

## Chapter 7. Sound

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**Solution 1:**

Yes, we can hear in the dark room.

**Solution 2:**

Sound is produced by the vibrating objects.

**Solution 3:**

Yes, sound is a form of energy.

**Solution 4:**

No, sound cannot travel through vacuum. It needs a material medium to travel.

**Solution 5:**

Yes, sound requires a material medium for transmission.

**Solution 6:**

The speed of sound depends on the following factors: Density of air, Temperature , Humidity in air as well the wind.

**Solution 7:**

There is no effect on the wavelength and amplitude on the speed of sound.

**Solution 8:**

Speed of sound at room temperature is 330 m/s

**Solution 9:**

Yes, the speed of sound is different in different medium.

**Solution 10:**

No, the speed of sound in the gas is independent on the change in pressure of the gas.

**Solution 11:**

Using Laplace correction, the speed of sound in the gas is given by:

$V = \sqrt{\gamma P / \rho}$  where  $\gamma$  is ratio of specific heat of gas at constant pressure to that at constant volume.

**Solution 12:**

Yes, the speed of sound depends on the direction of wind. When wind is blowing in the direction of propagation of sound , the speed of sound increases. But, when wind blows in the direction opposite to that of sound , the speed of sound decreases.

**Solution 13:**

Ultrasonic are sounds having frequency higher than 20 KHz and not audible to the human being.

**Solution 14:**

**SONAR** stands for the “**SOund Navigation And Ranging**”.

**Solution 15:**

Ultrasonic sound has higher frequency than infrasonic sound.

**Solution 16:**

No, we cannot hear the sound produced due to the vibration of second's pendulum.

**Solution 17:**

No, SONAR does not make use of infrasonic waves. Instead, it make use of ultrasonic waves.

**Solution 18:**

Yes, ultrasound in the medium travels faster than the audible sound.

**Solution 19:**

No, it is not possible to hear the friend's voice in vacuum because sound needs a material medium to travel.

**Solution 20:**

The following are the requisites of medium to travel:

- The medium should possess elasticity so that particles of medium have tendency to come back to their original position after the displacement.
- The medium should be frictionless so that there should be loss of energy.
- The medium must possess inertia so that particles of medium have ability to store energy.

**Solution 21:**

Sound is produced by the vibrating objects. We require a material medium for the propagation of sound because vibrations of object need to get transferred or transmitted from one place to another.

**Solution 22:**

With increase in temperature of gas, there is increase in speed of gas because increase in temperature decreases the density of gas. And speed of sound is inversely proportional to density of gas. The speed of gas is independent of the pressure of gas.

**Solution 23:**

- No, there is no effect of wavelength and amplitude on the speed of sound.
- With increase in density, there is decrease in the speed of sound in gas.

**Solution 24:**

Sound is defined as form of energy that produces the sensation of hearing in our ears. The sound travels in medium through energy transfers by wave motion from one place to another. For example , when the prong of the tuning fork vibrate , the waves start moving from one fork to another , the air start getting compressed . The compression is pushed forward. Now, when the fork vibrate in another direction, the air in the immediate neighbor which was compressed, now get rarefied. As a result, a series of compression and

rarefactions are produced and sound energy travels in the direction where compression and rarefactions travel.

**Solution 25:**

The ratio of speed of sound in air to speed of sound in steel is  $1/15$ .

**Solution 26:**

The distance of observer from the gun = speed of sound  $\times$  time taken for the explosion =  $350 \times 2 = 700\text{m}$

**Solution 27:**

Yes, light travels faster in air than water. Because, light does not require any medium for their propagation and they are not mechanical waves. The quantities which oscillate in light are mechanical and electric field. And electric and magnetic field decrease with the medium in between them. So, light travels faster in air than water.

**Solution 28:**

The flash of light reaches earlier than the sound of thunder because the speed of light (its  $3 \times 10^8$ ) is much larger than the speed of sound in air (its  $330 \text{ m/s}$ ).

**Solution 29:**

The sound of  $1000 \text{ Hz}$  frequency will be audible to us. Others  $2\text{Hz}$  is infrasonic sound frequency and  $200 \text{ KHz}$ ,  $8 \text{ MHz}$  is ultrasonic sound frequency.

**Solution 30:**

The sketch diagram of bell jar is



Take an air tight bell jar having an arrangement of electric bell as shown above in the diagram. The electric bell is suspended inside the glass bell-jar, which is further connected to the vacuum pump. When the circuit of the electric bell is completed, the hammer strikes the gong repeatedly and sound is heard.

Now, start withdrawing the air from the glass bell-jar using the vacuum pump and loudness of the sound will keep decreasing. When the whole of the air is withdrawn, no sound will be heard. So, this experiment shows that a material medium is needed for the propagation of sound.

**Solution 31:**

There is no atmosphere on moon. So, we cannot hear each other on moon because sound needs a material medium to travel from one place to another. No kind of sound can be heard.

**Solution 32:**

The following are the three characteristics of the medium required for the propagation of

sound:

- The medium must possess elasticity so that the particles of medium have the tendency to return back to their original positions.
- The medium must be frictionless so that there is no loss of energy during transmission.
- The medium must possess inertia such that the particles of medium have the ability to store energy.

### **Solution 33:**

The simple experiment that a person can do to calculate the speed of sound in air is that a person stands at a known distance ( $d$  meter) from the cliff and fires a pistol and simultaneously start the stop watch. He stops the stop-watch as soon as he hears a echo. The distance travelled by the sound during the time ( $t$ ) seconds is  $2d$ .

So, speed of sound = distance travelled / time taken =  $2d/t$

### **Solution 34:**

Ultrasonics sound is the sound having frequency more than 20KHz. The application of ultrasonic sound is as follows:

- It is used to detect the flaws in metal casting of automobile tyres.
- Used in hospitals to detect defects in certain parts of body.

### **Solution 35:**

Sound waves are produced by the object motion back and forth in the medium. Due to which it compresses the medium and compression waves are moved forward. The sound travels in medium through energy transfers by wave motion from one place to another. For example, when the prong of the tuning fork vibrates, the waves start moving from one fork to another, the air starts getting compressed. The compression is pushed forward. Now, when the fork vibrates in another direction, the air in the immediate neighbor which was compressed, now gets rarefied. As a result, a series of compression and rarefactions are produced and sound energy travels in the direction where compression and rarefactions travel.

### **Solution 36:**

Light waves are electromagnetic waves while the sound waves are mechanical waves. Light waves do not require any material medium for their propagation while sound waves need the material medium for its travel from one place to another.

Due to large magnitude of difference between speed of light (i.e.  $3 \times 10^8$  m/s) to the speed of sound in air (330 m/s), the light reaches first and then the sound from the object. Like, in thunderstorm, the light reaches first to earth and then person hears the sound of light.

### **Solution 37:**

- **Pressure of air:** The speed of sound in air is independent of pressure of air.
- **Temperature of Air:** Speed of sound in air is directly proportional to the temperature of air. As the temperature of air increases, the density of air decreases and hence speed of sound increases.
- **Humidity:** The speed of sound increases with increase in humidity. The increase of moisture decreases the density of the atmosphere and therefore sound travels faster in moist air.

- **Wind:** The speed of sound depends on the direction of wind. When the wind is blowing in the direction of propagation of sound, the speed of sound increases. But, when the wind blows in the direction opposite to that of the sound, the speed of sound decreases.

#### **Solution 38:**

- **The bat during its flight at night:** Bats emits its own distinctive sounds. The echoes of the sound helps bat to navigate and to locate their prey during night.
- **The dolphin to locate small fish as its prey:** Dolphins sends the sound having frequencies between 120 KHz to 150KHz. The returning echoes used to help their preys.

#### **Solution 39:**

A person hearing at one end of the long metal bar hears two distinct sounds when the other end is struck with a stone because sound comes from the metal bar as well as from air. The sound travels faster in solids than air. So, first sound comes from metal bar hitting and then from air.