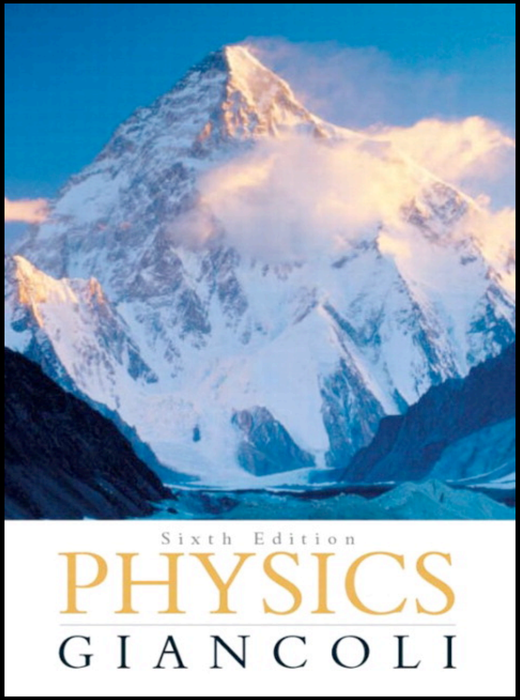

ConcepTest PowerPoints

Chapter 12

Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 12.1a Sound Bite I

When a sound wave passes from air into water, what properties of the wave will change?

1) the frequency f
2) the wavelength λ
3) the speed of the wave
4) both f and λ
5) both v_{wave} and λ

ConcepTest 12.1a Sound Bite I

When a sound wave passes from air into water, what properties of the wave will change?

1) the frequency f
2) the wavelength λ
3) the speed of the wave
4) both f and λ
5) both v_{wave} and λ

Wave speed must change (different medium).
Frequency does not change (determined by the source).
Now, $v = f\lambda$ and since v has changed and f is constant then λ must also change.

Follow-up: Does the wave speed increase or decrease in water?

ConcepTest 12.1b Sound Bite II

We just determined that the wavelength of the sound wave will change when it passes from air into water. How will the wavelength change?

1) wavelength will increase
2) wavelength will not change
3) wavelength will decrease

ConcepTest 12.1b Sound Bite II

We just determined that the wavelength of the sound wave will change when it passes from air into water. How will the wavelength change?

1) wavelength will increase
2) wavelength will not change
3) wavelength will decrease

The speed of sound is greater in water, because the force holding the molecules together is greater. This is generally true for liquids, as compared to gases. If the speed is greater and the frequency has not changed (determined by the source), then the wavelength must also have increased ($v = f\lambda$).

ConcepTest 12.2a Speed of Sound I

Do sound waves travel faster in water or in ice?

(1) water

(2) ice

(3) same speed in both

(4) sound can only travel in a gas

ConcepTest 12.2a Speed of Sound I

Do sound waves travel faster in water or in ice?

(1) water

(2) ice

(3) same speed in both

(4) sound can only travel in a gas

Speed of sound depends on the inertia of the medium and the restoring force. Since ice and water both consist of water molecules, the inertia is the same for both. However, the force holding the molecules together is greater in ice (because it is a solid), so the restoring force is greater. Since $v = \sqrt{(\text{force} / \text{inertia})}$, the speed of sound must be greater in ice !

ConcepTest 12.2b Speed of Sound II

Do you expect an echo to return to you more quickly or less quickly on a hot day, as compared to a cold day?

1) more quickly on a hot day
2) equal times on both days
3) more quickly on a cold day

ConcepTest 12.2b Speed of Sound II

Do you expect an echo to return to you more quickly or less quickly on a hot day, as compared to a cold day?

1) more quickly on a hot day
2) equal times on both days
3) more quickly on a cold day

The speed of sound in a gas increases with temperature. This is because the molecules are bumping into each other faster and more often, so it is easier to propagate the compression wave (sound wave).

ConcepTest 12.2c Speed of Sound III

If you fill your lungs with helium and then try talking, you sound like Donald Duck. What conclusion can you reach about the speed of sound in helium?

1) speed of sound is less in helium
2) speed of sound is the same in helium
3) speed of sound is greater in helium
4) this effect has nothing to do with the speed in helium

ConcepTest 12.2c Speed of Sound III

If you fill your lungs with helium and then try talking, you sound like Donald Duck. What conclusion can you reach about the speed of sound in helium?

1) speed of sound is less in helium
2) speed of sound is the same in helium
3) speed of sound is greater in helium
4) this effect has nothing to do with the speed in helium

The higher pitch implies a higher frequency. In turn, since $v = f\lambda$, this means that the speed of the wave has increased (as long as the wavelength, determined by the length of the vocal chords, remains constant).

Follow-up: Why is the speed of sound greater in helium than in air?

ConcepTest 12.3 Wishing Well

You drop a rock into a well, and you hear the splash 1.5 s later. If the depth of the well were doubled, how long after you drop the rock would you hear the splash in this case?

1) more than 3 s later
2) 3 s later
3) between 1.5 s and 3 s later
4) 1.5 s later
5) less than 1.5 s later

ConcepTest 12.3 Wishing Well

You drop a rock into a well, and you hear the splash 1.5 s later. If the depth of the well were doubled, how long after you drop the rock would you hear the splash in this case?

1) more than 3 s later
2) 3 s later
3) between 1.5 s and 3 s later
4) 1.5 s later
5) less than 1.5 s later

Since the speed of sound is so much faster than the speed of the falling rock, we can essentially ignore the travel time of the sound. As for the falling rock, it is accelerating as it falls, so it covers the bottom half of the deeper well much quicker than the top half. The total time will not be exactly 3 s, but somewhat less.

Follow-up: How long does the sound take to travel the depth of the well?

ConcepTest 12.4a Sound Intensity I

You stand a certain distance away from a speaker and you hear a certain intensity of sound. If you double your distance from the speaker, what happens to the sound intensity at your new position?

1) drops to 1/2 its original value
2) drops to 1/4 its original value
3) drops to 1/8 its original value
4) drops to 1/16 its original value
5) does not change at all

ConcepTest 12.4a Sound Intensity I

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4) drops to 1/16 its original value
5) does not change at all

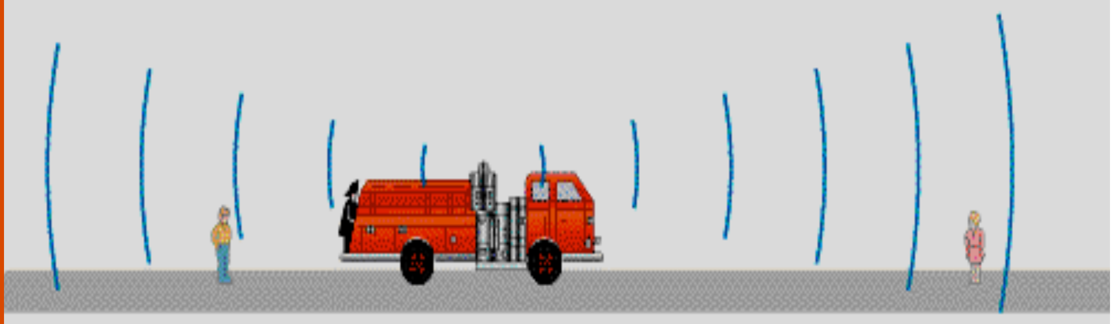
For a source of a given power P, the intensity is given by $I = P/4\pi r^2$. So if the **distance doubles**, the intensity must **decrease to one-quarter** its original value.

Follow-up: What distance would reduce the intensity by a factor of 100?

ConcepTest 12.4b Sound Intensity II

You hear a fire truck with a certain intensity, and you are about **1 mile** away. Another person hears the same fire truck with an intensity that is about **10 times less**. Roughly how far is the other person from the fire truck?

1) about the same distance
2) about 3 miles
3) about 10 miles
4) about 30 miles
5) about 100 miles

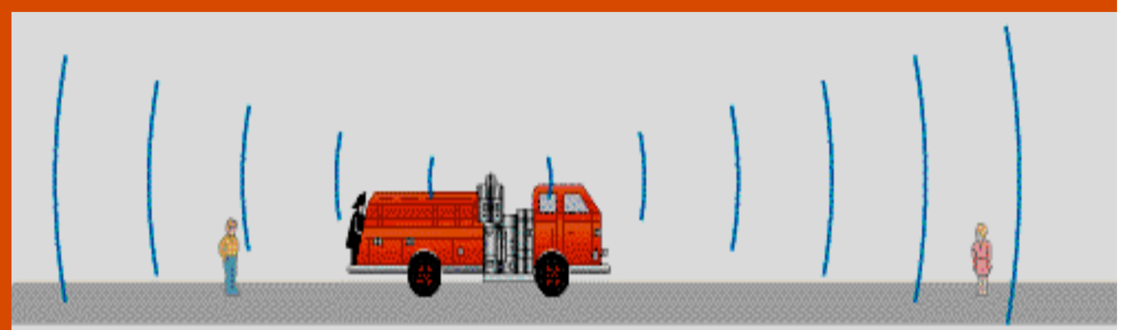


ConcepTest 12.4b Sound Intensity II

You hear a fire truck with a certain intensity, and you are about **1 mile** away. Another person hears the same fire truck with an intensity that is about **10 times less**. Roughly how far is the other person from the fire truck?

1) about the same distance
2) about 3 miles
3) about 10 miles
4) about 30 miles
5) about 100 miles

Remember that intensity drops with the **inverse square of the distance**, so if intensity drops by a factor of 10, the other person must be $\sqrt{10}$ farther away, which is about a factor of 3.



ConcepTest 12.5a Decibel Level I

When Mary talks, she creates an intensity level of 60 dB at your location. Alice talks with the same volume, also giving 60 dB at your location. If both Mary and Alice talk simultaneously from the same spot, what would be the new intensity level that you hear?

1) more than 120 dB
2) 120 dB
3) between 60 dB and 120 dB
4) 60 dB
5) less than 60 dB

ConcepTest 12.5a Decibel Level I

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1) more than 120 dB
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3) between 60 dB and 120 dB
4) 60 dB
5) less than 60 dB

Recall that a difference of 10 dB in intensity level β corresponds to a factor of 10^1 in intensity. Similarly, a difference of 60 dB in β corresponds to a factor of 10^6 in intensity!! In this case, with two voices adding up, the intensity increases by only a factor of 2, meaning that the intensity level is higher by an amount equal to: $\Delta\beta = 10 \log(2) = 3$ dB. The new intensity level is $\beta = 63$ dB.

ConcepTest 12.5b Decibel Level II

A quiet radio has an intensity level of about 40 dB. Busy street traffic has a level of about 70 dB. How much greater is the intensity of the street traffic compared to the radio?

1) about the same
2) about 10 times
3) about 100 times
4) about 1000 times
5) about 10,000 times

ConcepTest 12.5b Decibel Level II

A quiet radio has an intensity level of about 40 dB. Busy street traffic has a level of about 70 dB. How much greater is the intensity of the street traffic compared to the radio?

1) about the same
2) about 10 times
3) about 100 times
4) about 1000 times
5) about 10,000 times

increase by 10 dB ⇒⇒ increase intensity by factor of 10^1 (10)

increase by 20 dB ⇒⇒ increase intensity by factor of 10^2 (100)

increase by 30 dB ⇒⇒ increase intensity by factor of 10^3 (1000)

Follow-up: What decibel level gives an intensity a million times greater?

ConcepTest 12.5c Decibel Level III

Intensity level is given by β = 10 log(I/I_0) with $I_0 = 10^{-12}$ W/m^2. The usual threshold of human hearing is defined as intensity level of β = 0 dB. What does this actually mean in terms of sound intensity?

1) intensity is undefined at that level
2) intensity is 10^0 W/m^2
3) intensity is 0.0 W/m^2
4) intensity is 10^{-12} W/m^2
5) intensity is 1.0 W/m^2

ConcepTest 12.5c Decibel Level III

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5) intensity is 1.0 W/m^2

In order for β to be equal to zero, the term $\log(I/I_0)$ must also be zero. This occurs when the argument is 1.0, because log(1.0) = 0. In other words, the value of I must be equal to I_0.

ConcepTest 12.6a Pied Piper I

You have a **long pipe** and a **short pipe**. Which one has the **higher frequency**?

1) the long pipe

2) the short pipe

3) both have the same frequency

4) depends on the speed of sound in the pipe

ConcepTest 12.6a Pied Piper I

You have a **long pipe** and a **short pipe**. Which one has the **higher frequency**?

1) the long pipe
2) the short pipe
3) both have the same frequency
4) depends on the speed of sound in the pipe

A **shorter pipe** means that the standing wave in the pipe would have a **shorter wavelength**. Since the wave speed remains the same, the **frequency has to be higher** in the short pipe.

ConcepTest 12.6b Pied Piper II

A wood whistle has a variable length. You just heard the tone from the whistle at maximum length. If the air column is made shorter by moving the end stop, what happens to the frequency?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

ConcepTest 12.6b Pied Piper II

A wood whistle has a variable length. You just heard the tone from the whistle at maximum length. If the air column is made shorter by moving the end stop, what happens to the frequency?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

A shorter pipe means that the standing wave in the pipe would have a shorter wavelength. Since the wave speed remains the same, and since we know that $v = f\lambda$, then we see that the frequency has to increase when the pipe is made shorter.

ConcepTest 12.6c Pied Piper III

If you blow across the opening of a partially filled soda bottle, you hear a tone. If you take a big sip of soda and then blow across the opening again, how will the frequency of the tone change?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

ConcepTest 12.6c Pied Piper III

If you blow across the opening of a partially filled soda bottle, you hear a tone. If you take a big sip of soda and then blow across the opening again, how will the frequency of the tone change?

1) frequency will increase
2) frequency will not change
3) frequency will decrease

By drinking some of the soda, you have effectively increased the length of the air column in the bottle. A longer pipe means that the standing wave in the bottle would have a longer wavelength. Since the wave speed remains the same, and since we know that $v = f\lambda$, then we see that the frequency has to be lower.

Follow-up: Why doesn't the wave speed change?

ConcepTest 12.7 Open and Closed Pipes

You blow into an open pipe and produce a tone. What happens to the frequency of the tone if you close the end of the pipe and blow into it again?

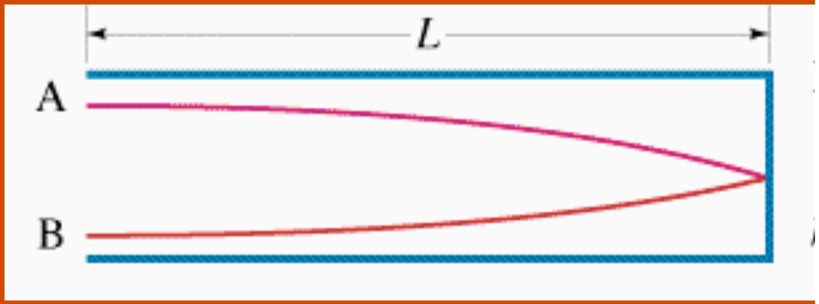
1) depends on the speed of sound in the pipe
2) you hear the same frequency
3) you hear a higher frequency
4) you hear a lower frequency

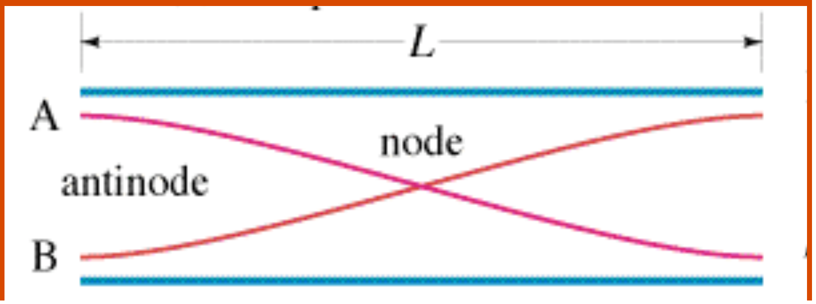
ConcepTest 12.7 Open and Closed Pipes

You blow into an open pipe and produce a tone. What happens to the frequency of the tone if you close the end of the pipe and blow into it again?

1) depends on the speed of sound in the pipe
2) you hear the same frequency
3) you hear a higher frequency
4) you hear a lower frequency

In the open pipe, 1/2 of a wave "fits" into the pipe, while in the closed pipe, only 1/4 of a wave fits. Because the wavelength is larger in the closed pipe, the frequency will be lower.





Follow-up: What would you have to do to the pipe to increase the frequency?

ConcepTest 12.8 Out of Tune

When you tune a guitar string, what physical characteristic of the string are you actually changing?

1) the tension in the string
2) the mass per unit length of the string
3) the composition of the string
4) the overall length of the string
5) the inertia of the string

ConcepTest 12.8 Out of Tune

When you tune a guitar string, what physical characteristic of the string are you actually changing?

1) the tension in the string
2) the mass per unit length of the string
3) the composition of the string
4) the overall length of the string
5) the inertia of the string

By tightening (or loosening) the knobs on the neck of the guitar, you are changing the tension in the string. This alters the wave speed, and therefore alters the frequency of the fundamental standing wave because $f = v/2L$.

Follow-up: To increase frequency, do you tighten or loosen the strings?

ConcepTest 12.9 Interference

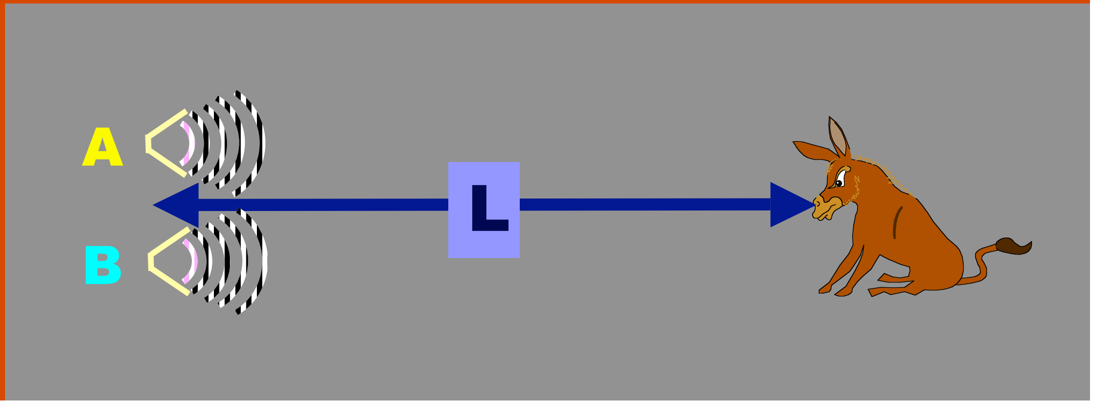
Speakers A and B emit sound waves of $\lambda = 1$ m, which interfere constructively at a donkey located far away (say, 200 m). What happens to the sound intensity if speaker A steps back 2.5 m?

1) intensity increases

2) intensity stays the same

3) intensity goes to zero

4) impossible to tell



ConcepTest 12.9 Interference

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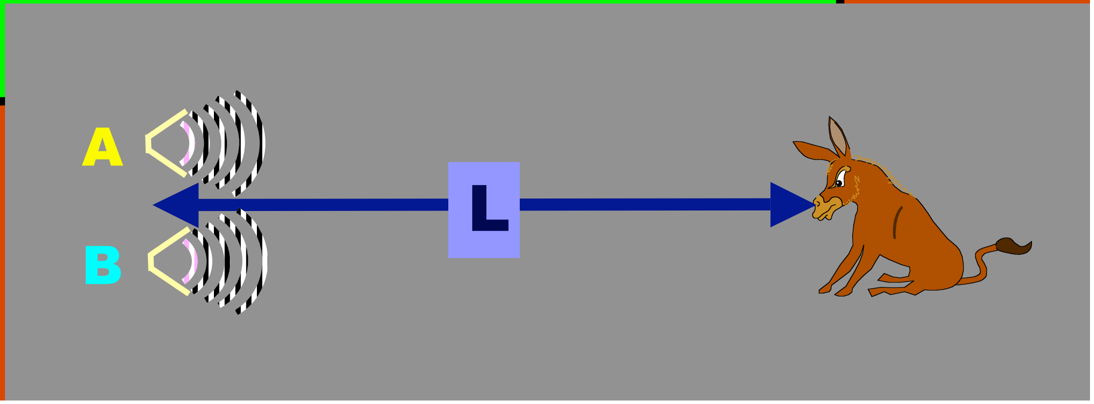
1) intensity increases
2) intensity stays the same
3) intensity goes to zero
4) impossible to tell

If λ = 1 m, then a shift of 2.5 m corresponds to 2.5λ, which puts the two waves out of phase, leading to destructive interference. The sound intensity will therefore go to zero.

Follow-up: What if you move back by 4 m?



ConcepTest 12.10 Beats

The traces below show beats that occur when two different pairs of waves interfere. For which case is the ***difference in frequency*** of the original waves ***greater***?

1) pair 1
2) pair 2
3) same for both pairs
4) impossible to tell by just looking

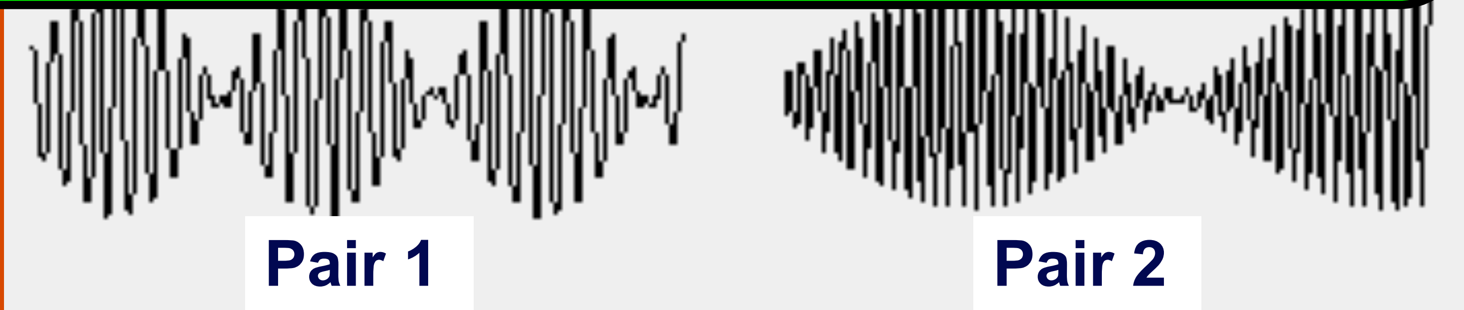
ConcepTest 12.10 Beats

The traces below show beats that occur when two different pairs of waves interfere. For which case is the *difference in frequency* of the original waves *greater*?

1) pair 1
2) pair 2
3) same for both pairs
4) impossible to tell by just looking

Recall that the beat frequency is the difference in frequency between the two waves: $f_{beat} = f_2 - f_1$

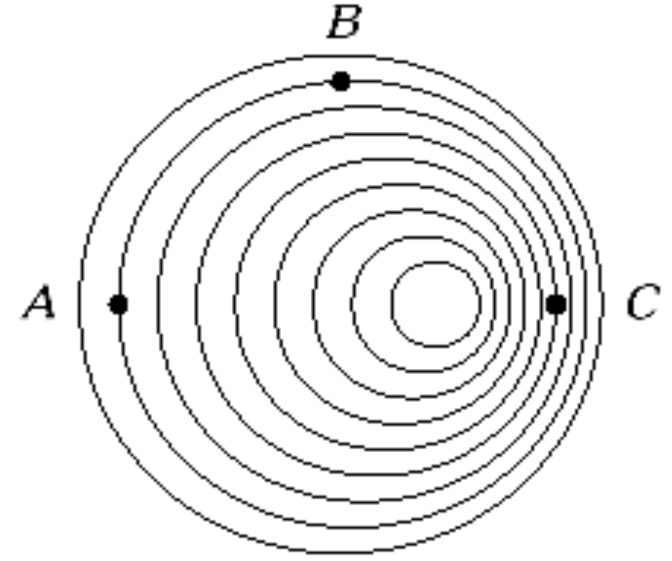
Pair 1 has the greater beat frequency (more oscillations in same time period), so Pair 1 has the greater frequency difference.



ConcepTest 12.11a Doppler Effect I

Observers A, B, and C listen to a moving source of sound. The location of the wave fronts of the moving source with respect to the observers is shown below. Which of the following is true?

1) frequency is highest at A
2) frequency is highest at B
3) frequency is highest at C
4) frequency is the same at all three points



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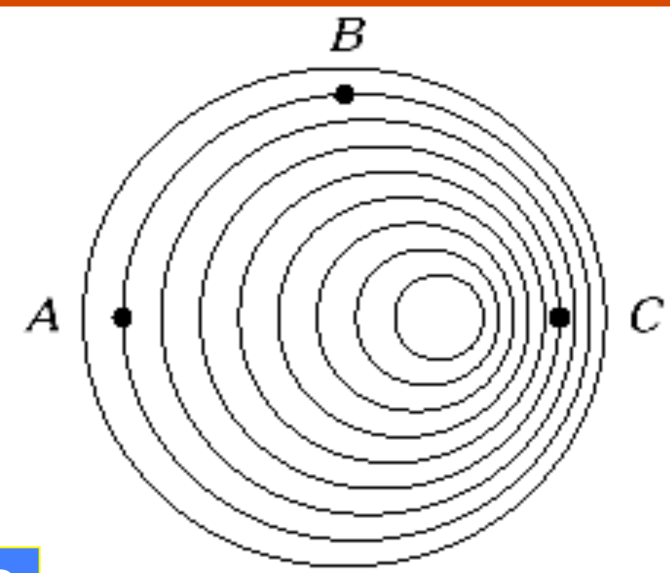
1) frequency is highest at A
2) frequency is highest at B
3) frequency is highest at C
4) frequency is the same at all three points

The number of wave fronts hitting observer C per unit time is greatest – thus the observed frequency is highest there.



Follow-up: Where is the frequency lowest?

ConcepTest 12.11b Doppler Effect II

You are heading toward an island in a speedboat and you see your friend standing on the shore, at the base of a cliff. You sound the boat's horn to alert your friend of your arrival. If the horn has a rest frequency of f_0, what frequency does your friend hear?

1) lower than f_0
2) equal to f_0
3) higher than f_0

ConcepTest 12.11b Doppler Effect II

You are heading toward an island in a speedboat and you see your friend standing on the shore, at the base of a cliff. You sound the boat's horn to alert your friend of your arrival. If the horn has a rest frequency of f_0, what frequency does your friend hear?

1) lower than f_0
2) equal to f_0
3) higher than f_0

Due to the approach of the source toward the stationary observer, the frequency is shifted higher. This is the same situation as depicted in the previous question.

ConcepTest 12.11c Doppler Effect III

In the previous question, the horn had a rest frequency of f_0, and we found that your friend heard a higher frequency f_1 due to the Doppler shift. The sound from the boat hits the cliff behind your friend and returns to you as an echo. What is the frequency of the echo that you hear?

1) lower than f_0
2) equal to f_0
3) higher than f_0 but lower than f_1
4) equal to f_1
5) higher than f_1

ConcepTest 12.11c Doppler Effect III

In the previous question, the horn had a rest frequency of f_0, and we found that your friend heard a higher frequency f_1 due to the Doppler shift. The sound from the boat hits the cliff behind your friend and returns to you as an echo. What is the frequency of the echo that you hear?

1) lower than f_0
2) equal to f_0
3) higher than f_0 but lower than f_1
4) equal to f_1
5) higher than f_1

The sound wave bouncing off the cliff has the same frequency f_1 as the one hitting the cliff (what your friend hears). For the echo, you are now a moving observer approaching the sound wave of frequency f_1 so you will hear an even higher frequency.