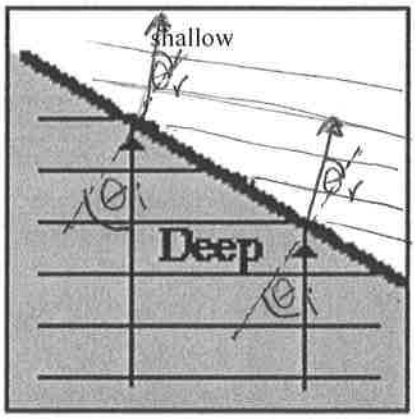
Refraction: bending of a wave away or toward normal



Complete the diagram showing the refraction of the wave.

When a wave refracts, are there any changes in

a) direction? yes b) speed? yes c) wavelength? yes d) frequency? no e) phase? no

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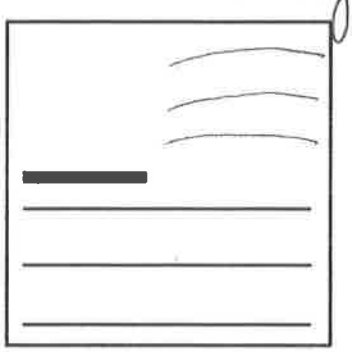
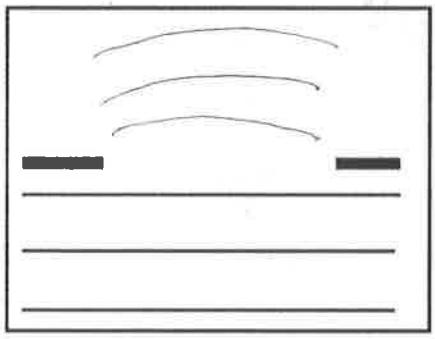
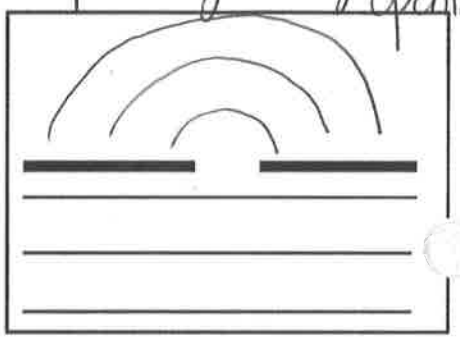
Diffraction: bending of a wave around a barrier or spreading through an opening.



Complete the diagram showing the diffraction of a wave around the edge of a barrier.



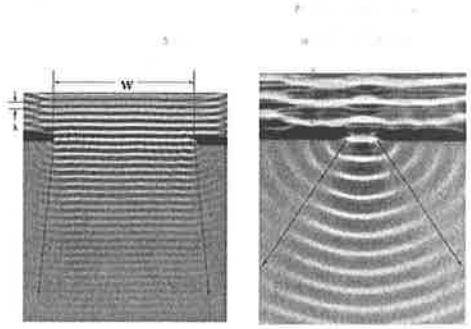
Complete the diagram above showing diffraction through a wide opening.



Complete the diagram above showing diffraction through a narrow opening.

1. When a wave diffracts, are there any changes in

   a) direction? yes b) speed? no c) wavelength? no d) frequency? no e) phase? no

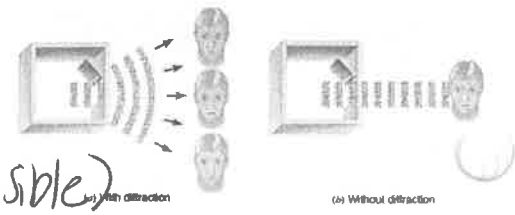


2. What happens to the diffraction pattern as the width of the opening decreases?

   diffraction increases or becomes more noticeable

3. Condition for noticeable diffraction to occur:

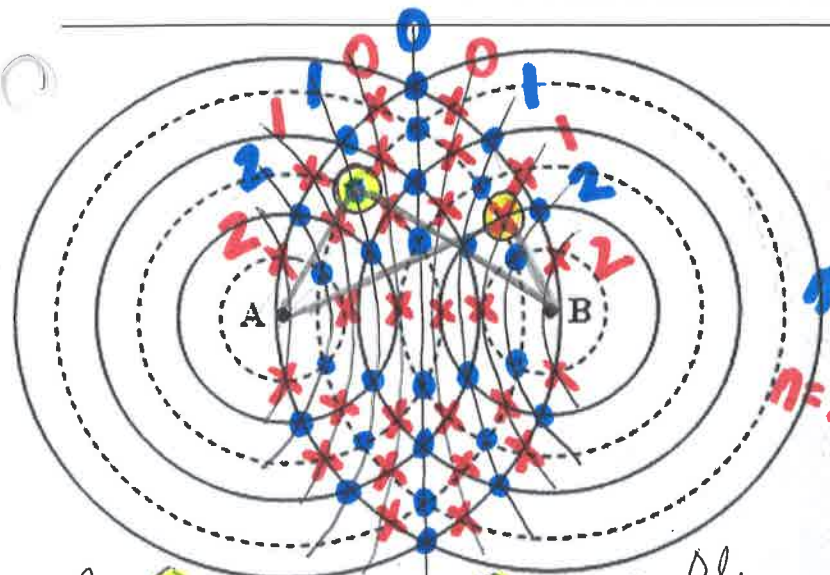
   width of opening is on order of wavelength width ≈ λ

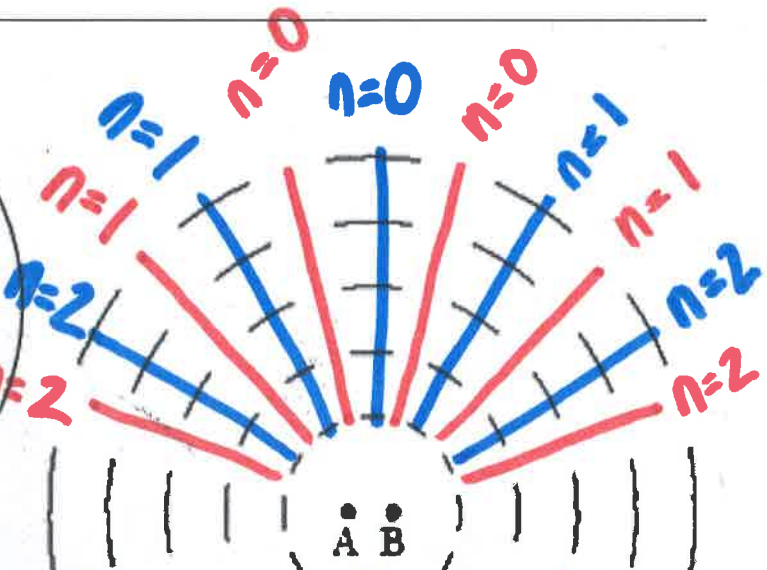


4. Why can you hear around a corner but can't see around a corner?

   sound waves diffract more than light (visible) because they are longer in wavelength.

Two-Source Interference of Waves





n=1 A → ⊙ − 1.5λ B → ⊙ − 2.5λ Δℓ = 1λ A → ⊗ = 2.5λ B → ⊗ = 1λ n=1 Δℓ = 1.5λ

Path Length (ℓ) – distance traveled by a wave from source to a location length to A or length to B

Path Difference (Δℓ) – difference in path lengths between two waves = $|\ell_1 - \ell_2|$ |length A − length B|

Anti-nodal Line:

line of maximum (constructive) interference

Conditions for Anti-nodal Line

Phase difference: in phase 0° difference

Path difference: … $\Delta\ell = n\lambda$

Nodal Line:

line of constant (destructive) interference

Conditions for Nodal Line

Phase difference: 180° out of phase

Path difference $\Delta\ell = (n + \frac{1}{2})\lambda$

Conditions for a stable interference pattern:

1) waves have approximately same amplitude/intensity and frequency/wavelength

2) sources are coherent

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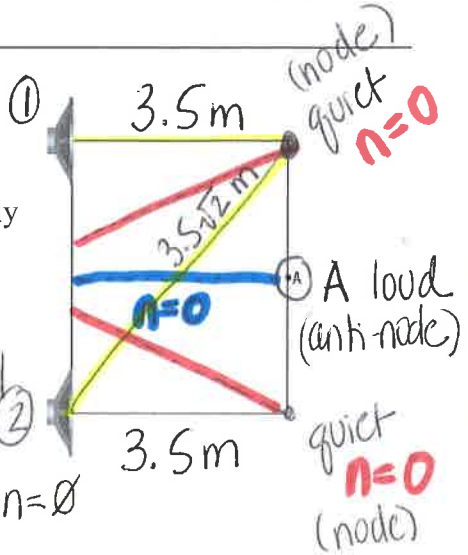
1. A square is 3.5 m on a side, and point A is the midpoint of one of its sides. On the side opposite this spot, two in-phase loudspeakers are located at adjacent corners. Standing at point A, you hear a loud sound and as you walk along the side of the square toward either empty corner, the loudness diminishes gradually but does not entirely disappear until you reach either empty corner, where you hear no sound at all. Find the wavelength of the sound waves.



loudspeaker ① → node = 3.5m

loudspeaker ② → node = $3.5\sqrt{2}$ m

$\Delta\ell = |(3.5\text{m} - 3.5\sqrt{2}\text{m})|$

$\Delta\ell = (n + \frac{1}{2})\lambda$ for nodal lines where n=Ø

$\lambda = \dfrac{\Delta\ell}{(n+\frac{1}{2})} = \dfrac{|3.5\text{m} - 3.5\sqrt{2}\text{m}|}{(\text{Ø} + \frac{1}{2})} = 2.9\text{m} = \lambda$