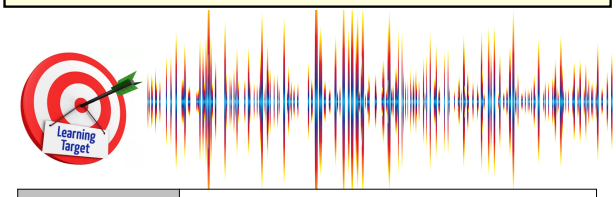
PRACTICE	LABS	TESTS
• Unit 13 Problems (1-19) • Video example problems	• Rube Goldberg lab reports due tomorrow	Unit 13 Test Wednesday (4/17/19)

Properties and Detection of Sound



13.4 I can define, analyze, and solve problems involving sound.

UNIT 13 REVIEW: LEARNING TARGET 13.1

$$T = \frac{2\pi}{\omega} = \frac{1}{f}$$

f = frequency
T = period
ω = angular speed

UNIT 13 REVIEW: LEARNING TARGET 13.2

$$x = A\cos(2\pi ft)$$

$$T_s = 2\pi\sqrt{\frac{m}{k}}$$

$$T_p = 2\pi\sqrt{\frac{\ell}{g}}$$

A = amplitude
f = frequency
k = spring constant
ℓ = length
m = mass
T = period
t = time
x = position

UNIT 13 REVIEW: LEARNING TARGET 13.3

$$\lambda = \frac{v}{f}$$

f = frequency
v = speed
λ = wavelength

$\lambda = vT$

Key Concepts

- Sound is a pressure variation transmitted through matter as a longitudinal
- A sound wave has frequency, wavelength, speed, and amplitude.
- The frequency of a sound wave is heard as its pitch.
- The pressure amplitude of a sound wave can be measured in decibels (dB).
- The loudness of sound as perceived by the ear and brain depends mainly on its amplitude.

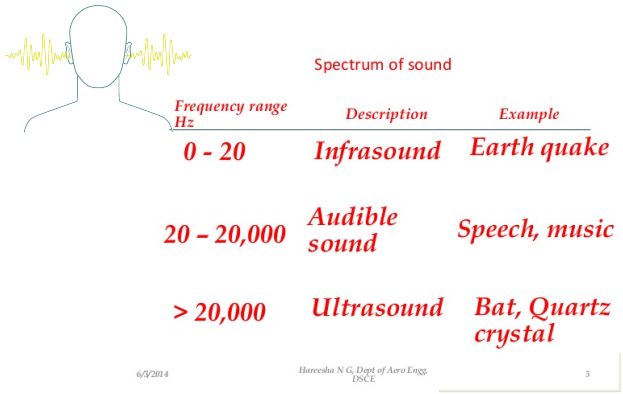


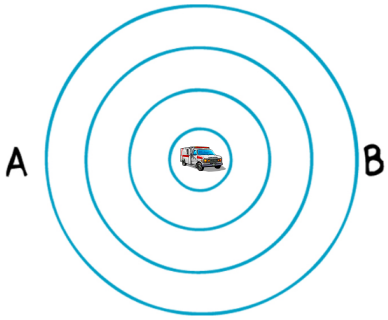
Table 15-1 Speed of Sound in Various Media	
Medium	**m/s**
Air (0°)	331
Air (20°)	343
Helium (0°)	972
Water (25°)	1493
Seawater (25°)	1533
Copper (25°)	3560
Iron (25°)	5130

Speed of Sound

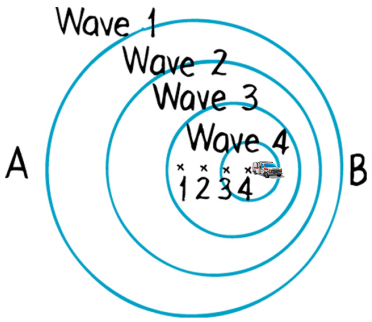
Refraction

Sound waves bend when parts of the wave fronts travel at different speeds. This bending of sound is called **refraction**.

Sound Waves



Sound Waves



The Doppler Effect

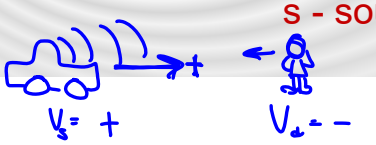
The **Doppler Effect** describes the change in frequency of a wave for an observer moving relative to the source of the wave.

The Doppler Effect

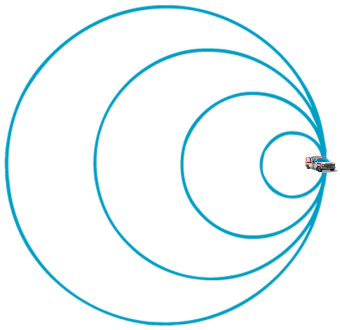
$$f_d = f_s\left(\frac{v - v_d}{v - v_s}\right)$$

$V = 343\ m/s$

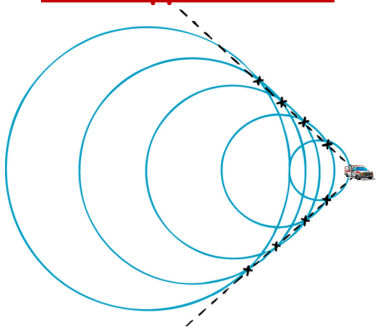
d - detector
s - source



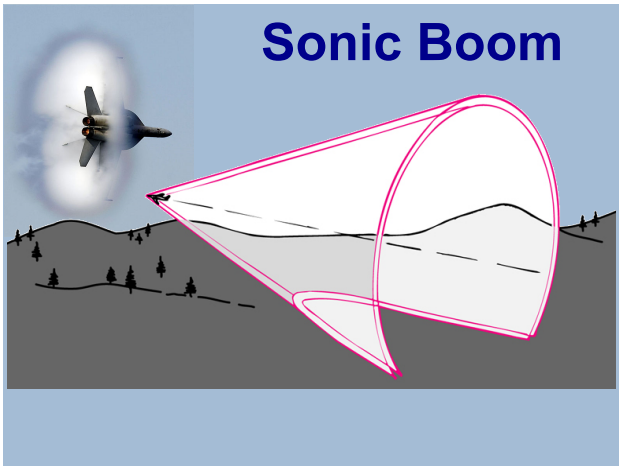
The Doppler Effect



The Doppler Effect



Sonic Boom



UNIT 13: IN-CLASS PROBLEMS

6. During a thunder storm, you see a flash of lightning. Five seconds later you hear the corresponding thunder. How far away was the lightning strike?
7. You drop a stone from rest into a well that is 7.35 m deep. How long does it take before you hear the splash?
8. A trumpet player sounds C above middle C (524 Hz) while traveling in a convertible at 24.6 m/s. If the car is coming toward you, what frequency would you hear?

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$x = v\,t$

$x = (343\ m/s)(5\ s)$

$x = 1715\ m$

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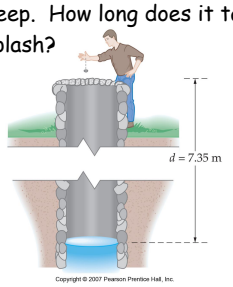

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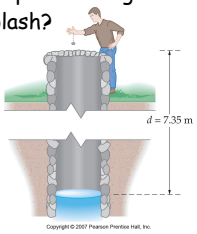

$y = \frac{1}{2} g t_1^2$

$t_1 = \sqrt{\frac{2d}{g}} = 1.22\ s$

$d = v\,t_2$

$t_2 = \frac{d}{v} = \frac{7.35\ m}{343\ m/s} = 0.0214\ s$

$t = t_1 + t_2 = 1.24\ s$

EXAMPLE Problem 1

8. A trumpet player sounds C above middle C (524 Hz) while traveling in a convertible at 24.6 m/s. If the car is coming toward you, what frequency would you hear?

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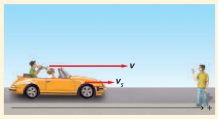
Known:
$v = +343\ m/s$
$v_s = +24.6\ m/s$
$v_d = 0\ m/s$
$f_s = 524\ Hz$

Unknown:
$f_d = ?$



$$f_d = f_s\left(\frac{v - v_d}{v - v_s}\right) = (524\ Hz)\left(\frac{343\ m/s - 0}{343\ m/s - 24.6\ m/s}\right) = 564\ Hz$$

Problems (20-21)