Reminders 1-17-07:

Protect your belongings while in the tutoring center!

- Log onto Webassign ASAP!!!
- Log onto Computers!!!
- Read Syllabus
- Get lab software from desktop of computers in lab.
- Check course web page once a week.
- All lab reports worth 20 points, require a cover sheet, and are to be turned in at beginning of lab meeting.
- Sign prerequisite certificate form
- Login & Log out of Physics Tutoring Center or S-107 (lab)
- Read Chapter 13
- Sign up for Physics 2Y. Homework will be discussed in this class, not (generally) during lecture.

Objectives:

- Oscillations of the Pendulum
- Properties of Waves
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http://www.acoustics.salford.ac.uk/feschools/waves/shm2.htm

$$F = -kx \qquad x = A\cos\omega t$$

$$v = -A\omega \sin\omega t$$

$$a = -A\omega^2 \cos\omega t$$

$$v_{max} = A\omega \qquad \omega = \sqrt{\frac{k}{m}}$$

$$a_{max} = A\omega^2$$

$$T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{m}{k}}$$

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

Mass on Spring Characteristics

- From conservation of energy $E_i = E_f$

$$\tfrac{1}{2}kA^2 = \tfrac{1}{2}mv^2 + \tfrac{1}{2}kx^2 \text{ and}$$

$$v = [(k/m(A^2 - x^2)]^{1/2} = [(k/m(A^2 - (A\cos\omega t)^2)]$$

$$[(k/m(A^2 - A^2\cos^2\omega t)]^{1/2} = [(kA^2/m)(1 - \cos^2\omega t)]^{1/2}$$

$$v = [(k/m(A\sin\omega t)^2)]^{1/2} = \omega A\sin\omega t$$

  - V is 90° out of phase with x.
  - Maximum speed $v = (kA^2/m)^{1/2} = A\omega$ $\omega = \sqrt{\frac{k}{m}}$

- What if x=0 at t=0s?

$x = A\cos\omega t$

If $x = 0$ at $t = 0$ and $v = v_0$ at $t = 0$, then initial potential energy is zero and initial energy is kinetic; in addition, as it moves KE decrease and PE increases.

Then $x = A\sin\omega t$ is valid

and $v = A\omega\cos\omega t$

$a = -A\omega^2\sin\omega t$

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Example

- Suppose a mass on a horizontal surface is connected to a spring. Its period and amplitude of oscillation is 3.00s and 4.0cm, respectively. Assume v=0 at t=0s.
  - Write x=x(t),v=v(t), and a=a(t)
  - Find t, when x=A/2 and -A/2.
  - When is a= zero the first time?
  - When does v reach a first maximum?
  - How do you determine k? need mass!
  - What if v=4.00cm/s and x=0 at t=0?
- Discuss its motion if the mass were vertical.

$x = A\cos\omega t \qquad A = 4.0\text{ cm}$

$\omega = \frac{2\pi}{T} = \frac{2\pi}{3}$

$x = (4.0\text{cm})\cos\left(\frac{2\pi}{3}t\right)$

$v = -A\omega\sin\omega t = -(4.0)\left(\frac{2\pi}{3}\right)\sin\left(\frac{2\pi}{3}t\right)$ (v_{max})

$a = -A\omega^2\cos\omega t = -(4.0)\left(\frac{2\pi}{3}\right)^2\cos\left(\frac{2\pi}{3}t\right)$ (v_{max}, a_{max})

$\frac{A}{2} = A\cos\left(\frac{2\pi}{3}t\right)$

$\frac{1}{2} = \cos\left(\frac{2\pi}{3}t\right)$ → $60° = \frac{\pi}{3}$

want $\frac{2\pi}{3}t = \frac{\pi}{3}$ $\quad t = \frac{1}{2}$

$2t = 1$

$-\frac{1}{2} = \cos\left(\frac{2\pi}{3}t\right)$ $\quad \theta = \frac{2\pi}{3} = 120°$

so $t = 1$ $\quad \frac{2\pi}{3}t = \frac{2\pi}{3}$

$\cos^{-1}\left(-\frac{1}{2}\right) = \frac{2\pi}{3}t = \frac{2\pi}{3}$

$a = 0$ the 1st time when $x = 0$ the 1st time

$a = -\frac{k}{m}x$

$0 = A\cos\frac{2\pi}{3}t$

$0 = \cos\frac{2\pi}{3}t$

$\cos^{-1}0 = \frac{2\pi}{3}t = \frac{\pi}{2}$

$t = \frac{\pi}{2}\cdot\frac{3}{2\pi} = \frac{3}{4}\,s$

$V = -A\omega\sin\omega t$

$\dot{X} = A\cos\omega t$

$a = -A\omega^2\cos\omega t$

V is a maximum when $x = 0$ and $a = 0$

$t = \frac{3}{4}\,s$ is when $v = v_{max} = (4.0)\left(\frac{2\pi}{3}\right)$