Multiple Slits

Aside: the minima of the multiple slit case is different to the single slit case.

the minima in 2-slit cases occurs when the phase difference is $\pi, 3\pi, 5\pi, \cdots$.

these are <u>also</u> minima in the N-slit case ($N > 2$), but there are <u>more</u>:

$$\phi = n\frac{2\pi}{N}, \quad n \in \mathbb{Z}$$

<u>except</u> when $\phi = 2\pi n$.

so, ...

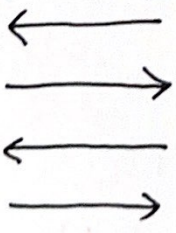
in the $N = 4$ slit case, we have $(N-1) = 3$ intensity minima in $\phi \in (0, 2\pi)$:

$\phi = \pi$ ✓

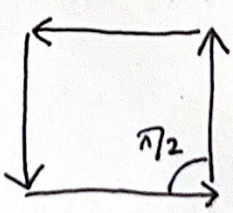
$\phi = \frac{\pi}{2}, \frac{3\pi}{2}$ ✓ ✓

← these phasor diagrams are the same, just oriented differently.

phasors:



✓



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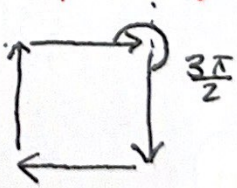

the phase difference is

$$\phi = \frac{2\pi d \sin\vartheta}{\lambda} .$$

since the screen is sufficiently far away, the angle of the rays relative to the normal of the screen, are small.

$\Rightarrow \sin\vartheta \approx \vartheta$

$$\Rightarrow \phi \approx \frac{2\pi d\vartheta}{\lambda} .$$

$$\Rightarrow \vartheta = \frac{\lambda\phi}{2\pi d} . \checkmark$$

let $y = R\vartheta$ be the distance of a point on the screen to the location of the central bright fringe so

$$y(\phi) \equiv y = \frac{R\lambda\phi}{2\pi d} \checkmark$$

... $y = R\tan\vartheta$, ϑ small so $\tan\vartheta \approx \vartheta$ and $y = R\vartheta$.

$$\rightarrow y\left(\frac{\pi}{2}\right) = \frac{2.00 \times 4.80\times10^{-7}}{2\pi \times 9.50\times10^{-6}} \times \frac{\pi}{2} \approx 2.53 \text{ cm}$$

$y(\pi) = \ldots$ ≈ 5.05 cm

$y\left(\frac{3\pi}{2}\right) = \ldots$ ≈ 7.58 cm

$\checkmark$

9/9

+1 presentation