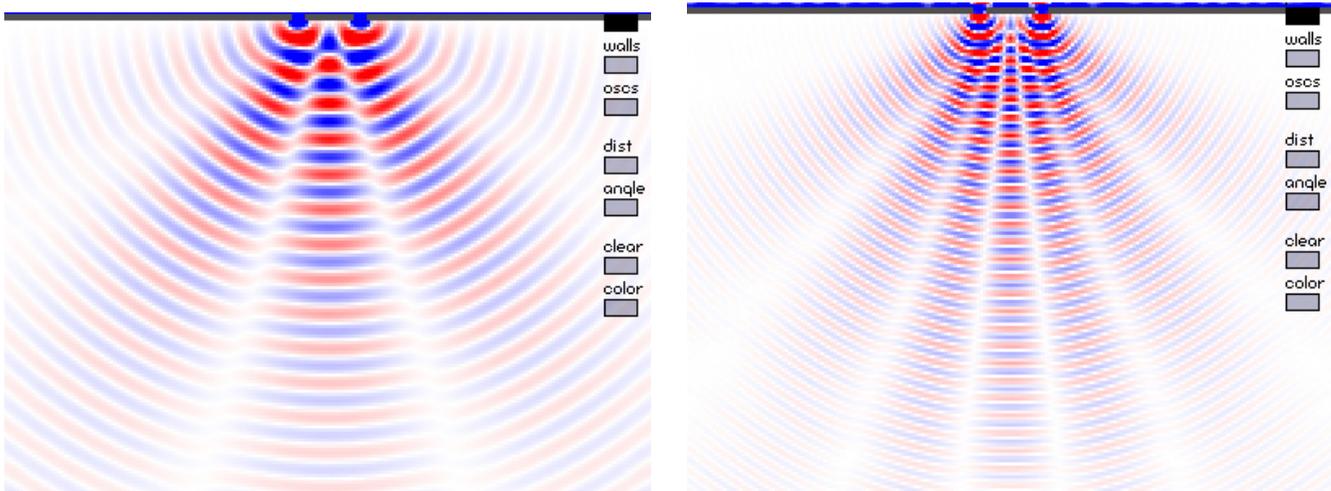
A

B

In the two 2-slit interference patterns above, the frequency of the wave on the left (A) is larger or smaller than the frequency of the wave on the right (B)? The slit spacing d is the same in both cases.

1. *A* larger than *B*
2. *A* smaller than *B*
3. Don't have a clue

Two Slit Interference:



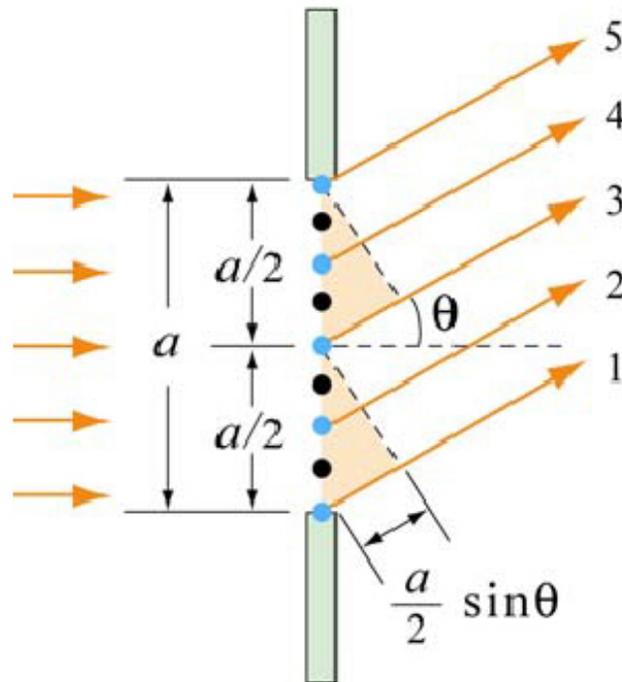
A

B

Answer: (1) A smaller than B . Two ways to argue. The most straightforward is to realize that the wavelength in A is *longer* than the wavelength in B , therefore since $\lambda f = c$, the frequency in A must be *smaller* than the frequency in B . The other way is to look at

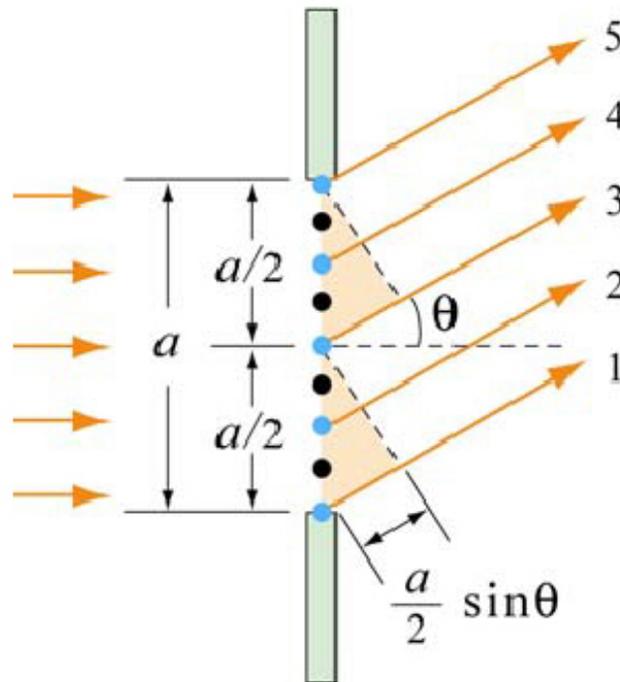
$$\sin \theta_{destructive} = \left(m + \frac{1}{2}\right) \frac{\lambda}{d}$$

so the smaller $\theta_{destructive}$ in B means smaller λ and thus higher frequency.



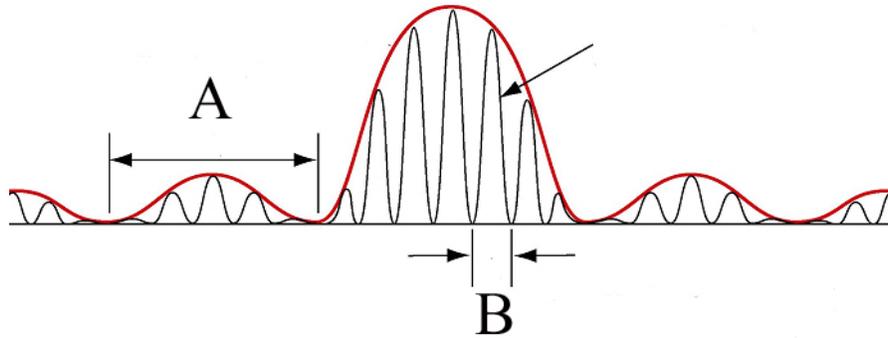
The light passing through this slit when seen on a screen far from the slit will exhibit *destructive* interference when

1. $\frac{a}{2} \sin \theta = \frac{\lambda}{4}$
2. $\frac{a}{2} \sin \theta = \frac{\lambda}{2}$
3. $\frac{a}{2} \sin \theta = \lambda$
4. **Don't have a clue.**



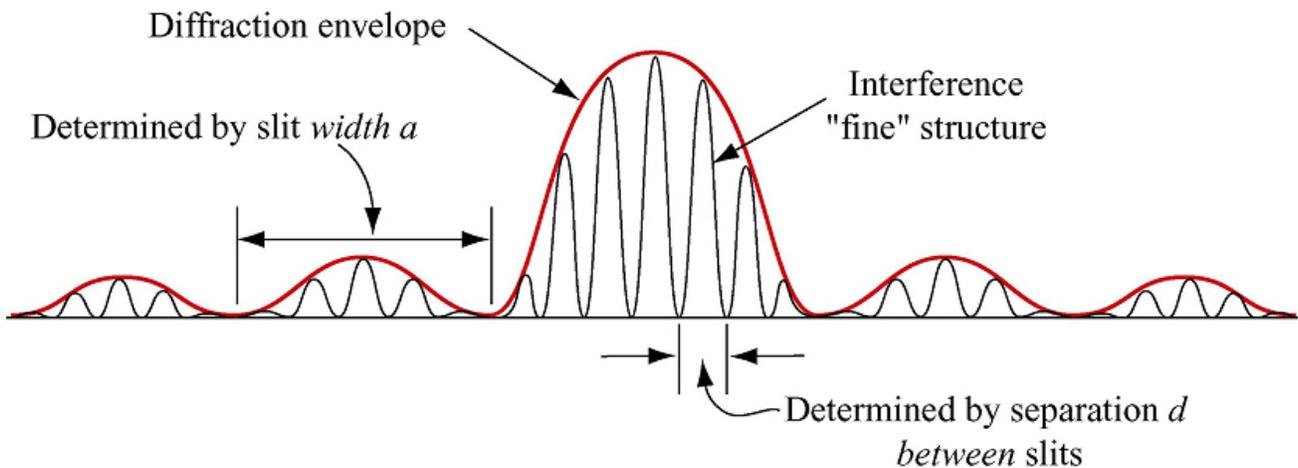
Answer: 2. $\frac{a}{2} \sin \theta = \frac{\lambda}{2}$.

For this angle, the path difference between rays 1 and 3 will be exactly half a wavelength, and those waves will interfere destructively. This will also be true for rays 2 and 4. Therefore all the rays from the slit will interfere destructively when the condition above is satisfied.

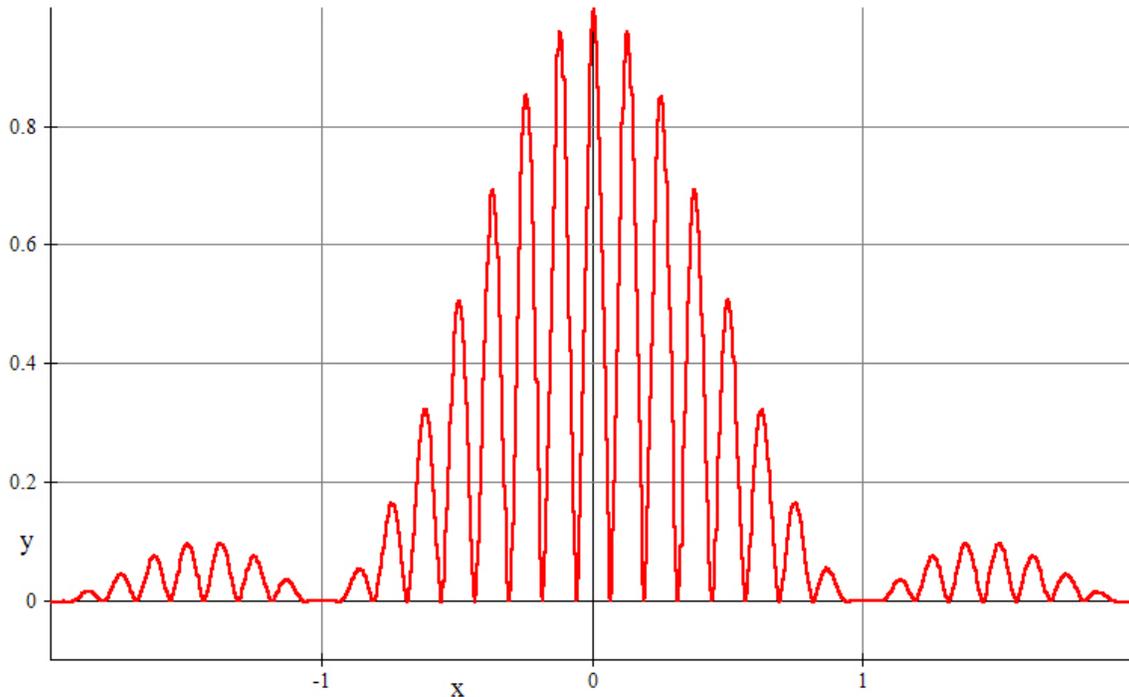


Coherent monochromatic plane waves impinge on two long narrow apertures (width a) that are separated by a distance d ($d \gg a$). The resulting pattern on a screen far away is shown above. Which structure in the pattern above is due to the finite width a of the apertures?

- 1. The distantly-spaced zeroes of the envelope, as indicated by the length A above.**
- 2. The closely-spaced zeroes of the rapidly varying fringes with length B above.**
- 3. Don't have a clue.**

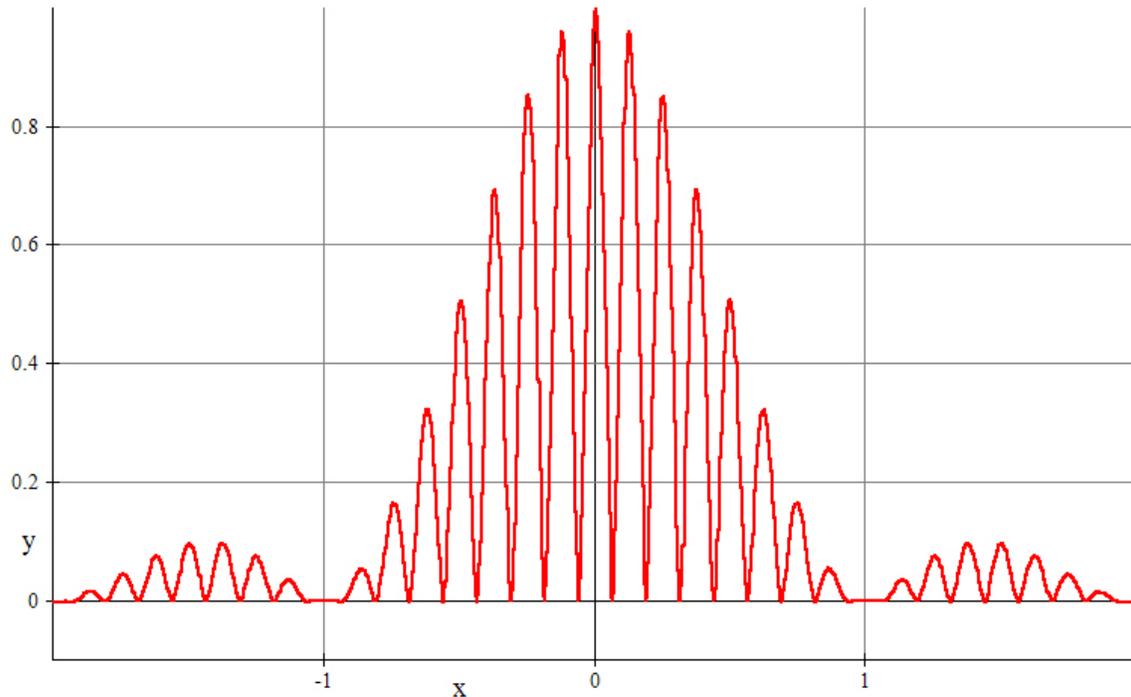


Answer: 1. The distantly-spaced zeroes of the envelope are determined by the width $a \ll d$ of the apertures, which is much smaller than the separation d of the apertures. The much larger distance d determines the “fine-scale” structure in the graph above.



Coherent monochromatic plane waves impinge on two long narrow (width a) apertures separated by a distance d . The resulting pattern on a screen far away is shown above. For this arrangement:

- 1. The value of d/a is about $1/8$**
- 2. The value of d/a is about $1/4$**
- 3. The value of d/a is about 4**
- 4. The value of d/a is about 8**
- 5. Don't have a clue.**



Answer: 4. The value of d/a is about 8.

d determines spacing of the “fine-scale” zeroes (spacing proportional to $1/d$). a determines spacing of envelope zeroes (spacing proportional to $1/a$). So there are d/a fine-scale zeroes in the rapid fluctuations before we get to the first zero in the envelope. Here there are 8.