



Concept:

Here is an obvious and mesmerizing example of deterministic chaos which may be of particular interest to upper division and graduate students. Although the equations of motion for the two pendulums are straight forward to express and evaluate, this simple system displays the essential characteristic of all chaotic systems; exquisite dependence on initial conditions. Note that although the exact solutions to the equations of motion can be easily found and thus determine completely the positions and velocities of the pendulums at all future times, the ultra-sensitive dependence of the system on the initial values of position and velocity make it impossible to predict the future motion. A detailed analysis can be found at http://en.wikipedia.org/wiki/Double_pendulum.

Equipment:

- Large Support Stand (Short Bar)
- Large Rod Clamp
- Chaotic Double Pendulum with Lock-Bolt
- (2) Large C-Clamps

Procedure:

1. Verify that the pendulum support stand is clamped to a rigid surface and the lock-bolt is in place.
2. Lift the end of the pendulum to the desired height and release it to set it oscillating like a single bar pendulum.
3. Unscrew and remove the lock-bolt so that the bottom bar is allowed to swing freely.
4. Lift the end of the double pendulum to the desired height and release it to set it oscillating as a chaotic double pendulum.