



Discuss and Answer:

Reviewing the equation sheet, are you familiar with the equations?

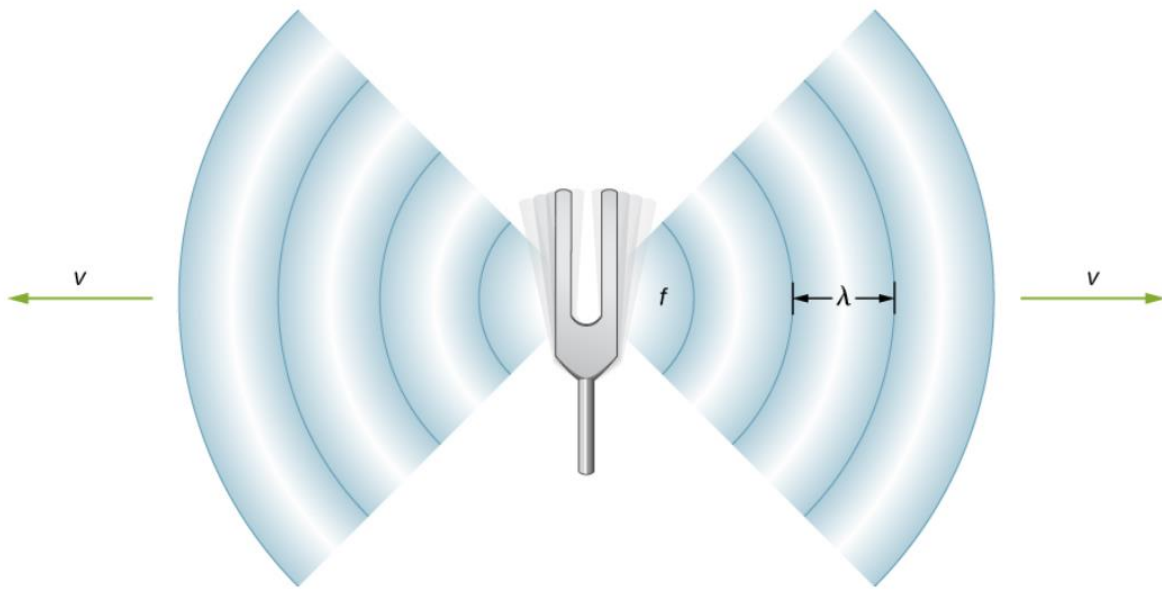
Are there any you'd like added?

Any that we never covered?

Notes

- Last homework due today
- Final Exam Structure
 - Cumulative Aspect: 9 Zombie questions from previous exams
 - New Material: 6 questions from final homework topic
- Can replace lowest midterm score!
- Survey #2 for participation points available

Recap: *Prelecture Review*: Acoustic Oscillations



$$v = \sqrt{\frac{\text{elastic property}}{\text{inertial property}}}$$

Speed of sound on a string
Speed of sound in a solid
Speed of sound in an ideal gas
Sonic Boom



What are our comments
and questions?

Key Points: Sound in Air

Sound

$$I = \frac{P}{A}$$

$$dB = 10 \log_{10}\left(\frac{I}{I_0}\right) \quad I_0 = 10^{-12} \frac{W}{m^2}$$

$$c_{air} \approx 343 \text{ m/s}$$

$$c = \sqrt{\gamma P / \rho} = \sqrt{\gamma kT / m} \quad PV = nkT$$

$$f_0 = \frac{v + v_0}{v + v_s} f_s$$

- The intensity is the power per area
- Intensity is usually measured logarithmically, in dB
- The speed of sound depends on the pressure and density, which are related to the temperature via the ideal gas law.
- Doppler effect

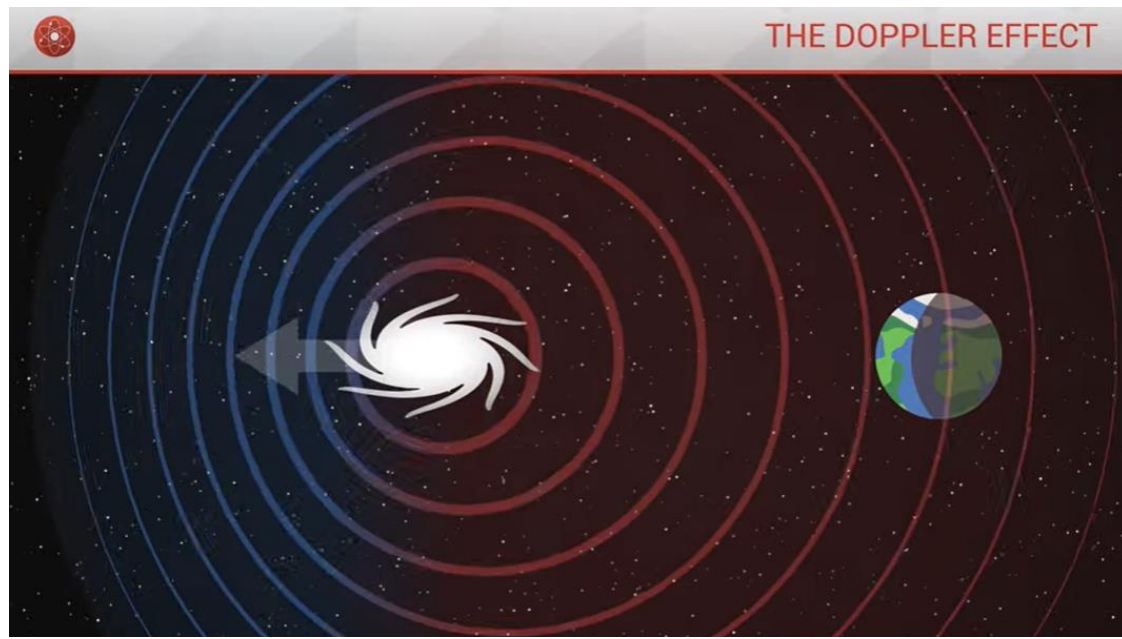
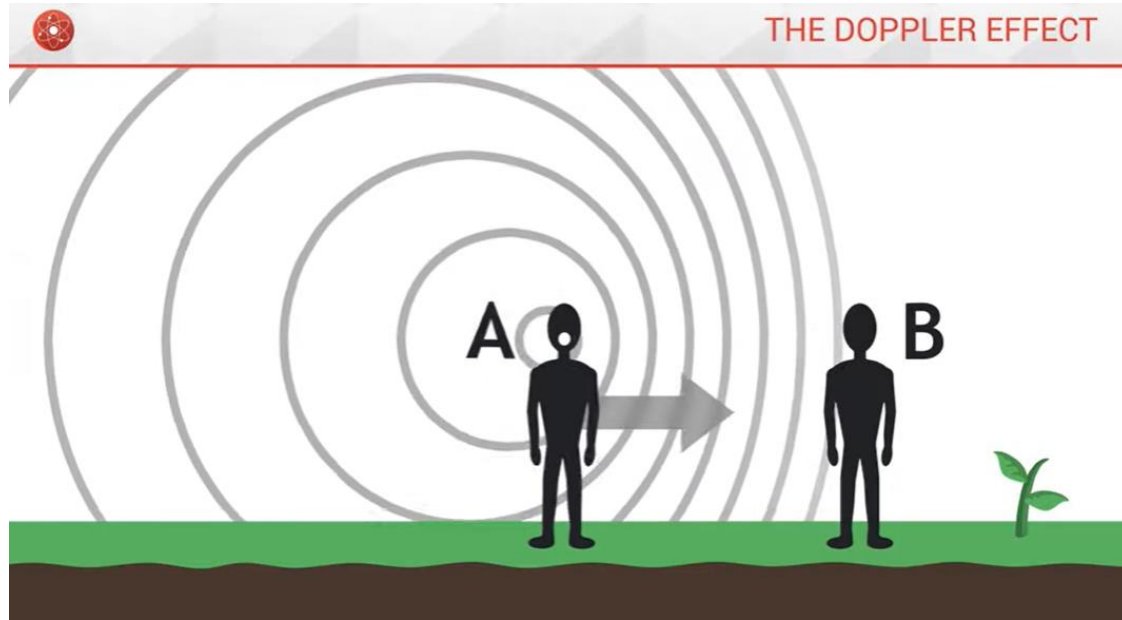


A listener measures the sound intensity from a loud source of sound and finds that the intensity is 90dB. He moves 10 times further from the source of the sound. The sound intensity measured by the listener is now most nearly:

- A: 80dB B: 70dB C: 60dB D: 50Db
E: 40dB

**Discuss and
Answer:**

Prelecture Review: The Doppler Effect



Doppler Effect

When a vehicle with a siren passes you, a noticeable drop in the pitch of the sound of the siren will be observed as the vehicle passes. This is an example of the Doppler effect. An approaching source moves closer during period of the sound wave so the effective wavelength is shortened, giving a higher pitch since the velocity of the wave is unchanged. Similarly the pitch of a receding sound source will be lowered.

Source receding:

$$f_{\text{observed}} = \left[\frac{v}{v + v_{\text{source}}} \right] f_{\text{source}}$$

Source approaching:

$$f_{\text{observed}} = \left[\frac{v}{v - v_{\text{source}}} \right] f_{\text{source}}$$

Stationary source of frequency f_{source}

All observers hear same frequency.

λ

Moving source

v_s

Hears sound of longer wavelength, lower frequency, lower pitch.

λ'

Hears sound of shorter wavelength, higher frequency, higher pitch.

λ''

The diagram shows a stationary source on the left and a moving source on the right. The moving source is moving to the right with velocity v_s . The stationary source emits waves with wavelength λ . The moving source emits waves with a shorter wavelength λ'' in front and a longer wavelength λ' behind. A box points to the longer wavelength region with the text 'Hears sound of longer wavelength, lower frequency, lower pitch.' Another box points to the shorter wavelength region with the text 'Hears sound of shorter wavelength, higher frequency, higher pitch.'

What are our comments and questions?

Comments and Questions

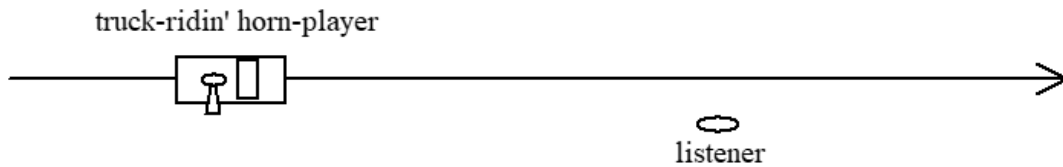
- How do doppler ultrasounds work?

Most people speculated a similar effect would occur for both motions

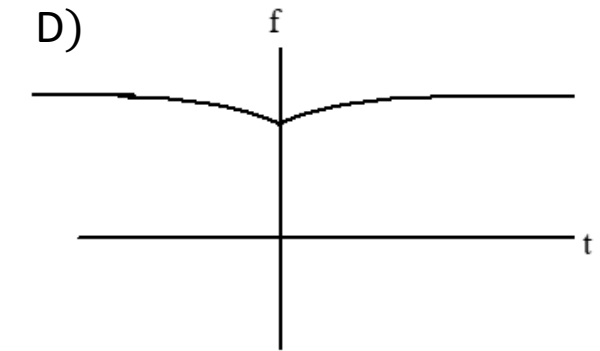
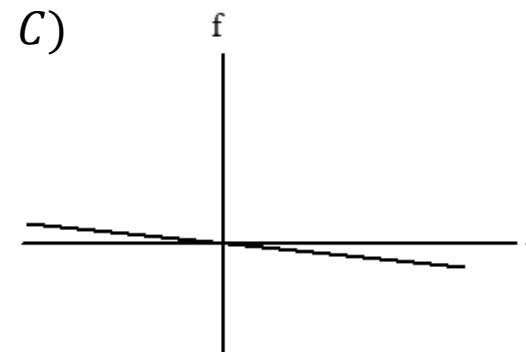
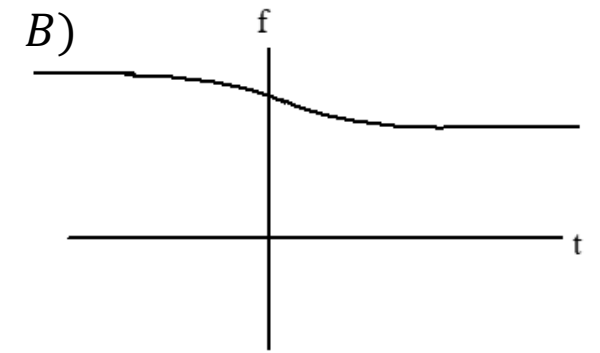
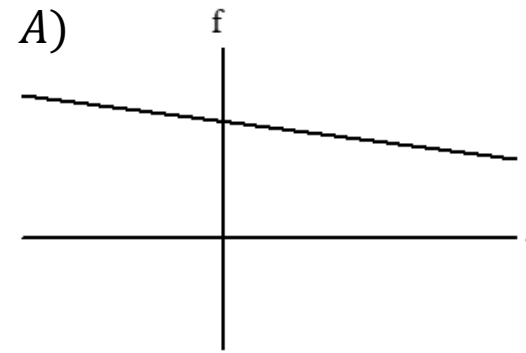


Discuss and Answer:

A musician playing a perfect "concert A" tone ($f = 440\text{Hz}$) on his horn is standing on the back of a fast-moving pickup truck which drives by a listener standing on the sidewalk. The truck has constant velocity.



Which graph below most accurately shows the frequency heard by the listener vs. time?



Questions over the equation sheet?
Over the final exam?