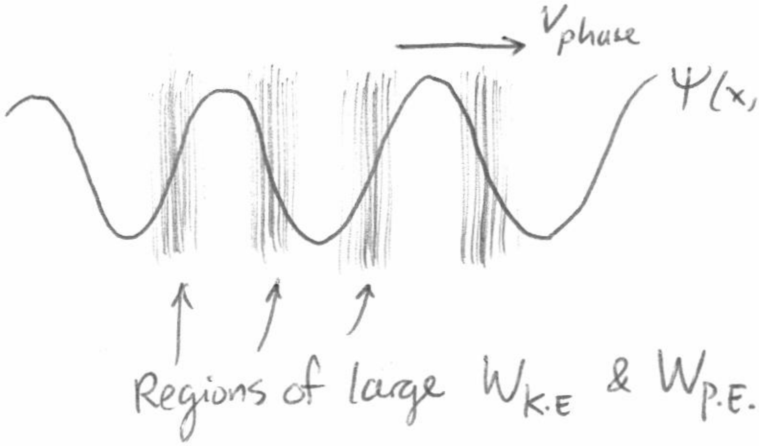
DAY 7

PH 424

Last time

$$W_{K.E.} = \frac{1}{2}\mu\left(\frac{\partial\psi}{\partial t}\right)^2 \qquad W_{P.E.} = \frac{1}{2}\tau\left(\frac{\partial\psi}{\partial x}\right)^2$$

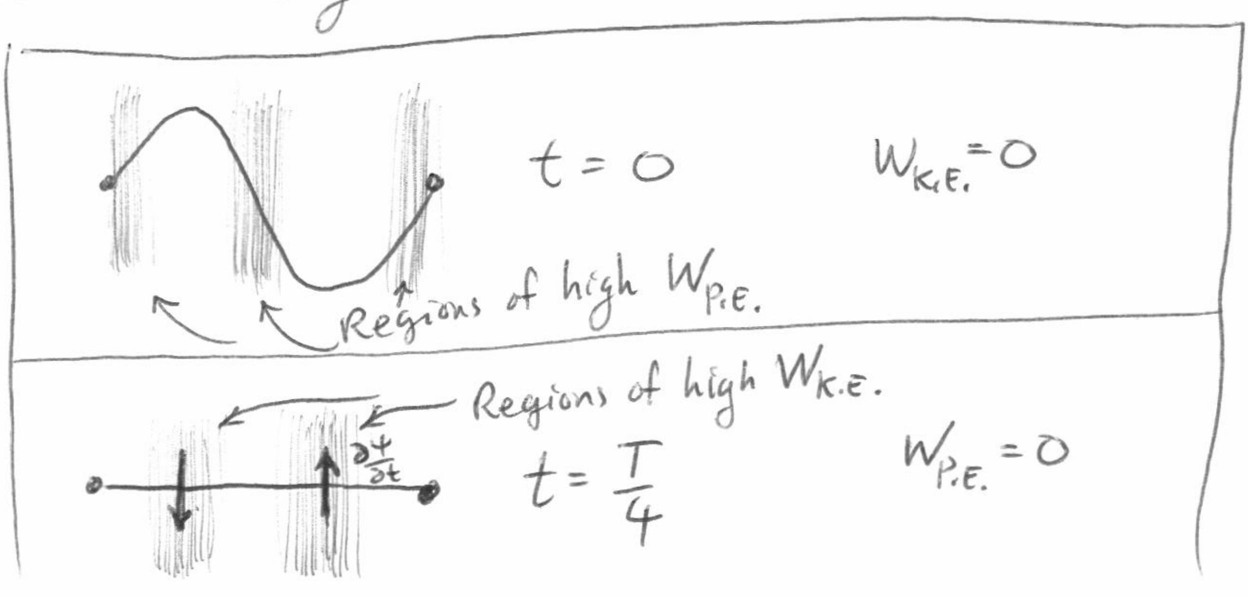
For a traveling wave



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

These regions move to the right at v_{phase}.
Energy is transported to the right.

For a standing wave

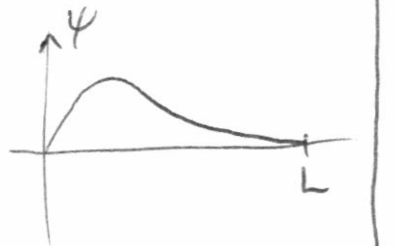


SUPERPOSITION OF TWO STANDING WAVES

(worksheet).

Stretched string starts in this shape:

$$\psi(x, t=0) = A \sin\left(\frac{\pi x}{L}\right)\left(1 + \cos\left(\frac{\pi x}{L}\right)\right)$$



find $\psi(x,t)$.

I want to express this ~~in terms~~ as a sum of simple sine and cosine functions. ~~with dif~~

$$= A \sin \frac{\pi x}{L} + \frac{A}{2} \sin \frac{2\pi x}{L}$$

[using Trig identity]

$k = \pi/L$ $\qquad$ $k = \frac{2\pi}{L}$

Recall the general solution to the non-dispersive wave eq^n

$$\psi(x,t) = \sum_i \left\{ \begin{aligned} &A_i \cos k_i x \cos \omega_i t \\ &+ B_i \cos k_i x \sin \omega_i t \\ &+ C_i \sin k_i x \cos \omega_i t \\ &+ D_i \sin k_i x \sin \omega_i t \end{aligned} \right\}$$

where $\frac{\omega_i}{k_i} = v$ for every i.

We are told that $\left.\frac{\partial \psi}{\partial t}\right|_{t=0} = 0.$

Therefore, all time dependence must be of the form $\cos \omega_i t$.

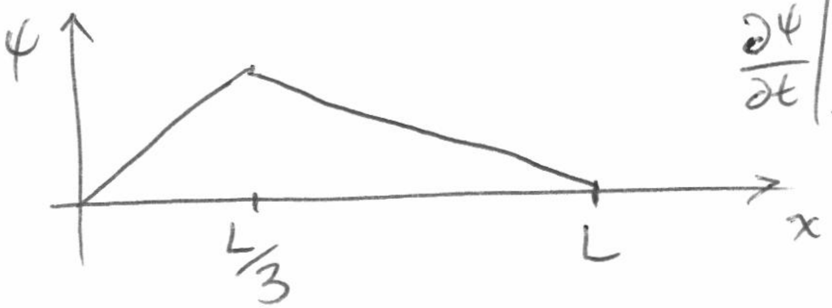
$$\Rightarrow \boxed{\psi(x,t) = A \sin\frac{\pi x}{L} \cos\frac{\pi v}{L}t + \frac{A}{2}\sin\frac{2\pi x}{L}\cos\frac{2\pi v}{L}t}$$

Note the similarity to time dependent state vectors in quantum mechanics

$$\frac{1}{\sqrt{2}} e^{-i\frac{E_+}{\hbar}t}|+\rangle + \frac{1}{\sqrt{2}} e^{-i\frac{E_-}{\hbar}t}|-\rangle$$

different basis states have different time dependence.

Introduction to Friday's HW question



$$\left.\frac{\partial \psi}{\partial t}\right|_{t=0} = 0$$

~~Need to~~

Project this function onto standing waves that have different values of k.