Interference and the Doppler Effect

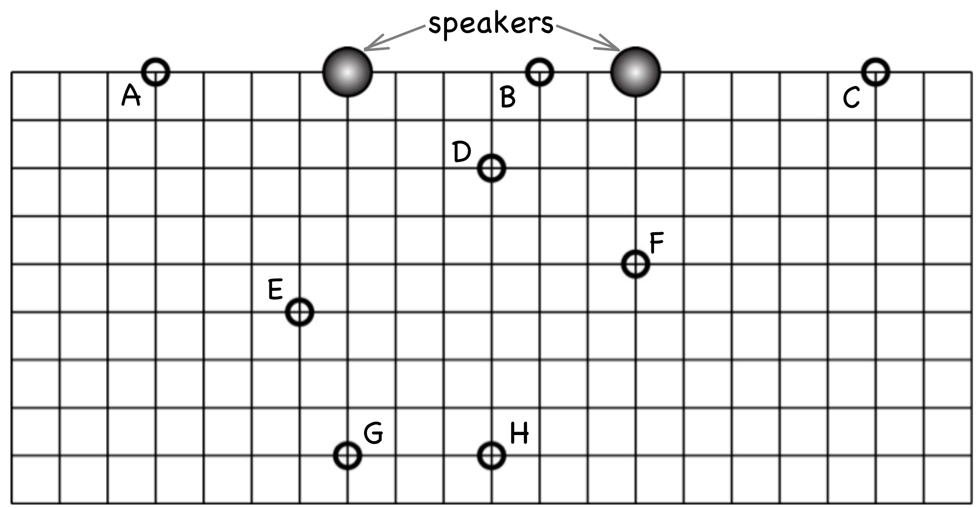
Pre-Class Questions

Problem Set (due next time)
Ch 12 - 33, 52, 55, 58a

Lecture Outline

1. Interference
2. The Doppler Effect

Interference



The two 360° speakers shown above are 3m apart. The floor of the room is marked out in half-meter squares. The speakers broadcast a sound wave that has a wavelength of 1m. There are eight marked positions labeled a through H. For each marked position:

- Fill in the circles where there is constructive interference.
- Put and X through the circles where there is destructive interference.
- Put a ? near the circles with neither constructive nor destructive interference.

CONCEPTUAL **Physics** PRACTICE PAGE

When an automobile moves toward a listener, the sound of its horn seems relatively

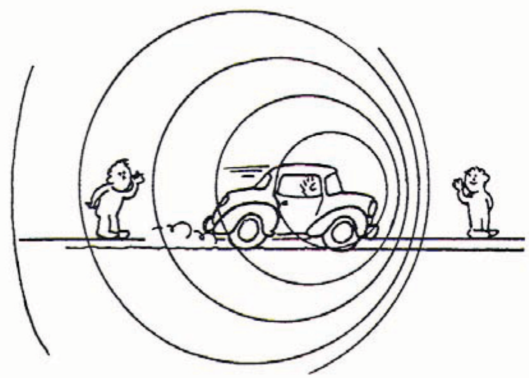
[low pitched] [high pitched] [normal]

and when moving away from the listener, its horn seems

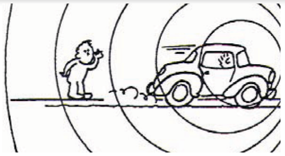
[low pitched] [high pitched] [normal].

The changed pitch of the Doppler effect is due to changes in

[wave speed] [wave frequency] [both].



Doppler Schmoppler



1. The relationship between the wave velocity, wavelength, and frequency of a sound source tells us that a wave travels a distance of exactly one ___________________ in a time called the _____________ which is the reciprocal of the frequency. This can be written mathematically as, $\lambda_S = vT_S = \frac{v}{f_S}$.

2. Suppose a sound source is moving away from you at speed v_S. Write the distance it has traveled in one period of the source sound wave, T_S.

$d_S =$

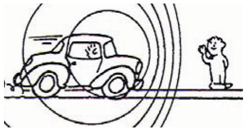
3. Since the source has moved forward since it began to emit the wave, the new wavelength, λ_L, should be longer by an amount equal to the distance the source moved. Write the longer wavelength in terms of the speed of the wave, v, the speed of the source, v_S, and the period, T_S.

$\lambda_L = \lambda_S + d_S =$

4. Since λ_L is in air, it is just the speed of sound in air, v, times the period heard you hear, T_L. This can be written mathematically as, $\lambda_L = vT_L$. Substitute this into the previous result so that you have a relationship between the period you hear T_L, the period emitted by the source T_S, the speed of sound in air v, and the speed of the source v_S.

5. Now rewrite the periods T_L and T_S in terms of the frequencies f_L and f_S. Solve for the frequency you hear, f_L.

6. What would be different in the final equation if the source were moving away from you?



Example 1: A formula one car emits sounds around 80Hz and often travel at speeds of 35m/s on straight aways. Find the frequency of the sound you would hear (a) when it is moving away from you and (b)when it comes toward you.

Example 2: You are heading south on 99 at 25m/s. A highway patrol car is heading northward at 35m/s with the 1000Hz siren wailing. Find the frequency that you hear for the siren.

Lecture 32- Summary

Constructive interference $\Delta P = n\lambda$

Destructive interference $\Delta P = (n + \frac{1}{2})\lambda$

Doppler Effect formula $f_L = \dfrac{v + v_L}{v + v_S} f_S$

You need to be careful about the signs of v_L and v_S.