PHY131H1S - Class 22

Today:

- Hanging Springs
- The Pendulum
- Damped Oscillations
- Driven Oscillations; Resonance

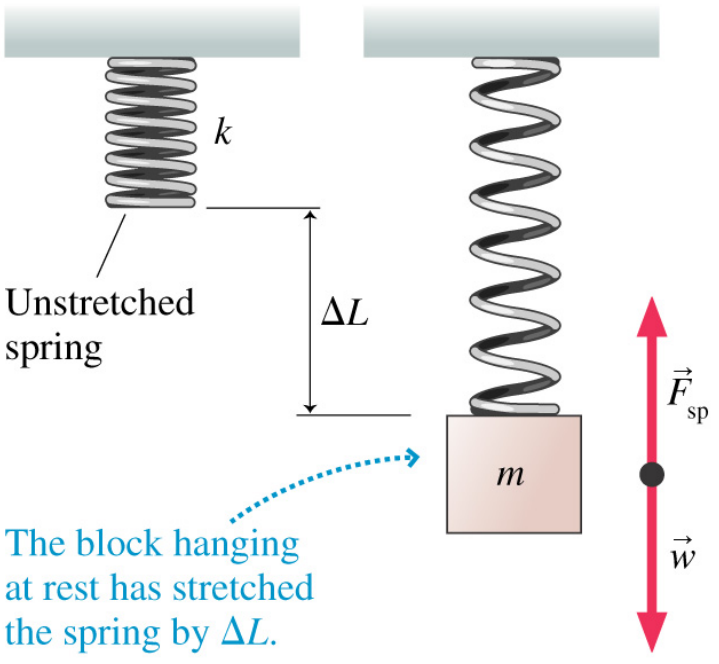
Italian opera singer Luigi Infantino tries to break a wine glass by singing top 'C' at a rehearsal.

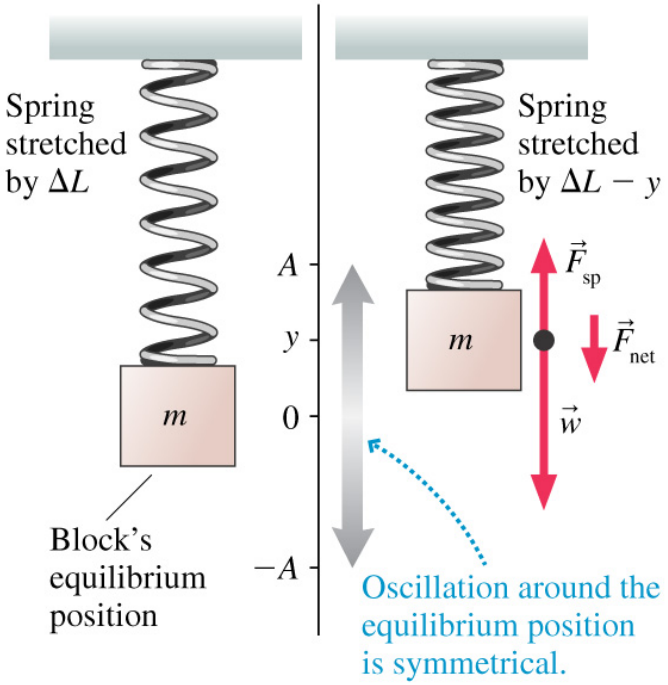
A little pre-class reading quiz on Ch.14…

Last day I asked at the end of class:

- A mass hanging from a string is swinging back and forth with a period of 2 seconds.
- What is the period if the mass is doubled?
- ANSWER:

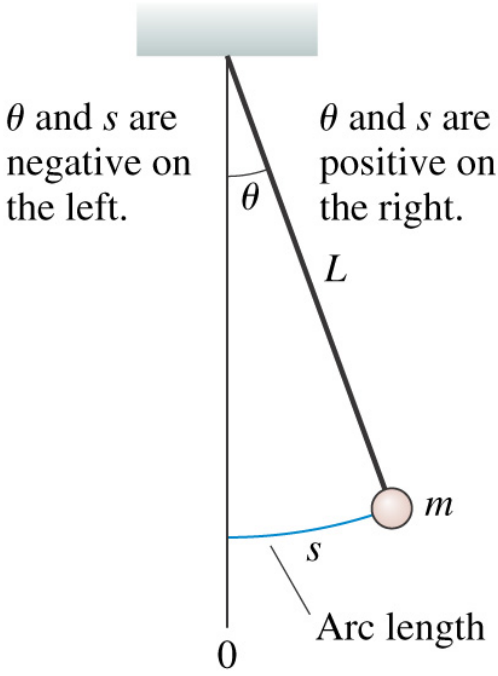
- What is the period if the length of the string is doubled?
- ANSWER:





EXAMPLE 14.7 **Bungee oscillations**

An 83 kg student hangs from a bungee cord with spring constant 270 N/m. The student is pulled down to a point where the cord is 5.0 m longer than its unstretched length, then released. Where is the student, and what is his velocity 2.0 s later?



The Pendulum

Suppose we restrict the pendulum's oscillations to small angles (< 10°). Then we may use the **small angle approximation** $\sin\theta \approx \theta$, where θ is measured in radians. Since $\theta = s/L$, the net force on the mass is

and the angular frequency of the motion is found to be

Mass on Spring versus Pendulum

	Mass on a Spring	Pendulum
Condition for S.H.M.	Small oscillations	Small angles
Angular frequency		
Period	$T = 2\pi\sqrt{\frac{m}{k}}$	$T = 2\pi\sqrt{\frac{L}{g}}$

Two pendula have the same length, but different mass. The force of gravity, F=mg, is larger for the larger mass.

A person swings on a swing. When the person sits still, the swing oscillates back and forth at its natural frequency.

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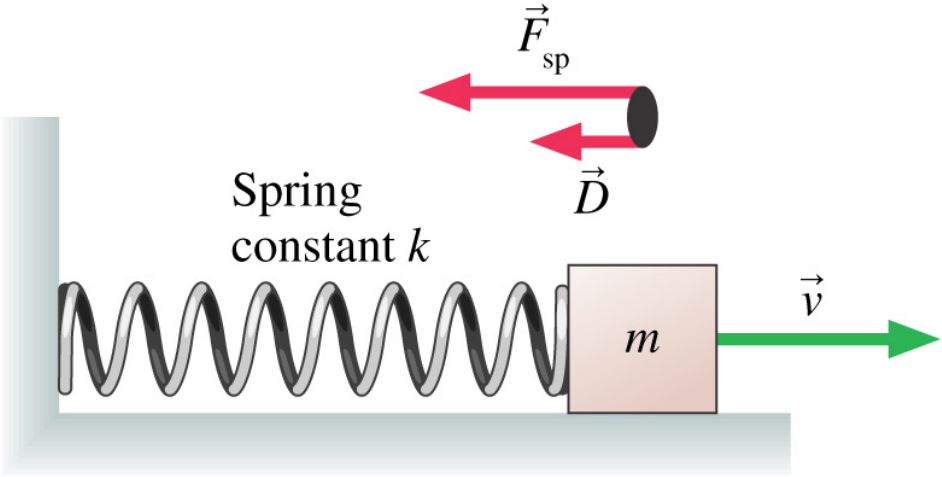
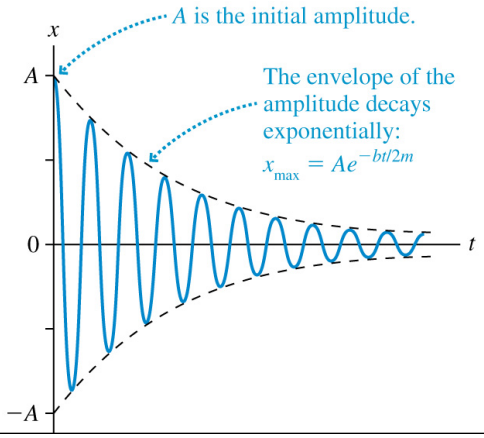


Damped Oscillations

When a mass on a spring experiences the force of the spring as given by Hooke's Law, as well as a drag force of magnitude $|D|=bv$, the solution is



Driven Oscillations and Resonance

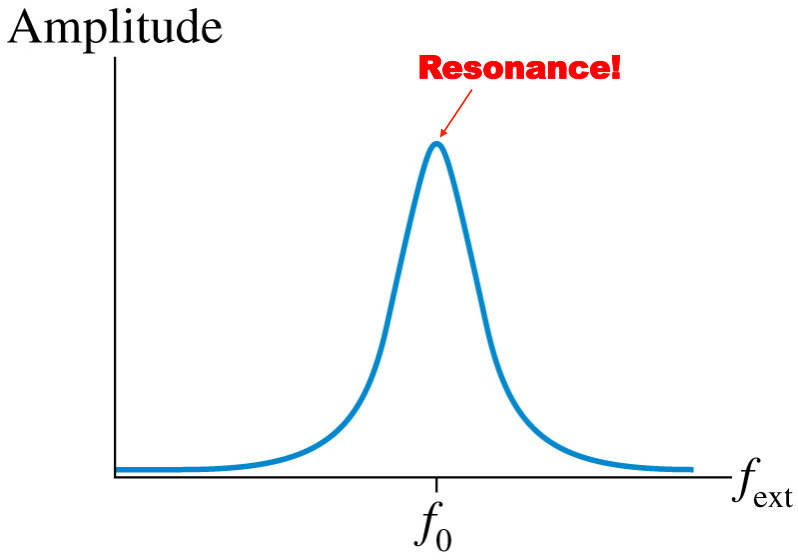
• Consider an oscillating system that, when left to itself, oscillates at a frequency f_0. We call this the **natural frequency** of the oscillator.

• Suppose that this system is subjected to a *periodic* external force of frequency f_{ext}. This frequency is called the **driving frequency**.

• The amplitude of oscillations is generally not very high if

• As gets closer and closer to , the amplitude of the oscillation rises dramatically.

14.8 Externally Driven Oscillations



Before Class 23 on Monday

- Tonight there is a MasteringPhysics Problem Set due. If you have not already done so, please submit your problem set by 11:59pm tonight.
- Over the weekend, please read the first 4 sections of Chapter 15 of Knight.

- Something to think about: If you stand on a waterproof bathroom scale in a wading pool, so that part of your legs are immersed in the water, will your measured weight be different than normal? If so, why?