Topic: Wave Phenomena

I recommend looking at a question in the textbook, if you don't get a theory.

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Formulae
\[ \omega = \frac{2\pi}{T} \quad \text{Frequency} \quad E_T = \frac{1}{2} m \omega^2 x_0^2 \quad \text{Kinetic Energy} \]
\[ a = -\omega^2 x \quad \text{Acceleration in SHM} \quad \text{Mass-spring:} \quad T = 2\pi \sqrt{\frac{m}{k}} \]
\[ x = x_0 \cos(\omega t) \quad \text{Velocity in SHM} \]
\[ v = \omega x_0 \cos(\omega t) \quad -\omega x_0 \sin(\omega t) \quad \text{Velocity in SHM} \]
\[ E_k = \frac{1}{2} m \omega^2 (x_0^2 - x^2) \quad \text{Kinetic Energy} \]
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Required Definitions

- **Angular velocity**: Radians per second, rods, \( \omega \). AKA Angular Frequency.
- **Diffraction**: The spreading out of waves by passing through a narrow aperture or across an edge.
- **Huygens' Principle**: Each point on a wave front emits a spherical wavefront of same wavelength.

Common Diagrams

- Understand path difference: \( \lambda = \text{distance between each wavefront (circle)} \)
- Constructive
- Destructive

Path difference = 0 for central maxima

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For a complete understanding of the content, please refer to the full document at [www.aceyourphysicsexams.com](http://www.aceyourphysicsexams.com).
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Common Graphs

Intensity of single-slit diffraction pattern
- Must know relative intensities of maxima
- Must know positions of minima

Exam Tip!
The bigger the $b$ in $\theta = \frac{b}{\lambda}$, the closer the maxima & minima. So, the graph is narrower.

So it spreads like VIBgyOR from center.
VIBgyOR is within one adjustable machine. Not different machine, different colour.

Experiment Summaries

If aperture is much larger than wavelength, diffraction is less.
If aperture is much smaller than wavelength, diffraction is more.
The aperture size is always in order of wavelength:

- $b = 6\lambda$, Bigger aperture, Less Diffraction
- $b = 2\lambda$, Smaller aperture, More Diffraction

The more the no. of slits in interference, the higher the central max intensity. $I_0 = N^2 I_0, N = \text{No. of slits}$

$\text{SO}_2$ for 2 slits $I_1 = 4I_0$

Other Notes: Learned From Past Papers

- Don't forget to convert units from mm or cm.
- $b$ is slit width and $d$ is slit spacing or distance between 2 slits.
- For double-slit, take $s$ as distance between 2 maxima. For single slit, take $s$ as distance between first minima and central max.
- Question per diffraction grating:
  - $S = \frac{\lambda d}{\sin \theta}$ applies to both cases
  - $S = \frac{\lambda D}{b}$ for diffraction grating, $d$: slit spacing

- If wave enters from slower speed to slower, it reflects in phase.
- If wave enters from higher speed to slower, it reflects out of phase.
- Transmission is always in phase.
- The angle of incidence is $\theta$.
- The angle of reflection is $\theta$.
- When $\theta = 0$, $\theta$ is in degrees.
- When the angle and $\alpha$ are equal, it is destructive interference.
- When the angle and $\alpha$ are equal, it is constructive interference.

$m = \text{no. of wavelengths}$
$2d\sin \theta = m\lambda$
$2dn = (m+1)\lambda$ (contructive)

n = refractive index of medium