Physics 151 Class Exercise: Simple Harmonic Motion II

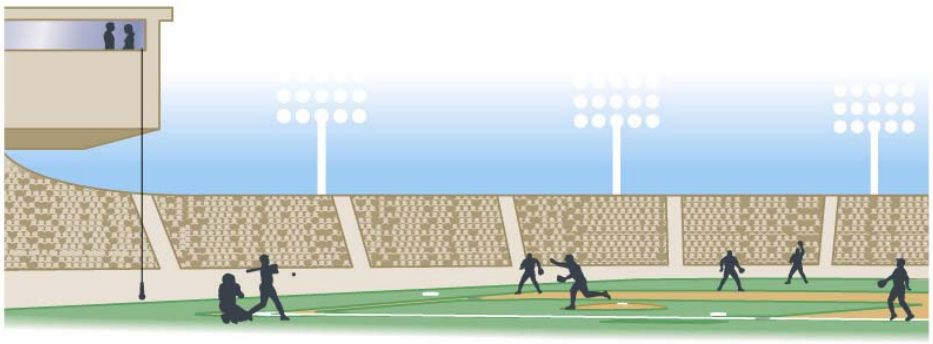
1. An observant fan at a baseball game notices that the radio commentators have lowered a microphone from their booth to just a few inches above the ground, as shown in the figure below. The microphone is used to pick up sound from the field and from the fans. The fan also notices that the microphone is slowly swinging back and forth like a simple pendulum. Using her digital watch, she finds that 10 complete oscillations take 60.0 s. How high above the field is the radio booth? (Assume the microphone and its cord can be treated as a simple pendulum.)

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

$$L = \left(\frac{T}{2\pi}\right)^2 g$$

$$= \left(\frac{\frac{60.0\text{ s}}{10}}{2\pi}\right)^2 \left(9.81\ \frac{\text{m}}{\text{s}^2}\right)$$

$$= \boxed{8.95\text{ m}}$$



2. A large, simple pendulum (10.0 m in length) is on display in the lobby of the United Nations building.
(a) What is the least amount of time it takes for the bob to swing from a position of maximum displacement to the equilibrium position of the pendulum? (Assume that the acceleration of gravity is g = 9.81 m/s^2 at the UN building.)
(b) Assuming that the amplitude of the pendulum is 8º, what is the velocity of the pendulum bob as is passes through the equilibrium position?

The time is one quarter-period:

$$\frac{T}{4} = \frac{\pi}{2}\sqrt{\frac{L}{g}} = \frac{\pi}{2}\sqrt{\frac{10.0\text{ m}}{9.81\ \frac{\text{m}}{\text{s}^2}}} = \boxed{1.59\text{ s}}$$

Using Conservation of Energy

$$mgl\left(1-\cos\theta\right) = \frac{1}{2}mv^2$$

$$v = \sqrt{2gl\left(1-\cos\theta\right)} = \sqrt{2\left(9.81\frac{m}{s^2}\right)\left(10.0m\right)\left(1-\cos 8°\right)} = 1.34\frac{m}{s}$$