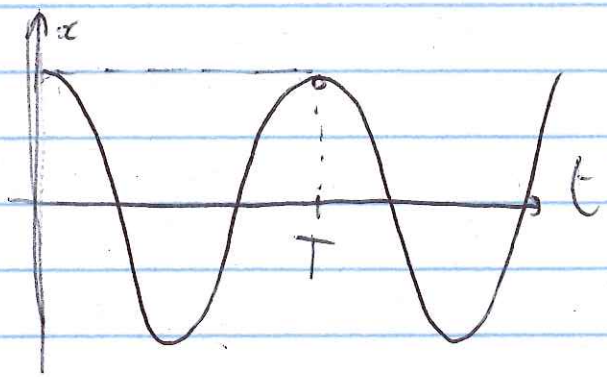
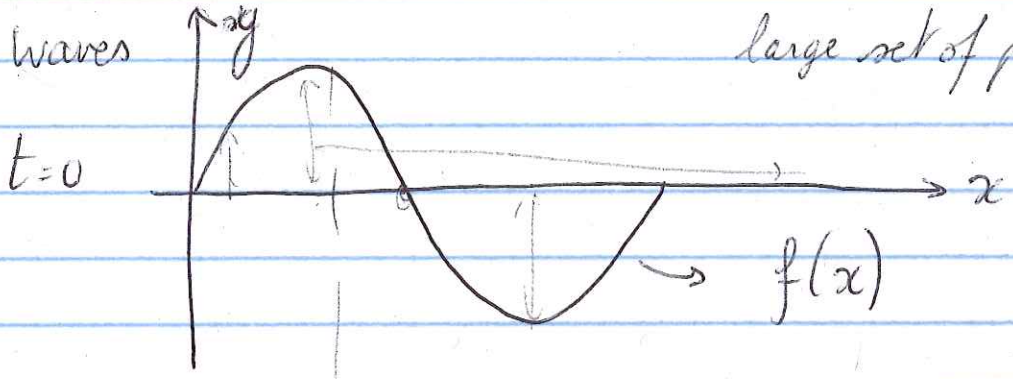


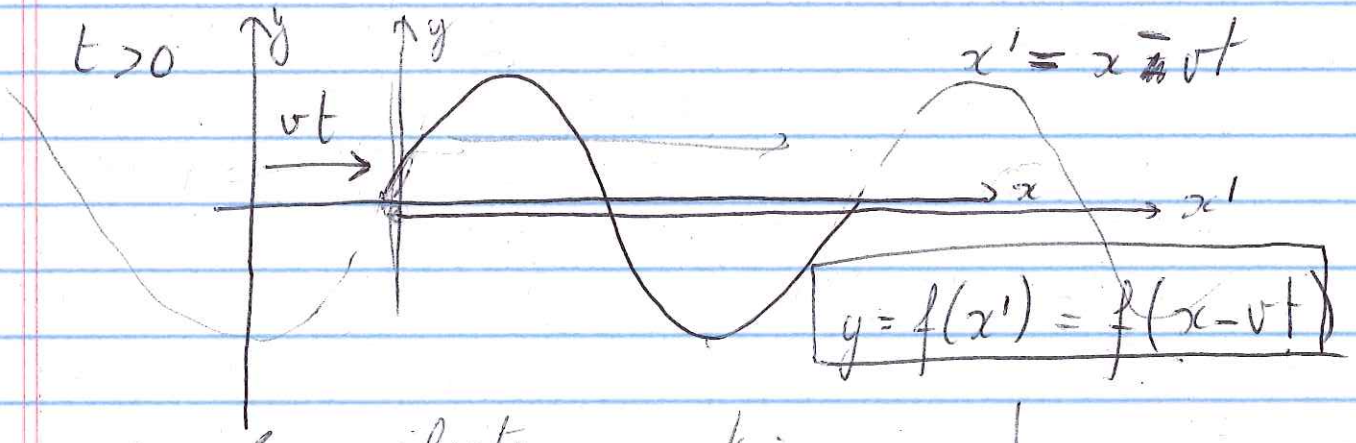
simple harmonic motion

1 point only

waves

large set of points

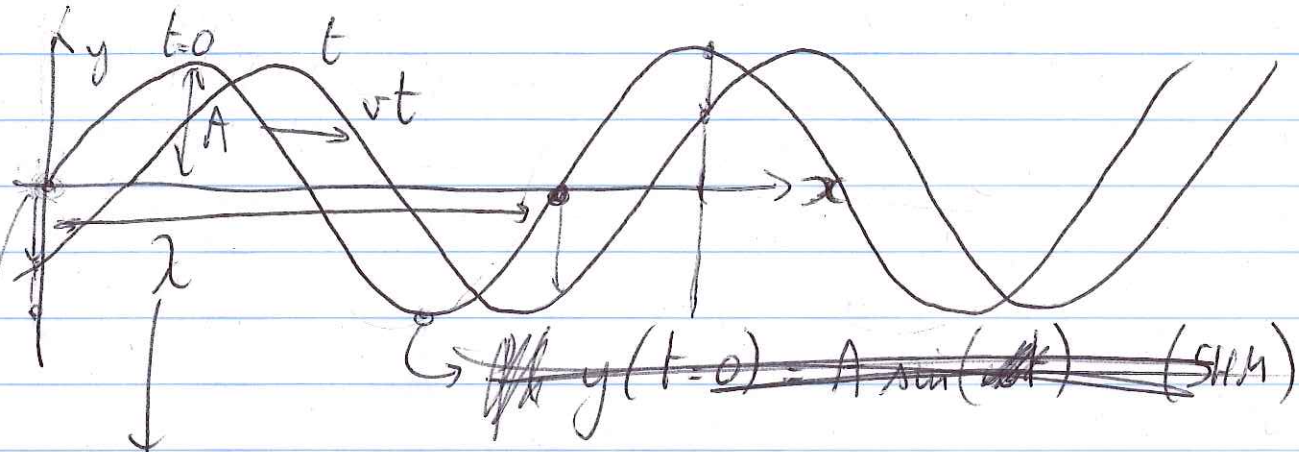




example: vibration on string
water waves
seismic waves
EM waves
nerves, pulses

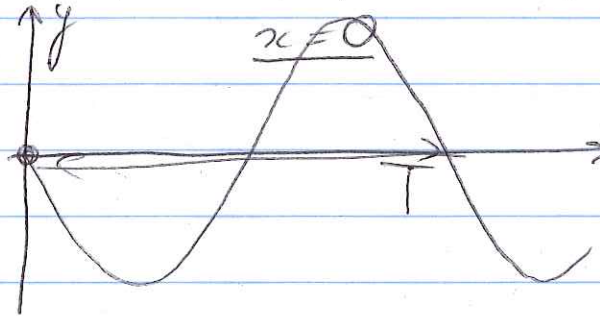
v = wave velocity

Periodic wave



wavelength = λ

frequency of SHM = f → T period



$$v T = \lambda$$

$$\boxed{v = \lambda f}$$

Example: WCWM: $f = 90.9\ MHz$, $v = c = 3 \times 10^8\ m/s$

$$\hookrightarrow \lambda = \frac{v}{f} = \frac{c}{f} = \frac{3 \times 10^8\ m/s}{90.9 \times 10^6\ Hz}$$

$$= 3.3\ m$$

microwave ovens: $f = 2.45\ GHz$, $v = c = 3 \times 10^8\ m/s$

$$\hookrightarrow \lambda = \frac{v}{f} = \frac{c}{f} = \frac{3 \times 10^8\ m/s}{2.45\ GHz}$$

$$= 12.5\ cm$$

light $v = c = 3 \times 10^8 \, m/s$ in vacuum (or air)

glass → $v = 2 \times 10^8 \, m/s$ $\left(\frac{1}{1.5} c\right)$

strings: velocity of waves on a string?

$T \left[N = kg \, m/s^2\right]$

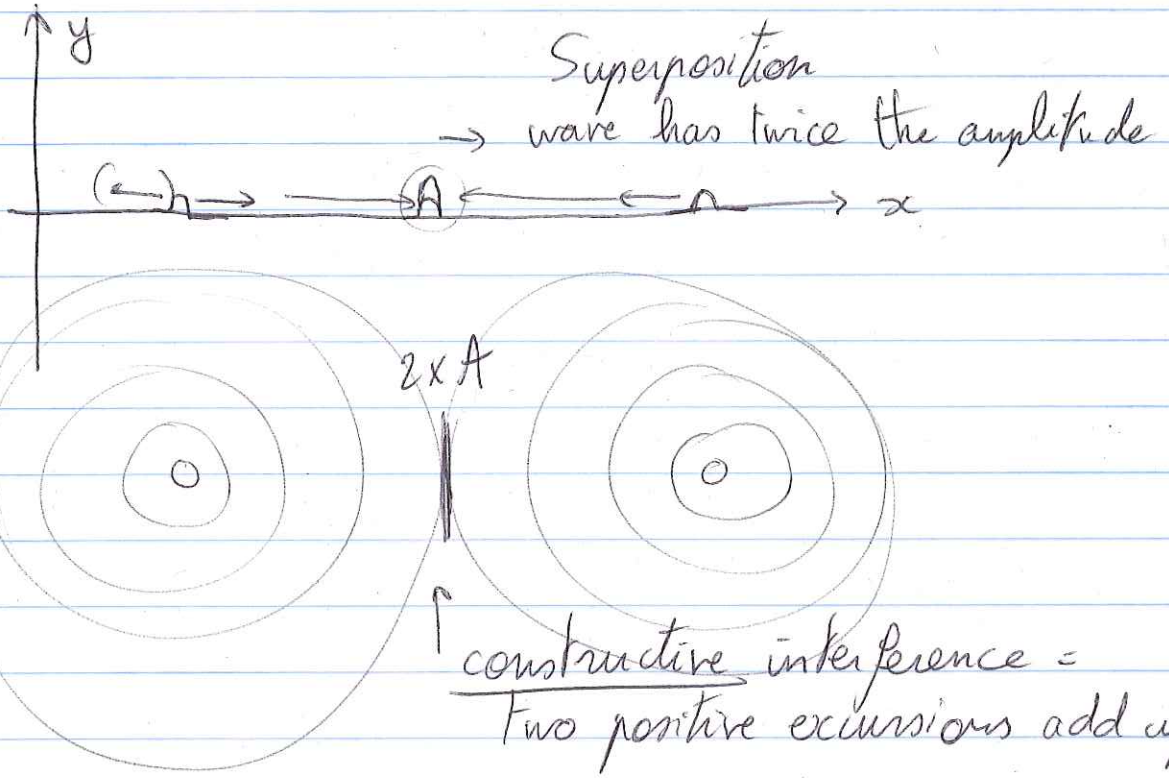
$m \left[kg\right]$

$\ell \left[m\right]$

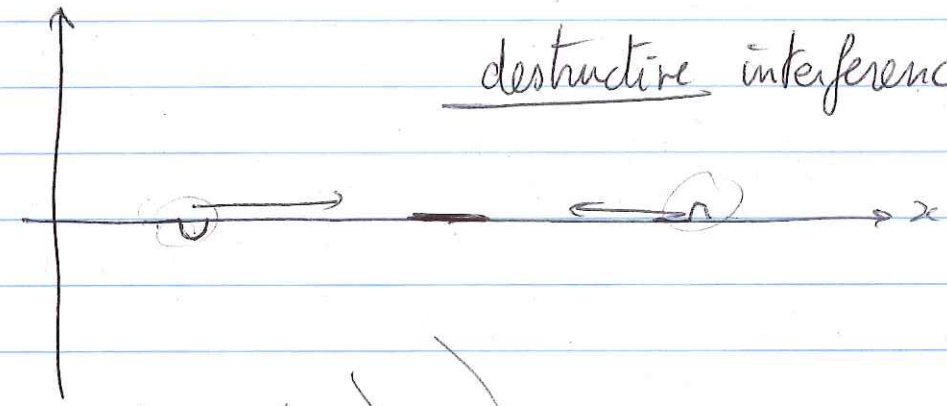
$\left[\frac{m}{s}\right] = \sqrt{\frac{T\ell}{m}}$ $\quad \frac{T\ell}{m} \left[\frac{m^2}{s^2}\right]$

$v = \sqrt{\frac{T\ell}{m}}$ $\quad \frac{m}{\ell} = \mu$ = mass per length

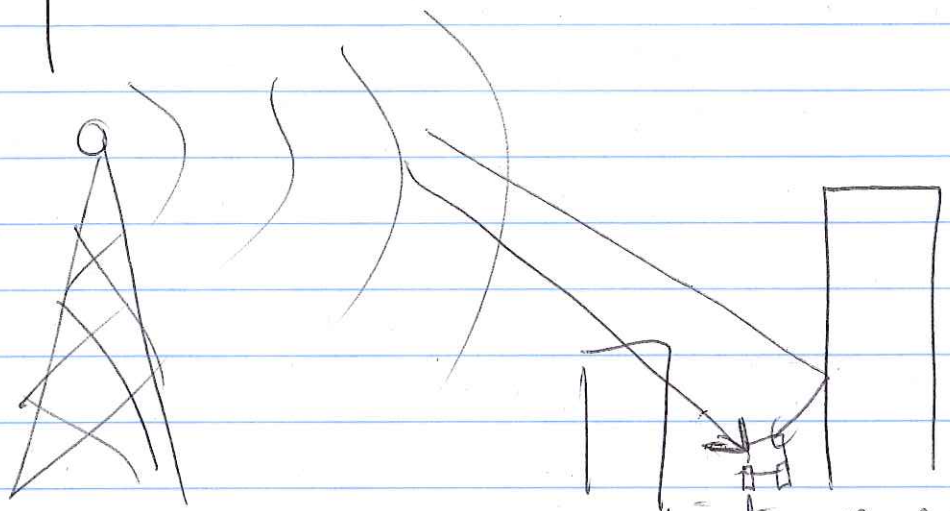
$v = \sqrt{\frac{T}{\mu}}$



constructive interference =
Two positive excursions add up



destructive interference



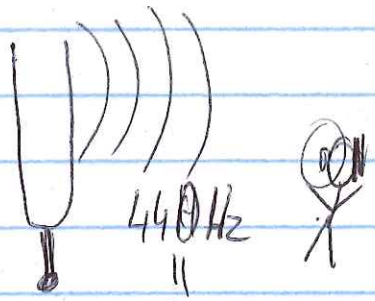
direct wave $f_1(x,t) = f_1(x-vt)$

reflected wave $f_2(x_m - vt)$

superposition

$f(x-vt) = f_1(x-vt) + f_2(x-vt)$

——— destructive interference



SHM $y_1 = A\cos(\omega_1 t)$
$= A\cos(2\pi f_1 t)$

$y_2 = A\cos(2\pi f_2 t)$

$$y = A\cos(2\pi f_1 t) + A\cos(2\pi f_2 t)$$

$$y = A.2\cos\left(\frac{2\pi f_1 t + 2\pi f_2 t}{2}\right)\cos\left(\frac{2\pi f_1 t - 2\pi f_2 t}{2}\right)$$

$$y = 2A\cos\left(2\pi\underbrace{(f_1 - f_2)}_{1\text{Hz}}t\right)\cos 2\pi\underbrace{\left(\frac{f_1+f_2}{2}\right)}_{440.5\text{Hz}}t$$