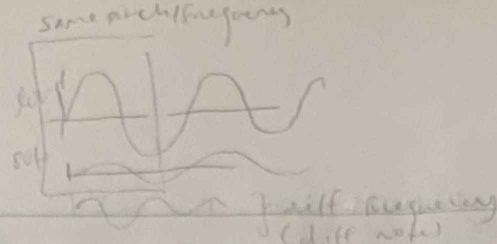
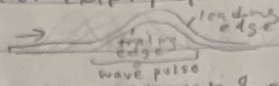
Chapter 16 Textbook Notes



16.1 - Representing Waves Graphically & 16.2 - Wave Propagation

A wave is a disturbance that propagates through a medium or empty space

A wave pulse is a single isolated propagating disturbance



The wave function represents the shape of a wave at any given instant & changes with time as the wave travels

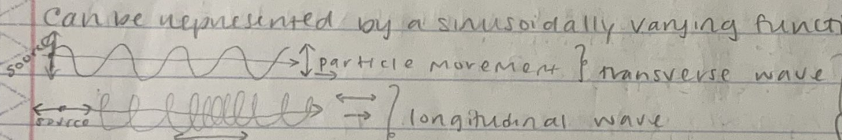
The wave speed c is the speed at which a wave propagates. For a mechanical wave, c is different from the speed v of the particles of the medium & is determined by the properties of the medium. → c of a wave pulse along a string is constant

The displacement $\vec{D}$ of any particle of a medium through which a mechanical wave travels is a vector that points from the equil. position of the particle to its actual posit.

In a transverse mech. wave, the particles of the medium move perpendicular to the direction of the pulse movement

In a longitudinal mech. wave, the particles of the medium move parallel.

In a periodic wave, the displacement at any location in the medium is a periodic function of time. A period wave is harmonic when the particle displacement can be represented by a sinusoidally varying function of space & time.



For a given disturbance, high wave speeds yield waves that are stretched out & lower speeds yield waves that are compressed

The speed c of a wave propagating along a string increases w/ increasing tension in string & decreases w/ increasing mass per unit length in the string.

If a wave travels in x-direction w/ speed c & $f(x)$ describes shape of the wave, the y-component D_y of displacement of a particle of the medium is: $D_y = f(x-ct)$ if travelling in $+x$ direction & $D_y = f(x+ct)$ if travelling in $-x$ direction

The wavelength λ of a periodic wave is the min. distance over which the wave repeats itself ⇒ $\lambda = cT$ & wave number $k = \frac{2\pi}{\lambda}$ & $\omega = \frac{2\pi}{T}$ & $c = \lambda f$

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Make flash-cards!!! / print out equation sheet! / take practice exam 6-4 thursday

16.5 - wave functions & 16.6

- For a transverse harmonic wave of amplitude A & initial phase ϕ_i travelling in +x direction, the y-component D_y of the displacement of a particle of the medium is $D_y = f(x,t) = A\sin(kx - \omega t + \phi_i)$
- standing wave = pulsating stationary pattern
- Nodes occur @ $x = 0, \pm\frac{\lambda}{2}, \pm\lambda, \pm\frac{3\lambda}{2}, \ldots$
- Antinodes occur @ $x = \pm\frac{\lambda}{4}, \pm\frac{3\lambda}{4}, \pm\frac{5\lambda}{4}, \ldots$

16.7 - Wave speed, 16.8 - Energy Transport in waves; 16.9 - wave equation

- For a uniform string of mass m & length l the linear mass density μ (mass per unit length) is $\mu = \frac{m}{l}$
- Speed of wave on a string under tension T is $c = \sqrt{\frac{T}{\mu}}$
- Average power that must be applied to generate a wave of period T is $P_{av} = \left(\frac{1}{2}\mu\lambda A^2\omega^2\right)/T = \frac{1}{2}\mu A^2\omega^2 c$
- Any function of the form $f(x-ct)$ or $f(x+ct)$ that represents a wave travelling with speed c is a solution of the wave equation: $\frac{\partial^2 f}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 f}{\partial t^2}$