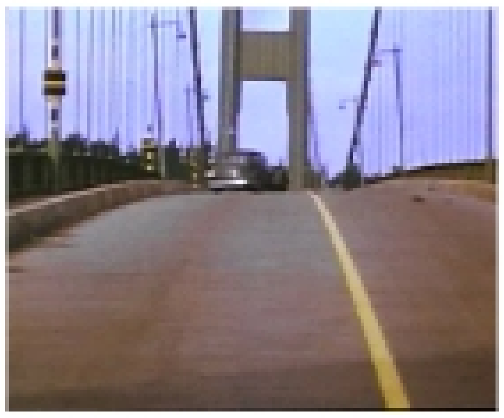
Physics 121, April 8, 2008.
Harmonic Motion.



Physics 121.
April 8, 2008.

- Course Information
- Topics to be discussed today:
  - Simple Harmonic Motion (Review).
  - Simple Harmonic Motion: Example Systems.
  - Damped Harmonic Motion
  - Driven Harmonic Motion

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- Homework set # 8 is due on Saturday morning, April 12, at 8.30 am.
- Homework set # 9 will be available on Saturday morning at 8.30 am, and will be due on Saturday morning, April 19, at 8.30 am.
- Requests for regarding part of Exam # 1 and # 2 need to be given to me by April 17. You need to write down what I should look at and give me your written request and your blue exam booklet(s).

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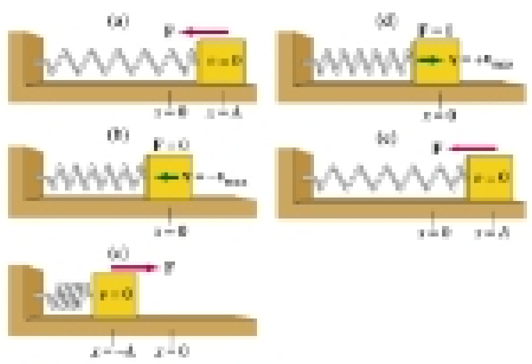
Harmonic motion (a quick review). Motion that repeats itself at regular intervals.



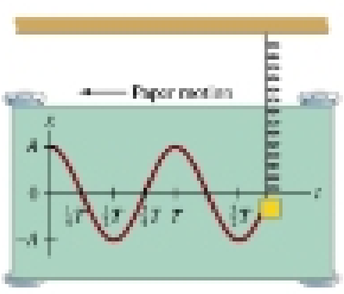
Simple Harmonic Motion (a quick review).

$$x(t) = x_m \cos(\omega t + \phi)$$

Amplitude: x_m

Angular Frequency: ω

Phase Constant: ϕ

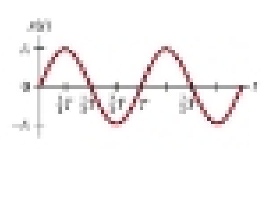


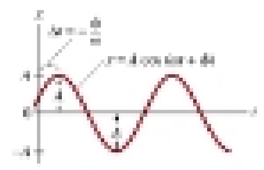
Simple Harmonic Motion (a quick review).

- Other variables frequently used to describe simple harmonic motion:
  - The period T: the time required to complete one oscillation. The period T is equal to $2\pi/\omega$.
  - The frequency of the oscillation is the number of oscillations carried out per second:

    $\nu = 1/T$

    The unit of frequency is the Hertz (Hz). Per definition, $1 \text{ Hz} = 1 \text{ s}^{-1}$.





Simple Harmonic Motion (a quick review). What forces are required?

- Using Newton's second law we can determine the force responsible for the harmonic motion:

  $F = ma = -m\omega^2 x$

- The total mechanical energy of a system carrying out simple harmonic motion is constant.
- A good example of a force that produces simple harmonic motion is the spring force: $F = -kx$. The angular frequency depends on both the spring constant k and the mass m:

  $\omega = \sqrt{(k/m)}$

Simple Harmonic Motion (SHM). The torsion pendulum.

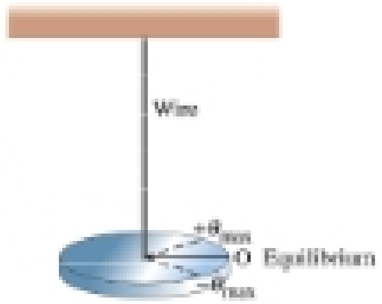
- What is the angular frequency of the SHM of a torsion pendulum:
  - When the base is rotated, it twists the wire and a the wire generated a torque which is proportional to the the angular twist:

    $\tau = -K\theta$

    The torque generates an angular acceleration α:

    $\alpha = d^2\theta/dt^2 = \tau/I = -(K/I)\,\theta$

    The resulting motion is harmonic motion with an angular frequency $\omega = \sqrt{(K/I)}$.



Simple Harmonic Motion (SHM). The simple pendulum.

- Calculate the angular frequency of the SHM of a simple pendulum.
  - A simple pendulum is a pendulum for which all the mass is located at a single point at the end of a massless string.
  - There are two forces acting on the mass: the tension T and the gravitational force mg.
  - The tension T cancels the radial component of the gravitational force.