3 Refraction Of Sound Examples: Detailed Insight And Facts | Lambda Geeks

Refraction in sound waves is caused when they change their medium and undergo a change in their path too.

Refraction of sound examples are as follows:-

Refraction of sound waves while traveling over water

The refraction of sound waves is followed by a change in the direction of the waves while going through a change in their medium.

In addition to this, the sound waves also face a change in their speed and wavelength. So we can say that whenever a wave changes its medium, it undergoes refraction. Refraction of sound waves is seen most commonly in our surroundings. One of the best examples to explain the refraction of sound waves is when the sound waves travel over a water body and undergo a medium change showing variations consequently.

Here we can see that when a wave travels over a water body, it is traveling in the air only it does not change its medium, but the air over the water itself has varying properties. And because of it goes through refraction and this can be explained further.

As we know, water has a moderating effect on the air above the water. The air mass occupying the area above water is comparatively cooler than the air from the water body. And we also know that sound waves tend to slow down their speed while traveling in a cooler medium than a warmer medium. And because of this, the wavefronts formed above the water body tend to slow down. Whereas wavefronts far from water body speed ups.

And due to its consequences, when sound waves move over a water body, it gets refracted towards the water body by these variations in air properties.

This can be more briefly explained by taking one more example. This occurs In sound waves traveling over oceans. Usually, the temperature of oceanic water decreases while going in-depth. This causes downward refraction of a sound wave that originates within/beneath the water body, which is totally opposite of the refraction of the sound wave mentioned above.

Many marine experts find this refraction of the sound wave as an advantage that helps marine organisms to travel or propagate. For example, whales and dolphins can communicate over a considerable distance because of this property.

In addition to marine organisms, it is also valuable for navigators traveling in oceans. These refractions from beneath create a shadow region, which helps identify a distant object.

Refraction of sound causes difference in hearing ability

Refraction of the sound wave causes some difference in our hearing ability.

Let us understand how the refraction of sound waves causes this. We all would have observed that we can hear more clearly during the night than daytime. This happens because, during the daytime, the air mass, which is close to the earth's surface, is warmer than air mass on some height. Whereas during the night, the air mass close to earth gets cooler than air mass at an altitude.

This change in temperature inversion happens because of insolation. As we know, the earth's source of energy is the sun. The energy from the sun is trapped in our atmosphere during the daytime because the landmass gets heated, and as a result, it heats the sir mass close to it. Whereas in the night, this pattern changes because there is no insolation.

As mentioned above, sound waves travel faster in warmer air than cooler air. So during the daytime, the sound waves moving will get refracted upwards and will move a short distance on the earth's surface. Whereas during the night, the sound waves are refracted towards the earth, and as a result, they will travel a longer distance over the earth's surface.

However, when there is a high cloud cover during the night period, we can find temperature inversion occurring. In a temperature inversion, while moving up an altitude, the air temperature is seen to be increased. Due to this, the sound waves traveling tends to refract towards the earth's surface.

This Temperature inversion only causes the sounds waves to travel a long distance. And consequently, people can hear the sound more clearly even after a long-distance much more clearly.

Similarly, the refraction of sound waves causes a difference in hearing ability on wion□s lebil n s ver Rusi□kn gh n g eaon.

Refraction of sound used in sea exploration

Sea exploration has become easy due to refraction, reflection, diffraction, etc.

One of the methods used while sea exploration is SONAR. Which helps to identify the distance in the water. Other than this, identifying gas reserves, petroleum, fossils, etc. They are also explored by using these phenomena.

As we know, the dead components of marine organism over a million years gets deposited in ocean beds. Due to the heat and pressure they face, they get converted into resources for today’s world. To discover these resources in ocean beds, refraction of sound waves is also used.

This petroleum created in oceans beds gets seeps into empty spaces in rocks around it. And a solid sedimentary layer is above them, which does not allow them to flow or seep.

Seismic reflection and refraction explore these reserves in the marine bed layer. In this echo, the sounding is used to measure the depth of the beds. And accordingly, sound impulses from ships are released in water, which gets reflected from oceans beds and reaches back to ship. And the time taken by these sound waves to travel back and forth is then used to determine the depth of the ocean bed containing resources.

During this process, the sound waves released get reflected and refracted from the ocean beds. And due to the refraction of sound waves, they also get passed on to different layers of the ocean’s beds.

And due to this refraction, the sound waves go in a complex way, which helps determine the density of each layer.

By following this information and many other processes, the resources are allocated in the ocean beds. The features provided by the refraction of sound waves indicated reserves, as they too have different densities.

What Is The Example Of Refraction Of Sound?

Hello,

To put it in simple terms, refraction is the process of waves bending when they enter a medium that redirects their form. Bending of waves occurs with both sound and light.

Visual examples of refraction help us to understand the concept of refraction itself. One example could be a toy car going from a wooden floor to a carpet. The toy will slow down and curve in direction because one wheel will hit the carpet first and thus be caused to slow down first, causing an inevitable bend in direction. This is refraction.

Sound in general emanates in all directions, however refraction allows sound to bend where it normally wouldn't travel. A good example of this is a fisherman at the lake in the early morning. The water is cool, however the sun has just begun to heat it up and therefore the air arising from the lake is slightly warmer. Another fisherman calling at him "good morning" from the other side of the lake will sound much closer, due to the fact that sound refraction has occurred as a by product of the air being warmer above the lake, and sound travels faster through warm air. This is a very rare natural occurrence, and also a rare natural example of refraction of sound.

3 Refraction Of Waves Examples: Detailed [illegible]

As we know, the air mass is heated, which means its particle is moving faster. So it will rise, now on farther with the heat source the air will relax. So as the air mass keeps on rising, the air at the top keeps on cooling. This creates an adiabatic lapse rate. As we observe here, the warm air is close to the earth.

Because of this, the sound wave will travel faster near the earth's surface. Because sound waves travel faster In a warm medium. This high speed of the sound wave in a warm atmosphere near the earth's surface creates Huygens' wavelets, which spread faster near the earth's surface.

Under conditions like the movement of sound waves in a perpendicular direction to the wavefront formed by the Huygen wavelets, the sound gets refracted upward, and it has vanished.

Refraction in light waves

When it passes through a homogeneous medium, a light wave passes straight without any hindrance or change. The change in density of a medium followed by change in medium causes refraction.

While moving through a rarer medium to a denser medium, the refraction of light wave is seen. While moving in such case it deflects more towards normal. In contrast, when the light wave travels from a denser medium to an optically rarer medium, it bends away from the normal. However, if the light wave falls perpendicular to the normal, it passes without deflections.

For the Refraction of light waves, two laws are followed. Firstly, the incident, refracted, and normal all lie on the same plane. And secondly, the ratio of the sine of incident angle and the sine of a refracted angle in a given medium remains the same.

As we know due to different density of particle, being unique, the light's speed also changes, which causes refraction. So whenever there is a change in the velocity of light, it goes through bending of the wave.

We all have seen the Refraction of light in our daily life many times. For example, Refraction in our eyes lenses, Refraction in ice, flattening of the sun at sunrise and sunset, Refraction in water drops, an apparent shift in the position at sunrise all occur due to Refraction of light.

Refraction in water waves

The Refraction of water waves depends upon the medium and the density it travels. The Refraction causes a change in the speed of water waves.

To understand the Refraction of water waves. First, let us understand some properties of water moving in oceans. The velocity of the water waves which are on the top is majorly defined by the depth of it. Water having a depth are have fast velocities.so if water which are at depth when meet the water of shallow depth there velocity decreases.

The decrease in the speed of water waves is followed by a decrease in their wavelength. Hence, this shows that when water waves from deep water and shallow water meets then their velocities decrease, their wavelength reduces, and consequently, its direction of motion changes too.

There is a change in medium on moving deeper water to shallow water. This happens because deeper water is cold and dense. After all, sunlight does not reach it. And hence no heat. While the shallow water is comparatively warmer because it faces sunlight to some extent, and hence it is less dense.

The waves that come from deep and shallow waters can be seen refracting, which means the waves slightly bend, their wavelength changes, and their speed is slowed down.

Refraction in radio waves

In our daily life, we all have heard the radio. These radios are operated by the radio waves transmitted. Let us understand how these radio waves reach all-around to operate radios.

The Radio waves are refracted in the uppermost layer of our atmosphere, which is the ionosphere. As it is the outermost layer of our atmosphere, it consists of a large number of free ions and electrons in it. This is due to the extreme amount of heat received by the sun, which ionizes all particles present there.

When the radio waves reach the ionosphere, the electrons present in the ionosphere get excited, which causes their motion. Due to this the radio waves are emitted again. Now as discussed above the concentration of free ions and electrons is high in this layer of atmosphere. When the radio waves further move due to excitement caused by free electrons, it faces a region of a very high density of electrons.

This high-density region reflects the radio waves back to earth. And that is how the radio wave is transmitted all-around a region. However, this reflection of radio waves depends upon the angle of incidence as well as the frequency of the radio waves. The Refraction, which occurs in the ionosphere due to inappropriate angle of incidence, tends to reduce when the frequency of the signals is improved.

Because of this, the Refraction is turn down, and reflection of radio waves starts in the outermost layer. As we know, the ionosphere is ionized, and moving particles are there. So the density does not remain the same all around; it varies. So the amount of Refraction varies.

Refraction of Sound

Balloons filled with helium, CO_2, or SF_6 act as diverging and converging lenses, respectively.

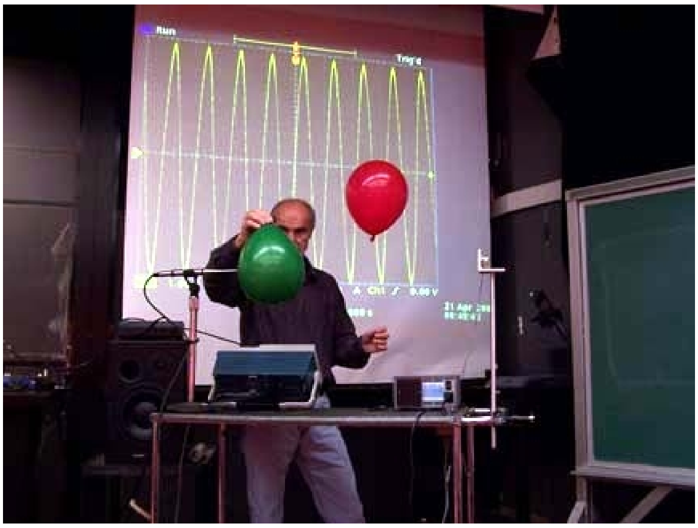
What it shows:

A balloon, filled with a gas different from air, will refract sound waves. A gas denser than air turns the balloon into a converging lens and a lighter gas makes it a diverging lens. An air-filled balloon has little effect.

How it works:

The refraction phenomenon occurs whenever waves travel from one medium to another in which the velocity of the wave changes. The amount of refraction at the media interface obeys Snell's law. Thus, a spherical balloon filled with a gas in which the velocity of sound is markedly different from that in air will act like a spherical lens.

The velocity of sound in sulfur hexafluoride (SF_6) is 0.44 times the velocity of sound in air; a balloon filled with SF_6 behaves like a converging lens. The velocity of sound in carbon dioxide (CO_2) is 0.78 times the velocity in air. A CO_2-filled balloon also acts like a converging lens, but not as strong as the SF_6. The velocity in He is 2.7 times the velocity in air; a He-filled balloon behaves like a diverging lens.



Setting it up:

The source of sound is a small speaker, emitting a pure tone at 2.5 kHz. The sound is picked up by a microphone (placed 50 to 60 cm away from the speaker) and the signal is displayed on an oscilloscope. When a balloon is held in front of the microphone, one observes its effect by the change in the displayed signal.

A function generator and amplifier provide the signal for the speaker. The PASCO PI 9587C serves this purpose well. The wavelength of the sound should be less than the dimension of the balloon (which is about 12 inches in diameter); 2.5 to 3 kHz works very well. The output of the microphone needs to be amplified before passing it on to the oscilloscope. For regular microphones, the Sure M267 mixer is sufficient. If using the omnidirectional (pressure) Earthworks M30 microphone (shown in photograph), the Yamaha MG10/2 mixer will provide the 48 V phantom power for it. Also notice in the photograph that the speaker and microphone are both mounted high, to minimize reflections off of the cart—this is more important with an omnidirectional microphone.

Having set the volume of the sound to an acceptable level, adjust the gain of the mixer and scope to display a signal which is roughly 1 division peak-to-peak. Hold an air-filled balloon in front of the microphone; no noticeable effect on the signal strength will be observed. Now place the SF_6 balloon in front of the mike as shown in the photo; the SF_6 balloon will focus the sound onto the mike and produce a full-scale signal on the screen (an increase in signal strength by a factor of 5). Note that in this set-up the focal point is close to the surface of the balloon. Repeat the experiment with a He balloon; it will significantly diminish the intensity of the sound reaching the microphone.

Comments:

Students often ask whether sound can be refracted. This is a very clear demonstration of the phenomenon. For your reference, the focal length of a spherical lens (measured from the surface of the lens to the focal point) is given by

$$f = \frac{r}{2}\,\frac{\left(2-\frac{n_2}{n_1}\right)}{\left(\frac{n_2}{n_1}-1\right)} = \frac{r}{2}\,\frac{\left(2-\frac{v_1}{v_2}\right)}{\left(\frac{v_1}{v_2}-1\right)}$$

where r is the radius of the sphere, n2 is the index of refraction of the lens material, and n1 is index of refraction of the surrounding medium.

If the source of sound is far away, the focal length of a 15-cm radius SF_6 balloon is close to its surface. The focal length of a similar CO_2 balloon is 19 cm from its surface, and that of a He balloon is -19 cm. For an air filled balloon, the focal point is at infinity (as it should be). Kenn Lonnquist (Colorado State) suggests using difluoroethane (CH_3CHF_2 in "Dust-Off"), for which the velocity of sound is 0.59 that of air, and thus should work "better" than CO_2.