# 1 - Formula of a Wave

#phys31-2 #waves #wave-equation

$$k = \frac{2\pi}{\lambda}$$
$$\omega = \frac{2\pi}{T}$$

$$y(x,t) = A\cos(kx \pm \omega t)$$

where $A$ is amplitude, $k$ is the wave number, and $\omega$ is the angular frequency.

By working to find the second partial derivatives with respect to $t$ and $x$, namely

$$\frac{\delta^2 y(x,t)}{\delta t^2} = -\omega^2 A\cos(kx - \omega t)$$
$$\frac{\delta^2 y(x,t)}{\delta x^2} = -k^2 A\cos(kx - \omega t)$$

And then finding the relationship between these two partial derivatives:

$$\frac{\frac{\delta^2 y(x,t)}{\delta t^2}}{\frac{\delta^2 y(x,t)}{\delta x^2}} = \frac{\omega^2}{k^2} = v^2$$

Then we get the wave equation:

$$\frac{\delta^2 y(x,t)}{\delta x^2} = \frac{1}{v^2}\frac{\delta^2 y(x,t)}{\delta t^2}$$

Note: In a lot of instances the speed of light $c$ is used in place of $v$.

## Summary

Function of a particle in a wave:

$$y(x,t) = A\cos(kx \pm \omega t)$$

Its components:

- Wave number $k = \frac{2\pi}{\lambda}$
- Angular frequency $\omega = 2\pi f = \frac{2\pi}{T}$
- Amplitude $A$