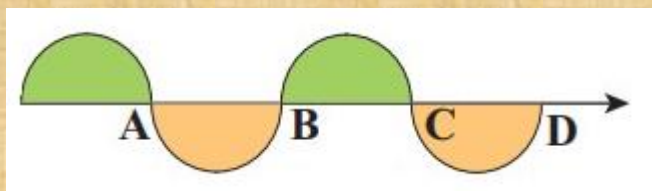


**CHAPTER 13****SOUND****Terms in Wave motion:****Phase:**

The points on a wave, which are in the same state of vibration are said to be in the same phase.

In the above figure, A and C are in the same phase, and B and D are in the same phase.



**Ex.** All points that lie on the crests are in the same phase similarly all points that lie on the troughs are in the same phase.

**Time period (T) or Periodic time:**

The time in which a vibrating body completes one vibration, or the time required to produce one complete wave (or cycle) is called the time period of a wave.

**Ex:** Suppose two waves are produced in 1 second. Then, the time required to produce one wave will be 0.5 seconds. In other words, the time period of this wave will be 0.5 seconds.

**Note:** The S.I. unit of time period is second (s).

**Frequency (f):**

The number of complete waves (or cycles) produced in one second, or the number of vibrations per second is called the frequency of a wave.

**Unit:** The S.I. unit of frequency is hertz (which is written as Hz).

**Hertz:** When a vibrating body produces one vibration in one second, then its frequency is said to be one hertz. 1 hertz is equal to 1 vibration per second.

$$\text{i.e., 1 hertz} = \frac{1 \text{ vibration (cycles)}}{1 \text{ second}}, 1 \text{ kHz} = 1000 \text{ Hz}$$

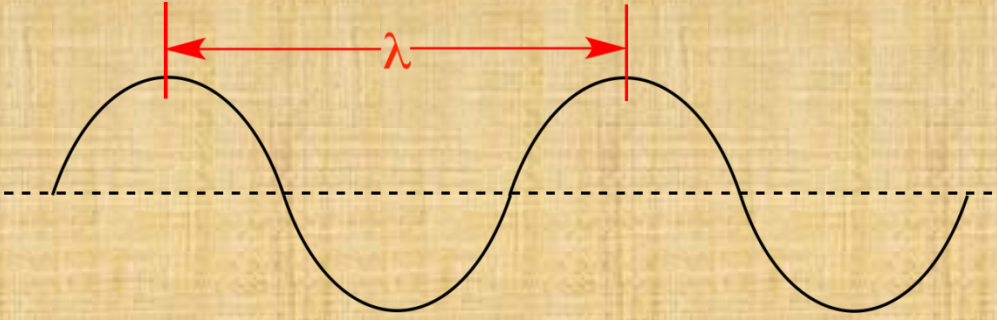
**Ex.** If 10 complete waves (or vibrations) are produced in one second, then the frequency of the waves will be 10 hertz (or 10 cycles per second).

**Note 1:** The frequency of a wave is fixed and does not change even when it passes through different substances.

**Note 2:** It does not depend on the wave velocity, amplitude, and nature of the medium.

### **Wavelength ( $\lambda$ ):**

The wavelength of a wave is the length of one wave. The distance travelled by the wave in one time period, that is, the distance between the two nearest particles which are in the same phase is called wavelength. It is denoted by the Greek letter  $\lambda$  (lambda).



**Ex:** Here the length of the wave is  $\lambda$ .

**Unit:** The S.I. unit of wave length is meter (m).

### **Wave velocity (velocity of the wave):**

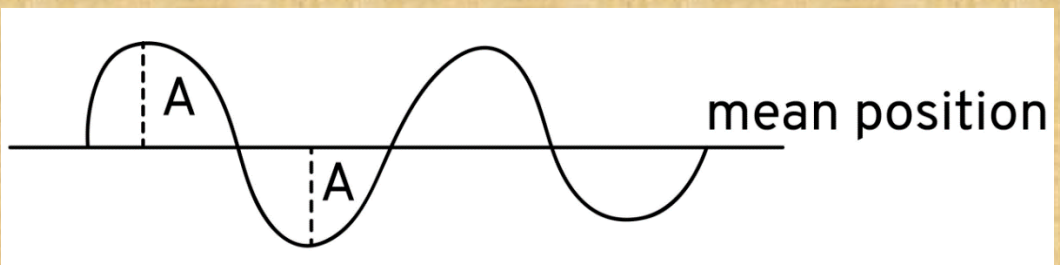
The distance traveled by a wave in one second is called the velocity of the wave. The wave velocity is denoted by  $v$ .

Wave velocity = Distance traveled by the wave divided by the time taken

**Unit:** The S.I. unit of wave velocity is m/s or  $\text{ms}^{-1}$ .

### **Amplitude (A):**

The maximum displacement of the particles of a medium from their mean positions during the propagation of a wave is called the amplitude of the wave. It is represented by the letter 'A'.



**Ex.** Here A is the amplitude of the wave.

**Unit:** The S.I unit of amplitude is metre (m).

**Note:** The amplitude of a wave is a measure of its energy. Thus, the greater the amplitude of a wave, the greater the energy carried by the wave.

### **Relation between time period (T) and frequency (f):**

The frequency of a wave is the reciprocal of its time period.

$$\text{i.e. Frequency} = \frac{1}{\text{time period}} \Rightarrow f = \frac{1}{T} \Rightarrow \frac{1}{f} = T$$

Where  $f$  = frequency of the wave

$T$  = time period of the wave.

### **Relationship between, time period, wavelength, and velocity:**

We know that, the velocity of the wave =

$$\frac{\text{Distance travelled by the wave}}{\text{Time taken}}$$

Suppose, a wave travels a distance  $\lambda$  in time  $T$ , then  $v = \frac{\lambda}{T}$

[i.e. Relation between wave velocity, wavelength, and time period]

Hence,  $T$  is the time taken by one wave.

We know that  $\frac{1}{T}$  becomes the number of waves per second and this known as frequency ( $f$ ) of the wave.

So the above equation can also be written as,  $v = f \times \lambda$

Where,  $v$  = velocity of the wave,  $f$  = frequency,  $\lambda$  = wavelength

Velocity of a wave = frequency  $\times$  wavelength

Thus, the velocity (or speed) of a wave in a medium is equal to the product of its frequency and wavelength.

1. The time period of a wave is equal to the reciprocal of the frequency of a wave.

$$\text{i.e. } T = \frac{1}{f} \Rightarrow f = \frac{1}{T}$$

2. Wave velocity =  $\frac{\text{Distance travelled by the wave}}{\text{Time taken}} \Rightarrow v = \frac{\lambda}{T}$

3. Velocity of a wave = Frequency  $\times$  wavelength (or)

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