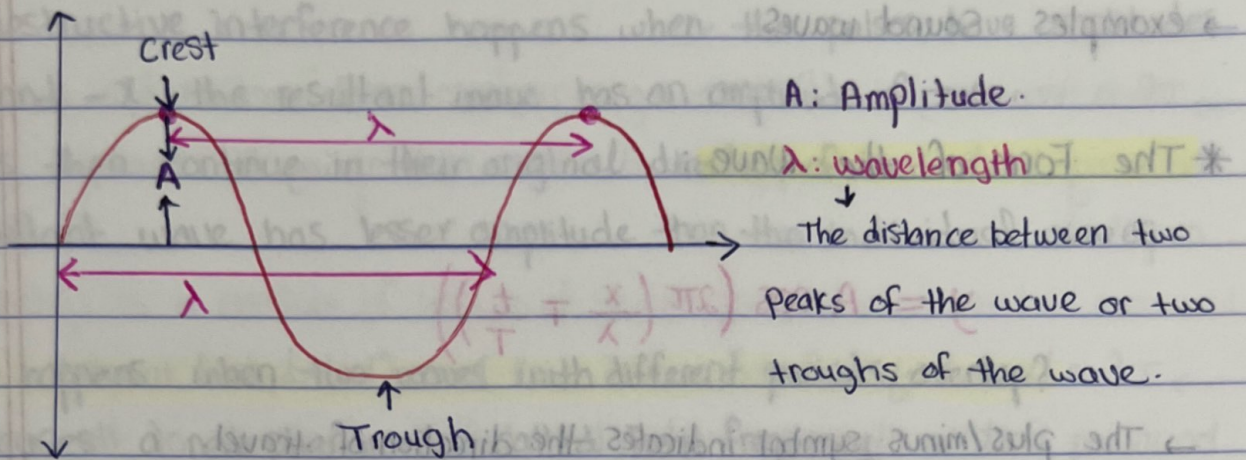


Chapter 8: Waves.



$$v = \lambda f$$

frequency $f = \frac{\text{\# cycles}}{\text{time}}$ (The number of cycles that occur per second).

Hertz (s^{-1}) $f = \frac{1}{T}$ seconds.

period $T = \frac{\text{time}}{\text{\# cycles}}$ (The time it takes to complete one cycle).

* **Wave**: is a disturbance in a medium that transfers energy from one place to another.

* **Types of waves**:

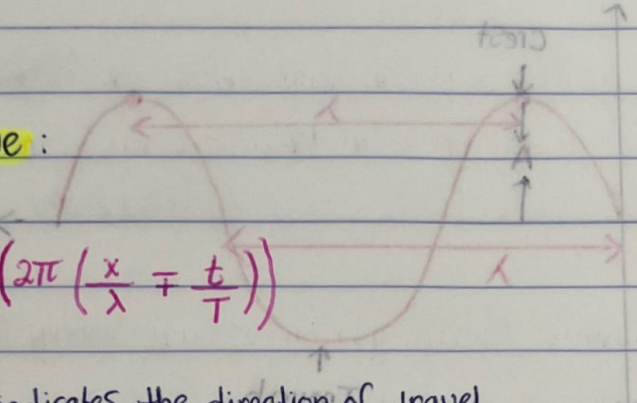
□ **Transverse wave**: a wave in which particles of a medium move up and down, perpendicular to the direction of the wave.

- examples: light waves, vibrations in strings, Electromagnetic waves.
- direction of movement: up and down.
- wave direction: to the right.

[2] Longitudinal waves: a wave in which particles of a medium move back and forth, parallel to the direction of the wave.

→ examples: Sound waves.

* The Form of the wave:


$$y = A \cos \left(2\pi \left(\frac{x}{\lambda} \mp \frac{t}{T} \right) \right)$$

→ The plus/minus symbol indicates the direction of travel.

→ A: is the amplitude of the wave.

wavenumber (k) = $\frac{2\pi}{\lambda}$ (How many cycles per metre).

Angular frequency (ω) = $2\pi f$

* The expression of the wave become:

$$y = A \cos (kx \mp \omega t)$$

→ The "-" sign, represents a wave travelling in the $x+$ direction.

→ The "+" sign, represents a wave travelling in the $x-$ direction.

* What happens when two waves overlap?

→ When two waves combine they will exhibit superposition, and this will produce an interference pattern.

→ The resultant wave has an amplitude of $2x$ at the moment of complete overlap.

→ The resultant wave has greater amplitude than the individual waves.

This is called constructive interference.

→ The destructive interference happens when the pulses have amplitudes of x and $-x$, the resultant wave has an amplitude of zero.

The waves then continue in their original direction of motion.

The resultant wave has lesser amplitude than the individual waves.

* What happens when two waves with different periods overlap?

→ It causes a new phenomena called Beat frequency.

→ The Beat happen when two waves with different frequencies overlap.

$$f_B = |f_1 - f_2| \quad (\text{The number of wobbles per second})$$

→ The wave go through constructive → destructive → constructive interference.

* Reflection:

→ When a wave arrives at a boundary between two materials, Three different things can happen:

1) The wave may be absorbed by the material. The energy of the wave will be stored in the material's energy.

2) The wave could be transmitted.

3) The wave could be reflected off the surface.

$$P.E = \frac{1}{2} kx^2$$

→ which one of the three things will happen depends on:
wavelength and Properties of two materials.

→ If a boundary is free to move, waves will be reflected,
bouncing back in the opposite direction maintaining the same
amplitude.

→ If a boundary is fixed, waves will be reflected and inverted,
bouncing back in the opposite direction but the amplitude of the
opposite sign.

* Standing Waves:

→ when waves are confined between two boundaries, where they
will experience repeated reflection at both ends of the string,
resulting in a multitude of wave cycles travelling in both
directions.

→ These kinds of waves can only have particular frequencies for
a string of a particular length.

* Wave Energy:

→ waves transfer energy through oscillations.

→ The amplitude is a direct ~~means~~ measure of the amount of
energy.

$$PE = \frac{1}{2}KA^2$$

* Power and Intensity:

→ Power and Intensity are both related to the energy.

→ Power: is a measure of how much energy is transmitted per unit time.

$$P = \frac{W}{t}$$

→ Intensity: is a measure of how much power per unit area, and is measured in watts per square metre.

$$I = \frac{P}{A}$$