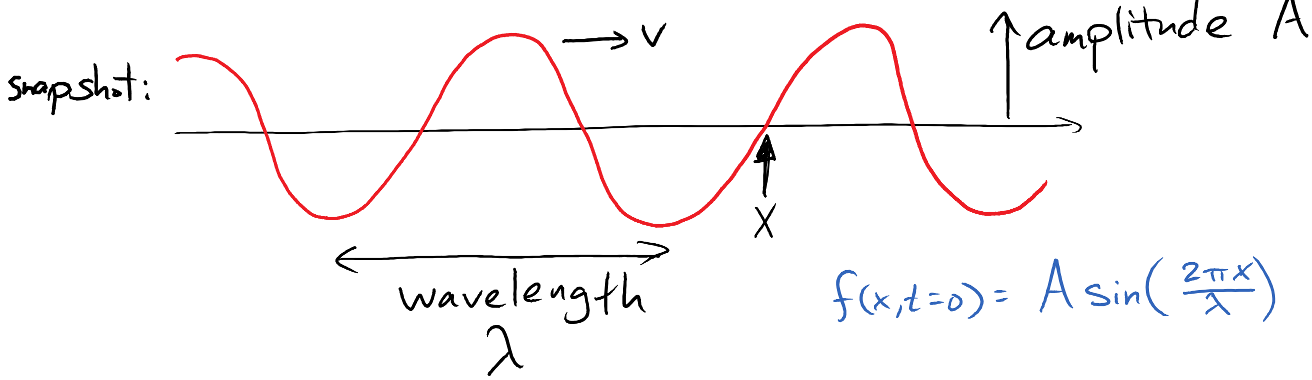
Important example: sinusoidal waves



$f(x,t=0) = A\sin\left(\frac{2\pi x}{\lambda}\right)$

At point X: time dependence is also sinusoidal

$f(x,t) = A\sin\left(\frac{2\pi}{\lambda}(x - vt)\right)$

(right moving)

KEY RELATION: $\boxed{f = \frac{v}{\lambda}}$

shorter wavelength: peaks pass X more frequently
$\therefore$ higher frequency

lingo: $\frac{2\pi}{\lambda} = k$ WAVE NUMBER

$2\pi f = \omega$ ANGULAR FREQUENCY

$f(x,t) = A\sin(kx - \omega t)$

Wave velocity: depends on properties of medium

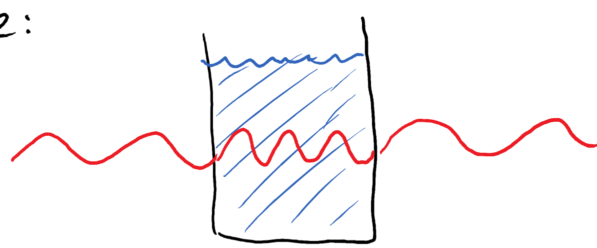
e.g. light $v = c$ in vacuum

$v = \frac{1}{n} \cdot c$ in other media

$n \leftarrow$ index of refraction.

can also depend on wavelength, but usually assume not!

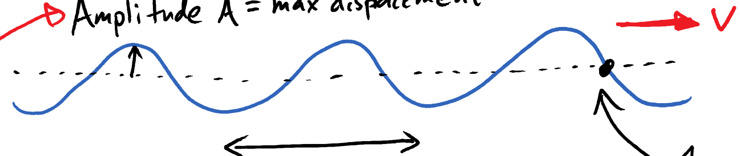
interface:



frequency is the same throughout (each part shakes neighboring part at same frequency)

Amplitude A = max displacement

$\rightarrow v$



Energy density $\propto A^2$

WAVELENGTH λ

This point oscillates up & down w. frequency $f = \frac{v}{\lambda}$

basic shape:

$$F(x) = A \sin\left(\frac{2\pi x}{\lambda}\right)$$

at time t:

$$D(x,t) = F(x - vt) = A \sin\left(\frac{2\pi}{\lambda}(x - vt)\right)$$

usual way to write this:

$$D(x,t) = A \sin(kx - \omega t + \phi)$$

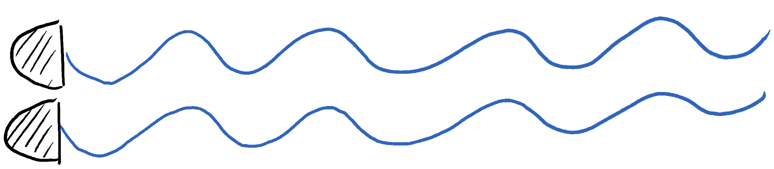
phase factor (shifts initial shape L or R)

$\phi = 2\pi$ "shift of 1 wavelength to left."

wave number $k = \frac{2\pi}{\lambda}$

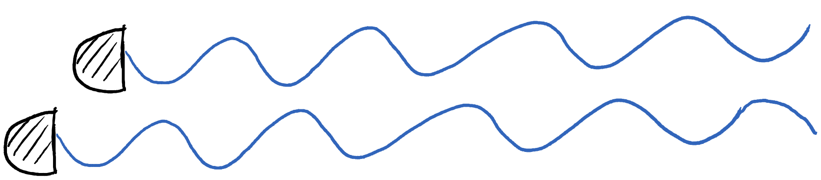
angular frequency $= 2\pi f$

Consequence of superposition principle: INTERFERENCE



constructive interference

path length difference $= 0, \lambda, 2\lambda \ldots$



destructive interference

path length difference $= \frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda \ldots$