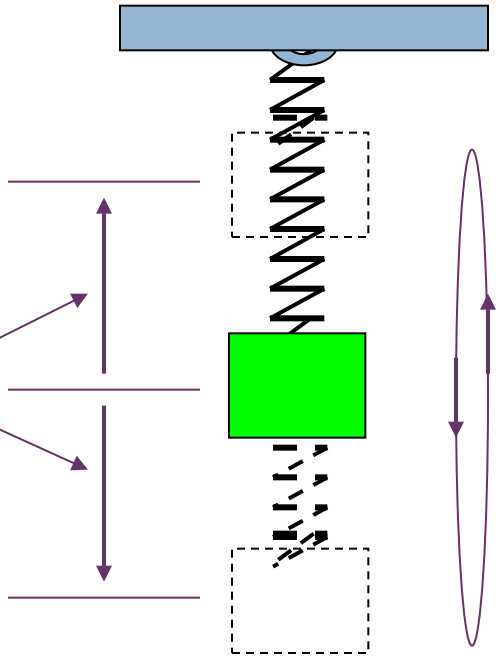
SIMPLE HARMONIC MOTION

Periodic Motion

Simple periodic motion is the motion in which a body moves back and forth over a fixed path, returning to each position and velocity after a definite interval of time.

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



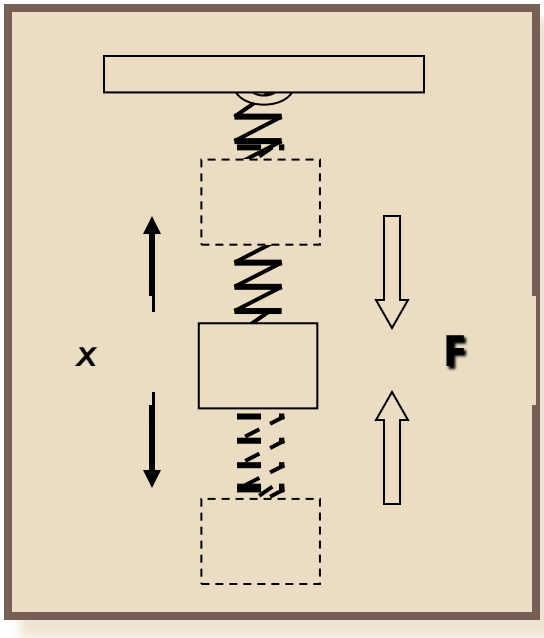
$$f = \frac{cycles}{time}$$

Period, T, is the time for one complete oscillation. (seconds, s)

Frequency, f, is the number of complete oscillations per second. Hertz (s^{-1})

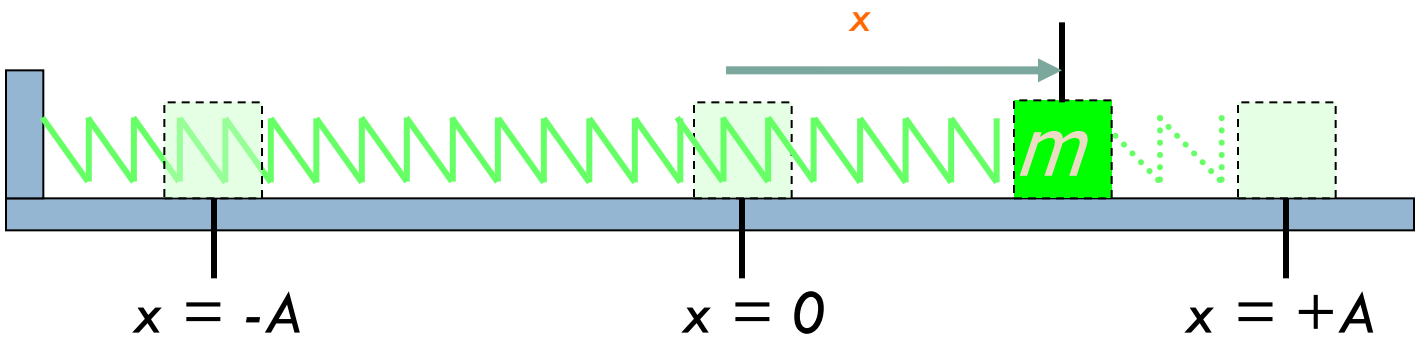
Simple Harmonic Motion, SHM

Simple harmonic motion: is periodic motion in the absence of friction and produced by a restoring force that is directly proportional to the displacement and oppositely directed.



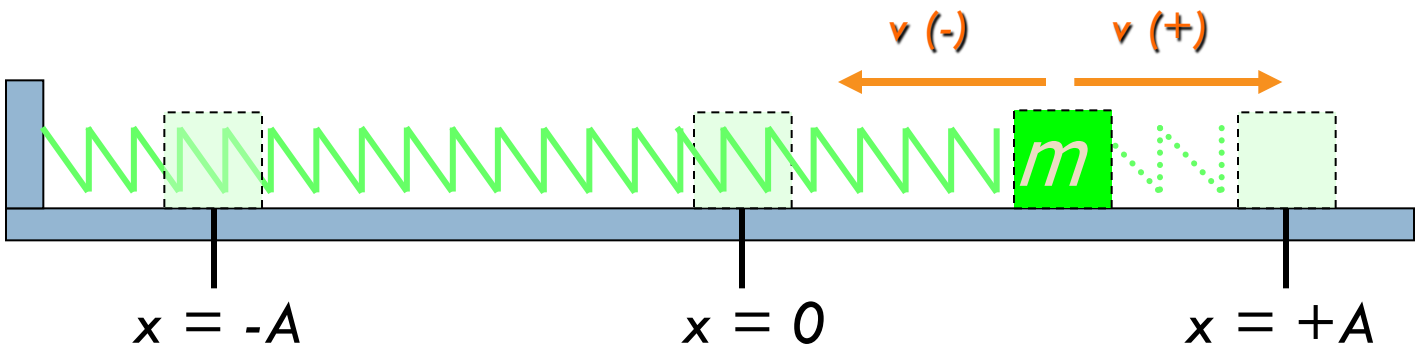
A restoring force, F, acts in the direction opposite the displacement of the oscillating body.

Displacement in SHM



- Displacement is positive when the position is to the right of the equilibrium position (x = 0) and negative when located to the left.
- The maximum displacement is called the amplitude A.

Velocity in SHM



- Velocity is positive when moving to the right and negative when moving to the left.
  - The velocity is zero at the end points and a maximum at the midpoint in either direction (+ or -).

Period and Frequency as a Function of Mass and Spring Constant.

For a vibrating body with an elastic restoring force:

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

k, spring constant (N/m)
m, mass (kg)
T, period (s)

Example 1 in the Notes

- The frictionless system has a 2-kg mass attached to a spring (k = 400 N/m). The mass is displaced a distance of 20 cm to the right and released.
  What is the frequency of the motion?

  What if the mass is displaced a distance a 25 cm instead?

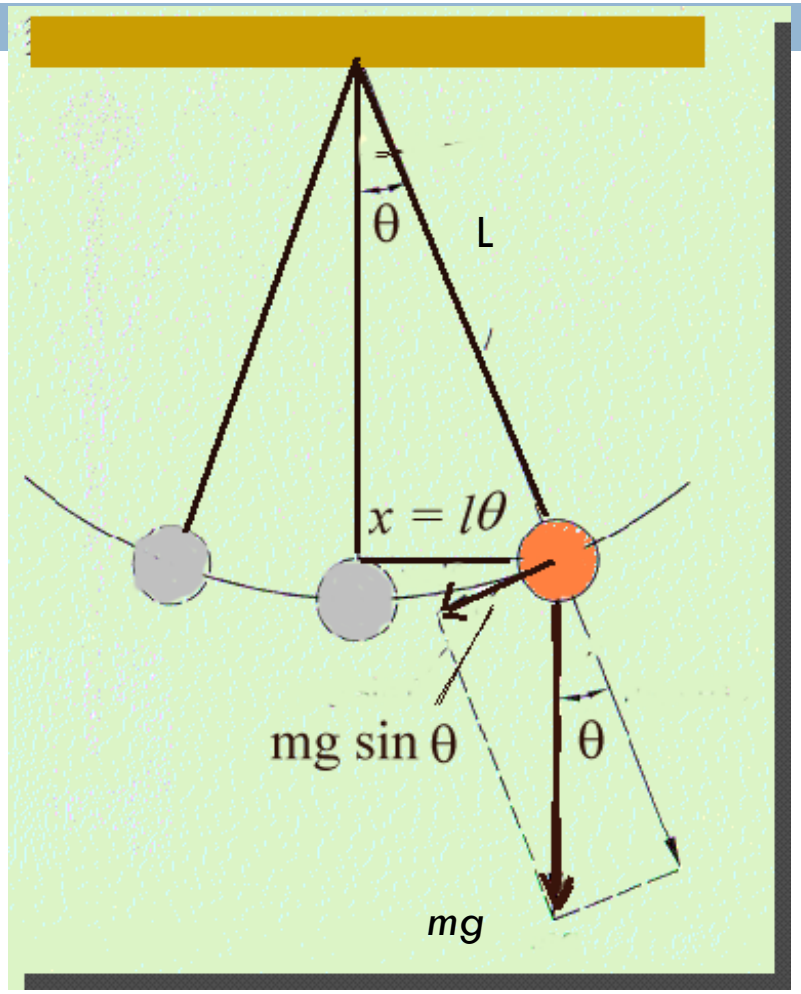
- What is the mass on the spring that produces a frequency of 30 cycles in 10s? Assume a spring constant of 200 N/m.

The Simple Pendulum

L, length of string (m)
g, gravity (+9.8 m/s^2)
T, period (s)

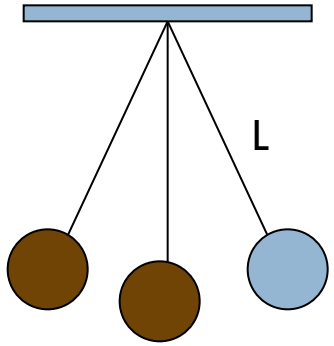
The period of a simple pendulum is given by:

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



What must be the length of a simple pendulum for a clock that has a period of one second?

http://videolectures.net/mit801f99_lewin_lec10/



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