

VIBRATIONS AND WAVES

VIBRATION

- Vibration:
 - The cyclical motion of an object about an equilibrium point
- Mechanical Wave:
 - The transfer of energy through a material due to vibration
- Medium:
 - The material that permits the transmission of energy through vibrations
- Net Motion:
 - The displacement of a particle over a certain time interval; the difference between the particle's initial and final positions



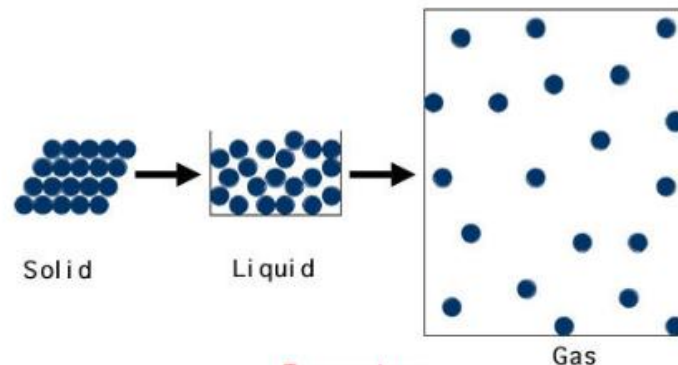
PARTICLE BEHAVIOUR

○ Elastic

- the property of a medium that returns to its original shape after being disturbed

○ Translational molecular motion

- the straight-line motion of a molecule; this motion is typical of gases because the particles in liquids and solids are not free to move in this manner

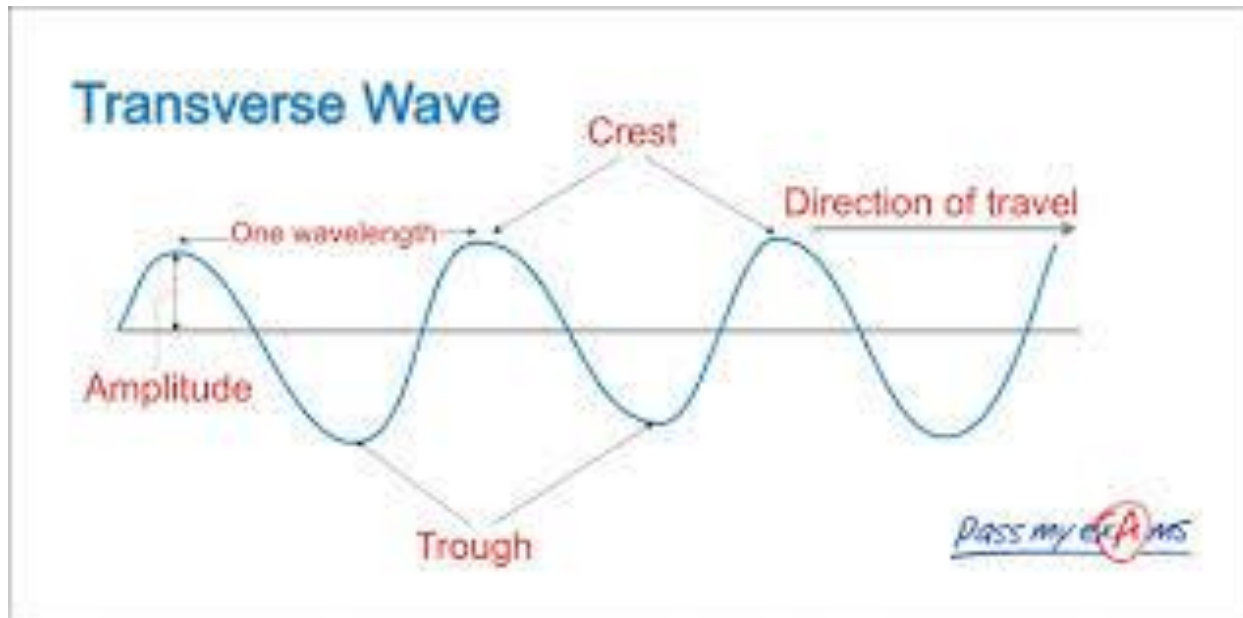


TYPES OF MECHANICAL WAVES

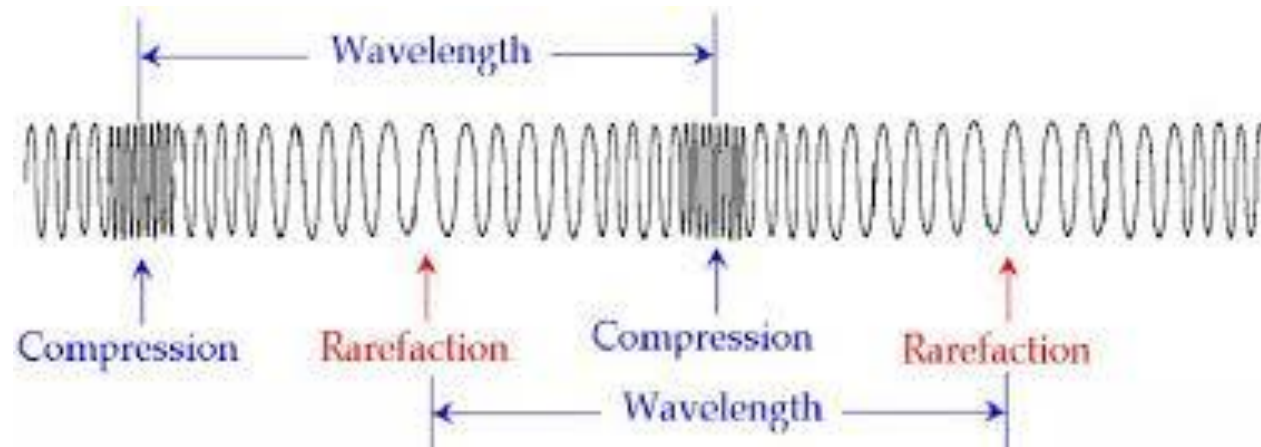
- Waves are classified according to the direction of particle motion compared to the direction of the wave motion
- Transverse Waves
 - a wave in which particles vibrate perpendicular to the direction of the flow of energy
- Longitudinal Waves
 - a wave in which particles vibrate parallel to the direction of the flow of energy



TRANSVERSE WAVE



LONGITUDINAL WAVE



COMPRESSIONS AND RAREFACTIONS

○ Compression

- The region in a longitudinal wave in which the medium's particles are closer together

○ Rarefaction

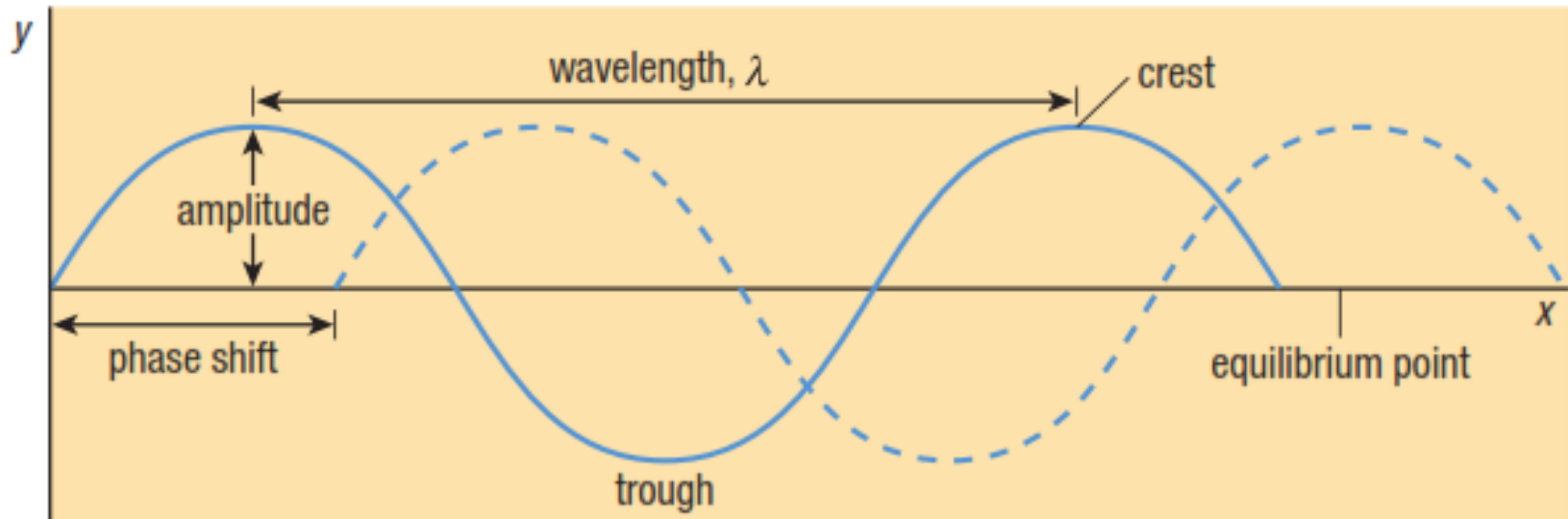
- The region in a longitudinal wave in which the medium's particles are farther apart

○ Sound

- a form of energy produced by rapidly vibrating objects detectable by sensory organs such as the ear



WAVE CHARACTERISTICS



GEOMETRIC WAVE CHARACTERISTICS

- Amplitude
 - the maximum displacement of a wave from its equilibrium point
- Waveform
 - the shape of a wave when graphed
- Crest
 - the maximum point of a transverse wave
- Trough
 - the minimum point of a transverse wave
- Wavelength λ
 - the distance between 2 similar points in successive identical cycles in a wave, such as from crest to crest or trough to trough



GEOMETRIC WAVE CHARACTERISTICS

- Phase
 - in a continuous transverse or longitudinal wave, the x coordinate of a unique point of the wave
- Phase shift
 - a shift of an entire wave along the x -axis with respect to an otherwise identical wave
- In phase
 - the state of two identical waves that have the same phase shift
- Out of phase
 - the state of two identical waves that have different phase shifts



TIME-BASED WAVE CHARACTERISTICS

- frequency (f)
 - the number of complete cycles that occur in unit time, usually 1 s
 - measured in hertz (Hz)
 - frequency = # of cycles / unit of time

$$f = \frac{1}{T}$$



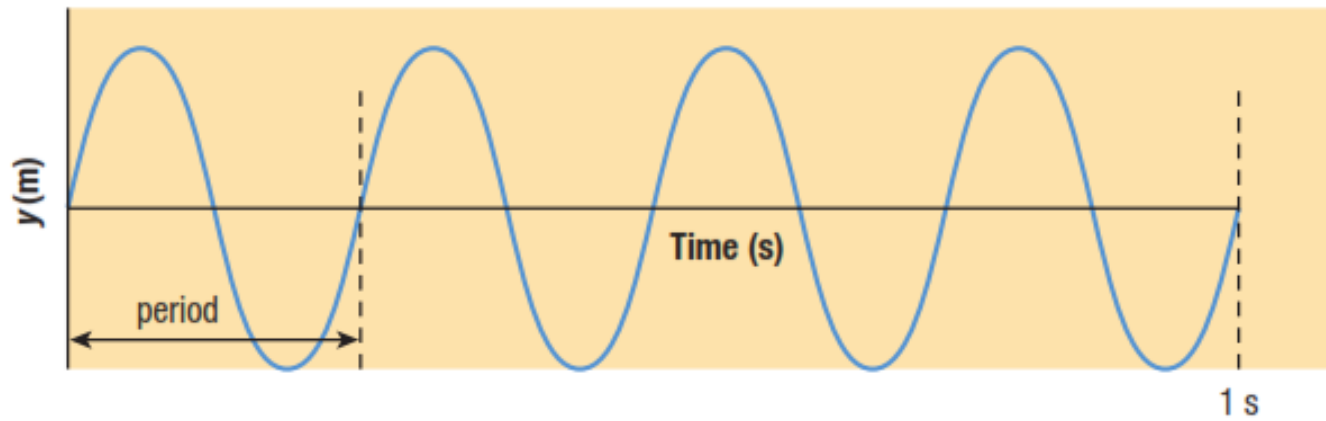
TIME BASED WAVE CHARACTERISTICS

- period (T)
 - the time for a vibrating particle to complete one cycle
 - period = time / unit cycle

$$T = \frac{1}{f}$$



TIME-BASED WAVE CHARACTERISTICS



WAVE SPEED

- Wave speed (v)
 - the rate at which a wave is travelling through a medium; also a measure of how fast the energy in the wave is moving
 - wave speed = length of one cycle / time for one cycle

$$v = \frac{\lambda(m)}{T(s)}$$

