Reminders 02-25-08:

-Turn in Spring-Mass Worksheet Wednesday. Change mass to 816 grams. Go to Web Page for new version.

-Ch. 13 Homework Due Tomorrow Night

-POW 4 by 5PM Wednesday; remember these are extra credit problems.

Outline:

-More SHM Examples

-Physical Pendulum

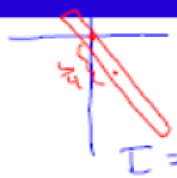
-Properties of Mechanical Waves

-Traveling Harmonic Waves

Example

- A uniform rod of mass M and length L is pivoted about a point that is L/4 above its center of mass so that it is free to rotate in a vertical plane. Show that the period of oscillation small angles is

$$T = 2\pi\sqrt{\frac{7L}{12g}}$$



$$T = 2\pi\sqrt{\frac{I}{mgd}}$$

$$d = \frac{L}{4}$$

$$I = I_{cm} + m\left(\frac{L}{4}\right)^2$$

$$= \frac{1}{12}mL^2 + m\frac{L^2}{16} = \frac{7}{48}mL^2$$

$$T = 2\pi\sqrt{\frac{\frac{7}{48}\cancel{m}L^2}{\cancel{m}g\frac{L}{4}}} = 2\pi\sqrt{\frac{28}{48}\frac{L}{g}}$$

$$T = 2\pi\sqrt{\frac{7}{12}\frac{L}{g}}$$

$$y = \frac{6}{(x-4.5t)^2+3}$$

How do I prove that y satisfies the wave equation?

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

Example

- A wave pulse is a function of x as described by the following equation:

$$y = \frac{6}{x^2 + 3}$$

If this wave is now moving with a v_x = 4.5 m/s, what is y as a function of both x and t?

- The equation of a wave is

$$y = 0.05\sin[\pi/2(10x - 40t) - \pi/4]\ \text{m}$$

  - Find: λ, f, v, and the particle velocity for the wave at x=1.0m, t=0.20s)

$$y = .05\sin\left[5\pi x - \underline{20\pi} t - \frac{\pi}{4}\right]$$

$$K = 5\pi = \frac{2\pi}{\lambda}$$

$$\lambda = \frac{2\pi}{5\pi} = \frac{2}{5}\,m = 0.4\,m$$

$$v_y = \frac{dy}{dt} = -(.05)20\pi\cos\left[5\pi x - 20\pi t - \frac{\pi}{4}\right]$$

$$= -\pi\cos\left[5\pi x - 20\pi t - \frac{\pi}{4}\right]$$

$$= -\pi\cos\left[5\pi - 4\pi - \frac{\pi}{4}\right]$$

$$= -\pi\cos\left[\frac{3\pi}{4}\right]$$

$$= \pi\,\frac{\sqrt{2}}{2}$$

Feb 25-2:45 AM

Energy and Power

$$y = A\cos(kx - \omega t)$$

$$\Delta K = \tfrac{1}{2}\Delta m\, v^2$$
$$= \tfrac{1}{2}\mu \Delta x\, v^2$$

$$\frac{dy}{dt} = -A\omega \sin(kx - \omega t)$$

$$\left(\frac{dy}{dt}\right)^2 = v^2 = A^2\omega^2 \sin^2(kx - \omega t)$$

$$\Delta K = \tfrac{1}{2}\mu \Delta x A^2 \omega^2 \sin^2(kx - \omega t)$$

$$\Delta U = \tfrac{1}{2} F \left(\frac{dy}{dx}\right)^2 \Delta x$$

$$\Delta U = \tfrac{1}{2} F \left[Ak \sin(kx - \omega t)\right]^2 \Delta x$$
$$= \tfrac{1}{2} \cancel{F} A^2 k^2 \sin^2(kx - \omega t)\Delta x$$
$$= \tfrac{1}{2} \mu \omega^2 A^2 \sin^2(kx - \omega t)\Delta x$$

$$\Delta U + \Delta K = \tfrac{1}{2}\mu \Delta x A^2 \omega^2 \sin^2(kx - \omega t)$$
$$+ \tfrac{1}{2} A^2 \mu \omega^2 \sin^2(kx - \omega t)\Delta x$$

$$v = \sqrt{\frac{F}{\mu}} \qquad v^2 = \frac{F}{\mu} \qquad F = \mu v^2 = \boxed{F = \mu\left(\frac{\omega^2}{k^2}\right)}$$

$$\omega = kv$$
$$v^2 = \frac{\omega^2}{k^2}$$

$$\Delta U + \Delta K = \mu \Delta x A^2 \omega^2 \sin^2(kx - \omega t)$$
$$= \Delta E$$

$$P = \frac{\Delta E}{\Delta t} = \mu \frac{\Delta x}{\Delta t} A^2 \omega^2 \sin^2(kx - \omega t)$$

$$P = \mu v A^2 \omega^2 \sin^2(kx - \omega t)$$

$$P_{avg} = \frac{\mu v A^2 \omega^2}{2}$$