

Concept

Matter Waves
Waves associated with particles like - electrons, protons, neutrons, atoms, molecules, etc.

Electromagnetic Waves
Do not require any material medium for their propagation e.g., light waves

Mechanical Waves
Require material medium for their propagation

Essential Properties for propagation

- Elasticity
- Inertia
- Minimum friction

Relation b/w wave velocity (v), wavelength (λ) and frequency (ν)
Wave velocity $v = \nu\lambda$
Time period (T) = $\frac{1}{\text{frequency}}$
Angular frequency (ω) = $2\pi\nu$
Wave number ($\bar{\nu}$) = $\frac{1}{\text{wavelength}}$

Types of waves

Transverse waves
Individual particles of the medium oscillate perpendicular to the direction of wave propagation

Longitudinal waves
Individual particles of the medium oscillate along the direction of wave propagation

WAVES
Information and energy propagate in the form of signal or disturbances without actual transfer of matter

Speed of longitudinal wave
Speed of sound, $V = \sqrt{\frac{E}{\rho}}$
 $= \sqrt{\frac{Y}{\rho}} = \sqrt{\frac{P}{\rho}} = \sqrt{\frac{\gamma P}{\rho}} = \sqrt{\frac{\gamma RT}{M}}$
for air $\gamma = 7/5$
Elasticity of solids maximum and of gases-minimum

Speed of transverse wave in a stretched string :
 $V = \sqrt{\frac{T}{M}}$ $T = \text{tension}$
and $M = \text{mass/length}$

Displacement relation in a plane progressive wave
 $y(x, t) = A \sin(\omega t - kx + \phi_0)$
 $y(x, t) = A \sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$
velocity amplitude $v_0 = A\omega$
Acceleration amplitude $a_0 = A\omega^2$

• If string is stretched by some weight then speed of transverse wave is given by

Speed of sound in gases
 $V = \sqrt{\frac{\gamma P}{\rho}}$
 $= \sqrt{\frac{\gamma RT}{M}}$

Wave equation
 $\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 y}{\partial t^2}$

Standing waves
When two waves of same frequency and amplitude travel in opposite directions, they interfere to form a standing wave.
 $y = 2A \sin kx \cos \omega t$

Standing waves in a pipe
In a pipe closed at one end, the length of the pipe is equal to an odd multiple of $\frac{\lambda}{4}$.
 $L = (2n-1) \frac{\lambda}{4}$

Standing waves in a string
In a string fixed at both ends, the length of the string is equal to an integral multiple of $\frac{\lambda}{2}$.
 $L = n \frac{\lambda}{2}$

Standing waves in a pipe
In a pipe open at both ends, the length of the pipe is equal to an integral multiple of $\frac{\lambda}{2}$.
 $L = n \frac{\lambda}{2}$

Chapter 20 Waves

Jianjun Gao



Chapter 20 Waves:

Whispering the Strategies of Language: An Psychological Quest through **Chapter 20 Waves**

In a digitally-driven earth wherever monitors reign great and immediate connection drowns out the subtleties of language, the profound strategies and emotional subtleties concealed within words frequently get unheard. However, situated within the pages of **Chapter 20 Waves** a charming fictional treasure pulsing with fresh thoughts, lies an extraordinary quest waiting to be undertaken. Composed by a skilled wordsmith, that charming opus attracts viewers on an introspective trip, softly unraveling the veiled truths and profound influence resonating within ab muscles cloth of each word. Within the emotional depths of the emotional review, we shall embark upon a genuine exploration of the book is primary subjects, dissect its fascinating publishing style, and succumb to the powerful resonance it evokes serious within the recesses of readers hearts.

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