Formula sheet for Exam 3 Posted

↑
All things rotational + fluids

"New" for final Exam ⇒ Periodic motion, Waves, Sound
* Ch. 15 * Ch. 16

WAVE: The transport of energy via the propagation of a disturbance.

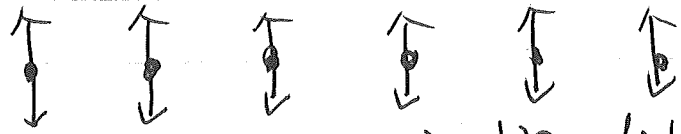
["Medium" is the material through which disturbance propagates (The stuff that is "waving" ☺)]

"Mechanical Waves"

TWO KINDS:

→ dir. of wave

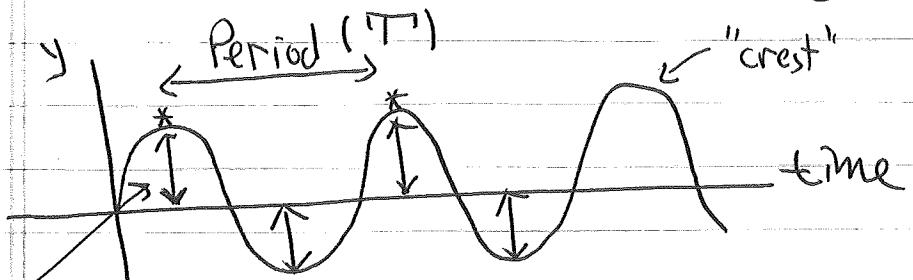
"Longitudinal Wave"



→ dir. of wave

"Transverse Wave"

Pictures of A wave (sinsoidal, but do not have to be)



Amplitude (A)

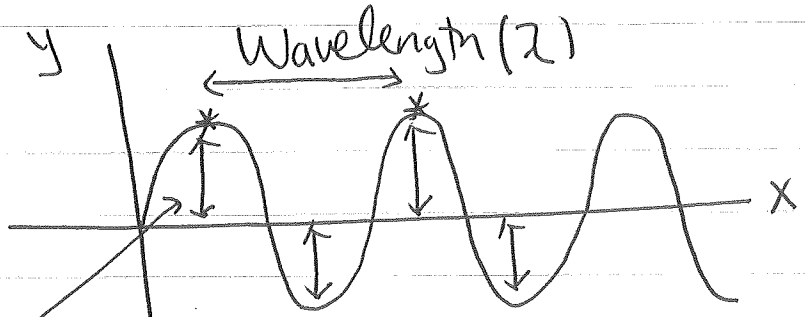
At a single location.

$$\text{frequency} = \frac{\#\text{ crests}}{\text{second}}$$

(hertz, Hz)

$$T = \frac{1}{f}$$

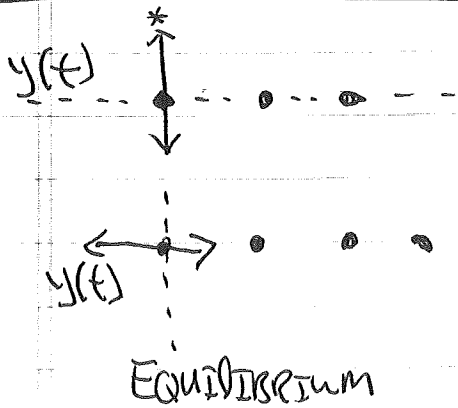
At a single instant in time



Amplitude

$$\lambda * f = v$$

↑ speed of wave



Eqtn. for a wave: (Sinusoidal Waves)

$$y(x,t) = y_{max} \begin{cases} \cos \\ \sin \end{cases} (kx \pm \omega t + \phi)$$

- y_{max}: Amplitude.
- k: "Wave number", $k = \frac{2\pi}{\lambda}$
- x: location in the medium
- $\pm$: direction ✡
- $\omega = 2\pi f$
- ϕ: constant "phase Angle"

Aside: $\lambda \cdot f = v$

NOTE: The spatial variable in sin/cos is the axis along which wave travels.

! [✡ "$-\omega t$", wave travels in $+x$ direction
"$+\omega t$", wave travels in $-x$ direction.

Ex.) Given: $y(x,t) = 75 \sin(43x + 27t)$

a.) Find λ, f, v, A.

b.) Find speed of a particle @ $x = 2$m when $t = 10$sec.

a.) $A = 75$m, $k = \frac{2\pi}{\lambda} = 43$, $\omega = 2\pi f = 27$

$\therefore \lambda = \frac{2\pi}{43}$ m $\quad \therefore f = \frac{27}{2\pi}$ Hz

$\therefore v = \lambda * f = \frac{2\pi}{43} * \frac{27}{2\pi} = 0.63$ m/s

in the $-x$ direction..

b.) Questions about parts of the medium have us working on left side of the equation

Given: $y(x,t)$

$V(x,t) = \frac{\partial}{\partial t} y(x,t)$ | $\frac{\partial}{\partial t}$ "Partial derivative"

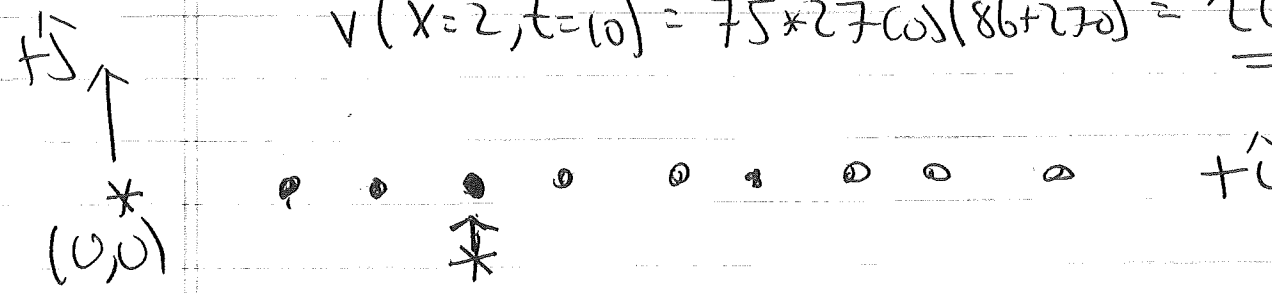
For the particle @ $x = 2m$

$y(x=2,t) = 75 \sin(86 + 27t)$

$V(x=2,t) = \frac{d}{dt} y(t) = 75 * 27 \cos(86 + 27t)$

$y(x=2, t=10) = 75 \sin(86 + 270) = -5.23$ m *

$v(x=2, t=10) = 75 * 27 \cos(86 + 270) = 2020$ m/s



Eqtn. of Motion for waves

WAVE EQTN

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

| general soltn. $F(x \pm vt)$

Last Practice Set for EXAM 3 posted Tuesday.

NO MORE GRADED HW.

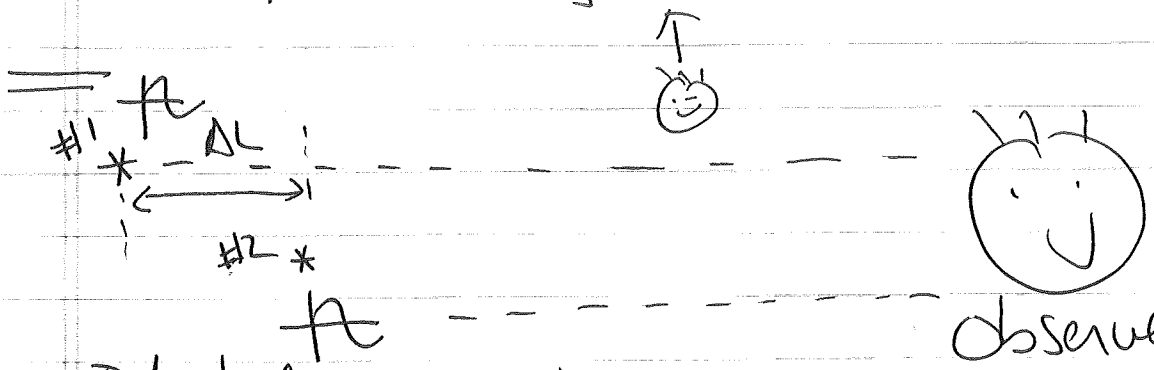
A Practice set for "new" find EXAM Material will also be posted. (waves and Sound.)

Interference (a property unique to waves)

Superposition of intersecting waves.
Algebraic addition.

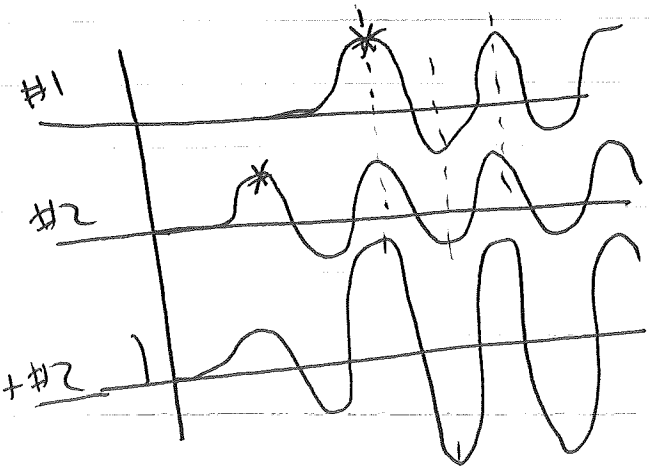
Wave #1 is colliding with wave #2:

$$Y(x,t) = y_1(x,t) + y_2(x,t)$$



Identical, "in phase"

★ Constructive Interference

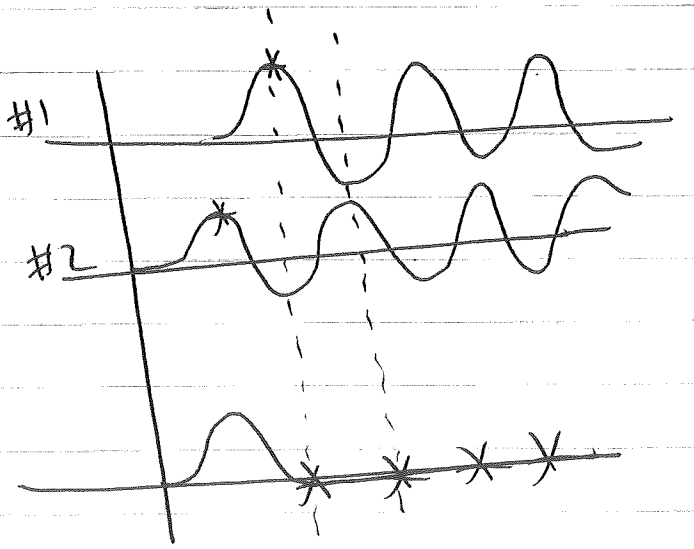


When does this happen?

!! $\Delta L = 0, \lambda, 2\lambda, 3\lambda, \ldots$

✡ Destructive Interference

$\Delta L = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}, \ldots$



Special Case: Standing waves