

## ANSWERS

NAME \_\_\_\_\_

SOUND HW 1

$V = WL * f$  ,  $V_{\text{sound air}} = 331 \text{ m/s} + .6 * ^\circ\text{C}$ ,  $0\text{dB} = 1 * 10^{-12} \text{ W/m}^2$  ,  $\text{Area} = \pi r^2$  ,  
Doppler  $f = f_0 * V_{\text{sound}} / (V_{\text{sound}} - V_{\text{source}})$

Read Section 13-1, 13-2 in Holt Physics Text

Pg. 483 Conceptual Challenge

1) If a bell is ringing inside a glass container, we cease to hear the sound when the air is pumped out, even though we can still see the bell vibrating. What difference does this indicate between the properties of sound and light waves? Does it explain why we can hear around a corner but can't see around a corner?

***Sound needs matter, light is a disturbance in the electromagnetic field.***

***Not really, that has to do with the reflection/transmission, and the fact that light waves are so much smaller in wavelength. You CAN hear radio waves around a corner!***

2) Hydrogen atoms have a smaller mass than the primary components of air (nitrogen), so they are accelerated more easily. How does this account for the great difference in the speed of sound waves traveling through air and hydrogen (as shown on pg 482)?

***Hydrogen is so much more because the small molecules are easier to accelerate.***

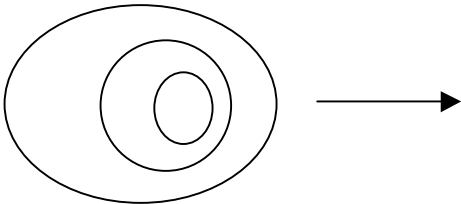
***F=mA***

Pg 486 Section Review

1. If you hear a higher pitch from a trumpet than from a saxophone, how do the frequencies of the sound waves from the trumpet compare with those from the saxophone?

***The trumpet frequencies are greater... (shorter wavelength)***

3. Draw schematic diagram of the Doppler effect in a ripple tank and show what direction the waves are moving.



5. Dolphins can produce sound waves with frequencies ranging from 0.25 KHz to 220 kHz, but only those at the upper end of this spectrum are used in echolocation. Explain why high frequency waves work better than low frequency waves. What size objects could they detect if the speed of sound through ocean water at 20° C is 1450 m/s?

***v = f \* WL so WL = v/f***

***WL1 = 1450/250 = 5.8 meters, WL2 = 1450/220,000 = .0066 m = .65 cm = 6.6 mm***

pg. 493

1. When the decibel level of traffic goes from 40 to 60 dB, how much louder does the traffic noise seem? How much greater is the intensity?

**Each 10 dB is twice as loud, so four times as loud.**

**Each 10 dB is ten times the intensity so 100 times as intense.**

5. A certain microphone placed in the ocean is sensitive to sounds emitted by dolphins. To produce a usable signal, sound waves striking the microphone must have a decibel level of 10 dB ( $1 \times 10^{-11} \text{ W/m}^2$ ). If the dolphins emit sound waves with a power of 0.05 Watts, how far can a dolphin be from a microphone and still be heard?

(Hint Area =  $\pi r^2$ )

$$\text{Intensity} = \text{Power/Area} \quad \text{so } 1 \times 10^{-11} \text{ W/m}^2 = 0.05 \text{ W} / (4\pi r^2)$$

$$r = \text{sqrt} (.05 / (1 \times 10^{-11} * \pi * 4)) = 19947 \text{ meters}$$

#### SECTION 13-1, 13-2 CONCEPT REVIEW

A train at rest blows a whistle to alert passengers that it is about to depart from a subway station. The pitch of this whistle is 11, 400 Hertz . The temperature is 18° C . The speed of sound in iron is 5130 m/s.

a) What is the wavelength of that sound in air? In iron?

$$V \text{ in air} = 331 + .6 * C = 341.8 \text{ m/s} = f * WL$$

$$WL = v/f = 341.8 / 11400 = .0299 \text{ m} = 3 \text{ cm}$$

$$\text{In iron } v=5130=f/WL \quad WL = 5130/11400 = .45 \text{ m} = 45 \text{ cm}$$

b) Assuming that the sound was loud enough to be heard from the end of the 1200 m long tunnel, when was it heard through air? Through the rails? If it bounces off the tunnel wall at the end, when is the echo heard?

$$V = D/T \quad T = D/V = 1200/341.8 = 3.5 \text{ seconds, for the rails } D/V = 1200/5130 = .233 \text{ sec.}$$

**Echo is twice that (air = 7 sec, iron = .468 sec)**

c) What was the apparent frequency of the sound waves that reached the end of the tunnel?

**If the train was stopped, frequency is the same!!**

d) As the train left the station at 40 m/s, how did the frequency appear to change for a listener on the platform, inside the train? At the other end of the tunnel?

**Inside the train, no change.**

**For a person on the platform, it got lower**

$$f = f_0 ( v / (v - v_{\text{source}})) = 11400 ( 341.8 ) / (341.8 - (-40)) = 10,205 \text{ Hz}$$

**For a person at the tunnel it got higher**

$$F = 11400 (341.8) / (341.8 - 40) = 12911 \text{ Hz}$$

e) How powerful would the whistle have to be for someone to hear it at 50 dB at the end of the tunnel?

$$50 \text{ dB} = 1 * 10^{-7} \text{ Watts/m}^2 = \text{Power} / \text{Area}$$

$$\text{Area} = 4\pi r^2 = 4 * 3.14159 * 1200^2 = 18095573 \text{ m}^2$$

$$\text{Power} = \text{Intensity} * \text{Area} = 18095573 * 10^{-7} = 1.8 \text{ Watts}$$