

# Wave optics



## Answer Key:

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### Part 1: Conceptual Questions (Short Answer)

**1. Define interference and diffraction in your own words.**

- **Interference:** Interference is the phenomenon where two or more coherent waves superimpose to form a pattern of alternating bright and dark fringes due to constructive and destructive interference.
- **Diffraction:** Diffraction is the bending or spreading of waves, especially light waves, as they pass through a small aperture or around the edge of an obstacle.

**2. Explain why interference requires coherent sources but diffraction can occur with a single wave.**

- Interference occurs due to the superposition of waves, so two or more coherent sources (with constant phase difference) are necessary to produce a stable interference pattern. Diffraction, on the other hand, results from the bending of a single wave as it passes through an aperture or around an obstacle, so it does not need multiple sources.

**3. Describe the appearance of the central maximum in a diffraction pattern. How is it different from an interference pattern?**

- In diffraction, the central maximum is the brightest and widest fringe. In an interference pattern, the fringes are evenly spaced, and the brightness of each bright fringe is nearly the same, unlike the diffraction pattern where the intensity diminishes away from the center.

**4. What happens to the width of the central diffraction maximum if the width of the slit is reduced? Explain why.**

- The width of the central maximum increases when the slit width is reduced. This is because diffraction is more pronounced when the slit size is comparable to the wavelength of the light, leading to a wider spread of the light.

**5. Give two everyday examples of diffraction in real life.**

- Diffraction of sound waves around a corner, allowing us to hear someone speaking even if they are out of sight.
  - Diffraction of light through a small aperture like a pinhole, causing light to spread and illuminate a broader area.
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### Part 2: Multiple Choice Questions (MCQs)

1. **Answer:** c) Equally spaced, and bright fringes have the same intensity.

2. **Answer:** b) Wider and more intense than the other maxima.
  3. **Answer:** b) Passes through a small slit or around an obstacle.
  4. **Answer:** b) Superposition of light from two or more coherent sources.
  5. **Answer:** b) Spread out wider.
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### Part 3: Fill-in-the-Blanks

1. In interference, the pattern is created by the **superposition** of light from two or more coherent sources.
  2. Diffraction occurs when a wave passes through a **small slit** or around an **obstacle**.
  3. In diffraction, the central bright fringe is **wider** and **brighter** compared to the other fringes.
  4. **Diffraction** refers to the phenomenon where light bends around obstacles or spreads after passing through a narrow opening.
  5. The intensity of the bright fringes in an interference pattern is typically **constant**, whereas in a diffraction pattern, the intensity **decreases** as you move away from the central maximum.
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### Part 4: True or False

1. **False:** Diffraction patterns can be created by a single wave source passing through a slit or around an obstacle.
  2. **True:** The central maximum in a diffraction pattern is the brightest and widest.
  3. **False:** Interference patterns are produced by multiple coherent light sources (like in a double-slit experiment), not a single slit.
  4. **True:** In interference, fringes are equally spaced, while diffraction patterns have unevenly spaced fringes with a wider central maximum.
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### Part 5: Match the Columns

Column A	Column B
1. Interference	d. Requires coherent light sources
2. Diffraction	a. Requires a single slit
3. Fringe Intensity in Diffraction	e. Intensity decreases as we move from the center
4. Central Maximum in Diffraction	b. Central maximum is wider and more intense
5. Fringe Spacing in Interference	c. Superposition of light from two sources

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### Part 6: Application-Based Question (3 Marks)

*Sample Answer:*

Imagine standing behind a wall with a small opening, and you hear someone speaking on the other side. The sound waves bend around the wall and spread into the space behind it. This is an example of diffraction. The obstacle (the wall) causes the sound waves to spread, allowing you to hear the sound even though you are not directly in the path of the sound waves.

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